Volume 37
Number 2
May 2012

ISSN 2230-9705

Journal of Agriculture Research and Technology

Publication of the
Mahatma Phule Krishi Vidyapeeth, Rahuri,
Dr. Panjabrao Deshmukh Krishi Vidyapeeth, Akola,
Marathwada Agricultural University, Parbhani and
Dr. Balasaheb Sawant Konkan Krishi Vidyapeeth, Dapoli, M.S. (India)

SUBSCRIPTION RATES

(1)	Student subscriber	Rs. 100/– per annum
(2)	Member subscriber	Rs. 150/– per annum
(3)	Institution	Rs. 800/– per annum
(4)	*Single Copy :*	
	(a) Individual	Rs. 60/–
	(b) Institution	Rs. 250/–
(5)	*Life Member :*	
	(a) Individual	Rs. 1,500/–*
	(b) Institution	Rs. 3,000/–
(6)	Patron	Rs. 8,000/–
(7)	Sustaining Associate	Rs. 15,000/–
(8)	*Foreign Countries :*	
	(a) Individual	$ 60/–
	(b) Institution	$ 120/–
(9)	*Foreign Countries (Single copy) :*	
	(a) Individual	$ 30/–
	(b) Institution	$ 50/–

(*can also be paid in 3 instalments in a year)

H **NAAS Rating 3.2** H

Journal of Agriculture Research and Technology

Volume 37 **Number 2** **May 2012**

CONTENTS

RESEARCH NOTES

J. Agric. Res. Technol., 37 (2) : 189-192 (2012)

Effect of Fertigation on Yield of Tomato

P. N. Shingade[1], A. G. Durgude[2] and D. D. Pawar[3]
Inter Faculty Department of Irrigation and Water Management,
Mahatma Phule Krishi Vidyapeeth, Rahuri - 415 722 (India)
(Received : 31-10-2009)

Abstract

A field experiment was conducted on fertigation to tomato on Vertic Haplustept. Fertilization treatments saved 60.68 per cent irrigation water and 20 to 40 per cent nutrients over surface irrigation system. Application of 100 per cent recommended dose of NPK through water soluble fertilizer (T_1) showed higher uptake of N, P and K (138.24, 27.63 and 169.53 kg ha^{-1} respectively) and recorded significantly higher yield of tomato 54.94 t ha^{-1} over surface irrigation with conventional fertilizer application treatments (T_6 and T_7).

Key words : Fertigation, water use efficiency, nutrient use efficiency, uptake of nutrient, yield.

Tomato is most widely used and popular vegetable having high nutritive value. It has a great demand all over the world. It acts as good export earner. India have a large scope to increase its production. The cultural practices along with balanced use of fertilizer and optimum use of irrigation water helps to increase productivity of tomato. As water and fertilizers are limited and costly inputs in Agriculture, its proper utilization is very essential. Fertigation found most important in this case. Fertigation implies application of water soluble fertilizer along with irrigation water near the root zone as per the need of crop, which results into better utilization of fertilizers along with higher yield and better quality of fruit.

Many research workers worked on this aspect and reported high yield as well as 20 to 40 per cent fertilizer saving (Dhake et al. 1995, Vasane et al. 1995 and Kolte et al. 1999). Here, the experiment conducted also aimed to workout effect of fertigation on yield, water use efficiency, uptake of nutrients and economics of tomato.

Materials and Methods

The field experiment was conducted on Vertic Haplustept soil at Institutional Farm of Inter Faculty Department of Irrigation Water Management, M.P.K.V., Rahuri during period of 2007-08. The experiment was carried out in randomized block design with seven treatments and three replications with spacing of paired row 0.60-1.20 x 0.45 m. and variety Vaibhav (summer variety). The treatment details were T_1 : Drip with 100 per cent RD of N P K through water soluble fertilizers, T_2 : Drip with 80 per cent RD of N P K through water soluble fertilizers, T_3 : Drip with 60 per cent RD of N P K through water soluble fertilizers, T_4 : Drip with 100 per cent RD through conventional fertilizer (N through drip and P, K through soil), T_5 : Drip with 100 per cent RD through conventional fertilizer (N, P, K through soil), T6 : Surface with 100 per cent RD of N P K through conventional fertilizer and T_7 : Surface with conventional fertilizer (400:200:200 NPK kg ha^{-1} applied by band placement), considered

1. M.Sc. (Agri.) student, 2. Asstt. Professor and 3. Head.

as farmer's practice.

The recommended dose of fertilizer (RDF) of N, P_2O_5 and K_2O were applied @ 300, 150, 150 kg ha^{-1} respectively. In case of T_1, T_2, T_3 urea, urea phosphate (17:44 N:P_2O_5) and muriate of potash were used for fertigation and the total recommended dose was divided into 14 splits at 7 days internal. In T_4, T_5, T_6 and T_7 fertilizers were used by band application (50% N and 100% P and K applied at the time of transplanting and remaining dose of N was applied at 3 equal doses).

The pan evaporation data was used for scheduling of irrigation. In surface treatment scheduled at 50 mm CPE (cumulative pan evaporation) for 9 irrigations @ 5 cm depth and therefore, the total depth of irrigation was 45 cm. In drip irrigation, irrigation was scheduled based on two/three days pan evaporation, crop coefficients (KC) and pan factor (KP).

Results and Discussion

Irrigation : The total water requirement in surface irrigation treatments was higher (450 mm), where as minimum water requirement (176.94 mm) was recorded in all drip-irrigated treatments. It indicated that there was saving of irrigation water to the extent of 60.68 per cent compared with surface irrigation method. The field water use efficiency was also higher under fertigation treatments, which ranged from 310.50 to 226.63 kg ha^{-1} mm^{-1}. The maximum water use efficiency was observed under treatment T_1 followed by T_2 and T_5. This might be due to 100 per cent recommended dose of NPK through fertigation always applied at field capacity leading to proper proportion of water and air in the root zone, more over there was no leaching of plant nutrient as the wetting zone was restricted to root zone only. Minimum water use efficiency was observed with surface irrigation with conventional fertilizer treatments T_6 and T_7 (81.26 and 76.42 kg ha^{-1} mm^{-1} respectively).

Available nutrients N, P, K in soil : The data presented in Table 2 revealed that available N P and K was highest in treatment T_7 (196.51, 16.20 and 538 kg ha^{-1}, respectively) after harvest, this might be due to heavy application of nutrients through conventional fertilizer under surface irrigation and less availability and uptake by tomato plant. Higher uptake of NPK was observed in fertigation treatments than surface irrigation treatments reflected on higher yield of tomato in fertigation treatments, this might be the reason for decreased availability of N, P and K in soil under fertigation treatments at harvest. The data in respect of available K in soil after harvest was non significant.

Uptake of N, P, K and nutrient use efficiency : The data regarding uptake of N, P and K by tomato plant at harvest are presented in Table 2. The results revealed that, treatment (T_1) of 100 per cent RD of N P K through fertigation showed significantly higher total N uptake (138.24 kg ha^{-1}) over all the treatments, except T_4 treatment which was at par. The lowest uptake of nitrogen (82.82 kg ha^{-1})

Table 1. Water applied, field water use efficiency as influenced by different treatment in tomato.

Treatment	Water applied (mm)	Effective rainfall (mm)	Total water use (mm)	Field water use efficiency (kg ha^{-1} mm^{-1})	Water saving (%)
T_1	172.94	4	176.94	310.50	60.68
T_2	172.94	4	176.94	286.02	60.68
T_3	172.94	4	176.94	260.99	60.68
T_4	172.94	4	176.94	239.00	60.68
T_5	172.94	4	176.94	226.63	60.68
T_6	450	0	450	81.26	-
T_7	450	0	450	76.42	-

Table 2. Available soil nutrients, yield, total nutrient uptake and nutrient use efficiency as influenced by different treatments in tomato.

Treatment	Available soil nutrient (kg ha^{-1})			Yield (t ha^{-1})	Total nutrient uptake (kg ha^{-1})			Nutrient use efficiency (kg ha^{-1})		
	N	P	K		N	P	K	N	P	K
T_1	161.56	15.88	510.0	54.94	138.24	27.63	169.53	57.90	115.8	115.8
T_2	157.38	14.24	504.0	50.61	130.30	24.76	148.36	54.33	108.66	108.66
T_3	155.41	12.21	500.0	46.18	114.86	21.93	123.84	31.16	62.33	62.33
T_4	160.97	15.23	513.4	42.29	138.15	20.54	113.91	15.77	31.46	31.46
T_5	165.97	15.33	525.4	40.10	101.67	18.43	102.45	8.43	16.86	16.86
T_6	170.20	16.05	522.6	36.57	90.07	15.26	91.13	-	-	-
T_7	196.51	16.20	538.0	34.39	82.82	13.83	90.01	-	-	-
S.E.±	2.70	0.64	14.35	0.81	-	-	-	-	-	-
CD at 5%	8.34	1.97	NS	2.50	-	-	-	-	-	-

obtained with treatment T_7 (surface irrigation with conventional fertilizer applied by band placement).

The total uptake of P (27.63 kg ha^{-1}) was significantly higher in T_1 treatment over all the treatments under study except T_2 which was at par. Significantly lowest total uptake of P (13.83 kg ha^{-1}) was obtained with treatment T_7 (farmer's practice) over rest of all the treatments except T_6 (surface irrigation with conventional fertilizer).

The total K uptake (169.53 kg ha^{-1}) was higher under treatment T_1 (100% RD of N P K through fertigation) and it was significantly superior to the rest of the treatments. Next to that the treatment T_2 recorded maximum uptake of K. The lowest K uptake was recorded in surface irrigation with convention fertilizer treatments of T_7 and T_6. Similar trends were also reported by Vasane *et al*. (1995), Dhake (1995) and Kolte *et al*. (1999).

The nutrient use efficiency of N, P and K was higher 57.90, 115.8 and 115.8 kg ha^{-1}, respectively in treatment T_1 and it was followed by T_2 treatments. Water soluble fertilizer saved 20 to 40 per cent nutrient over conventional fertilizer application.

Fruit yield : The highest yield of tomato was recorded (54.94 tha^{-1}) with application of 100 per cent recommended dose through fertigation (T_1) and it was significantly higher than the yield obtained with rest of the treatments (Table 2). The treatment T_1 showed 56 and 47 per cent increased in yield over T_7 and T_6 treatments, respectively.

All the fertigation treatments T_1 to T_3 were significantly superior in yield of tomato over drip with conventional fertilizer (T_4 and T_5) and surface irrigation with conventional fertilizer (T_6 and T_7). It clearly indicated that fertigation can save fertilizers without reducing yield of tomato. These results are in conformity with Chakraborty *et al*. (1999) and Kadam and Sahane (2001).

Based on the results of the present study, it can be concluded that, the application of 100 pre cent recommended dose of water soluble N, P, K fertilizer recorded significantly higher yield of tomato, total uptake of N, P and K by tomato and saved 20 to 40 per cent nutrient and also saved about 60.68 per cent of irrigation water.

References

Chakraborty, D., Singh, A. K. Aswani Kumar and Khanna, M. 1999. Movement and distribution of water and nitrogen in soil as influenced by fertigation in Broccoli. J. of Water Manag. 7(1 and 2): 8-13.

Dhake, A. V. 1995. Studies on liquid fertilizer (NPK) through drip irrigation to tomato on Entisol. Ph.D thesis submitted to MPKV, Rahuri (MS).

Kadam, J. R. and Sahane, J. S. 2001. Studies on water use and yield of tomato as influenced by NPK fertilization briquette. J. Maharashtra agric. Univ. 26(3): 231-233.

Kolte, U. M., Patil, M. S. and Tumbhare, A. D. 1999. Response of tomato crop to different mode of nutrient inpute and irrigation. J. Maharashtra agric. Univ. 24(1): 4-8.

Patil, M. V. 1999. Studies on efficiency of liquid fertilizer through drip for Brinjal (*Solarium melongena* L.). M.Sc. (Agri.) thesis submitted to M.P.K.V., Rahuri, (M.S.).

Vasane, S. R, Bhoi, P. G., Patil, A. S. and Tumbhare, A. D. 1995. Effect of liquid fertilizer through drip irrigation on yield and NPK of tomato. J. Maharashtra agric. Univ. 21(3): 488-489.

J. Agric. Res. Technol., 37 (2) : 192-195 (2012)

Evaluation of Promising Sugarcane Genotypes for Yield and Quality of Jaggery for South Maharashtra

G. S. Nevkar[1], D. S. Patil[2], S. M. More[3] and V. N. Nale[4]
Regional Sugarcane and Jaggery Research Station, Kolhapur - 416 005 (India)
(Received : 25-08-2008)

Abstract

It has been observed that promising genotype Co 92005 found excellent for jaggery quality and yield over the other promising genotypes and released varieties CoC 671 and Co 8014. None of any promising sugarcane genotypes from the midlate group performed better than the released varieties of Co 94012 and Co 86032 for yield and quality of jaggery.

Key words : Sugarcane, promising genotypes, jaggery quality, jaggery yield.

Quality of jaggery is influenced by number of the factors of pre-harvest technology *viz*., soil type, sugarcane variety, crop management, harvesting time, maturity of cane etc. The suitable varieties of sugarcane and maturity plays an important role in jaggery yield and quality (Jadhav *et al.* 1999). There is demand from jaggery manufacturing farmers for suitable sugarcane variety for superior quality jaggery and fetch higher prices in the market. With this view, the present investigation was undertaken.

1. Jr. Res. Officer, 2. Sr. Res. Officer, 3. Agronomist and 4. Jr. Res. Asstt.

Materials and Methods

The field experiment was conducted for three years at the research farm of Regional Sugarcane and Jaggery Research Station, Kolhapur during the year 2004-2005, 2005-2006 and 2006-07. The treatment consisted of four promising sugarcane genotypes of early maturity group *viz*., Co 92005, Co 95005, Co 95020, Co 88025, three genotypes of mid late group *viz*., Co 95006,Co 95012 and Co 2000-12 and four released varieties *viz*., CoC 671, Co 8014, Co 86032 and Co 94012. The crop was planted on ridges and furrows, spaced

at a distance of one meter. The experiment was laid out in a randomized block design with three replications and 6 x 5 m plot size. The sugarcane was planted in the first fortnight of January and harvested at 12 months crop age in every year. The recommended dose of chemical fertilizers 200:115:115 NPK kg ha^{-1} was applied to *suru* sugarcane crop for jaggery production. The crop was cultivated by adopting the recommended package of practices.

Five sugarcane clumps were selected randomly for observations of juice quality. The harvested sugarcane was used for crushing through horizontal, three roller crusher. The juice samples were analyzed for brix and sucrose content as per analytic methods described by Parthasarthi *et al*. (1979). Based on brix and sucrose content, the CCS and purity per cent were computed by using Winter's formula.

The jaggery samples were prepared from all the promising genotypes and varieties by using small pan of 50 litre capacity. The improved jaggery production process was adopted for jaggery production (Mungare et al. 2001) and the jaggery samples were analyzed for jaggery quality parameters *viz*., reducing sugars, non reducing sugar, pH and colour intensity. The reducing sugar was determined by Lane - Eynon volumetric method (A.O.A.C., 1960). The non reducing sugar was determined by using Polarimeter. The colour intensity was measured by using Klet Sumersion colourimeter at 540 nm wavelength.

Results and Discussion

The year wise and pooled data on juice and jaggery quality parameters and jaggery yield obtained from different promising sugarcane genotypes and varieties are presented in Table 1 to 3. All the promising sugarcane genotypes were categorized under early and mid late maturity group and compared with released sugarcane varieties.

Juice quality (Early group) : It was revealed from the pooled data, the significantly highest brix was recorded by the promising genotype Co 92005 (21.80%) however, it was at par with variety CoC 671 (21.72%) and Co 8014 (21.33 %). The lowest brix was recorded by the promising genotypes Co 95020 (20.32%). Regarding sucrose content, the variety Co 8014 recorded significantly highest sucrose in juice (20.08%) which was at par with promising genotype Co 92005 (19.97%) and variety CoC 671 (19.28%). Juice purity was found significantly highest in variety Co 8014 (93.02%) and it was at par with the promising genotype Co 92005 (91.26%). In respect of commercial cane sugar (CCS), released variety Co 8014 recorded significantly highest CCS (14.22%), and it was at par with promising genotype Co 92005 (14.06 %) and variety CoC 671 (13.19%).

Juice quality (Mid late group) : The pooled data revealed that (Table 1), the variety

Table 1. Mean juice quality parameters as influenced by different promising genotypes and varieties of sugarcane.

Genotype	Brix (%)	Sucrose (%)	CCS (%)	Purity (%)
Early group :				
Co 92005	21.80	19.97	14.06	91.26
Co 95005	20.54	18.04	12.44	87.40
Co 95020	20.32	18.32	12.69	89.20
Co 88025	21.25	19.49	13.61	88.55
CoC 671	21.72	19.28	13.19	87.61
Co 8014	21.33	20.08	14.22	93.02
Midlate group :				
Co 95006	20.47	18.55	12.96	90.26
Co 95012	21.17	19.32	13.51	90.41
Co 2000-12	20.53	18.40	12.78	89.94
Co 86032	21.44	18.75	13.40	91.46
Co 94012	21.89	19.77	13.86	90.26
SE±	0.31	0.43	0.35	0.80
CD at 0.05	0.93	1.27	1.05	2.37

Co 94012 recorded significantly highest juice brix (21.89%) followed by Co 86032 (21.44%) and promising genotype Co 95012 (21.17 %). The lowest juice brix was observed in promising genotype Co 95006 (20.47%). Regarding the sucrose content, significantly the highest sucrose content was obtained in variety of Co 94012 (19.77%) which was at par with promising genotype Co 95012 (19.32%). While considering the purity percentage, the variety Co 86032 showed significantly the highest juice purity (91.46%) followed by promising genotype Co 95012 (90.41%), Co 94012 (90.26%) and Co 95006 (90.26%). In respect of commercial cane sugar the variety Co 94012 recorded significantly the highest CCS (13.86%) but it was at par with promising genotype Co 95012 (13.51%) and Co 86032 (13.40 %).

Jaggery quality (Early group) : It was observed from the pooled data that the effect of different genotypes and varieties on jaggery pH was not influenced significantly. However, the reducing sugar, non reducing sugar and colour intensity were influenced significantly.

The significantly lowest reducing sugar was recorded by the variety CoC 671 (6.89%) and it was at par with Co 92005 (6.99%), Co 8014 (7.65%) and Co 95005 (7.93%). In respect of non reducing sugar, CoC 671 had significantly, highest (81.83%) but it was at par with promising genotype Co 92005 (81.71%) and variety Co 8014 (79.86%). The lowest NRS was observed in promising genotype Co 88025 (74.44%). Regarding the colour intensity, Co 92005 recorded the significantly superior jaggery colour (28.53%), while Co 95020 recorded better jaggery colour intensity (39.26) which was at par with Co 8014 (41.93) and CoC 671 (44.13).

Jaggery quality (Mid late group) : It was revealed from the pooled data, the effect on pH of jaggery due to different genotypes and varieties of mid late group was found to be non significant. The lowest reducing sugars was

Table 2. Mean jaggery quality parameter as influenced by different promising genotypes and varieties of sugarcane.

Genotype	pH	RS (%)	NRS (%)	Colour intensity
Early group :				
Co 92005	6.19	6.99	81.71	28.53
Co 95005	6.25	7.93	78.83	55.93
Co 95020	6.25	8.08	76.43	39.26
Co 88025	6.21	8.11	74.44	48.86
CoC 671	6.35	6.89	81.83	44.13
Co 8014	6.27	7.65	79.86	41.93
Midlate group :				
Co 95006	6.22	7.45	78.20	55.76
Co 95012	6.26	7.65	73.62	48.23
Co 2000-12	6.23	9.24	73.09	53.70
Co 86032	6.26	7.76	80.33	60.23
Co 94012	6.19	7.17	80.24	50.80
SE±	0.05	0.36	0.76	2.31
CD at 0.05	NS	1.08	2.26	6.83

Table 3. Mean jaggery yield parameters as influenced by different promising genotypes and varieties of sugarcane.

Genotype	Cane yield (t ha^{-1})	Jaggery yield (t ha^{-1})	Jaggery recovery (%)
Early group :			
Co 92005	105.00	13.65	12.63
Co 95005	85.66	9.55	10.91
Co 95020	98.00	11.01	10.96
Co 88025	95.00	10.63	10.91
CoC 671	99.66	11.55	11.38
Co 8014	94.33	10.30	10.97
Midlate group :			
Co 95006	80.33	8.12	9.99
Co 95012	94.00	10.14	10.52
Co 2000-12	91.67	10.21	10.93
Co 86032	102.33	11.39	11.02
Co 94012	103.66	12.92	12.15
SE±	2.49	0.60	0.40
CD at 0.05	7.35	1.76	1.18

observed in Co 94012 (7.17%) but it was at par with promising genotype Co 95006 (7.45%), Co 95012 (7.65%) and variety Co 86032 (7.76%). The promising genotype Co 2000-12 recorded significantly highest reducing sugars (9.24%). In respect of non reducing sugar, Co 86032 recorded significantly highest NRS (80.33%), however it was at par with Co 94012 (80.24%) and promising genotype Co 95006 (78.20%). Regarding the colour intensity, the superior jaggery colour was obtained from promising genotype Co 95012 (48.23) which was at par with Co 94012 (50.80) and Co 2000-12 (53.70). The Co 86032 showed the dark coloured jaggery (60.23).

Cane and jaggery yield (Early group): It was revealed from the pooled data (Table 3) that the cane yield was influenced significantly due to different sugarcane genotypes. However, the year wise cane yields were net influenced significantly. The genotype Co 92005 recorded highest cane yield (105 t ha^{-1}) and it was par with CoC 671 (99.66 t ha^{-1}) and Co 95020 (98.0 t ha^{-1}). Significantly the highest jaggery yield (13.65 t ha^{-1}) was recorded by genotype Co 92005 followed by CoC 671 (11.55 t ha^{-1}) and Co 95020 (11.01 t ha^{-1}). The promising genotype Co 92005 recorded significantly highest recovery (12.63%) over the varieties CoC 671 (11.38%) and Co 8014 (10.97%).

Cane and jaggery yield (Mid late group) : The variety Co 94012 recorded significantly highest cane yield (103.66 t ha^{-1}) and it was par with Co 86032 (102.33 t ha^{-1}) and genotype Co 95012 (94.00 t ha^{-1}). Significantly the highcst jaggery yield was recorded by Co 94012 (12.92 t ha^{-1}) which was at par with Co 86032 (11.39 t ha^{-1}).

The jaggery recovery was recorded significantly highest by variety Co 94012 (12.15%) and it was at par with Co 86032 (11.02%). Amongst the promising genotypes, Co 2000-12 recorded highest jaggery recovery (10.93%). These findings pertaining to cane yield, jaggery yield and quality confirmed with findings of Singh *et al.* (1999).

Based on three years pooled results, it was concluded that, the promising genotype Co 92005 found excellent for jaggery yield and quality over the varieties CoC 671 and Co 8014. While none of the promising genotypes under mid late group performed better than the varieties Co 94012 and Co 86032.

References

A.O.A.C. 1960. Official Methods of Analysis. A.O.A.C. 9th edition. Washington D.C. USA. pp. 427.

Jadhav, H. D., Mungare, T. S., Patil. J. P., Hasure, R. R., Jadhav, B. S. and Jaswant Singh. 1999. Effect of harvesting age on juice , jaggery quality and yield of different sugarcane varieties under pre-seasonal planting conditions. Proceed. of the Nat. Semi. on "Status, Problems and Prospects of Jaggery and Khandsari Industry in India" held on Dec. 2-3.) at IISR. Lucknow, pp. 238-244.

Mungare, T. S., Jadhav, H. D., Shinde, U. S., Jadhav, B. S. and Patil, J. P. 2001. Improved technology of manufacturing jaggery and liquid jaggery. A technical bulletin (Marathi) No. MPKV/ PUB/323/2001, pp. 10-12.

Parthasarthi, S. V., Mohanrao, P. J. and Krishna, B. 1979. Guide to research and development in sugarcane. Publ. by Sugdev Tech. Services, pp. 213.

Singh, R. K., Verma, P. S., Verma, S. K. and Singh, S. B. 1999. Jaggery yield and quality performance of some newly developed sugarcane varieties. Proceed. of the Nat. Semi. on "Status, Problems and Prospects of Jaggery and Khandsari Industry in India" held on Dec. 2-3, at IISR, Lucknow. pp. 234-237.

J. Agric. Res. Technol., 37 (2) : 196-200 (2012)

Effect of Spacing and Nitrogen Levels on Growth and Yield of Brinjal (*Solanum melongena* L.) cv. Phule Harit

L. K. Sonavane[1], P. V. Patil[2] and S. K Chavan[3]
College of Agriculture, Pune - 411 005 (India)
(Received : 25-10-2010)

Abstract

The growth parameters *viz*., plant height, plant spread and number of branches were significantly affected with different spacing and various nitrogen levels. The highest growth characters were obtained with wider spacing of 90 x 120 cm with 200 kg of nitrogen ha^{-1}. The yield contributing characters such as number of fruits plant^{-1}, weight of fruits plant^{-1} and yield ha^{-1} were significantly highest with 90 x 120 cm spacing and 200 kg ha^{-1} of nitrogen over rest of treatments. The incidence of shoot and fruit borer with this treatment was less as compared to the other treatments. The wider spacing had resulted in more vegetative growth and optimum dose of nitrogen resulted in good development of the fruit.

Key words : Spacing, nitrogen, Phule harit, brinjal, vegetative growth, yield.

Brinjal (*Solanum melongena* L.) is one of the most important, common and popular vegetable crops. In Maharashtra, the area under brinjal cultivation is 5.12 lakh ha. with the production of 8.45 million tonnes (Anon, 2007b). The green types are mostly preferred in North-Western Maharashtra for preparation of 'Bharta'. Phule Harit is an important cultivar for preparation of 'Bharta'. Brinjal crop demands good nutrition and it responds well to fertigation. In order to work out the optimum spacing and nitrogen requirement of this new variety in this region, the experiment was conducted by using three different spacings (90 x 60, 90 x 90 and 90 x 120 cm) and three nitrogen levels (*viz*., 100, 150 and 200 kg N ha^{-1}) during 2008-09.

Materials and Methods

The seed material of brinjal cv. Phule Harit was collected from All India Co-ordinated Vegetable Improvement Project, Mahatma Phule Krishi Vidyapeeth, Rahuri. The experiment was laid out in a factorial randomized block design with nine treatment combinations having three different spacings (90 x 60, 90 x 90, 90 x 120 cm) and three levels of nitrogen (100, 150, 200 kg ha^{-1}) and were replicated three times. Seedlings were transplanted as per treatment and five plants were randomly selected and labeled in each plot for recording the observations on plant height, spread, number of branches, fruit length, fruit diameter. The recommended package of practices were followed while conducting the experiment.

A basal dose of FYM @ 20 tonnes hectare^{-1}, phosphorus and potassium was applied to all the plots uniformly in the form of single super phosphate and murate of potash. The complete dose of both phosphorus and potassium was applied as basal dose at the time of transplanting. Nitrogen was applied in the form of urea in split doses as, 50 per cent dose of N at the time of transplanting as a basal dose, 25 per cent dose of N at 30 days after transplanting, 25 per cent dose of N at 50 days after transplanting.

1. M. Sc.(Agri.) student, 2. Asso. Prof., Dept. of Hort. PGI, M.P.K.V., Rahuri and 3. Asstt. Prof. of Hort.

Results and Discussion

The effects of the spacing and nitrogen treatments (Table 1) were significant in respect of the growth parameters *viz*., height of the plant, spread of the plant and number of branches plant^{-1}. The height of the plant was maximum with wider spacing of 90 x 120 cm and decreased gradually at the closer spacing 90 x 90 cm and 90 x 60 cm. The results obtained were in agreement with Abutiate (1988) who reported that in cv. Auberigines maximum plant height could be obtained with wider spacing. The height of the plant was increased significantly under the increasing levels of nitrogen. The maximum height of the plant was recorded with 200 kg N ha^{-1}, whereas minimum plant height was recorded with 100 kg N ha^{-1}. The present findings are in accordance with the findings obtained by Singh and Sandhu (1970).

The results pertaining to the spread of the plant showed that an increase in planting density resulted in corresponding increase in the spread of the plant (East-West and North-South directions). The wider spacing of 90 x 120 cm recorded the maximum East-West (103.13cm) and North-South (102.48 cm) spread of the plant. These results confirmed the findings of Abutiate (1988) and Harminder Singh *et al*. (1997). The maximum spread of the plant was recorded with 200 kg N ha^{-1} and minimum spread was recorded with 100 kg nitrogen ha^{-1}.

The number of branches produced plant^{-1} was significantly influenced by different plant spacings. The results showed that the number of branches were more under wider spacing (90 x 120 cm) and decreased gradually with the decrease in planting distance. However, the results obtained are similar to those reported by Harminder Singh *et al*. (1997). The results showed that the number of branches increased significantly with the increasing nitrogen application. The dose of 200 kg N ha^{-1} recorded maximum number of branches per plant^{-1}. The results obtained were similar to those reported by Patnaik and Farooqui (1964).

The spacing had the significant effect on both the length as well as the diameter of the fruit. The significantly maximum (18.01cm) length of the fruit was recorded with 90 x 120 cm spacing, Minimum length (15.57cm) of the

Table 1. Effect of spacing and nitrogen levels on growth and yield of brinjal cv. Phule Harit.

Characters	Spacing (cm)			Nitrogen (kg ha^{-1})				
	S_1 (90x60)	S_2 (90x90)	S_3 (90x120)	N_1 (100)	N_2 (150)	N_3 (200)	S.E.±	C.D. at 5%
Plant height (cm)	139.04	144.01	152.99	139.49	146.16	150.40	2.50	0.030
Plant spread (cm) :								
East West	96.08	99.22	103.13	95.28	99.34	103.81	1.83	5.50
North South	98.64	100.99	102.48	98.27	101.63	103.33	0.69	2.07
Branches	19.63	21.67	23.46	20.94	21.62	22.69	0.08	0.24
Fruit length (cm)	15.57	17.57	18.01	16.93	17.04	17.18	0.12	0.64
Fruit diameter (cm)	7.54	8.13	9.11	8.04	8.27	8.47	0.07	0.039
Fruits plant^{-1}	11.51	12.14	12.43	11.76	12.04	12.27	0.06	0.18
Fruit weight plant^{-1}	2.55	3.45	3.78	2.91	3.15	3.92	0.05	0.17
Yields plot^{-1} (kg)	33.46	34.94	35.58	31.50	34.37	38.13	0.58	1.73
Yield hectare^{-1} (t)	42.00	44.93	48.47	20.74	46.14	48.53	0.79	2.38
Shoot and fruit borer	9.55	8.63	8.05	7.49	8.12	9.22	0.83	0.35

fruit was obtained with 90 x 60 cm spacing. The maximum diameter (9.12 cm) of the fruit was obtained with wider spacing of 90 x 120 cm, which was significant over 90 x 90 and 90 x 60 cm spacing. Minimum diameter (7.51cm) of fruit was obtained with 90 x 60 cm spacing. These results were similar with that of Ruiter (1974). The various levels of nitrogen significantly affect the length as well as the diameter of the fruits. Maximum fruit length was obtained with the higher dose of nitrogen (200 kg ha^{-1}) which was followed by 150 and 100 kg N ha^{-1}. Similar results were also reported by Verma *et al*. (1974).

The spacing and nitrogen significantly influenced yield characters such as number of fruits per plant, mean fruit weight $plant^{-1}$, yield $plot^{-1}$ and yield $hectare^{-1}$. Spacing had significant effect on the number of fruits produced $plant^{-1}$. The highest number of fruits $plant^{-1}$ were produced with wider spacing having 90 x 120 cm distance, while the lowest was obtained with the spacing of 90 x 60 cm. These results confirm the findings of Pawar (1990) and Singh and Syamal (1995) who reported that wider spacing lead to the highest number of fruits in brinjal.

The various levels of nitrogen had significant effect on the number of fruits produced $plant^{-1}$. The significantly highest number of fruits $plant^{-1}$ were produced with higher dose of nitrogen i.e. 200 kg N ha^{-1} followed by 150 and 100 kg ha^{-1}. These results are in agreement with the findings obtained by Mertia and Chauhan (1970), Singh and Sandhu (1970) and Seth and Choudhary(1970).

The spacing had significant effect on the mean weight of fruits $plant^{-1}$. The significantly highest fruit weight (3.82 kg) $plant^{-1}$ was obtained with wider spacing of 90 x 120 cm. Minimum fruit weight per plant was obtained with 90 x 60 cm. These results are similar with that of Seth and Dhaudar (1970) and Pawar (1990) who reported that wider spacing resulted in higher fruit weight $plant^{-1}$. Application of nitrogen had increased the mean fruit weight $plant^{-1}$. Maximum fruit weight $plant^{-1}$ was obtained with 200 kg N ha^{-1} that was at par with 150 kg N ha^{-1}. Minimum fruit weight $plant^{-1}$ was obtained with 100 kg N ha^{-1}.

Table 2. Interaction effect of spacing and nitrogen levels on growth and yield of brinjal cv. Phule Harit.

Characters	**Interaction of spacing x nitrogen**										
	S_1N_1	**S_1N_2**	**S_1N_3**	**S_2N_1**	**S_2N_2**	**S_2N_3**	**S_3N_1**	**S_3N_2**	**S_3N_3**	**S.E.±**	**C.D. at 5%**
Plant height (cm)	133.13	135.21	135.27	136.05	136.49	137.11	137.80	138.61	140.11	0.24	0.74
Plant spread (cm) :											
East West	93.03	95.62	99.60	94.03	99.17	104.46	98.80	103.24	107.36	3.17	N.S.
North South	96.97	100.67	101.37	105.57	99.67	102.73	97.27	104.57	105.90	1.30	3.58
Branches	18.40	20.20	21.20	20.80	21.07	23.13	23.03	23.60	23.73	0.14	0.42
Fruit length (cm)	15.24	15.33	16.12	17.41	17.55	17.76	18.15	17.66	18.23	0.21	0.64
Fruit diameter (cm)	7.36	7.51	7.74	7.88	8.17	8.34	8.89	9.12	9.32	0.013	0.039
Fruits $plant^{-1}$	11.33	11.48	11.70	11.84	12.30	12.29	12.13	12.33	12.83	0.10	N.S.
Fruit weight $plant^{-1}$	2.18	2.34	3.85	3.24	3.32	3.79	3.32	3.79	4.12	0.14	N.S.
Yields $plot^{-1}$ (kg)	30.21	32.79	34.32	30.97	34.50	39.94	33.27	35.83	40.12	0.99	2.99
Yield $hectare^{-1}$ (t)	41.08	42.07	42.87	39.69	47.63	47.47	41.44	48.71	55.26	1.38	4.12
Shoot and fruit borer	7.70	8.65	9.87	7.64	8.06	8.58	7.12	7.66	9.21	0.20	0.61

The mean yield plot^{-1} had the significant effect with that of the spacing. The highest yield plot^{-1} was obtained with that of wider spacing of 90 x 120 cm. The medium spacing of 90 x 90 cm was at par with 90 x 120 cm spacing. Minimum yield plant^{-1} was obtained with 90 x 60 cm. and significantly maximum yield hectare^{-1}. (48.81 t ha^{-1}) was obtained by 90 x 120 cm spacing, followed by 90 x 90 and 90 x 60 cm spacings. Similar results were obtained with that of Pawar (1990), who reported that wider spacing lead to higher yield. The highest yield plot^{-1} (38.13 kg) and highest yield hectare^{-1} (48.53 t) were obtained with the highest nitrogen level of 200 kg hectare^{-1}. Whereas medium yield plot^{-1} (34.37 kg) and hectare^{-1} (48.14 t) was obtained with 150 kg nitrogen hectare^{-1}. The lowest yield plot^{-1} (31.49 kg) and hectare^{-1} (40.74 t) was obtained with 100 kg nitrogen hectare^{-1}.

The spacing had significant effect on the incidence of shoot and fruit borer Maximum incidence were observed in the plots with minimum plant density Satyanarayana (1984) who reported that closer spacing lead to more pest infestation reported similar results. Maximum unmarketable yield was obtained with the higher dose 200 kg nitrogen, which accounts to 19.12 per cent followed by 150 and 100 kg which accounts to 18.6 and 18.37 per cent. Thus the incidence of shoot borer significantly increased with increase in higher levels of nitrogen application.

The interactions of spacing and nitrogen levels had significant effects on growth, flowering, fruiting, and yield of brinjal (Table 2). The significant effects of the interactions of spacing and nitrogen were evident with regard to the height of the plant at all stages of plant growth. The interaction between 90 x 120 cm spacing with 200 kg of nitrogen hectare^{-1} produced the maximum and significantly more height was maintained at different stages of plant growth. The least height was observed under the interaction of 90 x 90 cm with 150 kg N ha^{-1} which was at par with 90 x 60 cm spacing with all the different doses on nitrogen.

The plant spread was influenced by the interaction of spacing and nitrogen at all the stages of plant growth. The interaction between 90 x 120 cm spacing with 200 kg of nitrogen hectare^{-1} resulted in maximum spread of the plant both East-West and North-South directions. The lowest plant spread was observed with 90 x 60 cm spacing with 100 kg of nitrogen hectare^{-1}.

The interaction between the spacing and nitrogen influenced significantly the number of branches at different stages of plant growth except at 45, 60, 75 days stage. The interaction between 90 x 120 cm spacing with 200 kg of nitrogen hectare^{-1} produced the maximum number of branches, which was at par with 90 x 90 cm spacing with 150 kg of nitrogen hectare^{-1}. The least number of branches was obtained with 90 x 60 cm spacing with 100 kg of nitrogen hectare^{-1}.

The interaction of spacing and nitrogen had significant effect with that of the length of the fruit and diameter of the fruit. The interaction between the spacing and nitrogen had no significant effect on the mean number of fruits plant^{-1} and fruits weight plant^{-1}. However, contrasting results were obtained by Singh and Syamal (1995) who reported that application of 100 kg nitrogen hectare^{-1} with widest spacing of 90 x 60 cm resulted in height, number of fruits as well as fruit weight.

The interaction between spacing and nitrogen had significant effect on the yield plot^{-1} and yield hectare^{-1}. Maximum yield plot^{-1} was obtained with 90 x 120 cm with 200 kg. nitrogen hectare^{-1} which was at par with 90 x 90 cm spacing and 150 kg nitrogen

hectare^{-1}. Minimum yield plot^{-1} was obtained with 90 x 60 cm with 100 kg nitrogen. The yield hectare^{-1} was significantly higher with 90 x 120 cm spacing with 200 kg of nitrogen hectare^{-1}. Minimum yield hectare^{-1} with all three spacings. The results obtained were in contrast with those of Mangual (1981), Pawar (1990) and Chadha *et al*. (1997) who reported that closer spacing with higher does of nitrogen helped in increasing the yield. Rastogi *et al.* (1979) showed highest yields with plots receiving 45 kg N ha^{-1} and having spacing at 45 x 30 or 60 x 30 cm.

The interaction of spacing and nitrogen had significant effect on the incidence of shoot and fruit borer. Maximum incidence of fruit borer was found with 90 x 60 cm spacing with 200 kg of nitrogen hectare^{-1}, whereas minimum incidence of shoot and fruit borer was occurred with 90 x 120 cm spacing with 100 kg of nitrogen hectare^{-1}. It was noticed that wider spacing with lower dose of nitrogen reduceded the incidence of fruit and shoot borer.

References

Abutiate, W. S. 1988. Effect of spacing on the yield of marketable fruits of eggplant (*Solanum melongena* L.) 'type. Oguanhwoa' Trop. Agric. 65(2): 188-189.

Anonymous. 2007b. Agricultural Statistic of Maharashtra State, http://www.mah.nick.in.

Chadha, A. P. S., Naidu, A. K., Amarchand and Verma, B. K. 1997. Effect of levels of N, P, K and plant spacing on yield and economics of brinjal (*Solanum melongena* L.) Recent Horti. 4: 156-157.

Harminder Singh, Sialmbhi, M. S., Bal, S. S. and Singh, H. 1997. A note on effect of plant population density on growth and yield of brinjal hybrids. Veg. Sci. 24(2): 134-166.

Mertia, N. S. and Chauhan, K. S. 1970. Effect of different levels of nitrogen, phosphorus and potassium on vegetative growth and yield of brinjal (*Solanum melongena* L.). Allahabad Fmr. 44(6): 439-445.

Mangual, Crespo, G. 1981. Responce of egg plant to various N, P, K levels and plant densities on an Oxisol. J. Agric. Uni., Puerto Rico. 65(3): 250-257.

Patnaik, B. P. and Farooqui, M. M. 1964. Effect of N singly and in combination with P_2O_5 and K_2O in brinjal. Fertl. News. 9(9): 21-27.

Pawar, P. B. 1990. Studies on plant population and nutritional requirement of brinjal cv. Pragati. M.Sc. (Agri.) thesis, M.P.K.V., Rahuri, India.

Rastogi, K. B., Korla, B. N. and Peshin, S. N. 1979. Effect of different levels of nitrogen and spacing on fruit yield of eggplant grown in the mid hill region of Himachal Pradesh. Indian Agric. Sci. 49(9): 680-682.

Ruiter, D. D. F. 1974. Experiment with eggplant of Naelwijik Groeuten in Fruit. 30(10): 427. (Hort. Abstr. 3271, Vol.: 44(4).

Satyanarayana, M. 1984. Influence of plant density on yield and yield parameters of brinjal cv. Bhagyamati. South Indian Horti. 32(5): 306-307.

Seth, J. N. and Choudhury, B. 1970. Effect of fertilizers and spacing on the fruit and seed yield in tomato (*Lycopersicon esculendm* M.). Prog. Horti. 2(3): 5-13.

Seth, J. N. and Dhaudar, D. G. 1970. Effect of fertilizers and spacing on the seed yield and quality of brinjal (*Solanum melongena* L.). cv. Pusa Purple Long. Prog. Horti. 1(4): 45-50.

Singh, K. and Sandhu, D. S. 1970. Effect of sol and foliar application of nitrogen on the vegetative growth and yield of brinjal (*Solanum melongena* L.). Punjab Horti. J. 10: 103-110.

Singh, V. N. and Syamal, M. M. 1995. Effect of nitrogen and spacing on yield and quality attributes of brinjal (*Solanum melongena* L.). J. Res. Birsa Agric. Univ. 7(2): 137-139.

Verma, J. P., Rathore, S. V. S. and Dayal, B. 1974. Response of certain varieties of brinjal to varying levels of nitrogen. Prog. Hort. 6(1): 25-30.

J. Agric. Res. Technol., 37 (2) : 201-205 (2012)

A High Yielding, Early Maturing and Downy Mildew Resistant Pearl millet Hybrid: GHB-719

C. J. Dangaria[1], K. K. Dhedhi[2], K. L. Raghavani[3], J. S. Sorathia[4], K. D. Mungra[5] and B. D. Bunsa[6]
Main Pearl millet Research Station, Junagadh Agricultural University, Jamnagar - 361 006 (India)
(Received : 07-08-2011)

Abstract

Gujarat Hybrid Bajra-719 (GHB-719), a new pearl millet hybrid was developed by crossing the male sterile line ICMA 95222 and restorer line J-2454. The average grain and dry fodder yield of GHB-719 was registered 24.34 and 48.00 q ha^{-1}, respectively, under *kharif* rainfed conditions at State level. It has reorded 5.92 and 37.67 per cent higher grain and 6.67 and 20.00 per cent higher dry fodder yield than check hybrids GHB-538 and MH-169, respectively. At national level, it produced on an average 24.06 and 53.67 q ha^{-1} grain and dry fodder yield in that order under *kharif* rainfed conditions across the years and locations. The hybrid GHB-719 has recorded 8.92, 9.23 and 16.69 per cent higher grain yield than national check hybrids ICMH-356, GHB-538 and HHB-67, respecdveiy. The hybrid GHB-719 has got attractive seed colour, bristled earhead, early maturity, downy mildew resistant and high grain and fodder yield potential as compared to check hybrids. Hence, it was recommended at National and State level for general cultivation under *kharif* season.

Key words : Pearl millet, GHB-719, grain yield, early maturity, downy mildew resistant.

Since pearl millet is grown in diverse agro climatic situation (Anonymous, 2010), the requirement of appropriate hybrids in regards to maturity group and yield potential also differs. Earlier hybrids like CJ-104, BJ-104 and Pusa-23 were popular. Recently released early maturing hybrid GHB-538 is becoming very popular in 'A1' zone of drought prone area of the country. However looking to the harsh and diverse environmental situations in *kharif* arid and semi arid pearl millet growing regions of the country (Harinarayana *et al*. 1999), there is need to have additional early maturing public hybrids to provide the need based choice options to the farmers. Thus there is an urgent need to have an additional early maturing and disease/pest resistant pearl millet hybrids in drought prone areas of the country.

Materials and Methods

The hybrid GHB-719 was developed by crossing male sterile line ICMA 95222 and restorer line J-2454 at the Main Pearl millet Research Station, Junagadh Agricultural University, Jamnagar (Gujarat), India. The male sterile line ICMA 95222 was developed by ICRISAT, Patancheru (A.P.) and restorer line J-2454 was developed at this centre by the cross of (RIB-3135/18 x RIB-335/74)-2-3-12-B. After preliminary testing, the seeds were multiplied and evaluated as GHB-719 during *kharif* seasons from 2003 to 2007 in different 11 locations (Jamnagar, Targhadia, Amreli, Dhari, Nana Kandhasar, Jam Khambhalia, S. K. Nagar, Kothara, Vallabhipur, Mahuva and Anand) in Gujarat state. Simultaneously, this hybrid was also tested at national level (Rajasthan, Haryana and New Delhi) under *kharif* rainfed conditions during the period from 2003-05. National level released popular early maturing hybrids GHB-538, HHB-67,

1. Director of Research and P. G. Dean, 2., 4., 5. Assistant Research Scientist, 3. Reserach Scientist (Pearl millet), and 6. Associate Research Scientist.

ICMH-356 and MH-169 were used as checks. The experiment was conducted in RBD with three replications at all the locations. The analysis of variance was performed as suggested by Panse and Sukhatme (1985).The recommended packages of practice were followed in each year at each location to raise the good crop.

Results and Discussion

Evaluation at state level : The hybrid GHB-719 was tested during *kharif* seasons under rainfed conditions at 11 locations over a period of five years (2003 to 2007). The perusal of Table 1 revealed that the hybrid GHB-719 has recorded an average grain yield of 24.34 q ha^{-1} with 5.92 and 37.67 per cent increase over check hybrids GHB-538 and MH-169, respectively. With respect to dry fodder yield, GHB-719, GHB-538 and MH-169 have produced 48.0, 45.0 and 40.0 q ha^{-1} average dry fodder yield in that order across over the years and locations. Thus, it has registered 6.67 and 20.00 per cent higher dry fodder yield than check hybrids GHB-538 and MH-169, respectively. The hybrid GHB-719 has showed comparatively less mean per cent incidence of downy mildew (4.10%) as compared to check hybrids GHB-538 (4.40%) and MH-169 (7.20%) under artificially epiphytic conditions during *kharif* seasons at Jamnagar, Anand and Sardar Krushinagar in Gujarat (Table 2A). It has also shown resistant to smut (12.50%) and rust (13.65%) diseases.

Table 1. Performance of GHB-719 and check hybrids under *kharif* rainfed conditions over 5 years.

Hybrid	Yield (q ha^{-1})	% increase over checks
Grain yield at State Level :		
GHB-719	24.34 (48)	-
GHB-538	22.98	5.92
MH-169	17.68	37.67
Dry fodder yield at State Level :		
GHB-719	48.00	-
GHB-538	45.00	6.67
MH-169	40.00	20.22
Grain yield at National Level :		
GHB-719	24.06 (20)	-
ICMH-356	22.09	8.92
GHB-538	17.99	9.23
HHB-67	16.84	16.69
Dry fodder yield at National Level :		
GHB-719	53.67	-
ICMH-356	48.33	11.04
GHB-538	46.00	2.17
HHB-67	35.50	32.39

Data in parenthesis indicated number of locations.

Similarly, it has registered comparatively low mean per cent infestation of shoot fly (3.89%) as against to checks GHB-538 (4.31%) and MH-169 (6.81%) at earhead stage, while GHB-719, GHB-538 and MH-169 have recorded 6.41, 9.56 and 21.91 per cent stem borer incidence at earhead stage, respectively, over the years at Jamnagar (Table 3).

The seeds of GHB-719 contain protein (9.53%) similar to other cultivated hybrids *viz*., GHB-538 (9.60%), MH-169 (8.60%), ICMH-

Table 2A. The reaction of diseases in percentage under artificially epiphytic condition at Jamnagar, Anand and SK Nagar (Gujarat) during *kharif* seasons (2003-2007).

Hybrid	Downy mildew				Smut				Rust			
	Jam-nagar	Anand	SK Nagar	Mean	Jam-nagar	Anand	SK Nagar	Mean	Jam-nagar	Anand	SK Nagar	Mean
GHB-719	2.9	3.7	5.8	4.13	25.1	-	0.0	12.5	11.0	16.3	-	13.65
GHB-538	2.4	2.8	7.9	4.36	22.1	-	2.0	12.1	2.2	2.5	-	2.35
MH-169	8.3	10.1	3.1	7.17	19.0	-	0.0	9.5	21.8	20.0	-	20.9

Table 2B. The reaction of diseases in percentage under artificially epiphytic condition at national level across the years and locations (2003-2005).

Hybrid	Downy mildew		Smut	Ergot	Rust	Blast
	At 30 days	At 60 days				
GHB-719	2.66	4.48	28.05	8.32	35.90	16.76
IGMH-356	2.85	4.46	37.77	9.80	23.23	9.22
GHB-538	2.30	3.10	33.40	23.20	11.90	6.95
HHB-67	7.30	8.90	15.40	11.70	30.50	21.2

356 (9.71%) and HHB-67 (9.18%) (Table 4). The seeds of GHB-719 have oil content (6.50%) similar to the almost check hybrids, GHB-538 (6.80%), MH-169 (6.00%), ICMH-356 (6.80%) and HHB-67 (5.95%). The same hybrid is not only early maturing and high yielding but also has good grain *rotala* making quality. GHB-719 is characterized by erect growth habit with a height of 165-170 cm, flowers in 40-45 days and matures in 69-74 days (Table 5). The panicles are compact, conical, bristled with length of 20-25 cm and produce yellow anther. Due to presence of sharp and short bristle on the earhead of GHB-719 helps to reduce bird damage as compared to non-bristle hybrids. The grain size is bold, globular in shape with gray light brownish in colour and grains are tasty and better than check hybrid such as MH-169.

In view of its early maturity, high resistance to downy mildew and tolerant to stem borer and shoot fly, higher grain and dry fodder yield potential over popular hybrids GHB-538 (5.92, 6.67%) and MH-169 (37.67, 20.00%), the hybrid GHB-719 was identified and recommended by 4th combined joint session of Agricultural Research Council Committee meeting held at NAU, Navsari on 3-5 April, 2008 for its general cultivation under *kharif* pearl millet growing areas of North Gujarat and Saurashtra zone of the Gujarat state.

Evaluation at National level : The hybrid GHB-719 (MH-1236) was first evaluated under NATP hybrid project trial (HPT) at six locations (Mandor, Jaipur, Jamnagar, Hissar, New Delhi and Dhule) in the country during *kharif* season of 2003-04. Due to its first rank in yield performance (34.22 q ha^{-1}) in HPT trial, the hybrid GHB-719 (MH-1236) was directly included in the AHPT of zone 'A_1' during 2004.

Table 3. Mean percentage infestation of shoot fly and stem borer.

Hybrid	Mean infestation of shoot fly (%)		Stem borer incidence (%)
	Vegetative stage	Earhead stage	Earhead stage
State level (Jamnagar) (2003-2007) :			
GHB-719	2.98	3.89	6.41
GHB-538	4.84	4.31	9.56
MH-169	10.43	6.81	21.91
National level (2003-2005) :			
GHB-719	10.35	4.36	3.91
ICMH-356	10.32	5.53	7.91
GHB-538	11.37	3.42	3.01
HHB-67	9.84	6.47	9.80

Table 4. Data on quality characteristics of GHB-719 with check hybrids.

Characters	Hybrid GHB-719	Check hybrids			
		GHB-538	MH-169	ICMH-356	HHB-67
Protein content (%)	9.53	9.60	8.60	9.71	9.18
Oil content (%)	6.50	6.80	6.00	6.80	5.95
Rotala quality rating	Superior	Superior	Good	Good	Good

The hybrid GHB-719 has also ranked second during second and third year of testing under AHPT trials. The perusal of Table 1 revealed that the hybrid GHB-719 has produced an average grain yield of 24.06 q ha^{-1} as compared to check hybrids, ICMH-356 (22.09 q ha^{-1}), GHB-538 (17.99 q ha^{-1}) and HHB-67 (16.84 q ha^{-1}) across the years and locations. Thus, it has shown overall improvement of 8.92, 9.23 and 16.69 per cent in grain yield than check hybrids ICMH-356, GHB-538 and HHB-67 respectively. The hybrids GHB-719, ICMH-356, GHB-538 and HHB-67 have manifested 53.67, 48.33, 46.00 and 35.50 q ha^{-1} average dry fodder yield in that order across the years and locations. Thus, it has recorded 11.04, 2.17 and 32.39 per cent higher dry fodder yield as against to checks ICMH-356, GHB-538 and HHB-67, respectively (Table 1).

The hybrid GHB-719 has recorded incidence of downy mildew (4.48%) near similar to check hybrids ICMH-356 (4.46%) and GHB-538 (3.10%), but registered low incidence of downy mildew as compared to check hybrid HHB-67 (8.90%) at 60 days after sowing under artificially epiphytic conditions during *kharif* seasons at national level testing centers (Table 2B). It has also shown comparatively less mean per cent incidence of smut (28.05%) and ergot (8.32%) as against check hybrids ICMH-356 (37.77, 9.80%) and GHB-538 (33.40, 23.20%) in that order over the years and locations. Similarly, the hybrid GHB-719 has registered comparatively less or more mean per cent incidence of rust and blast as compared to all the check hybrids. Infestation of shoot fly in GHB-719 was observed low (4.36%) as against to checks ICMH-356 (5.53%) and HHB-67 (6.47%) at ear head stage. Whereas, GHB-719, ICMH-356, GHB-538 and HHB-67 have recorded 3.91, 7.91, 3.01 and 9.80 per cent stem borer incidence at ear head stage in that order over the years and locations (Table 3).

Table 5. The characteristics of GHB-719 as compared to other released hybrids.

Characters	Hybrids		
	GHB-719	**GHB-538**	**MH-169**
Plant height (cm)	165-170	155-165	175-185
Days to 50 % flowering	40-45	40-45	42-46
Days to maturity	69-74	68-73	70-75
Synchrony of ear maturity	Good	Good	Good
Ear head length (cm)	20-25	22-25	19-22
Ear head exertion	Complete	Complete	Complete
Bristle on ear head	Present	Absent	Absent
Effective tillers $plant^{-1}$	4-6	3-5	4-5
Node pigmentation	Absent	Absent	Absent
Node pubescence	Absent	Absent	Present
Anther colour	Yellow	Light brown	Yellow
Ear head shape	Conical	Cylindrical	Cylindrical
Ear head compactness	Compact	Compact	Compact
Grain size	Bold	Medium	Bold
Grain colour	Gray light brownish	Gray brown	Gray
Grain shape	Globular	Globular	Obovate

In view of its desirable plant type like bristled panicle, upright synchronous tillering, early maturity, downy mildew resistant and higher grain and fodder yield potential over check hybrids ICMH-356, GHB-538 and HHB-67 and tolerant to stem borer and shoot fly, hybrid GHB-719 was identified and recommended at national level for general cultivation in *kharif* season under rainfed conditions in zone 'A_1' covering states of Rajasthan, Gujarat and Haryana by the Pearl Millet Varietal Identification Meeting held on 12th April, 2006 at Junagadh Agricultural University, Junagadh (Gujarat). Subsequently the hybrid was accepted and notified with notification No. S.O. 122 (E), dated 6th February, 2007 by Central Varietal Release and Identification Committee.

References

Anonymous. 2010. Annual Report-2010-11, All India Co-ordinated Pearl millet Improvement Project (ICAR), ARS, Mandor, Jodhpur, pp. 3.

Harinarayana, G., Anand Kumar, A. and Andres, D. J. 1999. Peral millet in Global Agric. Publ. Co. Pvt. Ltd., New Delhi, India. pp. 479-506.

Panse, V. G. and Sukhatme, P. V. 1985. Statistical Methods for Agricultural Workers. 2nd Edn., I. C. A. R., New Delhi.

J. Agric. Res. Technol., 37 (2) : 205-207 (2012)

Influence of Topping on Growth and Yield of Summer Sesame Varieties

J. J. Korhale[1], A. A.Shaikh[2], R. H. Hankare[3] and S. R. Salke[4]
College of Agriculture, Pune - 411 005 (India)
(Received : 07-08-2011)

Abstract

Among the varieties studied, AKT-101 showed its superiority in all the growth and yield characters namely number of branches plant^{-1}, number of capsules plant^{-1} and seed yield. In view of terminal topping practice done at different crop growth stages, topping at 30 days after sowing (DAS) recorded higher values over no topping for all the growth parameters and yield attributes evaluated. Both AKT-101 and Phule Til-1 were found to be highly amenable for topping at 30 days after sowing (DAS) over rest of the combinations studied in improving growth characters, yield attributes and finally yield.

Key words : Sesame, varieties, terminal topping, growth, yield.

The sesamun (*Sesamum indicum* L.) has yield potential of around 2.0 t ha^{-1} but low in productivity (363 kg ha^{-1}) and hence has tremendous options for management technologies. Yield is a manifestation of various physiological processes occruing in plants and they are usually modified by management practices in an environment. Besides, topping of terminal bud which activates the dormant lateral buds to produce more branches is an important operation for increasing sesame yield (Ramanathan and Chandrashekharan, 1998). Since management factors exert a profound effect on various growth and yield contributing characiers under the prevailing environmental condition, the present experiment was carried out to study the influence of morphological modification through terminal topping on summer sesame varieties

1. M.Sc. (Agri.) student, 2. Associate Professor of Agronomy, 3. Assistant Professor of Agronomy and 4. Jr. Res. Asstt.

Materials and Methods

Field experiments were conducted during summer 2008 and 2009 at Post Graduate Institute Farm, Mahatma Phule Krishi Vidyapeeth, Rahuri, India. The soil was silty clay in texture, optimum in bulk density (1.33 mg m^{-3}) and particle density (2.66 mg m^{-3}) with the porosity of 50 per cent, alkaline (pH 8.2), the electrical conductivity was low (0.49 dsm^{-1}), low in available nitrogen (238.40 kg ha^{-1}), moderate in available phosphorus (23.90 kg ha^{-1}) and high in available potassium (434.52

kg ha^{-1}). The experiments were conducted in a factorial randomized block design with five replications assigning two factors (varieties *viz*., Phule Til-1 and AKT-101, Terminal toping at 30, 45 days after sowing (DAS) and no topping). The crop was supplemented with nitrogen through urea, phosphorus through single super phosphate and potassium through muriate of potash at basal dose of 60:40:20 kg ha^{-1}, respectively. Thinning and gap filling were done on 15 and 25 DAS to achieve the required population. Five sample plants of sesame from each net plot were selected at random and labeled for biometric observations. The plant height, number of branched and number of capsule plant^{-1} were recorded at harvest stage. The crop was harvested separately from the net plots when the leaves and stem were turned yellow and the seed yield was recorded.

Results and Discussion

Effect of varieties : The data (Table 1) on growth parameters such as branches plant^{-1}, height and yield attributes such as number of capsules plant^{-1} and seed yield except plant height were superior in the variety AKT-101 was found to be remained on par with Phule Til-1 (Table 1). The plant height, remained higher for PhuleTil-1 compared with AKT-101 variety. AKT-101 recorded higher number of capsules plant^{-1} (67.10) and this was superior over Phule Til-1. The total DMP of the crop mostly depends on leaf area, photosynthetic rate and dry matter partition. The positive increase in number of branches plant^{-1} might have offered higher chance for the increased number of capsules plant^{-1}. AKT-101 recorded maximum seed yield of 868 kg ha^{-1} and was found on par with Phule Til-1. This might be due to more number of branches plant^{-1} that helped in production of more number of matured or productive capsules. Similar results were observed by Kathiresan *et al.* (1997).

Table 1. Influence of topping management on growth and yield of sesame varieties (Pooled mean over two seasons).

Treatment	Plant height (cm)	Branches plant^{-1}	Capsules plant^{-1}	Seed yield (kg ha^{-1})
Varieties :				
PhuleTil-1	62.45	3.60	55.42	716
AKT 101	41.51	4.26	67.10	868
SE(m)±	3.1	0.04	0.58	10.0
CD (P=0.05)	9.3	0.13	1.72	30.0
Topping :				
30DAS	23.86	5.08	81.27	849
45DAS	51.10	3.53	51.96	768
No topping	80.80	3.19	50.55	758
SE(m)±	3.8	0.05	0.71	10.0
CD (P=0.05)	11.4	0.16	2.10	40.0
Interaction (varieties x topping) :				
SE(m)	0.54	0.07	1.01	20.0
CD (P-0.05)	N.S.	N.S.	2.98	60.0

Table 2. Mean number of capsules per plant as influenced by interaction between varieties and topping management.

Varieties	Topping management			
	30 DAS	45 DAS	No topping	Mean
PhuleTil-1	68.57	47.88	48.29	54.91
ART 101	93.74	55.12	52.42	67.09
SE(m)±	1.05			
CD (P=0.05)	3.10			

Table 3. Mean seed yield (kg ha^{-1}) as influenced by interaction between varieties and topping management.

Varieties	Topping management			
	30 DAS	45 DAS	No topping	Mean
PhuleTil-1	754	702	691	716
AKT 101	944	834	825	868
SE(m)±	20.0			
CD (P=0.05)	60.0			

Effect of terminal topping : In terminal topping practice, the maximum plant height was noticed with no topping treatment when compared to all manual terminal toppings. Terminal topping at 30 DAS recorded more number of branches plant^{-1}, DMP and number of capsules plant^{-1}. In plants, the development of auxiliary buds are inhibited normally by Indole Acetic Acid (IAA) produced in the apical meristem. If the source of auxin is removed by exericising the apical meristem. the lateral branches get accelerated. Moreover, under terminal topping, the utilization of photosynthates by the crop for the production of lateral branches would be higher and this might be the reason for increased number of branches plant^{-1} at 30 DAS (5.08) over 45 DAS (3.53). Imayavaramban *et al.* (2004) reported more number of branches with manual clipping of leaves, leaving two pair of leaves above cotyledonary leaf. The increased number of branches and production of more leaves which alter the crop canopy that in turn increased number of productive capsules plant^{-1}. The terminal topping practice at 30 DAS recorded more number of capsules plant^{-1} (81.27). The terminal topping practice might have efficiently altered the crop architecture, which in turn increased lateral branches that led to greater chance for development of source and sink features in sesame. The beneficial impact of terminal topping on yield attributes was reported by Imayavaramban (2000). Topping at 30 DAS recoroed maximum seed yield of 849 kg ha^{-1}. This was due to induction of more number of lateral branches plant^{-1}.

Effect of varieties and topping practices : The variety Phule Til-1 in combination with no topping recorded maximum plant height (62.45 cm) which might be due to continuous supply of auxin to apical meristematic tissues. This is in accordance with the findings of Venkadachalam (2003). In terms of production of branches plant^{-1} all the varieties topped at 30 DAS produced higher number of branches owing to the practice of terminal topping which might have induced the formation of equally dominant branches. Similar finding was reported by Tewolde *et al.* (1994). As known that for individual effect the rest of the growth parameters was favorably influenced by the combination of variety AKT-101 for 30 DAS topping owing to the positive response of the variety for the topping practice. Sesame variety AKT-101 when topped at 30 DAS registered the highest seed yield of 944 kg ha^{-1}. The increase in seed yield of sesame in topped plants over non topped plants was due to increase in more number of branches and capsules plant^{-1} (Table 2,3). Similar results were reported by Venkadachalam (2003).

References

Imayavaramban, V. 2000. Agronomic strategies for yield maximization in sesame (*Sesamum indicum* L.) Ph.D. Thesis submitted to Annamalai University, Chidambaram.

Imayavaramban, V. P., Panneerselvam, R., Isaac, M. and Thabuthan, K. 2004. Effect of different nitrogen levels, clipping and growth regulators on the growth and yield of sesame. Sesame Safflower Newsl. 19: 40-44.

Kathiresan, G., Venkataraman, A. and Gnanamurthy, P. 1997. Effect of ethrel and clipping at different stages on sesame crop. Sesame Safflower Newsl. 12: 55-58.

Ramanathan, S. P. and Chandrashekharan, B. 1998. Effect of nipping, plant geometry and fertilizer on summer sesame (*Sesamum indicum* L.) Indian J. Agron. 43: 329-332.

Tewolde, H., Mulkey, J. R. and Fernandes, C. J. 1994. Recovery of sesame from defoliation and growth terminal clipping. Agron. J. 86: 1060-1065.

Venkadachalam, K. 2003. Response of sesame cultivars to crop geometry and clipping management in tail end of cauvery delta zone. M.Sc. (Agri.) thesis submitted to Tamil Nadu Agricultural University, Coimbatore.

J. Agric. Res. Technol., 37 (2) : 208-212 (2012)

Genetic Variability Studies in Garlic (*Allium sativum* L.)

B. T. Patil[1], P. P. Gidmare[2], M. N. Bhalekar[3] and K. G. Shinde[4]
All India Coordinated Research Project on Vegetable Crops
Mahatma Phule Krishi Vidyapeeth, Rahuri - 413 722 (India)
(Received : 07-08-2011)

Abstract

The garlic genotype RHRG-29 exhibited superior performance for yield contributing traits and can be further exploited in crop improvement programme. Higher GCV and genetic advance were observed for weight of 10 cloves, bulb weight, bulb yield ha^{-1} and number of cloves bulb^{-1} indicating all these traits are governed by additive gene action and hence direct selection for such traits is desirable for improvement of garlic yield.

Key words : Variability, GCV, PCV, heritability, genetic advance.

Garlic (*Allium sativum* L.) has attracted the attention all over the world due to its multifarious medicinal properties and used as valuable spice food. Genetic variability existing and created in both the cultivated and wild species either through natural processes or through crop breeding is essential for generating new gene complexes for realizing higher economic yield and resistance to biotic and abiotic stresses. Selection is perhaps the most important activity of all breeding programmes, the effectiveness of which in terms depends upon the range of the genetic diversity existing already in the population in respect of economic characters. The information of genetic variability on yield components is paramount importance in a crop improvement programme. The extent of genotypic variability indicates the amenability of a given character for its improvements, while the knowledge on the heritability along with genetic advance aid in drawing valuable conclusions based on phenotypic performance. The information on these aspects in garlic under different climatic conditions and also other parts of India is almost negligible. The present investigation was therefore planned to generate some basic information on genetic variability, heritability and genetic advance among various economic traits in garlic to aid in selection programme and to study the environmental influence.

Materials and Methods

Forty five genotypes of garlic maintained at All India Co-ordinated Research Project on Vegetable Crops, Department of Horticulture, Mahatma Phule Krishi Vidyapeeth, Rahuri, Maharashtra were evaluated during *rabi* 2009-10 in a randomized block design with two replications. Each genotype was sown in flat bed with spacing of 15 x 10 cm. All the recommended package of practices were followed as and when required to raise good crop. Observations were recorded on five randomly selected plants of each genotype from each replication on number of leaves plant^{-1}, plant height, neck thickness, bulb weight, bulb length, bulb diameter, weight of 10 cloves, number of cloves bulb^{-1}, bulb yield plot and bulb yield hectare^{-1}. The mean values of five randomly selected plants were used for

1. Jr. Vegetable Breeder, 2. M. Sc.(Hort.) student, 3. Sr. Vegetable Breeder and 4. Vegetable Research Officer.

Table 1. Mean performance of different characters of 45 garlic genotypes for some quantitative characters.

Genotypes	No. of leaves plant^{-1}	Plant height (cm)	Neck thick-ness (cm)	Bulb weight (g)	Bulb length (cm)	Bulb diam-eter (cm)	Weight of 10 cloves (g)	Cloves bulb^{-1}	Bulb yield plot^{-1} (kg)	Bulb yield ha^{-1} (q)	Days for harvest
RHRG-1	9.20	55.10	0.89	21.60	3.21	3.40	9.20	23.47	6.065	101.100	117.0
RHRG-2	8.30	49.40	0.65	14.62	2.83	3.24	9.30	15.72	5.350	89.180	117.0
RHRG-3	7.90	41.60	0.68	13.80	2.88	3.24	10.00	13.80	3.925	65.425	117.0
RHRG-4	8.40	47.40	0.70	15.40	2.86	3.56	9.20	16.74	5.242	87.390	117.0
RHRG-5	9.00	45.00	0.80	17.20	2.95	3.22	10.80	15.92	5.475	91.265	117.0
RHRG-6	9.00	55.40	0.99	20.40	3.47	3.64	9.80	20.82	5.560	92.680	117.0
RHRG-7	8.30	59.20	1.02	27.80	3.10	3.97	9.40	29.57	5.950	99.180	127.0
RHRG-8	8.50	46.80	1.18	30.20	3.62	4.12	13.40	22.54	8.900	148.358	123.0
RHRG-9	8.80	48.20	0.79	18.80	3.54	3.78	11.60	16.21	8.251	137.540	117.0
RHRG-10	8.40	49.90	0.90	24.50	3.55	4.06	10.60	23.11	8.000	133.355	123.0
RHRG-11	8.50	47.00	0.80	20.00	3.45	3.58	12.60	15.87	8.955	149.275	117.0
RHRG-12	7.00	52.20	0.87	25.00	2.95	4.03	7.00	35.71	8.250	137.520	127.0
RHRG-13	8.20	52.80	0.84	23.60	3.00	3.98	7.00	33.71	6.225	103.765	127.0
RHRG-14	7.40	48.40	0.78	18.80	2.76	3.66	9.20	20.43	6.750	112.515	127.0
RHRG-15	7.50	50.90	0.84	21.00	2.77	3.95	9.60	21.87	5.925	98.765	127.0
RHRG-16	8.70	44.70	0.79	19.30	2.82	3.67	10.80	17.87	6.125	02.100	127.0
RHRG-17	7.80	48.10	0.78	18.10	2.76	3.72	9.00	20.11	7.600	126.685	127.0
RHRG-18	7.80	49.60	0.74	18.80	2.74	3.76	9.40	20.00	7.200	120.020	127.0
RHRG-19	7.70	45.00	0.86	18.60	3.03	3.87	9.20	20.22	7.900	131.690	127.0
RHRG-20	8.40	51.60	0.86	21.70	3.24	3.74	13.40	16.20	8.100	135.020	123.0
RHRG-21	7.70	48.30	0.82	21.40	2.90	3.67	11.60	18.45	8.000	133.355	127.0
RHRG-22	8.90	54.70	0.96	25.00	2.81	4.22	11.00	22.73	9.825	163.780	127.0
RHRG-23	8.30	49.70	0.92	22.20	3.31	3.93	11.80	18.81	9.500	158.360	123.0
RHRG-24	9.30	50.60	1.07	35.70	3.90	4.44	13.00	27.46	11.250	187.530	123.0
RHRG-25	9.40	57.50	1.00	32.00	3.04	4.38	11.40	28.07	9.100	151.690	127.0
RHRG-26	7.60	49.50	0.88	22.80	2.94	3.90	7.00	32.57	9.150	152.525	127.0
RHRG-27	8.10	52.50	0.92	27.20	2.90	3.95	11.00	24.73	10.600	176.695	127.0
RHRG-28	7.40	56.30	0.90	28.80	2.98	4.14	9.00	32.00	8.000	133.355	127.0
RHRG-29	8.80	52.20	1.09	40.50	4.16	5.07	22.20	18.24	11.950	199.200	123.0
RHRG-30	8.10	55.10	0.73	24.40	3.11	3.58	9.20	26.52	10.400	173.360	127.0
RHRG-31	9.30	55.30	0.91	33.90	3.19	4.06	12.00	28.25	11.125	185.450	127.0
RHRG-32	8.10	55.90	1.01	25.30	3.46	4.16	11.60	21.81	10.600	176.700	123.0
RHRG-33	7.80	52.90	0.85	21.20	2.88	3.86	8.60	24.65	8.525	142.105	127.0
RHRG-34	7.80	51.10	0.91	22.00	2.84	3.83	9.20	23.91	8.550	142.525	127.0
RHRG-35	7.90	54.50	0.95	27.30	2.99	4.17	10.00	27.30	7.850	130.855	127.0
RHRG-36	9.00	53.20	0.97	31.00	2.88	4.12	13.60	22.79	7.875	131.270	127.0
RHRG-37	7.20	56.30	0.72	18.60	3.17	3.65	9.00	20.67	5.070	84.510	117.0
RHRG-38	9.40	54.10	1.16	35.40	4.09	4.48	15.00	23.60	11.775	196.285	123.0
RHRG-39	9.50	48.80	0.88	21.40	3.42	3.64	9.00	23.77	5.330	88.845	117.0
RHRG-40	8.85	47.80	0.81	23.00	3.55	3.53	11.70	19.66	6.925	115.435	117.0
RHRG-41	8.30	48.70	0.86	24.20	3.41	3.56	15.60	15.51	8.925	148.775	123.0
RHRG-42	8.00	44.10	0.77	13.00	2.74	3.20	9.60	13.54	4.145	69.095	117.0
RHRG-43	8.60	52.70	0.85	22.10	2.74	4.01	9.60	23.02	9.725	162.110	127.0
RHRG-44	9.00	48.60	1.00	24.30	3.69	4.04	12.60	19.28	8.125	135.435	123.0
RHRG-45	9.70	52.10	1.08	24.85	3.51	3.90	33.70	7.37	7.300	121.690	127.0
Mean	8.37	50.91	0.88	23.48	3.16	3.86	11.30	20.13	7.897	131.639	123.4
S.Em±	0.33	1.91	0.05	1.21	0.07	0.11	0.29	0.40	0.733	12.225	0.00
C.D. at 5%	0.93	5.44	0.13	3.45	0.20	0.32	0.83	1.15	2.090	34.843	N.S.

stastical analysis. The data was analyzed as per method suggested by Panse and Sukthame (1985). The PCV, GCV and heritability estimates (broad sense) were calculated according to the procedure suggested by Burton and DeVane (1953) while, genetic advance was calculated as per formulae given by Johnson *et al*. (1955).

Results and Discussion

The analysis of variance for all the characters studied revealed significant differences among all the genotypes under study. The mean performance of different characters of 45 genotypes of garlic was presented in Table 1. Significantly the highest number of leaves was recorded by genotype RHRG-45 (9.70) followed by RHRG-39 (9.50) while the lowest by RHRG-12 (7.00). The significantly the highest plant height was mentioned by genotype RHRG-7 (59.20 cm) followed by RHRG-3 (41.60). The significantly the highest neck thickness was recorded by genotype RHRG-8 (1.18 cm) followed by RHRG-38 (1.16 cm) while least values mentioned by RHRQ-2 (0.65 cm) which is the most desirable character in respect of storage of garlic bulb. Bulb weight was the highest in genotype RHRG-29 (40.50 g) followed by RHRG-24 (35.70 g) while the lowest bulb weight was in RHRG-42 (13.0 g). The highest bulb length was recorded by genotype RHRG-29 (4.16 cm) followed by RHRG-38 (4.09 cm) while lowest in RHRG-18 (2.74 cm). The significantly highest bulb diameter was recorded by genotype RHRG-29 (5.07 cm) followed by RHRG-38 (4.48 cm) while genotype RHRG-42 (3.20 cm) showed lowest mean values. Significantly highest weight of 10 cloves was recorded by genotype RHRG-45 (33.70 g) followed by RHRG-29 (22.20 g) while lowest values found in RHRG-12 (7.0 g). Number of cloves bulb^{-1} were recorded the highest in RHRG-12 (35.71) followed by RHRG-13 (33.71) while lowest number in genotype RHRG-45 (7.37). Significantly highest bulb yield was recorded by genotype RHRG-29 (11.950 kg plot^{-1} and 199.20 q ha^{-1}) followed by genotype RHRG-38 (11.775 kg plot^{-1} and 196.28 q ha^{-1}), RHR-24 (11.250 kg plot^{-1} and 187.53 q ha^{-1}) while the lowest yield recorded in RHRG-3 (3.925 kg plot^{-1} and 65.425 q ha^{-1}) respectively. Twelve genotypes were found earlier in respect of days required for harvest (117 days) for its maturity. Overall the genotype RHRG-29 being high yielder exhibited superior

Table 2. Genetic variability parameters of 45 garlic genotypes.

Characters	Range	Mean	P.C.V.	G.C.V	Heritability (%) in b.s.	Genetic advance (G.A.)	Expected Gen. Adv. as % of mean
Leaves plant^{-1}	7.00 - 9.70	8.37	8.89	6.99	61.86	0.94	11.33
Plant height (cm)	41.60 - 59.20	50.90	8.57	6.73	61.72	5.55	10.90
Neck thickness (cm)	0.64 - 1.18	0.88	14.85	12.78	74.11	0.20	22.67
Bulb weight (g)	13.00 - 40.50	23.48	25.82	24.77	92.01	11.49	48.94
Bulb length (cm)	2.74 - 4.16	3.16	11.97	11.56	93.28	0.72	23.00
Bulb diameter (cm)	3.20 - 5.07	3.86	9.83	8.91	82.21	0.64	16.65
Weight of 10 cloves (g)	7.00 - 33.70	11.30	38.08	37.91	99.09	8.78	77.75
Cloves bulb^{-1}	7.37 - 35.71	20.13	16.59	16.34	97.07	6.67	33.17
Yield plot^{-1} (kg)	3.92 - 11.95	7.89	27.27	23.90	76.82	3.40	43.16
Yield ha^{-1} (q)	65.42 - 199.20	131.64	27.27	23.90	76.82	56.82	43.16
Days for harvest	117 - 127	123.44	3.43	3.43	100.00	8.73	7.07

GCV = Genotypic coefficient of variation, PCV = Phenotypic coefficient of variation

performance for yield contributing traits and can be used in garlic crop improvement programme.

The extent of variability with respect to eleven quantitative characters in different advance lines of garlic is measured in terms of range, genotypic coefficient of variations (GCV), phenotypic coefficient of variations (PCV), heritability (h^2), genetic advance and genetic advances as per cent of mean (Table 2) showed considerable variations. In the present investigation phenotypic coefficient of variations was higher than GCV for all the traits, indicating environmental factors influenced their expression. The GCV and PCV were high for weight of 10 cloves, bulb yield, weight of bulb, number of cloves $bulb^{-1}$ and neck thickness. Remaining traits had low genotypic and phenotypic coefficient of variant. Similar results in some important traits were reported by Godhani and Singh, (2000), Dubey *et al*., (2010) and Jabeen *et al*., (2010). Wide difference between phenotypic and genotypic coefficient of variations in garlic crop indicated their susceptibility to environmental fluctuations and narrow difference showed less environmental interference on the expression of these traits. The traits which showed high GCV and PCV are of economic importance and there is scope for improvement of these traits through selection.

The heritability in broad sense ranged from 61.72 to 100 per cent. High value of heritability was recorded for days required to harvest (100.0%), weight of 10 cloves (99.09%), number of cloves $bulb^{-1}$ (97.07%), bulb length (93.28%), average bulb diameter (82.21%) and bulb yield (76.82%). Remaining characters showed moderate heritability. High heritability for above characters clarified that they were least affected by environmental modifications and selection based on phenotypic performance would be reliable. These findings are in consonance with observation of Mehta and Patel, (1985), Killadi *et al*. (2000), Dubey *et al*. (2010) and Jabeen *et al*. (2010).

The heritability estimates along with genetic advance are more useful than the heritability value alone for selecting the best individual. From the present investigation, the expected genetic advance as per cent of mean ranged from 7.07 to 77.75. High estimates of expected genetic advance was showed by weight of 10 cloves (77.75%) followed by bulb weight (48.94%), bulb yield ha^{-1} (43.16%), number of cloves $bulb^{-1}$ (33.17%) and rest of traits showed moderate to low expected genetic advance. High values of heritability, GCV and genetic advance as per cent of mean were observed for average weight of 10 cloves, average bulb weight, bulb yield ha^{-1}, number of cloves $bulb^{-1}$, suggesting that all these traits are genetically controlled by additive gene action (Panse 1957); and can be improved through mass selection, family selection and other modified selection methods. High heritability coupled with high genetic advance as per cent of mean were observed for above characters suggesting that these characters were governed by additive gene action. Similar findings have been reported by Selvaraj *et al*. (1997), Gvozdanovic Verga *et al*. (2002), Khar *et al*. (2005) and Jabeen *et al*. (2010). However, it is always not possible the high heritability coupled with high genetic advance because broad sense heritability is based on genetic variance which include both fixable and non-fixable variances.

Thus, from present investigation it could be concluded that the genotype RHRG-29 exhibited superior performance for yield and yield contributing characters and can be used in crop improvement programmes. High values of heritability, GCV and genetic advance were observed for weight of 10 cloves, bulb weight, bulb yield ha^{-1}, number of cloves $bulb^{-1}$

suggesting that all these traits are governed by additive gene action and hence direct selection for such traits may lead to further improvement in yield of garlic crop.

References

Burton, G. W. and De Vane, E. H. 1953. Estimating heritability in tall fascue (*Festuca* spp.) from replicated clonal materials. Agron. J. 45(9): 478-481.

Dubey, B. K., Singh, R. K. and Bhonde, S. R. 2010. Variability and selection parameters for yield and yield contributing traits in garlic. Indian J. of Agric. Sci. 80(8): 737-41.

Godhani, P. V. and Singh, S. P. 2000. Genetic variability correlation and path coefficient studies in garlic (*Allium sativum* L.). Nat. Symp. on onion and garlic production and post harvest manag. challenges and strategies held at Nashik on 19-21 Nov. : 44-47.

Gvozdanovic-Varga. J., Vasic, M. and Cervenski, J. 2002. Variability of characteristics of garlic genotypes. In: Proceed. of Second Balkan Symp. On Vegetable and Potatoes. pp. 171-175.

Jabeen, N., Khan, S. H., Chattoo, M. A., Murti, S. and Hussain, K. 2010. Genetic variability for various traits in garlic. Indian J. of Arecanut, Spices and Medicinal plants, Vol-12 (1): 13-17.

Johnson, H. W., Robinson, A. F. and Comstock, R. E. 1955. Estimates of environmental variability in soybean. Agron. J. 45: 374-378.

Khar, A., Ashadevi, A., Mahajan, V. And Lawande, K. E. 2005. Genetical studies in elite lines of garlic (*Allium sativum* L.). J. Maharashtra. agric. Univ. 30(3): 277-280.

Killadi Bharati, Netrapal and Singh, Narendra. 2000. Genetic variability in garlic. Nat. Symp. on onion and garlic production and post harvest management, challenges and strategies held at Nashik on 19-21 Nov.: 193.

Panse, V. G. 1957. Genetics of quantitative characters in relation to plant breeding. Indian J. Genet. PI. Breed. 17(2): 318-328.

Panse, V. G. and Sukhatme, P. V. 1985. Statistical Methods for Agricultural Workers. ICAR, New Delhi. 4th Edn. 145-148.

Mehta, K. G. and Patel, R. H. 1985. Genetic variability and path analysis in garlic. Madras Agric. J. 72(12): 691-695.

Selvaraj, N., Irulappan, I. and Vedamuthu, P. G. B. 1997. Path coefficient analysis of yield attributing factors in garlic. South Indian Hort. 45: 75-77.

J. Agric. Res. Technol., 37 (2) : 213-216 (2012)

New High Yielding Spanish Bunch Variety JL-501 for Western Maharashtra

R. S. Bhadane[1], S. S.Patil[2], J. P. Khatod[3], S. C. Patil[4] and T. R. Patil[5]
Oilseeds Research Station, Jalgaon - 425 001 (India)
(Received : 18-09-2011)

Abstract

A groundnut spanish bunch variety JL-501 was developed by secondary selection method, yielded higher dry pod yield of 3548 kg ha^{-1} in summer and 2011 kg ha^{-1} in *kharif* which was 45.35 per cent and 19.14 per cent more than widely adopted varieties *viz*., SB-XI and TAG 24 respectively in summer. In *kharif* this variety was superior by 17.40, 14.97, 19.40 and 42.83 per cent over the checks *viz*., JL 24. JL 286, SB XI and TAG 24 respectively. Considering proved performance, JL 501 has been released for cultivation in summer and *kharif* seasons for Western Maharashlra.

Key words : Groundnut, JL 501, secondary selection.

The present productivity of ground in Maharashtra State is only 1111 kg ha^{-1} in *kharif* while it is 1362 kg ha^{-1} in summer (Anonymous 2009). This production and productivity can be increased by developing niche specific varieties (Basu and Rathnakumar, 2004). Development of groundnut varieties still remains complex due to different combinations of gene required to get high yield. The high seed cost and low productivity leads replacement of area under other oilseed crops. Therefore, there is a need to develop varieties suits for *kharif* as well as rabi/summer season with higher productivity. The candidate variety holds potential for high yield to supplement the old varieties JL-24 and JL-286 in *kharif* and SB-XI and TAG-24 in summer season as productivity of groundnut is determined largely by performance of *kharif* crop (Anonymous 2010).

Materials and Methods

A promising genotype JL-501 has been developed by secondary selection during the year 2000 from established popular variety TAG-24 at Oilseeds Research Station, MPKV, Jalgaon. The selected genotype was studied for its yield and ancillary characteristics in station trials, multilocation as well as AICRP trials during 2002 to 2008 in summer and *kharif* seasons (Table-1 and 2). The variety was evaluated in randomized block design with three replications in university/state trials and with four replications in AICRP trials with checks. At maturity, the yield and yield contributing characteristics were recorded. The statistical analysis of yield data of all the trials was done according to Panse and Sukhatme (1985). The candidate variety was evaluated for its reaction to major pest and diseases under endemic conditions during 2003 to 2009. It was evaluated on farmer's field at 29 and 30 locations in summer and *kharif* seasons respectively.

Results and Discussion

Performance of JL-501 in AICRP trials: The JL-501 was tested in AICRP IVT stage I (2004), IVT II (2005) and Advanced Varietal Trial for zone I comprising Rajasthan,

1. Sr. Res. Asstt., 2. Asso. Professor, 3., 5. Jr. Res. Asstts. and 4. Principal Scientist.

Table 1. Performance of JL-501 for dry pod yield (kg ha^{-1}) in various multilocation and co-ordinated trials during summer 2002 to 2008.

Trial / variety	Locations	JL-501	SB-XI	TAG-24
University trials :				
Station trial	01	2083	1776	1 893
MLT	15	3646	2485	3050
Overall mean	16	3548	2441 (45.35)	2978 (19.14)
Adaptive trials :				
Summer 2005	29	3026	2560 (18.20)	2608 (16.03)
Coordinated trials :				
Trial / variety	**Locations**	**JL-501**	**R-8808**	**TAG-24**
IVT I and II	08	2784	2376 (17.17)	2570 (8.33)

Punjab, Haryana, Uttar Pradesh and zone II (Gujarat and Southern Rajasthan) during *kharif* 2006. In zone I of IVT the overall mean performance for two years, JL-501 showed 73.42 per cent increase in yield over JL-24 (NC) and 18.58 per cent over TAG-24. In zone II over all, mean performance of JL-501 showed 21.38 per cent increase in yield over JL-24 (NC), 29.86 per cent over SB-XI (ZC) and 10.25 per cent over GG-7 (ZC). In this zone the variety is identified at central level.

In overall performance for three years in all India trials it was found superior by 27.4, 57.3. 36.9 and 11.9 per cent over national check JL-24 and zonal cheek TG-37A, SB-XI and GG-7 respectively.

Table 2. Performance of JL-501 for dry pod yield (kg ha^{-1}) in various multilocation and co-ordinated trials during *kharif* 2002 to 2008.

Year / variety	Locations	Jl-501	JL-24	SB-XI	TAG-24	JL-286
Station trials, *kharif* :						
2002 to 2007	7	1554	1191	-	1077	1378
Per cent increase	-	-	30.5		44.3	12.8
***Kharif* MLT :**						
2002	10	1573	1513	1443	1 062	-
2003	8	2762	2407	2428	1893	-
2004	9	1891	1626	1680	1382	-
2005	3	2184	1986	-	1594	2091
2006	3	1570	1602	-	1228	1593
2007 MLT	7	2152	1726	-	1331	1725
RVMLT	10	2214	1898	1553	1511	2021
2008	8	2070	1518	-	1 605	1627
Pooled mean	58	2067 2081 (37) 2098 (31)	1776	1743 (37)	1447	1818 (31)
Per cent increase	-	-	116.39	19.40 (37)	4285	15.40 (31)
Pooled mean *kharif*	65	2011 1997 (38)	1713 -	- -	1408 -	1737 (38) -
Per cent increase	-	-	1740	19.40 (37)	42.83	14.07 (38)
Overall mean (*kharif* and summer)	81	2315 (81) 2524 (53)	- -	1954 (53) -	1718 (81) -	- -
Per cent increase		-	-	29. 17 (53)	34.75 (81)	-

Figures in parenthesis are number of trials, MLT - Multilocalion Trial, RVMLT - Regional Multilocation Varielal Trial

Table 3. Co-ordinated trials (*kharif*) Zone III (Khargone, Jalgaon, Akola).

Year / variety	Trials	JL-501	JL-24	SB-XI	GC-7	TG-37A
IVT-I 2004	3	1791	1358 (31.9)	1263 (41.8)	1576 (13.6)	-
IVT-II 2005	3	1934	1704 (13.5)	1599 (20.9)	1801 (7.4)	-
AVT 2006	5	1259	845 (49.0)	757 (66.3)	1074 (17.2)	1056 (19.2)
Pooled mean	11	1661	1304 (27.4)	1213 (36.9)	1484 (11.9)	1056 (57.3)
Adaptive trials :						
Year	Trials	JL-501	JL-286			
Kharif 2007	30	2024	1694 (19.48)			

Figures in parenthesis are per cent increase over.

Table 4. Mean per cent disease intensity of JL 501 in summer and *kharif* trials (2003-2009).

Variety	Summer					*Kharif*			
	S. rolfsii	***A. flavus***	**Tikka**	**Rust**	**PBND**	**LLS**		**Rust**	
						Score	**Reaction**	**Score**	**Reaction**
JL 501	2.4.12	3.00	11.88	5.8	5.25	6.0	MS	3.3	MR
TAG-24	30.80	19.33	10.98	5.4	7.22	7.0	S	2.8	MR
SB-XI	30.57	5.00	12.45	5.4	7.66	7.6	S	3.2	MR
JL 24	-	-	-	-	-	8.3	S	3.4	MR
JL 286	-		-	-		7.2	S	3.7	MR

PBND - Peanut bud necrosis disease, LLS- Late leaf spot

The evaluation of JL-501 was done in summer through station and multilocation trials for five years during 2002, 2003, 2004, 2006 and 2008 in 16 trials and performance was recorded on various traits. It was revealed that dry pod yield (Table 1) was 3548 kg ha^{-1} in which was 45.35 and 19.14 per cent higher than the check varieties SB-XI and TAG-24 respectively in summer trials.

It was tested, in *kharif* season, for seven years and total 65 trials were concluded during 2002 to 2008, The average yield (Table 2) over all the trials was 2011 kg ha^{-1} which was superior by 17.40, 19.40, 42.83 and 14.97 per cent over JL-24, SB-XI, TAG-24 and JL-286 respectively.

The genotype JL-501 was tested in co-ordinated trials under A1CRP on groundnut project in both the seasons i.e summer and *kharif* for three years. Performance of these trials was also superior over the corresponding checks (Table 3).

Considering the overall performance, 29 trials in summer, 30 in *kharif* and adaptive trials were conducted on farmer's fields. It was

Table 5. Mean per cent foliage damage of JL 501 in summer and *kharif* trials (2003-2009).

Variety	Summer			*Kharif*	
	Thrips	***S. litura***	**GLM**	**Thrips**	***S. litura***
JL 501	11.52	2.7	3.33	19.6	6.87
TAG-24	13.47	12.6	6.50	-	-
SB-XI	13.35	11.8	8.94	23.2	10.77
JL 24	-	-	-	31.6	11.47
JL 286	-	-	-	24.6	11.80

GLM - Groundnut leaf minor

observed that JL-501 (3026 kg ha^{-1}) has recorded 16.03 per cent higher dry pod yield over TAG-24 (2608 kg ha^{-1}) and 18.2 per cent over SB-XI (2560 kg ha^{-1}) in summer while it had yielded 2024 kg ha^{-1} which was 19.48 per cent higher than prevailing variety JL-286 (1694 kg ha^{-1}) during *kharif*. Taking into account best performance of JL-501 in multilocation trials in summer and *kharif* as well as co-ordinated trials, it was released for Western Maharashlra for cultivation for farmers in both the seasons

JL-501 has an erect growth habit and is medium tall in height. It is spanish bunch (*A. hypogaea* sub species fastigiata var. vulgaris) type. The leaves are oblong elliptical elongated and green. The variety has good germination and vigour, flowering basal, pod size bold with medium kernels, easy for peeling and shelling. The variety JL-501 has mainly two seeded pods rarely three seeded pods having moderate beak light tan in colour with none to little constriction. The oil content is 48-49 per cent with good shelling out-turn of 65-68 per cent. The variety is suitable for both *kharif* and summer season. This variety has no dormancy. Thus, it can be sown immediately for following season.

The variety JL 501 was found to be more resistant (Table 4 and 5) to wilt, tikka, rust and bud necrosis diseases and thrips and leaf minor pests as compared to check varieties during both the seasons.

Acknowledgement

Dr. A. O. Patil, Dr. R. B. Patil, Dr. A. J. Patil, Dr. M. P. Deshmukh, Prof. P. K. Dharne, Prof. D. A. Shambharkar, Prof. T. M. Bahale, Shri. R. T. Suryawanshi, Shri. K. U. Andhale, Shri. J. S. Suryawanshi, Shri. B. N. Farpat, Prof. R. T. Gaikwad, Prof. M. S. Shirke, Dr. A. P. Padhye were involved in development of JL 501 variety of groundnut are greatly acknowledged for their continuous efforts.

References

Anonymous. 2009. Annual Report of Oilseeds Research, MPKV, Jalgaon presented in Research Review Sub Committee Meeting, April.

Anonymous. 2010. Progress report of *kharif* groundnut workshop, UAS, Dharwad, April 24-26.

Basu, M. S. and Rathnakumar, A. L. 2004. Development of groundnut varieties for different agro climatic zones of India. In: Groundnut Research in India. Ed: M.S. Basu and N. B. Singh. Nat. Res. Centre for Groundnut, Junagadh, India.

Panse, V. G. and Sukhatme, P. V. 1985. Statistical Methods for Agricultural Workers. ICAR, Publ., New Delhi (India).

J. Agric. Res. Technol., 37 (2) : 217-222 (2012)

Assessment of Combining Ability for Yield and Yield Contributing Characters in Chilli (*Capsicum annum* Linn.)

D. P. Mohitepatil[1], B. B. Jadhav[2], S. G. Bhave[3] and S. S. Sawant[4]
Dept. of Agricultural Botany, College of Agriculture, Dapoli - 415 712 (India)
(Received : 18-09-2011)

Abstract

The parent, RHRC 16-5 was found to be the good general combiner for nine different characters, where as DH 5 was found to be good general combiner for eight different characters, out of sixteen characters studied. The parent BC 28 was found to be the good general combiner for dry fruit yield plant^{-1}, but poor combiner for green fruit yield plant^{-1}. The parents *viz*., DH 5, RHRC 16-5 and Pb Guchedar were found to be good general combiners for capsaicin content. The estimates of SCA effects revealed that none of the crosses was found superior for all the characters. The best two hybrids on the basis of SCA effects for fruit yield plant^{-1} (green and dry) were, DH 5 x Pb Guchedar and DH 5 x RHRC 16-5, which also registered high and desirable SCA effects for most of the yield attributes i.e., number of primary branches, fruits plant^{-1}, fruit diameter, days to first flowering and hundred fruit weight.

Key words : Combining ability, GCA, SCA, chilli.

The first step in generating promising hybrids is the selection of desirable parents. By and large, the selection of parents is based on the *per se* performance which may misleads the entire breeding programme. Sometimes, parents may have high yielding potential but, fail to transfer it in cross combination and vice versa. Hence, the contribution of parents in a cross and nick well ability of parents in crosses can be assessed by biometrical methods through combining ability. The knowledge of combining ability provides a useful clue for selection of desirable parents for development of better hybrids which are superior in yield and quality over the present cultivated hybrids.

Materials and Methods

The present investigation was carried out during January, 2008 to May, 2011. The seven divers genotypes of chilli *viz*., DH 5, Sel 2, LCA 312, ACS 92-4, BC 28, RHRC 16-5 and Pb Guchedar were used. The crossing programme was repeated as done in first season to obtain fresh F_1 seed (hybrid seed) of twenty one crosses. Some plants of parents were also selfed to get pure seed of parents. Twenty one F_1s alongwith seven parents and one check *viz*., Kokan Kirti (total 50, entries) were sown with three replications in a randomized block design. All cultural practices were carried out at the time of plantation.

The data collected on yield and yield contributing characters of parents and their hybrids with regards to the quantitative characters of the five randomly selected plants in each replication were averaged and the mean values obtained were subjected to statistical analysis. The combining ability analysis was carried out as per the procedure suggested by Griffing (1956) in Model-I, Method-2.

Results and Discussion

Various genetic variances were estimated from the analysis of variance for combining ability for sixteen characters studied and the

1. Ph.D. student, 2. Director of Research, 3. Asso. Dean and 4. Jr. Res. Asstt.

data are presented in Table 1.The GCA variances due to parents and SCA variances due to hybrids were highly significant for all the characters except hundred seed weight.

The general combining ability effect of parents (Table 2) revealed that, none of the parents was proved to be good general combiner for all the characters under study. The higher green yielding parent RHRC 16-5 was found to be good general combiner for nine characters *viz*., days to first flowering, number of fruits plant^{-1}, fruit length, number of seeds fruit^{-1}, first green fruit harvest, hundred green fruit weight, hundred dry fruit weight, yield plant^{-1} (dry) and capsaicin content, while it showed average performance in three other characters having either positive or negative but non-significant general combining ability effect which indicated its potential in chilli breeding programme. These, findings are in the line with Prasath and Ponnuswami (2008), Elizanilda Ramalho do Rego *et al*. (2009) and Kambale *et al*. (2009). The parent, DH 5 was good general combiner for the characters plant height (6.86), primary branches plant^{-1} (0.99), fruit length (0.34) and fruit diameter (0.29), but it showed higher negative general combining ability value for the character seeds fruit^{-1} (-0.59). The parent BC 28 showed highest desirable general combining ability value for fruits plant^{-1} (9.67). The parent Pb Guchedar showed highest general combining ability value for dry yield plant^{-1} (7.67) and capsaicin content (0.02).

The results on specific combining ability effects (Table 3) revealed that eleven hybrids had significant and desirable effect for plant height, six hybrids for primary branches plant^{-1} and days to first flowering, eight hybrids for fruits plant^{-1}, seeds fruit^{-1}, hundred dry fruit weight and green yield plant^{-1}, seven for fruit length, first green fruit harvest and dry yield plant^{-1}, nine for fruit diameter, four for crop duration for seed production and ten for

Table 1. Analysis of variance for combining abiliy (mean squares) for fifeen quantitative characters.

Sources of variation	d.f.	Plant height (cm)	Days to first flowering (days)	Primary branches plant^{-1}	Fruits plant^{-1}	Fruit length (cm)	Fruit diameter (mm)	Seeds fruit^{-1}	Crop duration for seed production (days)	Hundred seed weight (green) (g)	First fruit harvest (dry) (g)	First fruit weight (green) (g)	Hundred fruit weight (green) (g)	Hundred fruit weight (dry) (g)	Yield plant^{-1} (dry) (g)	Capsaicin content (%)
Parents	6	176.9**	6.8**	2.2**	714.8**	0.56**	0.91**	13.7**	11.58**	0.02	7.01**	4.50	2834.77**	92.46**	345.29**	0.003**
Crosses	21	270.1**	7.5**	1.5**	877.6**	1.59**	1.20**	21.6**	16.16**	0.01	9.75**	7.87**	4720.32**	256.33**	432.61**	0.003**
Error	54	1.30	1.0	0.2	5.8	0.09	0.09	1.18	2.00	0.01	1.01	3.22	17.03	1.87	1.26	0.000
σ^2 GCA		19.51	0.06	0.2	78.8	0.05	0.09	1.35	1.06	0.001	0.66	0.142	313.08	10.06	38.22	0.0004
σ^2 SCA		268.81	6.6	1.3	871.8	1.5	1.11	20.28	14.16	-0.001	8.69	4.644	4703.28	254.45	413.35	0.003
σ^2 GCA : σ^2 SCA		0.073	0.1	0.2	0.1	0.03	0.08	1.07	0.08	-0.62	0.07	0.030	0.06	0.09	0.08	0.119

*, ** Significant at 5 and 1 per cent probability levels respectively.

hundred green fruit weight. However, none of the hybrids could show any kind of significance for hundred seed weight.

Specific combining ability for plant height ranged from -24.46 to 29.79. The maximum specific combining ability effect was noticed in the hybrid DH 5 x Sel 2 (-24.46). This hybrid could be used in the area where dwarf chilli types are preferred. The specific combining ability effects for days to first flowering varied from -4.28 to 5.83. The best hybrid combination for first flowering was Sel 2 x LCA 312 (-4.28). Estimates of specific combining ability ranged inbetween -2.48 and 2.30 for number of primary branches plant^{-1}. The best specific combinations for this character were Sel 2 x LCA 312 (2.30) and DH 5 x RHRC 16-5 (2.23). Prabhudeva (2003) and Prasath and Ponnuswami (2008) also reported significant SCA effect for plant height and number of branches plant^{-1}, while Prasath and Ponnuswami (2008) reported significant SCA effect for days to first flowering.

The SCA for number of fruits plant^{-1} varied from -49.11 to 74.68. Significant SCA effects in desired direction were recorded by eight hybrids, while another eight hybrids had shown significant negative SCA effects. The best three hybrids having significant positive effects were DH 5 x Pb Guchedar (74.58), ACS 92-4 x Pb Guchedar (32.67%) and LCA 312 x BC 28 (24.23%) which could be exploited well as a commercial hybrid. Prabhudeva (2003), Prasath and Ponnmswami (2008), P'erez-Grajales *et al*. (2009), Elizanilda Ramalho do Rego *et al*. (2009) and Kambale *et al*. (2009) had shown significant SCA effect for number of fruits plant^{-1}. Specific combining ability effects for fruit length varied from -2.35 to 1.98 per cent. Seven hybrids each exhibited significant positive and significant negative SCA effects. The maximum SCA effect in positive direction was observed in ACS 92-4 x BC 28 (1.98)

Table 2. Estimates of general combining ability effects of parents for fourteen quantitative characters.

Parents	Plant height (cm)	Days to first flowering	Primary branches plant^{-1}	Fruits plant^{-1}	Fruit length (cm)	Fruit diameter (mm)	Seeds fruit^{-1}	Crop duration for seed production (days)	Hundred seed weight (g)	First fruit harvest (green) (days)	First fruit harvest (dry) (days)	Hundred fruit weight (dry) (g)	Yield plant^{-1} (dry) (g)	Capsaicin content (%)
DH5	6.86**	0.58	0.99**	4.92**	0.34**	0.29**	-0.59	0.16	0.03	-0.17	-0.40	-0.80	5.35**	0.01**
Sel2	-6.83**	0.85**	-0.05	-11.70**	-0.31**	0.22*	-2.00**	1.07*	0.02	1.64**	1.22*	-5.28**	-6.12**	-0.00**
LCA 312	1.28**	0.17	-0.22	-3.55**	0.01	-0.22*	-0.69*	0.84	-0.06*	0.43	0.18	2.83**	5.99**	-0.02**
ACS 92-4	2.28**	1.02**	0.03	-1 1.25**	0.09	0.19*	0.55	0.42	-0.04	-0.01	0.44	3.68**	-7.01**	-0.01**
BC 28	-0.32	-0.79*	-0.33*	9.67**	-0.30**	-0.04	-0.00	-0.96*	-0.01	-0.02	0.06	-2.34**	3.88**	-0.00
RHRC 16-5	0.79*	-0.74*	0.10	3.65**	0.22*	-0.60**	1.39**	-2.09**	0.03	-0.84*	-0.65	2.40**	2.20*"	0.01**
Pb Guchedar	-4.07**	-1.09**	-0.52**	8.28**	-0.05	0.15	1.34**	0.55	0.02	-1.02**	-0.84	-0.48	7.67**	0.02**
Range Min	-6.83	-1.09	-0.52	-11.70	-0.31	-0.60	-2.00	-2.09	-0.06	-1.02	-0.84	-5.28	-7.01	-0.02
Max	6.86	1.02	0.99	9.67	0.34	0.29	1.39	1.07	0.03	1.64	1.22	3.68	7.67	0.02
SE±	0.35	0.30	0.14	0.75	0.09	0.09	0.33	0.43	0.03	0.32	0.55	0.42	0.34	0.001
CD @5%	0.86	0.74	0.34	1.83	0.22	0.22	0.82	1.06	0.07	0.78	1.36	1.03	0.84	0.002

*, ** Significant at 5 and 1 per cent probability levels respectively

followed by DH 5 x LCA 312 (1.29) which was indicator of longer length fruits. As far as fruit diameter is concerned, specific combining ability effects revealed the range inbetween -2.00 to 1.69. Out of twenty one hybrid combinations studied, nine hybrids recorded significant positive SCA effects, while seven hybrids recorded significant negative effects. The hybrids having highest positive SCA effect was DH 5 x ACS 92-4 (1.69%). As far as SCA effects for the character primary branches plant^{-1} was concern hybrid Sel 2 x LCA 312 (2.30) and DH 5 x RHRC 16-5 (2.23) showed highest significant positive SCA effects. The hybrid DH 5 x Pb Guchedar (74.68) showed significant SCA value for fruits plant^{-1}. Ahmed *et al*. (2003), Pradsath and Ponnuswami (2008) and Elizanilda Ramalho do Rego *et al*. (2009) reported similar kind of significant SCA effects for fruit characters.

SCA effects for number of seeds fruit^{-1} ranged between -9.50 to 8.71. Out of twenty one hybrid combinations studied, eight hybrids each recorded significant positive and significant negative SCA effects. The best hybrid combinations for getting higher number of seeds fruit^{-1} were DH 5 x LCA 312 (8.71) and DH 5 x Pb Guchedar (5.77). SCA for crop duration for seed production ranged from -9.20 to 6.48. Four crosses recorded significant positive SCA effects while six crosses exhibited significant negative SCA effects. The hybrids having highest significant SCA effects were DH 5 x Sel 2 (6.48) and Sel 2 x RHRC 16-4 (5.68). These two hybrids could be considered as breeder's friendly hybrids as it had more spans for collection of hybrid seeds. For hundred seed weight, the range of SCA effects was very small and it was from -0.16 to 0.16. None of the cross showed significant SCA effect. However, LCA 312 x ACS 92-4 (0.16) had exhibited numerically superior SCA effect than other hybrids. Prasath and Ponnuswami (2008), P'erez-Grajales *et al*. (2009), Elizanilda Ramalho do Rego *et al*. (2009) reported significant SCA for these characters.

The SCA effects varied from -6.65 to 5.20 for first fruit harvest (green) in chilli. Seven cross combinations exhibited significant positive SCA effects, while six cross combinations exhibited negative significant SCA effects. The best hybrid having desired SCA effect was DH 5 x ACS 92-4 (6.65). For the character first fruit harvest (dry) SCA effects ranged from -4.16 to 5.02. Only three hybrid combinations recorded significant positive SCA effects, while only two cross combination exhibited negative significant SCA effects. These desired hybrids were Sel 2 x LCA 312 (-4.16) and ACS 92-4 x Pb Guchedar (-3.76) having negative SCA effect.

Specific combining ability effect for hundred fruit weight (green) ranged from -89.27 to 162.34. All of the twenty one hybrids exhibited significant SCA effects, out of which ten hybrids recorded significant positive SCA effects. The best two hybrids on the basis of SCA effects were, DH 5 x LCA 312 (162.34) and DH 5 x RHRC 16-5 (91.03). High and significant SCA effects were also reported by, Jadhav and Dhumal (2001), Prabhudeva (2003), P'erez-Grajales *et al*. (2009). Specific combining ability effects for hundred fruit weight (dry) ranged from -23.09 to 38.66. Only eight hybrids recorded significant positive effects. The best hybrid combinations for this character were DH 5 x LCA 312 (38.66) and ACS 92-4 x BC 28 (25.07). Elizanilda Ranalhodo Rego *et al*. (2009) also reported significant SCA effects for this character.

Most important character in breeding programme is yield plant^{-1}. In the present investigation, wide range of SCA effects was noticed for yield plant^{-1} (green). It ranged from -165.55 to 159.01. Out of twenty one crosses, eight hybrid combinations exhibited significant

Table 3. Estimates of specific combining ability effects of crosses for fourteen quantitative characters.

Crosses	Plant height (cm)	Days to first flowering (days)	Primary branches plant^{-1}	Fruits plant^{-1}	Fruit length (cm)	Fruit diameter (mm)	Seeds fruit^{-1}	Crop duration for seed production (days)	Hundred seed weight (green) (g)	First fruit harvest (green) (days)	First fruit harvest (dry) (days)	Hundred fruit weight (dry) (g)	Yield plant^{-1} (dry) (g)	Capsaicin content (%)
DH 5 x Sel 2	-24.46**	5.83**	-2.48**	-2.24	-2.09**	0.28	-3.67**	6.48**	0.08	1.10	0.02	-8.59**	-17.37**	-0.02**
DH5 x LCA312	4.60**	1.11	0.88*	-40.68**	1.29**	-1.43**	8.71**	-0.76	-0.10	2.60*	-1.80	38.66**	-8.43**	-0.09**
DH 5 x ACS 92-4	29.79**	0.86	0.99*	6.75**	-2.35**	1.69**	-9.50**	-9.20**	0.08	-6.65**	-3.20	-23.09**	-9.14**	0.10**
DH 5 x BC 28	1.15	-1.51	1.37**	-49.11**	0.93**	-2.00**	2.32*	1.78	-0.05	-2.84**	-2.55	-14. 13	-33.08**	-0.06**
DH 5 x RHRC 16-5	-21.06**	-2.69**	2.23**	23.97**	0.36	-0.68*	-2.54*	-2.28	0.05	-1.31	-1.32	12.75**	31.89**	0.01*
DH 5 x Pb Guchedar	-6.71**	-2.74**	-0.11	74.68**	0.28	0.84**	5.77**	3.73**	0.03	2.80**	1.28	-0.66	33.17**	0.06**
Sel 2 x LCA 3 12	10.38**	-4.28**	2.30**	-19.83**	-0.42	-0.13	-0.64	-3.39*	-0.15	-2.68**	-4.16*	-7.13**	-15.69**	-0.01**
Sel 2 x ACS 92-4	-10.08**	2.13*	-0.08	1.59	0.00	-1.81**	2.17*	2.49	0.09	0.37	2.37	16.68**	0.89	-0.05**
Sel 2 x BC 28	20.81**	-0.05	-0.38	-4.26	-1.64**	0.69*	-1.39	-3.38*	0.04	0.52	2.76	-8.05**	-10.21**	0.03**
Sel 2 x RHRC 16-5	14.41**	3.10**	0.18	1.71	1.18**	0.61*	-3.73**	5.68**	-0.02	5.20**	3.54*	-8.60**	-10.35**	0.02**
Sel 2 x Pb Guchedar	-10.95**	-1.08	-0.20	-17.35**	-0.61*	0.10	-1.67	-0.10	0.06	2.05*	-0.27	-6.79**	8.81**	0.00
LCA 312 x ACS 92-4	-19.13**	1.68	-1.25**	21.03**	-1.12**	0.79**	1.72	4.24**	0.16	3.31**	5.02**	-10.46**	27.92**	0.09**
LCA 312 x BC 28	-8.37**	3.16**	-0.22	24.23**	-1.46**	0.17	-3.97**	2.43	0.02	0.52	1.34	-12.86**	-18.93**	0.01
LCA 312 x RHRC 16-5	25.34**	-0.48	-0.66	-16.81**	-0.74*	0.77**	-2.24*	-4.89**	0.04	-3.39**	-1.15	7.02**	-5.31**	-0.01
LCA 312 x Pb Guchedar	4.42**	1.73	0.30	-17.37**	0.86**	-1.35**	2.47*	-0.88	-0.08	-2.35*	0.57	10.54**	-17.94**	-0.08**
ACS 92-4 x BC 28	16.95**	3.24**	1.87**	-0.26	1.98**	1.04**	3.24**	1.72	0.08	4.90**	3.87*	25.07**	21.79**	-0.03**
ACS 92-4 x RHRC 16-5	-6.17**	1.13	0.43	24.21**	0.66*	0.25	4.44**	1.79	-0.07	0.39	-3.29	13.34**	-7.86**	0.02**
ACS 92-4 X Pb Guchedar	6.03**	-1.24 *	-0.24	32.67**	-0.16	-1.01**	2.82**	0.40	-0.16	-1.30	-3.76*	11.37**	-16.67**	-0.10**
BC28 x RHRC 16-5	11.10**	-0.91	-0.87*	-30.44**	-0.30	-1.03**	-0.25	-3.74**	-0.02	1.27	0.63	-15.37**	-23.98**	0.01**
BC 28 X Pb Guchedar	-13.16**	-2.20*	-0.24	-13.33**	-0.47	1.02**	-6.07**	-5.19**	0.05	-3.62**	0.09	1.69	2.56*	0.03**
RHRC 16-5 Guchedar x Pb	13.21**	2.31*	-0.01	19.68**	0.78**	1.34**	-5.27**	0.13	0.01	2.33*	0.39	-8.42**	5.65**	0.03**
Range Min	-24.46	-4.28	-2.48	-49.11	-2.35	-2.00	-9.50	-9.20	-0.16	-6.65	-4.16	-23.09	-33.08	-0.10
Max	29.79	5.83	2.30	74.68	1.98	1.69	8.71	6.48	0.16	5.20	5.02	38.6	33.17	0.10
SE±	0.87**	0.74	0.34	1.84	0.22	0.23	0.83	1.08	0.07	0.78	1.37	1.05	0.86	0.00
CD at 5%	1.81	1.55	0.71	3.84	0.46	0.47	1.73	2.24	0.15	1.63	2.85	2.17	1.78	0.01

*, ** Significant at 5 and 1 per cent probability levels respectively

positive SCA effects. The best two cross combinations were, ACS 92-4 x BC 28 (159.01) and DH 5 x Pb Guchedar (156.40). Prasath and Ponnuswami (2008) and Kambale *et al*. (2009) also reported significant SCA effects for this character. Moderate range of SCA effects from -33.08 to 33.17 was observed for the character yield plant^{-1} (dry). Out of twenty one hybrids studied, seven hybrids had-shown significant SCA effects for this character. The best two cross combinations for this character were DH 5 x Pb Guchedar (33.17) and DH 5 x RHRC 16-5 (31.89). These three hybrids are having good response for yield plant^{-1} (green and dry). Hence, these hybrid combinations could be exploited for commercial cultivation at farmer's field after due testing. Similar kind, of significant SCA effects were also reported Savita (2004) and P'erez-Grajales *et al*. (2009).

Capsaicin content is the quality character responsible for pungency in chilli. In the present investigation, very little variation of SCA effects was noticed for this character. It ranged from -0.10 to 0.10. However, out of twenty one hybrids, ten hybrids exhibited significant positive SCA effects. The best two cross combinations were DH 5 x ACS 92-4 (0.10) and LCA 312 x ACS 92-4 (0.09). Significant SCA effects in capsaicin content was also reported by Prasath and Ponnuswami (2008).

Specific combining ability effects of the hybrids for all the characters showed that, none of the hybrid combinations was consistently good for all the characters. However, the best two hybrids on the basis of SCA effects and per se performance of yield were DH 5 x Pb Guchedar and DH 5 x RHRC 16-5 which had also registered high and desirable SCA effects for most of the yield attributes i.e., primary branches, fruits plant^{-1}, fruit diameter and hundred fruit weight apart from yield plant^{-1} (green and dry) was found to be the most promising for exploitation in practical primary breeding programme.

References

Ahmed, N., Hurra, M, Wani, S. A. and Khan, S. H. 2003. Gene action and combining ability for fruit yield and its component characters in sweet pepper. Cupsicum and Eggplant Newslett. 22: 55-58.

Elizanilda Ramalho do Rego, Mailson Menteiro Rego., Fernando Luiz Finger., Cosme Damiao Cruz and Vicente Wanger Dias Casali. 2009. A diallel study of yield components and fruits quality in chilli pepper (*Capsicum baccalum*). Euphytica. 168: 275-287.

Griffing, B. 1956. Concept of general and specific combining ability in relation to diallel hybridizing system. Aust. J. Biol Sci. 9: 463-493.

Jadhav, M. G. and Dhumal, S. A. 2001. Genetic studies of some quantitative characters in chilli. J. Maharashtra agric. Univ. 19: 62-64.

Kambale, Chandrakant, Mulge, Ravindra and Madalageri, M. B. 2009. Combining ability for earliness and productivity in sweet pepper (*Capsicum annuum* L.). Karnalaka J. Agric. Sci., 22 (1): 151-154.

Perez-Grajales, M., Gonzalez-Hernandez, V. A., Pena-Lomeli, A., Sahagun-Castellanos, J. 2009. Combining ability and heterosis for fruit yield and quality I Monzano hot pepper (*Capsicum pubescens* R & P) landraces. Revista chapingo serie ciencias forestries y del ambiente 15(1): 103-109.

Prabhudeva, S. A.. 2003. Variability, genetic diversity and heterosis study in chilli (*Capsicum annuum* L.). M. Sc. thesis, Univ. of Agric. Sci. Dharwad.

Prasath, D. and Ponnuswami, V. 2008. Heterosis and combining ability for morphological, yield and quality characters in paprika type chilli hybrids. Indian J. of Hort. 65(4): 441-445.

Savita, M. 2004. Heterosis, combining ability and gene action studies in chilli (*Capsicum annuum* L.). M. Sc. Agri. thesis, Univ. of Agric. Sci., Bangalore.

J. Agric. Res. Technol., 37 (2) : 223-227 (2012)

Phule Arjun : A Promising Brinjal Hybrid for Western Maharashtra

K. G. Shinde[1], M. N. Bhalekar[2] and B. T. Patil[3]
AICRP on Vegetable Crops, Mahatma Phule Krishi Vidyapeeth, Rahuri - 413 722 (India)
(Received : 18-09-2011)

Abstract

The brinjal F_1 hybrid, Phule Arjun (RBH-9) was found superior in respect of yield and consumers acceptance. The average yield obtained in various trials was 425.37 q ha^{-1} which was 27.37 per cent higher than Krishna, 39.86 per cent higher than NBH-743 and 36.99 per cent higher than Ajay, the commercial hybrids of brinjal. The plants are tall, semi spreading and sturdy. The fruits are oval with long pedicel and spiny calyx. The fruit colour is green with purple and white stripes. There is good consumer acceptance for Phule Arjun.

Key words : Brinjal, hybrid, evaluation.

Brinjal occupies a unique position among different vegetables grown in Maharashtra due to its mass appeal, wider adaptability and varied uses. Farmers generally grow impure open pollinated and old varieties having good adoption but poor yield potential. Rigid regional preferences led to the development of land races such as Manjri Gota (Kolhe, 1961), Surati Gota, Krishna Kathi, Kudchi, Dorli and several other types. In Western Maharashtra, besides high yield, medium fruits with spiny calyx, variegated colour with strips, good retention of colour, non lodging of branches are the most desirable characteristics of an ideal variety/hybrid. Most of the local types so developed are popular because of organoleptic quality, preferred by the consumer but they lack in productivity. With, an increasing popularity of F_1 hybrids in brinjal, it is imperative to obtain such hybrids, as have excellent qualities coupled with high yields. Efforts were made to develop high yielding varieties/hybrids coupled with consumers acceptance like Vaishali (Sonone *et al*. 1984), Pragati (Kale *et al*. 1989), Krishna F_1 (Lawande *et al*. 1992) and Phule Harit (Kadam *et al*. 2007). Although these varieties/hybrids are high yielding, they suffer from a few drawbacks like lodging in Vaishali, elongated fruit shape and non spiny fruits in Vaishali and Pragati, degradation of purple colour in Pragati and Krishna in summer season, consumer acceptance to particular area for Krishna, liking of consumers for variegated colours and incidence of pest and diseases in these varieties/hybrids. To overcome these drawbacks and liking of consumers acceptance, the series of intervarietal crosses were made during 2007-08 involving ten diverse brinjal types *viz*., Sirasgaon Kata, RB-24, RHR-white, JBR-1, IVBR-1, RHR 1-6-8-1, Kudachi, Dorli, Poona selection and DBSR-195. The 45 F_1 hybrids so developed were evaluated for yield and other characters over a period of 2008-2010 at different locations and seasons. Of these hybrids RBH-9 (Phule Arjun) was proved to be more promising and has been recently released for cultivation in Western Maharashtra (Anon. 2011).

Materials and Methods

The experimental material under investigation consisted of 45 brinjal hybrids

1. Vegetable Res. Officer, 2. Sr. Vegetable Breeder and 3. Jr. Vegetable Breeder.

Table 1. Mean yield performance of different brinjal hybrids in station trials (q ha^{-1}).

Hybrid	*Kharif*	Summer	Pooled mean
RBH-3	390.46	360.35	375.41
RBH-6	402.48	349.14	375.81
RBH-7	429.45	382.64	406.05
RBH-8	420.51	368.98	394.75
RBH-9	471.33	428.80	450.07
Krishna (c)	365.25	307.07	336.16
NBH 743 (c)	303.38	283.02	293.20
Ajay (c)	326.88	252.84	289.86
SE±	12.68	15.19	13.94
CD at 5%	38.39	45.78	42.29
CV%	7.10	7.74	7.42

derived from 10 diverse brinjal types by adopting diallel system of mating excluding reciprocals. The F_1 hybrids along with their parents were evaluated during summer 2008 at All India Coordinated Research Project on Vegetable Crops, Mahatma Phule Krishi Vidyapeeth, Rahuri and best five hybrids were selected on the basis of colour, shape, size, consumers preference in market and yield attributing characters. The five hybrids *viz*., RBH-3, RBH-6, RBH-7, RBH-8 and RBH-9 and three hybrid checks *viz*., Krishna, NBH-743 and Ajay were evaluated in a randomized block design with three replications during 2008-2010 in *kharif* and summer seasons at station trials. The multilocation trials were conducted during 2009 and 2010 at NARP Ganeshkhind, Pune, Agricultural Research Station, K. Digraj, Dist Sangali, Agricultural Research Station Pimpalgaon (Baswant) Dist. Nasik, and College of Agriculture, Kolhapur.

The five hybrids along with three checks were raised by adopting 75 x 75 cm inter and intra row spacing. Five competitive plants (except border plants) from each replication were selected at random and observations on fruit colour, fruit shape, spiny ness, yield, fruit length, fruit diameter, fruit girth, average weight of fruit, number of fruit $plant^{-1}$, yield $plant^{-1}$, days to 50 per cent flowering, plant height, number of branches $plant^{-1}$, plant spread (S-N and E-W) and fruit borer infestation were recorded and means were used for statistical analysis as per method suggested by Panse and Sukhatme (1985).

Results and Discussion

The yield differences due to hybrids in six station trials (Table 1) were significant, where

Table 2. Yield performance of different brinjal hybrids in multilocation trials (q ha^{-1}).

Hybrid	NARP, Ganeshkhind, Pune		ARS, K. Digraj		ARS, Pimpalgaon (B)		Agril. College Kolhapur		Pooled mean		Overall mean
	2009	2010	2009	2010	2009	2010	2009	2010	2009	2010	
RBH-3	346.29	320.99	460.49	478.90	318.32	268.65	312.65	314.71	359.43	345.81	352.62
RBH-6	364.26	409.16	422.01	432.56	349.91	302.23	307.25	312.45	360.85	364.10	362.47
RBH-7	328.05	306.56	391.15	396.61	364.52	308.06	311.34	322.54	348.76	333.44	341.10
RBH-8	335.46	285.43	443.21	403.78	360.97	314.57	313.97	341.23	363.40	336.25	349.82
RBH-9	355.18	463.33	449.58	500.40	379.33	335.13	359.91	362.52	386.00	415.34	400.67
Krishna (c)	285.55	373.70	333.13	391.91	357.81	267.96	314.18	325.50	322.66	339.76	331.21
NBH 743 (c)	271.20	333.09	354.13	360.16	320.68	281.67	299.65	299.87	311.41	318.69	315.05
Ajay (c)	356.29	456.67	330.86	324.25	281.19	299.15	299.09	301.81	316.85	345.47	331.16
SE±	14.23	19.70	14.73	17.42	17.40	15.34	12.40	13.51	14.69	16.49	15.59
CD at 5%	43.18	59.75	44.68	51.26	52.80	41.48	37.30	40.53	44.49	48.25	46.37
CV%	7.46	9.25	6.22	7.38	8.87	8.12	6.82	7.58	7.34	8.08	7.71

the hybrid RBH-9 recorded the significantly higher yield in all six trials. The hybrid RBH-9 recorded the highest yield of 471.33 q ha^{-1} as compared to checks Krishna (365.25 q ha^{-1}), NBH-743 (303.38 q ha^{-1}) and Ajay (326.88 q ha^{-1}) in the trials conducted in *kharif* seasons. While in summer trials the same hybrid RBH-9 recorded highest yield of 450.07 q ha^{-1} as compared to checks *viz*., Krishna (336.16 q ha^{-1}), NBH-743 (293.20 q ha^{-1}) and Ajay (289.86 q ha^{-1}). Similar trend for yields in brinjal hybrids was also reported by Lawande *et al*. (1992).

The multilocation trials conducted at four locations during the year 2009 and 2010 (Table 2). At NARP Ganeshkhind Pune, the hybrid RBH-6 (364.26 q ha^{-1}) followed by RBH-9 (355.18 q ha^{-1}) recorded highest yields in 2009 as compared to checks Krishna (285.55q ha^{-1}) and NBH 743 (27l.20 q ha^{-1}) while check Ajay (356.29 q ha^{-1}) at par with RBH-9. In 2010, the RBH-9 recorded highest yield of 463.33 q ha^{-1} as compared all the three checks. At Agricultural Research Station, K. Digraj, during 2009, the hybrid RBH-3 recorded the highest yield of 460.49 q ha^{-1} followed by RBH-9 (449.58 q ha^{-1}) as compared to check Krishna (333.13 q ha^{-1}), NBH-743 (354.13 q ha^{-1}) and Ajay (330.86 q ha^{-1}), the RBH-9 has recorded the highest yield of 500.40 q ha^{-1} in 2010 as compared all the three checks. At Agricultural Research Station, Pimpalgaon (Baswant), during both the years the RBH-9 has recorded highest yields of 379.33 and 335.13 q ha^{-1} as compared to three checks. At College of Agriculture Kolhapur, the hybrid RBH-9 has recorded highest yields of 359.91 and 362.52 q ha^{-1} during both the years as compared to all the three checks. In overall pooled mean for all the four locations the hybrids RBH-9 has recorded the highest yield of 400.67 q ha^{-1} as compared to Krishna (331.21 q ha^{-1}), NBH 743 (315.05 q ha^{-1}) and Ajay (331.16 q ha^{-1}).

The hybrid RBH-9 recorded higher yield than checks Krishna, NBH- 743 and Ajay. The percentage increase in yield over check was about 27.47 per cent in Krishna, 39.86 per cent in NBH-743 and 36.99 per cent in Ajay for fourteen locations consist of six station trials and eight multilocation trials. The average mean yield for both the trials, the RBH-9 has recorded highest yield of 425.37 q ha^{-1} as compared to Krishna (333.69 q ha^{-1}), NBH 743 (304.13 q ha^{-1}) and Ajay (310.51 q ha^{-1}) (Table 3). Thus the new hybrid RBH-9 gave 27.47 per cent higher yield over check Krishna, comparative performance in different trials also confirmed the superiority of hybrid RBH-9.

Table 3. Overall yield performance of promising hybrids in brinjal (q ha^{-1}).

Hybrid	Station trial (6)	MLT (8)	Mean (14)	% increase over		
				Krishna	NBH-743	Ajay
RBH-3	375.41	352.62	364.02	9.09	19.69	17.23
RBH-6	375.81	362.47	369.14	10.62	21.38	18.88
RBH-7	406.05	341.10	373.58	11.95	22.84	20.31
RBH-8	394.75	349.82	372.29	11.57	22.41	19.90
RBH-9	450.07	400.67	425.37	27.47	39.86	36.99
Krishna (c)	336.16	331.21	333.69	-	-	-
NBH 743 (c)	293.20	315.05	304.13	-	-	-
Ajay (c)	289.86	331.16	310.51	-	-	-

Station trials = 06; Multilocation trials = 08 and Total locations = 14

The ancillary observations presented in Table 4, indicated that the plants of hybrid RBH-9 were vigorous, tall and semi spreading. Fruits are slightly bigger and there were more number of fruits per plant than other hybrids and checks. Fruits are green with purple and white stripes, oval in shape and spiny, average fruit, length (6.43 cm) and average fruit diameter was 4.53 cm. It was also early in flowering as compared to check and other hybrids. The per cent incidence of fruit borer was less as compared to other hybrids and checks. The hybrid RBH-9 has recorded the 17.92 per cent incidence of fruit borer as compared to check Krishna (22.90%), NBH-743 (25.74%) and Ajay (27.55%).

Due to long green pedicel and highly spiny calyx with better retention of colour, the hybrid RBH-9 has better market acceptance and consumers preference. The fruits are green with purple and white stripes has good consumers acceptance. Considering all above yield levels and other characters, the hybrid RBH-9, was released in the Joint Agrosco meeting held at Mahatma Phule Krishi Vidyapeeth Rahuri between 29-31 May 2011 in the name of 'Phule Arjun' and recommended for cultivation in Western Maharashtra (Anon, 2011).

Acknowledgement

Authors are thankful to all the technical and field staff who helped in conducting various trials at AICRP (VC) Rahuri, NARP, Ganeshkhend, Pune; Agricultural Research Station, Kasbe Digraj, Dist Sangali; Agricultural Research Station, Pimpalgaon (Baswant) Dist. Nasik; and Collage of Agriculture, Horticulture section, Kolhapur. Thanks are also due to all the University Authorities who guided or helped directly or indirectly for developing the new brinjal hybrid.

Table 4. Ancillary observations of brinjal hybrids.

Hybrids	Fruit colour	Fruit shape	Spiny-ness	Fruit length (cm)	Fruit dia-meter (cm)	Fruit girth (cm)	Av. weight of fruit (g)	Fruits plant^{-1}	Yield plant^{-1} (kg)	Days to 50% flow-ering	Plant height (cm)	Bran-ches plant^{-1}	Plant spread (S-N) (cm)	Plant spread (E-W) (cm)	% fruit borer infe-station
RBH-3	Green with white tip	Round	Less spiny	5.28	4.53	14.53	49.50	35.56	1.76	61.96	77.73	7.76	81.26	92.59	22.37
RBH-6	Green with purple and white stripes	Round	Spiny	6.00	5.16	16.06	54.63	34.97	1.91	55.96	82.30	7.63	86.90	103.43	22.08
RBH-7	Green with cream tip	Round	Less spiny	6.66	5.00	18.36	59.00	31.12	1.83	68.23	76.84	8.50	79.43	99.52	21.76
RBH-8	Green with purple and white stripes	Round	Spiny	5.36	4.03	12.56	41.20	31.16	1.28	60.33	74.09	6.96	80.36	90.63	19.14
RBH-9	Green with purple and white stripes	Oval	Spiny	6.43	4.53	14.86	61.06	36.78	2.24	58.41	73.29	8.86	85.10	94.73	17.92
Krishna (c)	Purple with white stripes	Round	Spiny	5.80	4.70	14.96	50.76	31.92	1.61	78.00	68.53	6.86	80.60	85.33	22.90
NBH 743 (c)	Green with cream tip	Round	Less spiny	5.20	4.56	14.30	49.20	29.81	1.50	70.33	65.06	6.83	84.36	92.03	25.74
Ajay (c)	Green with purple and white stripes	Round	Spiny	5.53	4.70	15.23	50.36	30.53	1.53	71.71	71.99	7.53	80.60	86.90	27.55
S.E. ±	-	-	-	0.38	0.17	0.71	2.75	1.40	0.12	1.37	3.81	0.29	2.69	3.79	0.86
C.D. at 5%	-	-	-	1.14	0.53	2.17	8.35	4.22	0.38	4.15	N.S.	0.90	N.S.	N.S.	2.63
CV%	-	-	-	11.38	6.62	8.22	9.18	9.95	12.82	3.62	10.37	6.81	5.67	7.06	6.70

References

Anonymous, 2011. Research Review Report on Vegetable Crops, Maharashtra Agric. Univ. Joint Agrosco. pp. 8.

Kale, P. N., Lawande, K. E. Raijadhav, S. B., Choudhari, K. G. and Sonone, H. N. 1989. Pragati - A new brinjal cultivar with high yield and excellent fruit quality. Maharashtra J. Hort. 5(1): 154-160.

Kolhe, A. K. 1961. Studies in Vegetable of Maharashtra. Poona Agric. Collage Magazine, 52(142): 17-30.

Sonone, H. N., Deore, B. P. and Patil, S. K. 1984. Vaishali (RHR-51)-A high yielding variety of brinjal for Maharashtra, J. Maharashtra agric. Univ. 9(3): 341-342.

Kadam, K. G., Warade, S. D., Pawar, D. B., Joishi, V. R., Asane, G. B. and Nirmal, S. V. 2007. Phule Harit - A new brinjal variety for Maharashtra. J. Maharashtra agric. Univ. 32(3): 327-28.

Lawande, K. E., Gadakh, S. R., Kale, P. N., Budgujar, C. D. and Joshi, V. R. 1992. Krishna - A promising F1 hybrid in brinjal for Western Maharashtra. Maharashtra J. Hort. 6(2): 51-55.

Panse, V. G. and Sukhatne, P. V. 1985. Statistical Methods for Agricultural Workers. Publ. and Inform. Div., ICAR New Delhi, pp. 58.

J. Agric. Res. Technol., 37 (2) : 227-231 (2012)

Residue Study of Spinosad on Brinjal

Aparna Kalawate[1] and M. D. Dethe[2]
Department of Entomology, Mahatma Phule Krishi Vidyapeeth, Rahuri - 413 722 (India)
(Received : 10-11-2010)

Abstract

Based on the dissipation of residues on fruit after last spray of spinosad (90 and 180 g a.i. ha^{-1}), initial residues reached below detection limit (T_{BDL}) in about 14 to 16 days. Considering all safety parameters to consumers the waiting period (PHI) of about 1 to 3 days is proposed for spinosad.

Key words : Residue, spinosad, brinjal.

In the recent past, synthetic pyrethroids have been extensively used for the control of insect pests of brinjal. However, their indiscriminate use has created a number of problems such as development of resistance and pest resurgence. Among the harmful effects of pesticides, persistence of toxic residues in plants, soil and water are of great concern from the point of view of consumers health. In order to overcome above problems, systematic evaluation of new molecules with better insecticidal properties, lower mammalian toxicity and lower application dosage with selective action is essential. Such molecule fits very well in the concept of Integrated Pest Management (IPM).

Spinosad is reported to be broad spectrum pesticide effective against pests of important commercial crops. Moreover due to stringent regulations on pesticide residues to ensure food safety, the identification and quantification of pesticide residues in food commodities is of obvious importance. The data on residues of spinosad is limited. Therefore, in the present

1. Ph. D. student and 2-Ex-Head.

investigation the residues of spinosad have been studied.

Materials and Methods

The experiments were conducted both under field and laboratory conditions during the year 2005 and 2006. Field experiments were conducted at the Instructional Farm of Post Graduate Institute, MPKV, Rahuri. The analytical work on residues was carried out at the Pesticide Residues Research Laboratory, MPKV, Rahuri. Residue studies were carried out in both the season (*kharif* and summer) in respect of fruits harvested after third spray of treatments with spinosad 45 per cent SC (90 and 180 g a.i. ha^{-1} $spray^{-1}$). At the same time fruits from untreated control plots were also subjected to residue analysis. Pesticide residues were analysed in edible quality fruits collected periodically to decide the safety of treatments to consumers. Fruit samples from each plot were collected at an interval of 0 (2 hr), 3 and 5, 7, 10 and 15 days after last spray and subjected to analysis by following the procedure outlined by AINP on Pesticide Residues, Kalyani (West Bengal) with some modifications (Kale, 2003).

Sampling : Brinjal fruits from crop of treatment plots of spinosad sprayed at the dose of 90 and 180 g a.i. ha^{-1} $spray^{-1}$ were harvested and randomly sampled separately for each replicate. Control samples were collected similarly from the untreated plots in the polythene bags. The samples collected from the replications for each treatment were pooled together and they were made into two replicates for residue analysis. From each treatment 500 g of brinjal fruits were taken. The fruits were chopped finely, from that 50 g of sub-sample in duplicate was drawn for laboratory analysis and kept at -40°C in deep freezer until extraction of residues.

Extraction : The analytical procedure outlined by AINP on Pesticide Residue, Kalyani (West Bengal) was used for analysis of spinosad residues (Kale, 2003). The samples were taken from the deep freezer and allowed to thaw to room temperature. The samples were blended with 100 ml acetonitrile : water mixture (8:2) in a blender for 2 min and transferred the whole material in a wide mouth conical flask. Then the samples were shaken for 30 min on mechanical shaker and subsequently the samples were filtered through a Buchner funnel. The cake was washed with 2 x 25 ml acetotitrile : water (8:2) mixture. The combined filtrate was reduced to about 40 ml in a rotary vacuum evaporator and transferred to a 500-ml separatory funnel. The evaporating flask was rinsed with 2 x 30 ml of dichloromethane and transferred to the separatory funnel. The separatory funnel was shaken vigorously for 20-30 seconds. After separation of layer, the organic phase was collected in a conical flask. The aqueous portion was again partitioned with 50 ml dichloromethane and the organic phase

Table 1. Residues of spinosad on brinjal fruits (mg kg^{-1}).

Days after treatment	Mean residues (±SD)			
	90 g a.i. ha^{-1}		180 g a.i. ha^{-1}	
	Kharif	Summer	*Kharif*	Summer
0	0.355 (0.012)	0.368 (0.001)	0.653 (0.013)	0.627 (0.182)
1	0.278 (0.002)	0.297 (0.017)	0.588 (0.001)	0.565 (0.023)
3	0.229 (0.001)	0.234 (0.004)	0.538 (0.001)	0.527 (0.007)
5	0.191 (0.001)	0.203 (0.008)	0.334 (0.004)	0.318 (0.010)
7	0.117 (0.002)	0.123 (0.013)	0.168 (0.047)	0.156 (0.009)
10	0.030 (0.001)	0.035 (0.006)	0.06 (0.006)	0.05 (0.001)
15	BDL	BDL	BDL	BDL
RL_{50} (days)	3.09	3.22	2.91	2.76
T_{MRL} (days)	0.17	0.29	3.09	2.89
T_{BDL} (days)	13.54	14.23	15.67	14.82

BDL = Below detectable limit of 0.02 ppm, MRL = Maximum residue limit of 0.4 ppm

was drained and combined. Then 10 ml methanol and 1 ml 1 N sodium hydroxide solution was added to the aqueous phase along with additional 100 ml dichloromethane and shaken vigorously. Then the organic phase was collected in the same flask containing organic phase. It was then evaporated to dryness in a rotary vacuum evaporator at 40°C and the residue was reconstituted in 20 ml hexane.

Column cleanup : The hexane extract was purified by using silica SPE (Solid Phase Extraction) cartridge. The cartridge was conditioned with 20 ml hexane under vacuum. The sample solution in hexane was added to the silica SPE cartridge and eluted. The evaporating flask was successively rinsed with 20 ml hexane and 10 ml of dichloromethane and consequently the rinsates were added to the cartridge and eluted accordingly. Then the cartridge column was dried under vacuum for at least 10 min. Again the evaporating flask was rinsed with 10 ml acetonitrile and the rinsate was added to the cartridge and eluted. Finally the evaporating flask was rinsed with 25 ml of 1 per cent tri-ethyl amine in acetonitrile and the rinsate was added to the cartridge and the eluate was collected in 25 ml vial. The eluate was immediately evaporated to dryness in a rotary vacuum evaporator. The residue was constituted in 1 ml mixture of methanol : acetonitrile : 2 per cent ammonium acetate solution (1:1:1) for final HPLC analysis.

Estimation : The HPLC analysis was carried out on Shimadzu LC-10 AT high performance liquid chromatography system with SPD-10A UV detector and Chromatopac 5000 integrator. The stationary phase in the column was Grace Vydac C-18 protein and peptide (150 mm x 4.6 mm i.d.) and mobile phase used was acetonitrile : methanol : 2 per cent ammonium acetate (42:42:16), in isocratic mode at the flow rate of 0.4 ml min^{-1}. The UV detection was made at 245 nm. Signals from detector were recorded on integrator and responses were reported as relative response (peak height for test compound/peak height for standard) per microgram of compound. Quantification was performed by comparing sample peak heights with those obtained for standard solutions.

Operating parameters

Mobile phase : Actonitrile (42%) + Methanol (42%) + 2% Ammonium acetate (16%)

Wave length (λ max) : 245 nm

Flow: 0.4 ml min^{-1}

Retention time (RT) : 5.83±0.08 minutes for spinosyn A and 6.92±0.06 minutes for spinosyn D.

Results and Discussion

Spinosad had a retention time of 5.83 + 0.08 minutes for spinosyn A and 6.92 + 0.06 minutes for spinosyn D. For the control samples, no peaks were present in the chromatograms. Spinosad in treated samples was quantified by reading the samples against the chromatograms of spinosad standard. The concentration of compound (Table 1) at zero time (= 2 hr) in three subsamples of brinjal were 0.355 (±0.012) and 0.368 (±0.001) at 90 and 0.653 (±0.013), 0.627 (±0.182) ppm at 180 g a.i. ha^{-1} in *kharif* and summer season, respectively. The residue decreased with time to a level of 0.278 (±0.002) and 0.297 (±0.017) at 90 and 0.588 (± 0.001) and 0.565 (± 0.023) at 180 g a.i. ha^{-1} within 1 day. The samples collected on 1 day, was within the maximum residue limit (MRL) of 0.4 ppm. The residue dissipated to 0.030 (±0.001) and 0.035 (±0.006) at 90 g a.i. ha^{-1} and 0.06 (± 0.006) and 0.05 (±0.001) ppm at 180 g a.i. ha^{-1} in *kharif* and summer, respectively within 10 days. Detectable residue was not noticed in

brinjal samples collected on 15th day. The dissipation half-life under field condition ranged between 2 and 3 days.

Estimated half-lives ($T_{1/2}$) and time to reach MRL (T_{MRL}) : Log residue values of pesticides were plotted against time and the half-lives were calculated by means of the formulae $T_{1/2}$ = Log 2/K. The straight line regression equations with correlation coefficient (r^2) values, half-lives ($T_{1/2}$) and time to reach MRL (T_{MRL}) are given in Table 2.

Both the regression lines of spinosad residues had correlation coefficient values (r^2) of 0.8947 and 0.9048 at lower dose (90 g a.i. ha^{-1}), 0.9328 and 0.9241 at higher dose (180 g a.i. ha^{-1}) during *kharif* and summer season, respectively (Table 2). The dissipation half-life of spinosad residue at higher rate was 2.91 and 2.76 days while it was 3.09 and 3.22 days in lower rate during *kharif* and summer season, respectively. Very few data on spinosad residues on food commodities are available in literature. According to Nowak *et al*. (2000) no observed effect level for days following 13 weeks of dietary exposure to spinosad is 5.6 mg kg^{-1} day^{-1}.

The values of maximum permissible intake (MPI) and theoretical maximum residue contribution (TMRC) are compared for establishing MRL. If the value of TMRC is lower than MPI, then the maximum residue concentration remaining on the crop according to good agricultural practices (GAP) is fixed as MRL on that crop. The value of TMRC in this example is 0.0161 mg kg^{-1} which is smaller than the MPI of 3.36 mg day^{-1}. Since brinjal in diet could theoretically contribute 0.0161 mg to a maximum permissible intake of 3.36 mg day^{-1}, the proposed maximum residue limit (maximum residue present on the crop) of 0.297 mg kg^{-1} would be acceptable. The mean residue determined on brinjal 1 day post-application are 0.297 ppm (rounded as 0.30 ppm) which is equal to the value of 0.3 mg kg^{-1} proposed in this study as MRL on the basis of GAP. The estimated PHI for spinosad, therefore, would be 0.17 and 0.29 day in *kharif* and summer season at lower dose and in case of higher dose 3.09 and 2.89 days in *kharif* and summer season, respectively.

Spinosad is a naturalyte compounds, which is relatively safer to mammals. It registered for use on many commercial crops in India. Because brinjal makes an important contribution to human diet, data on levels of spinosad residues after application according to GAP is essential both for establishing MRLs and calculating the theoretical daily intake. At the international level, the MRLs are established by EPA (FAO/WHO committee). Therefore, the MRLs of spinosad estimated in this study is

Table 2. Regression equation, correlation coefficients (r^2), half-life ($T_{1/2}$) and time to reach MRL (T_{MRL}).

Pesticide (a.i. ha^{-1})	Regression equation	R^2	Calculated	
			$T_{1/2}$ (days)	PHI (days)
***Kharif* season (2005) :**				
Spinosad 90 g	Y = 2.6 182 - 0.0973 X	0.8947	3.09	0.17
Spinosad 180g	Y = 2.9219 - 0.1034 X	0.9328	2.91	3.09
Summer season (2006) :				
Spinosad 90 g	Y = 2.6294 - 0.0933 X	0.9048	3.22	0.29
Spinosad 180 g	Y = 2.9169 - 0.1091 X	0.9241	2.76	2.89

Y = Log of residues in ppm, X = Log of days

meant for the purpose of estimating pre-harvest intervals only. They have no relevance for any other purposes.

The different half-lives demonstrate the differences in the dissipation rate of test compound. The varying rates can be attributed to different physical and chemical properties of these compounds. The higher initial deposits in brinjal were expected because of the larger number of treatments (3) and the larger surface to mass ratio. Average brinjal fruit of 7-8 cm length, weighs 30-40 g which has considerably larger surface to mass ratio. Probably, the previous two treatments could also have contributed to the higher residues. The solitary fruiting character of brinjal also gives more exposure of fruit to spray droplets. Furthermore, in the winter conditions of this study, short days and cool climate also might have influenced the dissipation. As the primary degradation of both pesticides is caused by sunlight, day length and low temperatures could have affected the degradation.

Residue behaviour studies in fruits and vegetables are important in assessing the health risks and pollution of environment. The climatic conditions after treatment are important factors in residue dissipation. Many conventional pesticides commonly used on vegetables are now under review for safety to consumers. Commercial production of brinjal requires repeated pesticide applications during fruiting stage. On the basis of the results and discussion of present investigation levels of residues in brinjal fruits reveal that application of spinosad (90 g a.i. ha^{-1}) according to good agricultural practice is risk free from residue point of view. Its use would be relatively most safe to consumers. Relatively shorter pre-harvest intervals will be needed for spinosad applications in comparison with conventional insecticides.

References

Kale, V. D. 2003. Studies on thiamethoxam, fipronil, abamectin and spinosad against pest of okra. Ph. D. (Agri.) thesis Mahatma Phule Krishi Vidyapeeth, Rahuri, District Ahmednagar, Maharashtra, India.

Nowak, J. T., Feltig, C. J., McCravy, K. W. and Berisford, C. W. 2000. Efficacy tests and determination of optimal spray timing value to control Nantucket Pine tip moth (Lepidoptera : Tortricidae) infestation. J. Econ. Entomol. 93(6): 1708-1713

J. Agric. Res. Technol., 37 (2) : 232-236 (2012)

Induction of Systemic Resistance in Safflower Against *Fusarium oxysporum* f. sp. *carthami* by Fluorescent Pseudomonads*

D. V. Indi[1], A. R. Alagawadi[2], K. S. Jagadeesh[3] and H. M. Vamadevaiah[4]
Department of Agricultural Microbiology, University of Agricultural Sciences, Dharwad - 580 005 (India)
(Received : 20-12-2010)

Abstract

The isolate MDF 449 (1) recorded least wilt (14.81% at 30 and 18.52% at 60 days after sowing) and the highest seed yield (3.03 g plant^{-1}). It recorded the highest total phenol content (27.83 mg and 37.31 mg 100^{-1} g dry weight), peroxidase activity measured in terms of ΔOD g^{-1} protein min^{-1} (9.28 and 11.26), phenylalanine ammonia lyase activity in terms of changes in cinnamic acid min^{-1} g^{-1} (0.35 and 0.39) and the chitinase activity in leaves in terms of µg N-acetyl glucosamine µg^{-1} protein min^{-1} (3.39 and 3.78) at 30 and 60 days after sowing respectively. The isolates *viz*., EGF 334 (6), *P. fluorescens* (NCIM-2099) and EGF 277 were also at par with MDF 449 (1) in all these respects. These results showed induction of systemic resistance in safflower against *F. oxysporum* f. sp. *carthami* by the fluorescent pseudomonads.

Key words : *Fusarium oxysporum* f. sp. *carthami*, *P. fluorescens*, *P. aeruginosa*, *P. aureofaciens*, systemic resistance.

Amongst the plant growth promoting rhizobacteria, fluorescent pseudomonads have emerged as the largest and potentially the most promising group owing to their rapid growth, aggressive soil and root colonization, simple nutritional requirements and a wider preference for different organic substrates. In addition to their ability to solubilize insoluble inorganic phosphates and produce the plant growth hormones, they inhibit soil borne plant pathogens through several mechanisms *viz*., production of antibiotics (Svercel *et al*., 2009), siderophores (Ahmadzadeh and Sharifi-Tehrani, 2009), HCN (Megha *et al*., 2007), competition for space and nutrients and induction of systemic resistance in plants. The induction of systemic resistance is mainly due to the elevated levels of phenolic compounds and the triggered activity of enzymes like peroxidase, polyphenol oxidase, phenylalanine ammonia lyase, chitinase, etc. in the plants (Van Loon *et al*., 1998 and Saravanakumar *et al*., 2007).

The incidence of wilt disease of safflower, caused by *Fusarium oxysporum* f. sp. *carthami*, is increasing every year in the traditional safflower growing areas (Murumkar *et al*., 2008). Recommended practice of treating seeds with chemical fungicides does not provide a season-long protection against the disease. It is, therefore, worthwhile to look for some environmentally safer and cost effective measures for management of this disease. The present investigation was therefore, undertaken to study the effect of some selected fluorescent pseudomonads on incidence of *Fusarium* wilt, seed yield and induction of systemic resistance in safflower with challenge inoculation of *Fusarium oxysporum* f. sp. *carthami*.

Materials and Methods

Out of 133 fluorescent pseudomonad isolates from rhizosphere of different forest

* Part of Ph.D, thesis submitted by the senior author to University of Agricultural Sciences, Dharwad.

1. Sugarcane Pathologist, CSRS, Padegaon, 2. Dean (Agriculture), College of Agriculture, Bijapur, 3. Head and 4. Professor of Biochemistry, A.R.S., Hebballi Farm.

plants of Western Ghats of Uttara Kannada district of Karnataka, 7 isolates highly antagonistic to *Fusarium oxysporum* f. sp. *carthami* causing wilt disease in safflower, 3 efficient phosphate solubilizers and 5 potential IAA/GA producers were selected based on the *in-vitro* studies and tested along with 3 reference strains {*P. fluorescens* (NCIM-2099), *P. aeruginosa* (NCIM-2036) and *P. aureofaciens* (NCIM-2026)} on safflower during *rabi* 2007-08. The experiment was conducted under pot culture conditions in a completely randomized design with 3 replications in the glasshouse of the Department of Agricultural Microbiology, University of Agricultural Sciences, Dharwad. The earthen pots of 30 cm top diameter were filled with 10 kg soil (medium black, pH - 7.87, organic carbon - 0.37 per cent, available N - 212 kg ha^{-1}, P_2O_5 - 31 kg ha^{-1} and K_2O - 338 kg ha^{-1}). The recommended dose of manures and fertilizers (FYM 10 t ha^{-1} and 75:75:40 kg N, P_2O_5 and K_2O ha^{-1}) was applied to each pot on soil weight basis. Half of the N was applied at the time of sowing and the remaining half was applied at 30 days after sowing (DAS). The selected 15 isolates and 3 reference strains were multiplied in King's B broth for 96 h at 30°C and these broth cultures were diluted to contain 10^8-10^9 cfu ml^{-1} and applied @ 50 ml per pot. The seeds of safflower (cv. A-l) were soaked in these diluted broth cultures of fluorescent pseudomonads for 15 min prior to sowing. The seeds in the treated control treatment were treated as above only with the diluted King's B broth before sowing and an uninoculated control was also maintained. The fungus, *Fusarium oxysporum* f. sp. *carthami* causing wilt disease in safflower was multiplied in potato dextrose broth for 15 days. This broth culture was further diluted to contain 10^8 to 10^9 cfu ml^{-1} and applied @ 50 ml pot^{-1}. Nine equidistant holes (4-5 cm deep) were made in each pot with fingers and one seed was sown in each hole and covered with the soil. The pathogen was also multiplied on pre-soaked and sterilized sorghum grains for 15-20 days and applied @ 50 g pot^{-1} at 15 DAS to ensure maximum disease incidence.

The pots were lightly watered after sowing and lateron after every 4-5 days with equal quantity of water. The weeds were removed by hand picking. For control of *Alternaria* leaf blight disease, the contact fungicide mancozeb 75 WP (0.25%) was sprayed twice at 15 days interval. The insect pests like aphid, grasshopper, leaf eating caterpillar and capsule borer were controlled by alternate sprays of endosulfan 35 EC (0.05%), dimethoate 30 EC (0.05%) and monocrotophos 36 SL (0.05%) at 15 days interval.

The observations on wilt incidence were recorded at 30 and 60 DAS. The total phenol content of leaves and activity of enzymes like peroxidase, phenylalanine ammonia lyase (PALase) and chitinase were determined at 60 and 120 DAS by using the standard procedures (Mahadevan and Sridhar, 1986; Sadasivan and Manickam, 1991 and Ross and Sederoff, 1992) to study the induction of systemic resistance. The plants were harvested after 120 days and the data on seed yield was recorded. The statistical analyses of the data were carried out and the critical differences were calculated at P = 0.01 wherever F tests were significant (Panse and Sukhatme, 1985).

Results and Discussion

All the isolates (Table 1), except DF 75 at 60 DAS, reduced the wilt incidence significantly as compared to treated control (48.15% at 30 and 59.26% at 60 DAS). The isolate MDF 449 (1) registered the lowest wilt incidence (14.81% at 30 and 18.52% at 60 DAS). However, it was on par with EGF 334 (6) (18.52 and 22.22%), *P. fluorescens* NCIM-2099 (18.52 and 22.22%), EGF 277 (18.52 and 25.93%), MDF

Table 1. Incidence of *Fusarium* wilt, seed yield and induction of systemic resistance in safflower by different fluorescent pseudomonad isolates with challenge inoculation of *F. oxysporum* f. sp. *carthami*.

Treatment	Wilt disease incidence (%)				Seed yield (g plant^{-1})	Total phenol content in leaves (mg 100 g^{-1}) dry weight)		Peroxidase activity (ΔOD g-1 protein min^{-1})		PALase activity (changes in cinnamic acid min^{-1} g^{-1})		Chitinase activity (µg Glc Nac µg^{-1} protein min^{-1}	
	30 DAS	Arc-sine*	60 DAS	Arc-sine*		30 DAS	60 DAS	30 DAS	60 DAS	30 DAS	60 DAS	30 DAS	60 DAS
MDF 449 (1)	14.81	22.35	18.52	25.23	3.03	52.24	61.80	14.81	18.43	0.35	0.39	3.39	3.78
MDF 323 (1)	22.22	28.11	25.93	30.49	2.74	45.93	55.32	13.40	16.50	0.32	0.36	3.09	3.43
EGF 343 (2)	25.93	30.49	29.63	32.87	2.57	42.64	52.96	12.69	15.59	0.30	0.35	2.94	3.28
EGF 334 (6)	18.52	25.23	22.22	28.11	2.91	51.90	61.30	14.58	17.94	0.33	0.38	3.24	3.68
EGF 333 (1)	25.93	30.49	29.63	32.87	2.46	41.30	50.69	12.07	14.76	0.30	0.34	2.89	3.18
SEF 342 (3)	25.93	30.49	29.63	32.87	2.54	42.22	51.79	12.50	15.05	0.30	0.34	2.89	3.23
CF498	25.93	30.49	29.63	32.87	2.45	39.87	49.34	11.69	14.24	0.28	0.32	2.74	2.98
DDF 101 (3)	29.63	32.87	33.33	35.25	2.45	39.28	48.84	11.20	13.60	0.28	0.32	2.69	2.88
SEF 233 (1)	29.63	32.87	33.33	35.25	2.38	37.00	46.48	10.73	13.12	0.27	0.31	2.59	2.78
DF 521 (2)	29.63	32.87	33.33	35.25	2.33	37.34	46.73	10.97	13.33	0.27	0.31	2.59	2.83
DF 75	37.04	37.43	37.04	37.43	2.17	34.73	44.12	9.56	11.69	0.25	0.30	2.44	2.58
EGF 277	18.52	25.23	25.93	30.49	2.81	48.62	58.10	13.98	17.54	0.33	0.37	3.19	3.53
MDF 481	22.22	28.11	25.93	30.49	2.79	46.77	56.33	13.51	17.18	0.33	0.37	3.19	3.48
EGF 358 (2)	29.63	32.87	33.33	35.25	2.28	35.40	44.88	10.26	12.53	0.26	0.31	2.49	2.68
DDF 347 (1)	33.33	35.25	37.04	37.43	2.25	35.07	44.63	9.59	11.71	0.26	0.30	2.49	2.58
P. fluorescens (NCIM 2099)	18.52	25.23	22.22	28.11	2.83	49.71	59.19	14.37	17.72	0.33	0.37	3.19	3.63
P. aeruginosa (NCIM 2036)	22.22	28.11	29.63	32.87	2.65	44.83	54.31	12.77	15.91	0.31	0.36	2.99	3.33
P. aureofaciens (NCIM 2026)	25.93	30.49	29.63	32.87	2.45	40.45	49.93	11.89	14.36	0.29	0.34	2.79	3.08
Only pathogen	48.15	43.92	59.26	50.35	1.74	27.83	37.31	9.28	11.26	0.23	0.27	2.19	2.40
Uninoculated control (UIC)	0.00	0.00	0.00	0.00	1.87	32.63	42.10	9.38	11.28	0.25	0.29	2.39	2.58
S.E.±	-	2.16	-	1.92	0.07	1.25	1.77	0.30	0.49	0.01	0.01	0.08	0.09
C.D. at 1 %	-	8.27	-	7.33	0.26	5.04	7.14	1.20	1.97	0.04	0.03	0.33	0.37

*Figures in the column are the arc-sines to which the statistical analyses pertain; Glc Nac = N-acetyl glucosamine; DAS = Days after sowing.

481 (22.22 and 25.93%) and MDF 323 (1) (22.22 and 25.93%) both at 30 and 60 DAS. There was no incidence of wilt disease in the uninoculated control. All the isolates were significantly superior to the treated control (1.74 g plant^{-1}) and uninoculated control (1.87 g plant^{-1}) in respect of seed yield. The isolate, MDF 449 (1) recorded the highest seed yield of 3.03 g plant^{-1} and was significantly superior to all others except EGF 334 (6) (2.91 g plant^{-1}), *P. fluorescens* NCIM-2099 (2.83 g plant^{-1}), EGF 277 (2.81 g plant^{-1}) and MDF 481 (2.79 g plant^{-1}) with which it was on par.

All the inoculated isolates except DF 75 at 60 DAS had significantly elevated levels of total phenols in the leaves as compared to the treated control which registered the least values at 30 DAS (27.83 mg 100^{-1} g dry weight) and 60 DAS (37.31 mg). MDF 449 (1) recorded the highest total phenols in leaves at both 30 DAS (52.24 mg) and 60 DAS (61.80 mg) and was significantly superior to all other isolates except EGF 334 (6) (51.90 and 61.30 mg), *P. fluorescens* NCIM-2099 (49.71 and 59.19 mg) and EGF 277 (48.62 and 58.10 mg) with which it was on par. All the isolates except DF 75, DDF 347 (1) and EGF 358 (2) at 30 DAS and SEF 233 (1) at 60 DAS recorded significantly higher peroxidase activity (measured in terms of ΔOD g^{-1} protein min^{-1}) in leaves than the treated control (9.28 at 30 and 11.26 at 60 DAS). Isolate, MDF 449 (1) recorded the highest peroxidase activity at both 30 and 60 DAS (14.81 and 18.43) and it was significantly superior to the rest of the isolates.

The results on phenylalanine ammonia lyase (PALase) activity indicated that all the isolates except SEF 233 (1), DF 521 (2), DF 75, EGF 358 (2) and DDF 347 (1) at 30 DAS and DF 75 and DDF 347 (1) at 60 DAS had significantly higher PALase activity (changes in cinnamic acid min^{-1} g^{-1}) in the leaves as compared to the treated control which registered the least values at 30 DAS (0.23) and 60 DAS (0.27). While MDF 449 (1) recorded the highest PALase activity at both 30 DAS (0.35) and 60 DAS (0.39), other treatments *viz*., EGF 334 (6), *P. fluorescens* NCIM-2099, EGF 277, MDF-481, MDF 323 (1) and *P. aeruginosa* NCIM-2036 were also at par with it. As regards the chitinase activity (µg N-acetyl glucosamine µg^{-1} protein min^{-1}), all the isolates except DF 75, DDF 347 (1) and EGF 358 (2) recorded significantly higher activity in leaves than the treated control which recorded the least values (2.19 µg at 30 DAS and 2.40 µg at 60 DAS). The isolate MDF 449 (1) recorded the highest chitinase activity at both 30 DAS (3.39 µg) and 60 DAS (3.78 µg). However, it was at par with EGF 334 (6), *P. fluorescens* NCIM-2099, EGF 277, MDF-481 and MDF 323 (1) wherein the chitinase activity ranged from 3.09 to 3.39 µg at 30 DAS and 3.43 to 3.78 µg at 60 DAS.

The overall results indicated that the isolate MDF 449 (1) recorded the least wilt incidence and the highest seed yield. Other isolates *viz*., EGF 334 (6), *P. fluorescens* (NCIM-2099), EGF 277 and MDF 481 were the next effective in the order of their biocontrol potential as well as ability to improve the seed yield. While growth promotional ability of these isolates could be attributed to production of higher amounts of IAA, GA, cytokinins and greater ability to solubilize P, their biocontrol ability could be ascribed to the elevated levels of total phenols in leaves and triggered activity of the enzymes like peroxidase, PALase and chitinase through their better establishment in the rhizosphere. Under *in-vitro* conditions, these isolates recorded the zone of inhibition of *F. oxysporum* f. sp. *carthami* in the range of 5.05 to 6.20 cm and produced 676 to 871 µg IAA, 237 to 306 µg GA and 15.74 to 58.44 µg cytokinin litre^{-1} broth and solubilized TCP in the range of 27.71 to 39.16 per cent.

References

Ahmadzadeh, M. and Sharifi-Tehrani, A. 2009. Evaluation of fluorescent pseudomonads for plant growth promotion, antifungal activity against *Rhizoctonia* solani on common bean, and biocontrol potential. Biol. Control. 48(2): 101-107.

Mahadevan, A. and Sridhar, R. 1986. Methods in Physiological Plant Pathology, Sivakami Publ. Madras.

Megha, Y. J., Alagawadi, A. R. and Krishnaraj, P. U. 2007. Multiple beneficial functions of fluorescent pseudomonads of Western Ghats of Uttara Kannada district. Karnataka J. Agric. Sci., 20(2): 305-309.

Murumkar, D. R., Indi, D. V., Gud, M. A. and Deshpande, A. N. 2008. Variability among isolates of *Fusarium oxysporum* f. sp. *carthami* from Maharashtra state. J. Pl. Dis., Sci., 3(1): 24-28.

Panse, V. S. and Sukhatme, P. V. 1985. Statistical Methods for Agricultural Workers, ICAR, New Delhi.

Ross, W. W. and Sederoff, R. R. 1992. Phenylalanine ammonia lyase activity from lobally pine: Purification of the enzyme and isolation of complementary DNA clones. Pl. Physiol., 98: 380-386.

Sadasivan, S. and Manickam, A. 1991. Biochemical Methods for Agricultural Sciences, Wiley Eastern Limited, New Delhi.

Saravanakumar, D., Harish, S., Loganathan, M., Vivekananthan, R., Rajendran, L., Raguchander, T. and Samiyappan, R. 2007. Rhizobacterial bioformulation for the effective management of *Macrophomina* root rot in mungbean. Arch. Phytopathology, Pl. Prot., 40(5): 323-337.

Svercel, M., Christen, D. Moenne-Loccoz, Y., Duffy, B. and Defago, G. 2009. Effect of long-term vineyard monoculture on rhizosphere populations of pseudomonads carrying the antimicrobial biosynthetic genes *phlD* and/or *hcnAB*. FEMS Microb. Ecol., 68 (1) : 25-36.

Van Loon, L. C., Bakker, P. A. H. M. and Pieterse, C. M. J. 1998. Systemic resistance induced by rhizosphere bacteria. Annu. Rev. Phytopath., 36: 453-483.

J. Agric. Res. Technol., 37 (2) : 237-243 (2012)

Resistance to Blight (*Alternaria brassicae*) in Mustard Induced by Plant Defence Activators*

A. M. Tirmali[1] and S. J. Kolte[2]
G. B. Pant University of Agriculure and Technology, Pantnagar - 263 145 (India)
(Received : 05-06-2011)

Abstract

In the present investigation the efficacy of five abiotic and two biological plant defense activators in the control of mustard *Alternaria* blight was assessed under glasshouse conditions. The susceptible cv. Kranti was used as experimental host. All the plant defense activators were found significantly superior in reducing size of spot of *Alternaria* blight on leaves in the range of 3.53 to 25.66 per cent in comparison to check. The significant reduction in number of spots was recorded in the range of 4.12 to 37.37 per cent. All the plant defense activators under study were significantly superior in controlling severity of Alternaria blight on leaves in the range of 22.35 to 49.83 per cent in comparison to check. These plant defense activators had no antifungal activity *in vitro* against the pathogen.

Key words : Resistance, plant defense activators, *Brassica juncea*, *Alternaria brassicae*.

In India, the rapeseed mustard crop is commonly affected by *Alternaria* blight (AB) which causes more than 46.57 per cent yield losses in yellow sarson and 35.38 per cent in mustard (Kolte, 1985a). The rapeseed-mustard crop was affected by *A. brassicae* causing 10-70 per cent yield losses. *Alternaria* blight of rapeseed-mustard was found to be a major constraint in the production of these crops in the countries such as England (Loof, 1959), Canada (Degenhardt *et al*. 1974) and in India (Kolte, 1985 a, b 1986, and Kolte *et al*. 1987).

In recent years, a new group of chemicals that activates host defense mechanism and protects the plant against pathogens has been developed to manage crop diseases. These chemicals are called "plant defense activators" or "plant activators" (Romero *et al.* 2001). Salicylic acid mimic compound (acibenzolar-s-methyl, Bion), phosphorpus salts (Foli-R-Fos 400, Nutri-Phite-P) and micronutrient potassium salts (Canon, Phytogard and Nutrol) have been developed as commercial plant activators (Graham and Leite, 2004; Becot *et al*. 2000; Mcmillan *et al.* 2000; Pajot *et al*. 2001).

Some biological plant defense inducers such as *Trichoderma, Pseudomonas*, *Bacillus*, *Serratra*, non-pathogenic strains of fusarium and yeast have been developed as commercial products to manage various diseases (Howell *et al.* 2000; Benhamon and Garand, 2001; Droby *et al*. 2002 and Varhagen *et al.* 2004). In the present studies different chemicals and two biological plant defense inducers were evaluated against mustard *Alternaria* blight under glass house conditions.

Materials and Methods

Efficacy of the plant activators in the control of mustard *Alternaria* blight was assessed under glass house conditions. Laboratory-cum-glass house experiments were conducted during

* Part of Ph.D. thesis submitted by senior author to GBPUA&T Pantnagar (Uttaranchal).

1. Jr. Mycologist, AICRP on Mushroom College of Agriculture, Pune and 2. Ex. Professor of Plant Pathology.

2003-3004 at G. B. Pant University of Agriculture and Technology GBPUA&T) Pantnagar, Uttarakhand. The mustard, cv. Kranti was used as experimental host. The trial was conducted in a randomized block design in glasshouse with three replications. AB infected young leaves of mustard were collected for isolation of pathogen cultures of isolates (A, C and D) and pathogenicity of *Alternaria* blight was proved on susceptible mustard cv. Kranti

Collection of *Alternaria* infected leaves : Infected leaves exhibiting typical symptoms of *Alternaria* spot of *A. brassicae* (isolates A, C and D) were collected from the field-grown plants of B. carinata from Crop Research Centre, GBPUA and T, Pantnagar. Leaf samples were brought to the laboratory for the microscopic examination and isolation.

Isolation of three *A. brassicae* isolates: Individual leaf spot to be taken for isolation was observed directly by putting infected leaf under the microscope. Only those leaf spots which showed presence of typical *A. brassicae* conidia were selected for isolation. Infected leaves of *B. carinata* showing presence of typical *A. brassicae* conidia were thoroughly washed with tap water and cut into small pieces with the help of a previously sterilized scalpel. These spots were washed three-four times in sterilized distilled water and then surface sterilized with 0.1 per cent mercuric chloride solution for 1 min followed by washing with sterilized water 3-4 times. The excess of water was removed by keeping these pieces in between the two folds of sterilized blotting paper. Surface sterilizes pieces were then aseptically transferred into Petri dishes containing PDA with the help of sterilized forceps. These petri dishes were then sealed with the help of paraffin film and placed in an incubator at 23±2°C for 7 days.

After 7 days of incubation, the growing mycelium from margin of the pieces on the medium was transferred to PDA culture tubes. These culture tubes were incubated for 15 days at 23±2°C in the incubator providing alternate cycle of 12h light and 12h darkness.

Purification : After 15 days of incubation, temporary slides of cultures were prepared in lacto phenol and these slides were examined under compound microscope with a magnification of 10X and 40X and the fungus cultures (isolates A, C and D) were identified on the basis of their conspicuous characteristic morphology as described by Awasthi and Kolte (1989). These cultures were purified by single spore isolation method and were maintained on PDA.

Isolation and maintenance : Ten ml of sterilized distilled water was poured into a sporulated culture tube and shaken well. Spore suspension was diluted in such a way that single desirable spore could be isolated. Diluted spore suspension was poured into sterilized Petri dish containing 1 per cent water agar and after 6hr, spores were observed under microscope. The spore location was marked individually. Small pieces of water agar along with spore of each isolate were cut with the help of cork borer and were placed into the medium by using inoculating loop. Culture tubes containing single spore of, A, C and D isolates were incubated at 23±2°C for 15 days. Sporulated culture of each isolate tube was kept in refrigerator at 4-5°C and transferred into freshly prepared medium after 20 days. The cultures were further used for inoculation whenever necessary.

Pot filling : Plastic pots of 15-cm size were filled in with sandy loam soil and compost 3:1 proportion, sieved through 0.2 mm sieve and was filled in the pot which were used for sowing. Diammonium phosphate (2g) was mixed with soil in each pot before sowing.

Sowing and maintenance : The pots were first watered and left as such in the glass house for two days to ensure appropriate moisture for seed germination. Five seeds were sown in each pot. Proper thinning was done and 2-3 seedling were maintained in each pot. In order to keep the plant free from insects pests, one spray of a mixture of thiodan (0.1%) and metasystox (0.1%) was applied at seedling stage for the control of mustard saw fly (*Athalia proximo*) and Bihar hairy caterpillar (*Diacrisia blique*). One more spray was applied with the same insecticide at the flowering stage to control the mustard aphid (*Lipaphis erysimi*).

Inoculation : Two week old culture of each isolate on PDA was taken and blended with blender in 250 ml distilled sterilized water. The concentration was adjusted to 10^5 spores ml^{-1}. The suspension was sprayed on the plant surface using automizer. Inoculated plants were incubated for 72 hr humid chamber at 90-100 per cent relative humidity.

Symptom development : Development of symptoms was carefully monitored the isolates were more from the infected leaves inoculated with different isolates. The cultures were maintained for further studies.

The treatments included talc product of *Trichoderma harzianum* (1%) and *Pseudomonas fluorescens* (obtained from Dr. U. S. Singh , Bio-control Laboratory of GBPUAT, Pantnagar) and commercial product of potassium sulphate (1%), calcium sulphate (1%), salicylic acid (0.25%), borax (0.5%), talc powder (1%) and standard check fungicide smancozeb (0.2%). All the biotic and abiotic inducers were tested as post inoculation spray treatments against AB using 25-day old plants of cv. Kranti.

Observations on *Alternaria* blight (AB) : Size of spots on leaves was recorded at 10 days interval 30-50 days after sowing (DAS). Diameter of randomly selected five spots/leaf was measured in mm including yellow halo, chlorotic area with necrotic brown area in the centre. Spot was measured with thin plastic scale and average size of spot was then calculated. The number of spots on leaf was counted per 25 mm^2 leaf area at 10 days interval. Observations were taken on randomly

Table 1. Effect of biotic and abiotic agents on size of *AIternaria* leaf spot at different stages of growth of mustard cv. Kranti under glasshouse conditions.

Treatment	Conc. (%)	Size of spot (mm) at DAS				Reduction over check (%)
		30	40	50	Mean	
T_1 - *Trichoderma harzianum*	1.0	0.60	1.85	2.71	1.72	23.89
T_2 - *Pseudomonas fluorescens*	1.0	1.10	1.90	2.61	1.87	17.25
T_3 - Borax	0.5	0.50	1.38	3.16	1.68	25.66
T_4 - Salicylic acid	0.25	0.60	1.75	2.90	1.75	22.56
T_5 - Potassium sulphate	1.0	1.15	1.92	2.39	1.82	19.46
T_6 - Calcium sulphate	1.0	0.70	1.95	2.65	1.70	24.77
T_7 - Talcum powder	1.0	1.35	2.19	3.00	2.18	3.53
T_8 - Mancozeb	0.2	1.00	1.44	2.89	1.61	28.76
(Unsprayed) Check	-	1.25	2.26	3.30	2.26	-
CD at 5%						
Treatment		-	-	-	0.27	-
Interval		-	-	-	0.15	-
Interaction		-	-	-	0.47	-

DAS = Days after sowing

five leaves and average number of spots per 25 mm^2 leaf area was then calculated. Mean disease index on leaf due to AB was calculated at 10 days interval by using 0-5 rating scale adopted by Conn *et al*. (1990).

Results and Discussion

Effect of biotic and abiotic inducers on size of spot indicated by *A. brassicae* : The size of *Alternaria* leaf spot as influenced by biotic and abiotic agents was measured from 30 to 50 days after sowing at 10 days interval (Table 1). There was highly significant difference among treatments different intervals. All the treatments except T_7, Talcum powder at 1.0 per cent showed significantly lower size of spot in comparison to the check (2.26 mm). The size of spot increased from 30 to 50 DAS. The minimum size of spot was observed in T_3 Borax at 0.5 per cent (1.68 mm), which was at par with T_8 mancozeb at 0.2 per cent (1.61 mm) followed by T_6 (calcium sulphate at 1 per cent (1 .70 mm), T_1 *Trichoderma harzianum* at 1.0 per cent (1.72 mm) and T_4 salicylic acid at 0.25 per cent (1.75 mm), which were at par with each other. The interactions between different treatments and observation intervals were also found highly significant. These findings suggested that minimum number of spots per leaf may be important criteria for finding the source of resistance against *Alternaria* blight of mustard. These results are in consonans with those of Vishvanath *et al.*, 1999 who reported that avirulent isolate previously inoculated prior to challenge inoculation provided protection against *Alternaria* blight. Kaur and Kolte (2001) also obtained similar results in case of white rust of mustard.

Effect of biotic and abiotic inducers on number of AB spots : There was highly significant difference among treatments (Table 2). The minimum number of leaf spots/25 mm^2 leaf area was observed in T_4 salicylic acid at 0.25 per cent (2.58) which was slightly higher than T_8 mancozeb at 0.2 per cent (2.38). The number of leaf spots (2.71) observed in T_3 borax at 0.5 per cent was at par with T_6 calcium sulphate at 1.0 per cent (2.76).

The number of spots (2.82) observed in T_5 potassium sulphate at 1.0 per cent which was

Table 2. Effect of biotic and abiotic agents on number of *Alternaria* leaf spots at different stages of growth of mustard cv. Kranti under glasshouse conditions.

Treatment	Conc. (%)	Leaf spots/25 mm^2 area at DAS				Reduction over check (%)
		30	40	50	Mean	
T_1 - *Trichoderma harzianum*	1.0	2.10	2.65	3.95	2.90	29.61
T_2 - *Pseudomonasfluorescens*	1.0	1.95	2.86	3.80	2.87	24.27
T_3 - Borax	0.5	1.80	2.75	3.58	2.71	34.22
T_4 - Salicylic acid	0.25	1.36	2.80	3.60	2.58	37.37
T_5 - Potassium sulphate	1.0	1.25	2.30	4.91	2.82	31.55
T_6 - Calcium sulphate	1.0	1.69	2.85	3.76	2.76	33.00
T_7 - Talcum powder	1.0	2.82	3.78	5.25	3.95	4.12
T_8 - Mancozeb	0.2	1.72	2.00	3.12	2.38	42.23
(Unsprayed) Check	-	2.90	4.00	5.46	4.12	-
CD at 5%						
Treatment		-	-	-	0.29	-
Interval		-	-	-	0.17	-
Interaction		-	-	-	0.51	-

DAS = Days after sowing

at par with T_2 *Pseudomonas fluorescens* at 1.0 per cent (2.87) and T_1 *Trichoderma harzianum* at 1.0 per cent (2.90). The average number of spots/25 mm^2 progressively increased from 30 to 50 DAS. The interactions among different treatments and observation intervals were also found highly significant. The maximum number of leaf spots/25 mm^2 leaf area was observed in check (4.12). These findings suggested that minimum number of spots may be important criteria for finding source of resistance against *Alternaria* blight of mustard. These results are in consonans with Vishvanath *et al*., 1999. who reported that avirulent isolate previously inoculated prior to challenge inoculation provided protection against *Alternaria* blight. Kaur and Kolte (2001) also reported similar results in another host-pathogen system indicating that inducers previously inoculated prior to challenge inoculation provided protection against white rust of mustard.

Effect of biotic and abiotic inducers on disease index of AB : The per cent disease index (PDI) due to AB on leaf was recorded at 30 to 50 DAS in cv. Kranti (Table 3). There was progressive increase in PDI from 30 to 50 DAS. The difference in highly significant among the treatments as well as between observation intervals. Among abiotic and abiotic agents, minimum PDI was observed in treatment T_4 salicylic acid at 0.25 per cent (10.66%) which was higher than T_8 mancozeb at 0.2 per cent (8.20%), followed by treatment T_6 calcium sulphate at 1.0 per cent (13.25%), T_1 *Trichoderma harzianum* at 1 per cent (14.12%), T_2 *Pseudomonas fluorescens* at 1 per cent (15.25%), T_5 potassium sulphate (16.50%).

The maximum per cent disease index was observed in check (21.25%). The interactions among the variables were also highly significant. Mustard plants acquired resistance against *Alternaria* blight and white rust by previous or subsequent inoculation with chemicals and biotic agents (Cohen, 1994, Gorlach *et al*. 1996, Singh *et al*. 1999, Vishwanath *et al*. 1999, Howell *et al*. 2000 and Kaur and Kolte 2001). These results are also in agreement with the findings of Spletzer

Table 3. Effect of biotic and abiotic agents on disease severity of *Alternaria* blight all at different stages of growth of mustard cv. Kranti under glasshouse conditions.

Treatment	Conc. (%)	Disease index (%) at DAS				Reduction over check (%)
		30	40	50	Mean	
T_1 - *Trichoderma harzianum*	1.0	3.36 (10.37)	10.50 (18.90)	28.50 (32.25)	14.12 (20.51)	33.55
T_2 - *Pseudomonasfluorescens*	1.0	5.75 (13.85)	11.60 (19.88)	29.40 (32.82)	15.25 (22.18)	28.23
T_3 - Borax	0.5	2.82 (9.65)	9.68 (18.10)	22.6 (28.37)	11.70 (18.71)	44.90
T_4 - Salicylic acid	0.25	2.76 (9.54)	8.00 (16.40)	20.71 (27.07)	10.66 (17.67)	49.83
T_5 - Potassium sulphate	1.0	4.60 (12.38)	10.2 (16.11)	34.70 (36.08)	16.50 (21.51)	22.35
T_6 - Calcium sulphate	1.0	3.50 (10.76)	10.75 (19.12)	27.50 (31.61)	13.25 (20.50)	37.64
T_7 - Talcum powder	1.0	8.60 (17.03)	14.20 (22.09)	37.20 (37.57)	20.00 (25.26)	30.63
T_8 - Mancozeb	0.2	1.80 (7.68)	6.50 (14.72)	15.90 (23.47)	8.20 (15.29)	61.41
(Unsprayed) Check	-	9.80 (18.24)	14.6 (22.44)	39.35 (38.84)	21.25 (2651)	-
CD at 5%						
Treatment		-	-	-	1.48	-
Interval		-	-	-	0.86	-
Interaction		-	-	-	7.52	-

Values in parenthesis are angular transformed values, DAS = Days after sowing

and Enyedi, (1999), Becot *et al*., (2000), Macmillan *et al*. (2000) and Reyuni *et al*. (2000). It can finally be concluded that biotic and abiotic inducers represent a new group of plant defense activator off capable of protecting mustard plants against *Alternaria* blight in glass house conditions. However, further studies are required to find out mechanism of action and the role of environmental factors on the efficacy and formulations of these plant defense activators in managing *Alternaria* blight and plant health.

References

Awasthi, R. P. and Kolte, S. J. 1989. Effect of some epidemiological factors on occurrence and severity of AJternaria blight of rapeseed and mustard. Proc. I.D.R.C. (Canada) Oil crops: meeting held at Pantnagar and Hyderabad, India. JanA-ll pp. 49 -55.

Becot, S., Pajot, E., Corre, D., Monot, C., and Silne, D. 2000. Phytogard (K_2PHO_3) induces localized resistance in cauliflower to downy mildew of crucifers. Crop Protec. 19: 417-425.

Benhamon, N. and Garand, C. 2001. Cytological analysis of defense-related mechanisms in pea root tissues in response to colonization by nonpathogenic Fusarium oxysporum Fo47. Phytopath. 91: 730-740.

Cohen, Y. 1994. 3-Amminobutric acid induces systemic resistance against *Peronospor tabacina*, Physiol. Mol. Plant Pathol. 44: 273-288.

Conn, K. L., Tewari, J. P. and Awasthi, R. P. 1990. A disease assessment key for *Alternaria* black spot in rapeseed- mustard. Can. Plant. Dis Surv. 70: 19-22.

Degenhardt, K. J., Skoropad, W. P. and Kondra, Z. P. 1974. Effect of *Alternaria* black spot on yield, oil content and protein content of rapeseed. Can. J. Plant. Sci. 54: 795-799.

Droly, S., Yinokur, V., Wiess, B., Cohen. L., Daws, A., Goldschmidt, E. E. and Porat, R. 2002. Induction of resistance to *Penniciliuni digitatum* in grape fruit by the yeast bio-control agent *Candida oleophila*. Phytopath. 92: 393-399.

Gorlach, J., Volrath, S., Knauf-Belter, G. ,Hengy, G., Bickhore, U., Kogel, K. H., Oostendrop, M., Staub., T., Ward, E. Kessmann, H. and Ryals, J. 1996. Benzothiadiazole a novel class of inducer of systemic acquired resistance, activates gene expression and disease resistance in wheat. The Plant Cell, 8: 629-643.

Graham, J. H. and Leite, R. P. 2004. Lack of control of citrus canker by induced, systemic resistance compounds. Plants Dis; 88: 745-750.

Howell, C. R., Hanson, L. E., Spitanovic, R. D. and Puckhaber C. S. 2000. Induction of terpenoid synthesis in cotton roots and control of *Rhizoctonia solani* by seed treatments with *T. vireris*. Phytopathol., 90:3, 248-252.

Kaur, A. and Kolte, S. J. 2001. Protection of mustard plants against staghead phase of white rust by folier treatment with benzothiadiazole. An activator of plant defense system. J. Mycol. PI. Pathol. 31: 133-138.

Kolte, S. J. 1985a. Disease of Annual Edible Oilseed Crops. (Volume I) rapeseed-mustard and sesame diseases. C.R.C. Press, Boca Raton, Florida pp. 135.

Kolte, S. J. 1985b. Disease management strategies of rapeseed - mustard crops in India. Agric. Rev. 6: 81-88.

Kolte, S. J. 1986. Important diseases of rapeseed and mustard in India: Present progress and future research needs. In: oil crops: Niger and Rapeseed/ Mustard. Proceed. of the third oil crops Network, workshop held in Addis Ababa, Ethiopfa, 6-10 October, 4&6. pp. 91 -106.

Loof, B. 1959. Economically important diseases of cruciferous oil crops and possibilities for control, especially by breeding for resistance. Severig. Utsadesforn Tidskr. 69: 237-250.

Mcmillan, R. T., Graves, W., and Me Laughlin, H. J. 2000. Keyplex effect on sigatoka of banana. PWC Florida State Hort. Soc., 112: 192-193.

Pajot, E., Corre, D. Le., Silue, D. 2001. Phytogard and DL-β-aminobutyric acid (BABA) induced resistance to downy mildews (*Bremia lactucae*) in lettuce (l*ettuce sativa*). Eur.J.Plant.PathoL 107: 861-864.

Rewveni, R., Doi, G., Raviv, M., Rewveni, M. and Tuzun,S. 2000. Systemic resistance against *Sphaerotheca fulizinca* in cucumber plants exposed to phosphate in hydroponics system, and its control by foliar spray of monopotassium phosphate. Crop Protect. 19: 355-361.

Romero, A. M., Kousik, C. C. and Ritchie, D. F. 2001. Resistance to bacterial spot in bell pepper induced by acibenzolar-5-methyl. Plant Dis., 85: 189-194.

Singh, U. S., Bought, K. J., Nashaat, N. I., Bennet, R. N. and Kolte, S. J. 1999. Induction of systemic resistance to *Albugo Candida* in *Brassica juncea* by pre or co-inoculation with an incompatible isolate. Phytopath.

89: 1226-1232.

Spletzer, M. E. and Enyedi, A. J. 1999. Salicylic acid induces resistance to *Alternaria solani* in hydroponically grown tomato. Phytopath. 89: 9, 722-727.

Verhagen, B. W. M., Glazebrook, J. T., Chang, H. S., Van Loon, L. C. 2004. The transcriptome of *Rhizobacteria* induced systemic resistance in Aratfidopsis. Mol. Plant-Microbe interact., 17:985-908.

Vishwanath, Kolte, S. J., Singh, M. P. and Awasthi, R. P. 1999. Introduction of resistance in mustard (*Brassica juncea*) against *Alternaria* black spot with an avirulent *Alternaria brassicae* isolate-D. Euro. J. Plant. Path. 105: 217-220.

J. Agric. Res. Technol., 37 (2) : 243-246 (2012)

Bio-efficacy of Organic Insecticides Against Aphids (*Aphis gossypii* Glover) in *Bt* Cotton

S. B. Kharbade[1], J. R. Kadam[2], M. D. Dethe[3], S. S. Mehetre[4] and C. B. Wayal[5]
AICRP Cotton, Mahatma Phule Krishi Vidyapeeth, Rahuri - 413 722 (India)
(Received : 08-07-2011)

Abstract

The organic insecticides *viz*., spinosad 48 SC @ 75 g a.i., vertimec 1.9 EC @ 45 g a.i., *Verticillium lecanii*, *Bevaria bassiana* and *Metarhizium anisopliae* each @ 5 x 10^{12} conidia, *dashparni* extract @ 2 litre and neem oil @ 1 litre ha^{-1} were evaluated against aphids in *Bt* cotton for their bio-efficacy. The overall pooled results revealed that the treatments with spinosad 48 SC and vertimec 1.9EC were found to be most effective by recording lowest population of 8.65 and 10.35 aphids 3^{-1} leaves, respectively. This was followed by neem oil which recorded 13.73 aphids 3^{-1} leaves. The next best treatments in order of efficacy were *M. anisopliae* (16.94), *V. lecanii* (17.66), *dashparni* extract (17.98), and *B. bassiana* (18.89).

Key words : *Bt*. cotton, sucking pest-aphid, bio-efficacy, organic insecticides.

The Indian cotton scenario noted the highest production of 315 lakh bales and export touching to the tune of 85 lakh bales with average productivity of 520 kg ha^{-1}. (Anonymous, l009). The area under *Bt* cotton kept on expanding and India gained status of mega Biotech country. With the introduction of high yielding *Bt* hybrids, intensive cultivation, the sucking pests on *Bt* cotton is becoming a serious menace. The overall losses due to sap suckers have been estimated at the tune of around 50 per cent (Naqvi, 1976). The cotton grower resort more to unscheduled and injudicious use of chemical insecticides that upsets delicate balance of field prevailing natural enemies. Sole reliance on chemical control leads to problems of pest resistance, resurgence of pests and environmental pollution. Under such circumstances the use of organic pesticides which includes mycoinsecticides, botanical pesticides, spinosyns and avermectins in pest management is considered an ecological viable proposition which overcome the above problems. Therefore, present investigations were undertaken to evaluate the bio-efficacy of organic insecticides against aphids in *Bt*. cotton.

1. Professor, 2. Prof. of Entomology, 3. Ex. Head, 4. Director of Research and 5. Asstt. Professor.

Materials and Methods

The field experiments were carried out at All India Co-ordinated Cotton Improvement Project, Mahatma Phule Krishi Vidyapeeth, Rahuri during 2007-08 and 2008-09 on summer irrigated *Bt*. cotton in a randomized block design replicated thrice consisting of eight treatments. The Bt cotton hybrid RCH-2 *Bt* was sown on 25.5.2007 and 23.5.2008 with a spacing of 90 x 90 cm^2. All the agronomic practices were followed including the fertilizer dose @120:60:60 of N, P_2O_5 and K_2O ha^{-1}, respectively for raising the good crop. The spray fluid was applied at the rate of 500 litres $hectare^{-1}$ with hand operated knapsack sprayer. The observations on number of aphids were recorded on top, middle and bottom leaves of five randomly selected plants in each treatment at 1,3,5,7 and 10 days after spraying. Application of insecticides commenced from 45 days of the crop. In all three rounds of spray applications were undertaken at an interval of 20 days. The experimental data on number on aphids were first transformed to their corresponding square root of x+0.5 values and then statistically analysed.

Results and Discussion

The data on the post-treatment mean aphids count $three^{-1}$ leaves during 2007 revealed that all the organic insecticide treatments were significantly superior over untreated control. Among the evaluated organic insecticides, the treatments with spinosad and vertimec were observed to be most effective against aphids by recording lowest population of 8.86 and 10.62 aphids 3^{-1} leaves, respectively. The next best treatments in order of efficacy were neem oil (14.16), *M. anisopliae* (17.44), *V. lecanii* (18.18), *dashparni* extract (18.51) and *B. bassiana* (19.45). During 2008, the post treatment count of aphids 3^{-1} leaves indicated that spinosad (8.44) and vertimec (10.09) continued to be the most potent treatments followed by neem oil (13.35). Next effective treatments in order of their efficacy were *M. anisopliae* (16.44), *V. lecanii* (17.14),

Table 1. Overall field bioefficacy of organic insecticides against aphids, *A. gossypii* on *Bt* cotton.

Treatment	Dose ha^{-1}	Mean No. of aphids 3^{-1} leaves						Protection over control (%)
		1 DAS	3 DAS	5 DAS	7 DAS	10 DAS	Mean	
T_1 - Spinosad 48 SC	75 g a.i.	11.90 (3.52)	10.09 (3.25)	8.31 (2.97)	7.05 (2.75)	5.87 (2.52)	8.65 (3.00)	80.17
T_2 - Vertimec 1.9 EC	45 g a.i.	13.38 (3.72)	11.83 (3.51)	10.38 (3.30)	8.84 (3.05)	7.34 (2.80)	10.35 (3.28)	76.27
T_3 - *V. lecanii*	5 x 10^{12} conidia	24.08 (4.95)	20.87 (4.62)	17.06 (4.19)	14.42 (3.86)	11.88 (3.51)	17.66 (4.23)	59.50
T_4 - *B. bassiana*	5 x 10^{12} conidia	24.69 (5.01)	22.62 (4.80)	19.03 (4.41)	15.14 (3.95)	12.98 (3.67)	18.89 (4.37)	56.68
T_5 - *M. anisopliae*	5x 10^{12} conidia	23.56 (4.90)	20.05 (4.53)	16.45 (4.11)	13.28 (3.71)	11.38 (3.44)	16.94 (4.14)	61.16
T_6 - *Dashparni* extract	2 lt	25.17 (5.06)	20.33 (4.56)	17.57 (4.25)	14.27 (3.84)	12.54 (3.61)	17.98 (4.26)	58.77
T_7 - Neem oil	1 lt	17.37 (4.22)	15.23 (3.96)	13.47 (3.73)	12.09 (3.54)	10.63 (3.33)	13.76 (3.76)	68.45
T8 - Untreated control	-	37.29 (6.13)	40.51 (6.38)	43.00 (6.58)	47.47 (6.90)	49.79 (7.07)	43.61 (6.61)	
SE±		0.07	0.09	0.11	0.11	0.10	0.10	
CD @ 5%		0.22	0.28	0.34	0.34	0.30	0.30	

dashparni extract (17.44) and *B. bassiana* (18.33). The overall pooled results of 2007-08 and 2008-09 revealed that the means computed from 1-10 DAS indicated the supremacy of spinosad (8.65) and vertimec (10.35). This was followed by neem oil which recorded 13.76 aphids 3^{-1} leaves. The next best treatments in order of their efficacy were *M. anisopliae* (16.94), *V. lecanii* (17.66), *dashparni* extract (17.98) and *B. bassiana* (18.89), which were stastiscally in similar range.

The treatments *viz*., spinosad, vertimec, *V. lecanii*, *B. bassiana, M. anisopliae*, *dashparni* extract and neem oil reorded 80.17, 76.27, 59.50, 56.58, 61.16, 58.77 and 68.45 per cent protection of aphid population over untreated control. The general trend of field bioefficacy of the treatments under the studies against the aphids indicated as spinosad and vertimec > neem oil > *M. anisopliae*, *V. lecanii*, *dashparni* extract and *B. bassiana*.

The results of the present findings are in agreement with the findings of the earlier workers. Rovesti and Desco (1990) reported that neem and its oil extract and derivatives were effective against aphids on cotton. Ruberson and Tillman (1999) recorded excellent selectivity of spinosad against sucking pests on cotton with considerable promise as IPM tools. Gahukar (2000) reported that neem products/pesticides were effective against sucking pests in cotton. Mann *et al*. (2001) observed that azadirachtin enriched neem based insecticides were effective against aphids. Olga Malsam *et al.* (2002) found that *M. anisopliae* commercial products were effective against sucking pests. Acharya *et al.* (2002) reported that abamectin was effective against jassids. The organic insecticides *viz*., *M. anisopliae*, *B. bassiana*, Bhu-neem were effective against aphids on cotton (Anonymous, 2003). Knight *et al.* (2003) reported that *B. bassiana* was most effective against aphids on cotton. Vitalis (2003) found that *B. bassiana* and *M. anisopliae* were effective against sucking pests. Balakrishnan *et al*. (2004); reported effectiveness of neem and trichoderma against aphids on cotton. Rajendran (2004) reported that *M. anisopliae* and *B. bassiana* were found effective in reducing aphids population on cotton. Ramarethinam *et al*. (2005) suggested biorational use of *V. lecanii* against sucking pests. Nirmala *et al*. (2006) recorded fungal pathogenicity of *M. anisopliae* and *V. lecanii* against aphids. Anitha (2007) reported that botanicals and mycopathogens were effective against aphids. Adilakshmi *et al*. (2008) reported that neem oil, NSKE and Vanguard were found effective against aphids. Naik and Shekharappa (2009) reported that *M. anisopliae*, *B. bassinana* and *V. lecanii* were effective in management of aphids.

References

Adilakshmi, A., Korat, D. M. and Vaishnay, P. R. 2008. Bio-efficacy of some botanical insecticides against pests of okra. Karnataka J. Agric. Sci., 21(2): 290-292.

Acharya, S., Mishra, H. P. and Dash, D. 2002. Efficacy of insecticides against okra jassid, *Amrasca biguttula biguttula* Ishida. Ann. PI. Prot. Sci., 10(2): 230-232.

Anitha, K. R. 2007. Seasonal incidence and management of sucking pests of okra. M.Sc. (Agri.) thesis submitted to Univ. Agri. Sci., Dharwad (India).

Anonymous, 2003a. Bio-pesticides-Multiplex Metarhizium, Multiplex Biotech Pvt.Ltd., www.multiplezbiotec.com/multiplezmetarhizium.html, pp. 1-2.

Anonymous. 2009. Estimation of losses due to sucking pests in Bttcotton. Ann. Prog. Report of Cotton Res. Scheme, 2008-09, MAU, Parbhani, ENT: 10-12.

Balakrishnan, N., Murali Baskaran, R. K. and Mahadevan, N. R. 2004. Evaluation of different IPM modules on the effective management of sucking pests of cotton under rainfed condition. Internat. Symp. on "Strategies for sustainable cotton production- A Global Vision" 3-Crop protection, 23-25 Nov., UAS, Dharwad, Karnataka (India), pp. 254-257.

Gahukar, R. T.2000. Use of neem products/pesticides in cotton pest management. Internat. J. Pest Mgmt., 46(2): 149- 160.

Knight, K. M., Holdom, D. G. and Hauxwell, C. 2003.

Development of fungal biopesticides for use against green vegetable bugs and mirids. www.australian oil seeds.com

Mann, G. S., Dhaliwal, G. S. and Dhawan, A. K. 2001. Effect of alternate application of neem products and insecticides on population of *Bemisia tabaci* Gennadius and its impact on bollworm damage in upland cotton. Ann. PI. Prot. Sci., 9(1): 22-25.

Nirmala, R., Ramanujam, B., Rabindra, R. J. and Rao, N. S. 2006. Effect of entomofungal pathogen on mortality of three aphid species. J. Biol. Control, 20: 89-94.

Naik Harischandra, P. R. and Shekharappa. 2009. Field evaluation of different entomopathogenic fungal formulations against sucking pests of okra. Karnataka J. Agric. Sci., 22 (3-Spl. Issue): 575-578.

Naqvi, K. M. 1976. Crop protection to boost up the cotton production. Seminar organized by ESSO, Pert. Co. Ltd., Pakistan.

Olga Malsam, Michael Kilian, Erich-Christian Oerke and Heinz-Wilhelm Dehne. 2002. Oils for increased efficacy of *Metarhizium anisopliae* to control whiteflies. Biocon. Sci. and Techn., 12(3): 337-348.

Rajendran, T. P. 2004. Challenges for management of sap sucking pests in cotton. Internat. Symp. on "Strategies for Sustainable Cotton Production-A Global Vision", Crop Protection, 23-25 Nov. Univ. of Agri. Sci., Dharwad, Karnataka (India). pp. 37-41.

Ramarethinam, S., Marimutthu, S. and Mrugsen, N. V. 2005. Entomopathogenic fungi *Verticillium lecanii* - An overview, T. Stens and Co. Ltd, Coimbatore. Pestology. 29(11):9-27.

Rovesti, L. and Desco, K. V. 1990. *Azaradirachta indica* A Juss (neem) and its potentiality in the control of insects. Informatore phytopathology, 40(11): 27-32.

Ruberson, J. R. and Tillman. 1999. Effect of selected insecticides on natural enemies in cotton laboratory studies. In proceed. of Beltwide, Cotton Conf., Orlando, Florida 2(4): 1210-1213.

Vitalis Wafula Wekesa. 2003. Evaluation of pathogenic fungi *Beauveria bassiana* and *Metarhizium anisopliae* for control of tobacco spider mite *Tetranychus evansi* Baker & Pritchard (Acarina: Tetranychidae) infesting tomatoes, http:// testoline.com/intl/preview.

J. Agric. Res. Technol., 37 (2) : 246-251 (2012)

Effect of Different Organic Leachets on Biochemical Properties of Soil under Soybean Crop

A. A. Jadhav[1], G. K. Kadlag[2] and P. H. Rasal[3]
College of Agriculture, Pune - 411 005 (India)
(Received : 07-08-2011)

Abstract

The organic leachets application showed the beneficial effects on soil chemical and biological properties. There was increasing trend on total bacterial count *Azotobacter* and phosphate solubilising bacterial count recorded at 60 DAS of soybean. Also, the total nitrogen and available phosphorus content of soil were increased during 50 per cent flowering stage (60 DAS) from the initial level. The application of poultry manure compost leachet recorded significantly better soil biochemical properties.

Key words : Organic leachets, microbial count, soil bio-chemical properties.

Organic farming is gaining a vast significance since the use of chemical fertilizers is deteriorating the soil health day by day. Long lasting improvement in soil both physical and chemical characteristics are possible only by the additions of sufficient amounts of organic

1. M.Sc. (Agri.) student, 2. Agril. Supervisor, Dept. of Agriculture, Pune and 3. Asstt. Professor.

manures. Much attention has been paid in recent years to manage different organic resources at low cost input as well as on eco-friendly basis. There is ample amount of organic wastes available in India. About 196 million tons of crop residues are available in India annually (Gupta *et al*. 2004). Recycling of these crop residues and organic wastes through composting is the key technology for production of organic manures. Mineralized nutrients from organic manures in liquid form can directly be absorbed and utilized by the crops for growth and production. Therefore, the leachets can replace the partial requirement of the soluble fertilizers in the high valued crops.

The compost prepared from different organic substrates differ in chemical composition and thereby the leachets obtained from their composts may differ accordingly. Therefore, the present research was proposed to study the effects of various leachets *viz*., mushroom spent compost leachet, poultry manure compost leachet, vermicompost leachet and lignite leachet obtained from compost of different organic sources on microbial population in the soil. The microbial population in the soil plays an important role in availability of plant nutrients. The research aimed to reduce an application of voluminous quantity of organic matter and supply available form of nutrients to the growing crops and energy to the microorganisms through their concentrated form as leachets.

Materials and Methods

The experiment was conducted at Department of Plant Pathology and Agril. Microbiology, College of Agriculture, Pune under glass house conditions. Six organic leachets *viz*., mushroom spent compost leachet, poultry manure compost leachet, soybean straw compost leachet, sugarcane trash compost leachet, vermicompost leachet and lignite leachet were obtained from composts of different organic sources soaked in equal quantity of water for a period of seven days, and drained out. These leachets were applied in both organic matter [OM] rich soil and OM poor soil. In all 14 treatments, maintaining untreated control was replicated thrice in factorial completely randomized design. The crop soybean JS-335 variety was grown in pots having capacity of ten kg soil. Five seeds of the variety was sown in each pot at equidistance. The soil samples were drawn and analysed for total microbial count, *Azotobacter* and PSB at initial and at flowering [60 DAS] by following the standard procedures. The data obtained was statistically analysed through methods described by Panse and Sukhatme (1967).

Results and Discussion

The chemical composition of compost used for extraction of leachets revealed that (Table-1) maximum nitrogen and available phosphorus content was found in poultry manure compost, followed by vemicompost, mushroom spent compost, soybean straw compost and sugarcane trash compost. The lowest nitrogen and phosphorus content was recorded in the lignite. Similar trend of nitrogen content was also recorded in leachet extracted from the same compost.

Regarding biochemical properties of the

Table 1. Composition of organic manures and their leachets.

Parameter	MSC	PMC	SSC	STC	VC	Lignite
Total nitrogen (%)	1.36 (0.29)	1.68 (0.36)	1.10 (0.25)	0.35 (0.09)	1.52 (0.33)	0.31 (0.07)
Available phosphorus (%)	0.83 (0.20)	1.39 (0.29)	0.58 (0.14)	0.10 (0.03)	1.2S (0.26)	0.07 (0.03)

Figures in the parentheses indicate leachet composition.

soils (Table 2 and 3) utilized for growing soybean crop showed that organic matter rich soil recorded higher total nitrogen (0.125%),available phosphorus (16.52 kg ha^{-1}) and organic carbon (1.23%) than organic matter poor soil. The initial microbial population was also higher in organic matter rich soil than organic matter poor soil.

Total microbial count : An application of different organic leachets in two different types of soil increased the total bacterial count (Table 2) from 12.00 to 38.50 CFU x 10^5 g^{-1} of soil at flowering stage of soybean crop (60 DAS). The significantly higher total bacterial count was recorded (38.50 x 10^5 g^{-1} of soil) in OM rich soil treated with poultry manure compost leachet and lowest (12.00 x 10^5 g^{-1} of soil) in OM poor soil alone.

Significantly higher mean bacterial count (31.57 x 10^5 g^{-1} of soil) across the different organic leachets was recorded in OM rich soil than in OM poor soil (16.79 x 10^5 g^{-1} of soil). Further, significantly higher mean microbial count across the soil types was recorded (30.50 x 10^5 g^{-1} of soil) due to poultry manure compost leachet, followed by vermicompost leachet (27.50 x 10^5 g^{-1} of soil), lignite leachet (25.50 x 10^5 g^{-1} of soil), mushroom spent compost leachet (23.75 x 10^5 g^{-1} of soil), soybean straw compost leachet (22.75 x 10^5 g^{-1} of soil) and sugarcane trash compost leachet (20.25 x 10^5 g^{-1} of soil). The lowest mean microbial count (19.00 x 10^5 g^{-1} of soil) was recorded in the untreated soil. The interaction due to organic leachets and soil types were found to be significant indicating beneficial effects of organic matter and organic leachets on microbial population in the soil.

***Azotobacter* :** The *Azotobacter* population (Table 2) in soil increased due to application of leachets from different types of

Table 2. Effect of organic leachets on microbial population in different types of soil under soybean crop at 60 DAS (CFU g^{-1} soil).

Soils/microbial population	Initial count	Control	MSCL	PMCL	SSCL	STCL	VCL	LL	Mean
Organic matter rich soil :									
Total count 10^5	16.50	26.00	31.50	38.50	30.00	27.50	35.00	32.50	31.57
Azotobacter 10^4	12.50	15.50	19.00	24.00	18.50	17.00	22.00	20.50	19.50
PSB 10^4	5.50	7.50	11.00	15.00	9.00	8.50	14.00	12.50	11.07
Organic matter poor soil :									
Total count 10^5	9.50	12.00	16.00	22.50	15.50	13.00	20.00	18.50	16.79
Azotobacter 10^4	7.50	9.50	14.00	20.00	12.50	11.00	18.00	15.50	14.36
PSB 10^4	2.50	3.50	6.50	8.50	5.00	4.00	8.00	7.00	6.07
Mean									
Total count 10^5		19.00	23.75	30.50	22.75	20.25	27.50	25.50	24.J8
Azotobacter 10^4		12.50	16.50	22.00	15.50	14.00	20.00	18.00	16.93
PSB 10^4		5.50	8.75	11.75	7.00	6.25	11.00	9.75	8.57
		Total count			***Azotobacter***			**PSB**	
	S	**OL**	**S_XOL**	**S**	**OL**	**S_XOL**	**S**	**OL**	**S_XOL**
SE±	0.36	0.67	0.95	0.42	0.78	1.10	0.36	0.67	0.95
CD at 5%	1.06	1.98	2.83	1.23	2.30	3.40	1.06	1.96	2.81

S = Soil, OL = Organic leachet

organic manures. The population was varied between 9.50 to 24.0 CFU x 10^4 g^{-1} of soil due to soil types and different organic leachets. The highest *Azotobacter* count was recorded (24.00 x 10^4 g^{-1} of soil) in OM rich soil treated with poultry manure compost leachet over all other organic compost leachet except vermicompost leachet which was at par with each other and lowest count (9.50 x 10^4 g^{-1} of soil) was recorded in OM poor soil in control.

Significantly, higher *Azotobacter* count (19.50 x 10^4 g^{-1} of soil) was recorded in OM rich soil across the organic compost leachets than the OM poor soil (14.36 x 10^4 g^{-1} of soil). The highest mean *Azotobacter* count across the soil types was recorded (22.00 x 10^4 g^{-1} of soil) due to poultry manure compost leachet over mushroom spent compost leachet (16.50 x 10^4 g^{-1} of soil), soybean straw compost leachet (15.50 x 10^4 g^{-1} of soil), sugarcane trash compost leachet (14.00 x 10^4 g^{-1} of soil) and lignite leachet (18.00 x 10^4 g^{-1} of soil) but at par with vermicompost, leachet (20.00 x 10^4 g^{-1} of soil). The lowest mean *Azotobacter* count (12.50 x 10^4 g^{-1} of soil) was recorded with the control. The interaction due to organic leachets and soil types were found to be significant. Alexander (1961) and Talashilkar (1987) reported that organic matter available in the soil serves as a good substrate for growth and activity of *Azotobacter*. Hazra (1994) also reported proliferation of *Azotobacter* due to high nitrogen and humic acid content in soil.

Phosphate solubilising bacteria (PSB): The PSB count (Table 2) was increased from 3.50 to 15.00 x 10^4 g^{-1} of soil at 60 DAS due to different types of soils and leachets. The highest PSB count was recorded (15.00 x 10^4 g^{-1} of soil) in OM rich soil treated with poultry manure compost leachet over mushroom spent compost leachet, soybean straw compost leachet, sugarcane trash compost leachet and lignite leachet but at par with vermicompost leachet in same soil type and lowest (3.50 x 10^4 g^{-1} of soil) in OM poor soil with control.

The higher PSB count (11.07 x 10^4 g^{-1} of soil) was recorded in OM rich soil than the OM poor soil (6.07 x 10^4 g^{-1} of soil). The highest mean PSB count across the soil types was recorded (11.75 x 10^4 g^{-1} of soil) due to poultry manure compost leachet over mushroom spent compost leachet (8.75 x 10^4 g^{-1} of soil), soybean straw compost leachet (7.00 x 10^4 g^{-1} of soi), sugarcane trash compost leachet (6.25 x 10^4 g^{-1} of soil) and lignite leachet (9.75 x 10^4 g^{-1} of soil) but at par with vermicompost leachet (11.00 x 10^4 g^{-1} of soil) in same soil. The lowest mean PSB count (5.50 x 10^4 g^{-1} of soil) was found with the control. The interaction due

Table 3. Effect of different leachets on N and P content of soil under soybean at 60 DAS.

Soil/nutrient	Initial	Control	MSCL	PMCL	SSCL	STCC	VCL	LCL	Mean
OM rich soil :									
N. (%)	0.125	0.140	0.235	0.285	0.195	0.180	0.260	0.155	0.21
Availabie P (kg ha^{-1})	16.52	19.82	21.48	22.36	20.87	20.24	21.76	19.93	20.92
OM poor soil :									
N. (%)	0.085	0.090	0.140	0.165	0.125	0.110	0.150	0.105	0.13
Available P (kg ha^{-1})	10.72	12.17	14.33	15.54	13.96	13.24	15.04	12.88	13.88
		N			**P**				
	S	**OL**	**S x OL**	**S**	**OL**	**S x OL**			
SE±	0.006	0.01	0.015	0.36	0.67	0.95			
CD. at 5%	0.16	0.03	1.05	1.05	1.97	2.85			

to organic leachets and soil types was found to be significant. During crop growth period PSB multiplied faster due to organic matter, humic acid ,presence of *Azotobacter* and root exudates as reported by Subba Rao (1977) Gaur *et al.* (1978) and Shankaraiah *et al*. (2000).

Nutrient content in soil : The total nitrogen content in soil (Table 3) varied between 0.090 to 0.285 per cent. Significantly maximum total nitrogen content (0.285%) was observed in the organic matter rich soil treated with poultry manure compost leachet over all other organic leachets except vermicompost leachet and the lowest in organic matter poor soil with control (0.090%).

An interaction between organic leachets and soil types showed the significant difference in nitrogen content in between OM rich and OM poor soils, the higher being recorded with OM rich soil than OM poor soil (0.13%). Among the organic leachets across the soil types, poultry manure compost leachet recorded significantly highest nitrogen content (0.23%) over mushroom spent compost leachet (0.19%), soybean straw compost leachet (0.16%), sugarcane trash compost leachet (0.15%) and lignite leachet (0.13%) but at par with vermicompost leachet (0.21%). The lowest nitrogen content in soil was present in control (0.12%). The interactions due to organic leachets and soil types were found to be significant. Similar results were also reported by Negi *et al* (1987) and Dobereiner *et al.* (1993).

Available phosphorus : Available phosphorus content in soil varied between 12.17 to 22.36 kg ha^{-1}. Significantly the maximum phosphorus content (22.36 kg ha^{-1}) was observed in organic matter rich soil treated with poultry manure compost leachet and minimum was recorded in organic matter poor soil with control (12.17 kg ha^{-1}).

The available phosphorus content of two different soil types across the organic leachets was found significantly higher in OM rich soil (20.92 kg ha^{-1}) than OM poor soil (13.88 kg ha^{-1}). Significantly,the highest phosphorus content (18.95kg ha^{-1}) across the organic leachets was recorded in poultry manure compost leachet over sugarcane trash compost leachet (16.74 kg ha^{-1}) and lignite leachet (16.41 kg ha^{-1}) but at par with mushroom spent compost leachet (17.91 kg ha^{-1}), soybean straw compost leachet (17.42 kg ha^{-1}) and vermicompost leachet (18.40 kg ha^{-1}). The lowest available phosphorus content was recorded with control (16.00 kg ha^{-1}). The interaction due to organic leachets and soil types was found to be significant for increase of phosphorus content in the soil . Similar findings were also reported by Beillaki *et al*. (1998) and Dass *et al.* (2008).

References

Alexander, M. 1961. Introduction to Soil Microbiology. John Wiley and Sons, Inc. New York pp. 472.

Beilljki, M. A., Badnaue, V. P. and Setty, R. A. 1998. Effect of long term integrated nutrient management on some important properties of vertisol. J. Indian Soc. Soil Sci. 46: 176-180.

Dass, A., Lenka, N. K., Sudhishris, S. and Patnaik, U. S. 2008. Influence of integrated nutrient management on production, economics and soil properties in tomato under on farm conditions in eastern ghats of Orisa. Indian J. Agril. Sci. 78(1): 40-43.

Dobereiner, J., Baldani, V. L. D., Olivares, F. and Reis, V. M. 1993. Endophytic Diazotrophs. The key to BNF in graminaceous plants. Sixth Internat. Cong. on BNF with non legumes held in Egypt.

Gaur A. C, Mathur, R .S. and Sadasivan, K. V. 1978. Effect of organic materials and phosphate dissolving cultures on the yield of wheat and green gram. Indian J. Agron. 25(3): 501-503.

Gupta, S. B, Tamrakar, D. K., Thakur, M. P., Tedia, K., Tomar, A. and Keshry, P. K. 2004. Effect of crop beneficial microbes on decomposition rates of different crop residues. Soils Crops. 4(1): 1-4.

Hazra, C. R. 1994. Response of biofertilizers in forage and fodder crops. Pert. News. 39(4): 43-53.

Negi, M., Sadasivam, K. V., and Tilak, K. V. B. R. 1987.

A note on the effect of non symbiotic nitrogen fixers and organic wastes on yield and nitrogen up take of barley. Biol. Wastes. 22: 179-185.

Panse, V. G. and Sukhatme, P. V. 1967. Statistical Methods for Agriculture Workers. ICAR, New Delhi. pp. 110-387.

Shankaraiah, G., Hunsigix, G. and Nagaraju, M. S. 2000. Effect of levels and source of phosphorus and phosphate solubilizing microorganisms on growth, yield and quality of sugarcane. Sugar Tech. 2(1 and 2) pp. 23-28.

Subba Rao, N. S. 1977. Soil Microorganisms and Plant Growth. Oxford and IBH. Publ. Co. Pvt. Ltd. New Delhi.

Talashilkar, S. C. 1987. Effect of microbial culture (*Azotobacter chroococcum*) on humification and enrichment of mechanised compost. Indian J. agric. Chem. 20(1): 85-88.

J. Agric. Res. Technol., 37 (2) : 251-257 (2012)

Biointensive Pest Management in *Bt* Cotton : Evaluation and Validation of Module

D. S. Pokharkar[1], R. V. Nakat[2], A. S. Dhane[3], N. D. Tamboli[4] and B. M. Mhaske[5]
AICRP on Biological Control of Crop Pests and Weeds,
Entomology Section, College of Agriculture, Pune - 411 005 (India)
(Received : 12-10-2011)

Abstract

Biointensive pest management (BIPM) module in *Bt* cotton was evaluated in comparison with existing package in *Bt* cotton and farmer's practice in non *Bt* cotton employing MCH 162 and RCH 2*Bt* and non *Bt* cotton varieties. All the treatments showed significant differences in suppressing the sucking pest population as well as bollworm damage with increase in natural enemies and yield of seed cotton in the respective years. Pooled analysis of three years data revealed that the BIPM package and existing package with chemical control tested in *Bt* and non *Bt* cotton blocks exhibited non-significant differences in respect of aphids, thrips, white flies and predators' population. The *Bt* cotton with existing package found effective in suppressing the sucking pests population because of seed treatment with imidacloprid and spraying of systemic insecticides like dimethoate 0.03 per cent and methyl demeton 0.025 per cent. However, the natural enemies coccinellids and chrysopids population was maximum in *Bt* cotton blocks with BIPM package. The *Bt* cotton with BIPM package and existing package found statistically comparable with each other in respect of bollworm damage and yield of seed cotton. The BIPM practice on farmers' field in Dhule district was effective in suppressing the sucking pests' population and bollworm damage. The population of natural enemies, coccinellids and chrysopids and yield were recorded higher in BIPM blocks than farmer's practice. Hence, the BIPM practice in *Bt* cotton could be recommended for biological suppression of pest complex and conservation of natural enemies in *Bt* cotton ecosystem.

Key words : Biointensive pest management, *Bt* cotton, validation.

Cotton (*Gossypium hirsutum* Linn.) is an important cash crop grown in India. The pest-insects like aphids, jassids, thrips, white flies, mealy bugs, spotted bollworm, American bollworm, pink bollworm and tobacco leaf eating caterpillar are recognizable in the state during recent days. However, the bollworm complex was the major threat causing serious losses owing to direct damage to squares, flowers, bolls (Sundaramurthy and Chitra, 1992). The introduction of *Bt* cotton in India

1. Entomologist, 2. Asstt. Entomologist, 3. Jr. Res. Asstt., 4. Sr. Res. Asstt. and 5. Asstt. Professor of Entomology, KVK, College of Agriculture, Dhule.

has no doubt suppressed the bollworm damage to greater extent but the incidence of sucking pests is increasing day-by-day which requires additional pest control strategies.

The use of pesticides caused environmental pollution, health hazard to man and his animals, pesticide resistance, pest resurgence, outbreak of secondary pests and destruction of natural enemies population that adversely affected the natural balance. Such a grave situation can be tackled by introduction of natural enemies and their conservation in the cotton ecosystem. To augment natural enemies in cotton, there is need to follow biointensive pest management (BIPM) practice which includes use and incorporation of bioagents like *Chrysoperla*, *Trichogramma*, microbial and botanical products integrated with cultural practices to suppress the pest population density below EIL under field conditions. In current study, the BIPM module was employed in *Bt* as well as non-*Bt* cotton crop and compared with existing practices of chemical control of pest complex of cotton. The module was evaluated and validated on large scale on farmers' fields for popularization.

Materials and Methods

The field experiment on evaluation of BIPM module was carried out during three consecutive *kharif* seasons from 2003-04 to 2005-06 at the research farm of Agronomy Section, College of Agriculture, Pune and subsequently, validation of the module was done during 2007-08 to 2009-10 covering two villages in Dhule district of Maharashtra. The cotton var. MECH 162 *Bt* and RCH 2 *Bt*, non *Bt* were raised in separate blocks. The sowing of seeds was done in the plots of 20 x 40 m^2 size on ridges and furrows at plant spacing 90 x 90 cm in randomized block design with four treatments and ten replications. All the recommended agronomic practices except pesticide applications were followed to maintain healthy crop growth. The components employed as treatments in each *Bt* and non *Bt* cotton plots were T_1 - *Bt* cotton with BIPM package (Seed treatment with *Trichoderma harzianum* @ 5 g kg^{-1} seeds, border rows of maize crop, release of *Chrysoperla zastrowi sillemi* @ 14,000 grubs ha^{-1}, spraying of *SlNPV* @ 3 x 10^{12} POBs ha^{-1} mixed with 5 per cent crude sugar, sowing two border rows of non *Bt* cotton as refugia and erection of bird perches @ 10 ha^{-1}), T_2 - Non-*Bt* cotton with BIPM package (All above T_1 components, release of *Trichogramma chilonis* @ 1.5 lakh ha^{-1} $week^{-1}$ six releases and spraying *HaNPV* @ 3 x 10^{12} POBs ha^{-1} mixed with 5 per cent crude sugar), T_3 - *Bt* cotton with existing package of practices (Seed treatment with imidacloprid 70 WS (Gaucho) @ 10 g kg^{-1} seeds, two need based sprays of systemic insecticides for sucking pests (dimethoate 0.03% followed by methyl demeton 0.025% at 15 days interval) starting from 45 days after germination (DAG), three need based sprays of recommended insecticides for bollworms [endosulfan 0.07% followed by cypermethrin 0.0075% and fenvalerate 0.01% at 15 days interval] and sowing of two border rows of non-*Bt* cotton as refugia) and T_4 - Non-*Bt* cotton with farmers' practice (Seed treatment with imidacloprid 70 WS (Gaucho) @ 10 g kg^{-1} seeds and farmers' practice recommended spray schedule [dimethoate 0.03%, methyl demeton 0.025%, endosulfan 0.07%, cypermethrin 0.0075%, fenvalerate 0.01% at 15 days interval starting from 25 DAG]).

The application of various components of each module in treatment plots was started according to pest's incidence. Release of *Chrysoperla zastrowi sillemi* Esben-Petersen was carried out at 25 DAG and *Trichogramma chilonis* Ishii at 45 DAG of the crop in T_1 and T_2 blocks according to treatment schedule. The

bird perches were erected in 45 days old crop. Whereas spray applications of chemical insecticides dimethoate 0.03 per cent, methyl demeton 0.025 per cent, endosulfan 0.07 per cent, cypermethrin 0.0075 per cent and fenvalerate 0.01 per cent were given as per schedule in T_3 and T_4 blocks.

The observations on sucking pests and bollworms were recorded on leaves, shoots, locules and green bolls on five randomly selected and tagged plants from each treatment plots in replicates, a day prior to treatment application as pre-count and post counts at fortnightly interval. The population of sucking pests *viz*., aphids, jassids, thrips, white flies and mites were recorded on three leaves (top, middle and bottom portion) from each plant up to 75 DAG of the crop. The mealybug incidence noticed in BIPM validation blocks on farmers' fields in Dhule region was recorded on 5 cm shoot twig^{-1} length and three such shoots plant^{-1} at fortnightly interval till harvest of the crop.

The population of natural enemies *viz*., coccinellids and chrysopids were recorded at fortnightly interval from whole plant. The population count was inclusive of all stages of the predators. The yield of seed cotton was recorded replication wise at each picking and summed. Further, three seasons' data were pooled, transformed appropriately and then subjected to analysis of variance.

The validation of BIPM module was carried out in villages Ambapur and Morane, Dist. Dhule, Maharashtra in collaboration with Krishi Vidyan Kendra, College of Agriculture, Dhule during 2007-08 to 2009-10. The *Bt* cotton var. RCH 2 *Bt* was cultivated by the farmers. The observations on sucking pests, bollworm damage, natural enemies' population and yield were recorded from 20 representative plots in each village at fortnightly intervals during crop growth period.

Results and Discussion

Effect of BIPM on sucking pests in *Bt* cotton : The incidence of sucking pests *viz*., aphids, jassids, thrips, white flies and mites was recorded during 2003-04 and 2004-05, whereas all these pests except mite were observed in 2005-06. The data showed significant differences in sucking pests population recorded from the treatment blocks of BIPM package, existing package and farmer's practice in *Bt* and non-*Bt* cotton. The *Bt* cotton with existing package found statistically superior in suppressing the aphid, jassid, thrip and white flies population, followed by BIPM package in *Bt* cotton. Pooled analysis of three years data revealed that there were non-significant differences in sucking pests population except jassids (Table 1). The *Bt* cotton with existing package found effective in maintaining minimum population of aphids (27.16), jassids (6.82), thrips (20.38) and white flies (4.73) three^{-1} leaves plant^{-1}, followed by farmer's practice. It was because of application of chemical insecticides like seed treatment with imidacloprid and two sprays of systemic insecticides *viz*., dimethoate and methyl demeton. The BIPM package employed in *Bt* and non-*Bt* cotton blocks showed almost similar promise in the suppression of sucking pests where *Chrysoperla* was released.

Thus, the BIPM package was found to be the next best in suppressing the sucking pests' population after chemical control in the current investigation. Earlier, Natarajan (1990) made inoculative release of *Chrysoperla* sp. for the control of white flies in cotton. Saminathan *et al*. (2003) recorded highest count of *Chrysoperla* sp. in cotton intercropped with sunflower and cowpea which ultimately resulted into effective suppression of *Aphis gossypii* Glover, *Bemesia tabaci* Gennadius and *Helicoverpa armigera* Hubner with its predatory activity. Further, Godhani (2006)

recorded significant reduction in sucking pests population in cotton intercropped with maize, sesame and soybean which harboured about 12 species of parasitoids and predators. Xiao *et al*. (2006) observed highest density of natural enemies and low population of cotton aphids in relay cropping system of cotton and wheat. Thus, the natural occurrence of predators, harboring natural enemies on maize and inoculative release of *Chrysoperla* could help in suppressing the sucking pests' population in cotton.

Effect of BIPM on natural enemies : The predominant species of indigenous natural enemies observed in cotton plots during three years of experimentation were coccinellids, ladybird beetles (*Coccinella septempunctata* Linn., *Cheilomenes sexmaculata* Fab.) and chrysopids, green lace wing (*Chrysoperla zastrowi sillemi* Esben-Petersen). The occurrence of these predators in various treatment blocks showed significant differences during three years experimentation period except coccinellids in 2005-06. Pooled analysis of three years data revealed that statistical differences were non-significant in respect of the predatory population among the various treatment blocks (Table 1). The average population of coccinellids (7.93) and chrysopids (7.96) plant^{-1} were maximum in the plots of *Bt* cotton with BIPM package, followed by non-*Bt* cotton with BIPM block. The predator's population was relatively low in *Bt* and non-*Bt* cotton with existing package and farmer's practice wherein application of chemical insecticides was followed for the control of sucking pests as well as bollworms.

It is evident from the observations that the coccinellids and chrysopids number recorded higher in BIPM package blocks than the existing package and farmer's practice of employing chemical insecticides for the control of sucking pests. This practice affected the population built-up of the predators in cotton plots. In BIPM package blocks, the natural enemies population was undisturbed and besides, the planting of maize as border crop attracted and conserved the predators. Moreover, inoculative release of *Chrysoperla* augmented its population in the BIPM blocks.

Table 1. Effect of BIPM practices on pest complex, natural enemies and yield of *Bt* cotton (Pooled data for 2003-04 to 2005-06).

Treatment	Sucking pest population (3 leaves plant^{-1})*				NEs population (plant^{-1})*		Bollworm damage (%)**		Yield of kapas (kg ha^{-1})
	Aphids	Jassids	Thrips	White flies	Cocci-nellids	*C. carnea*	Squ-ares	Bolls	
Bt cotton with BIPM package	62.80 (7.51)	9.06 (3.04)	28.10 (4.95)	5.60 (2.43)	7.93 (2.89)	7.96 (2.83)	1.44 (6:60)	3.57 (9.38)	1520
Non *Bt* cotton with BIPM package	58.38 (7.22)	10.85 (3.32)	46.18 (5.92)	8.71 (3.00)	6.06 (2.61)	5.19 (2.44)	4.56 (11.83)	7.13 (14.83)	1150
Bt cotton with existing package	27.16 (5.10)	6.82 (2.69)	20.38 (4.33)	4.73 (2.24)	5.37 (2.50)	4.36 (2.27)	1.01 (5.52)	4.00 (10.64)	1528
Non *Bt* cotton with farmers practice	29.37 (5.39)	7.80 (2.88)	31.69 (5.09)	5.70 (2.52)	4.79 (2.37)	4.27 (2.23)	8.90 (17.11)	10.04 (18.27)	1012
SE±	(0.91)	(7.27)	(0.54)	(0.20)	(0.11)	(0.17)	(1.28)	(1.38)	41.69
CD at 5%	(NS)	(0.25)	(NS)	(NS)	(NS)	(NS)	(4.43)	(4.76)	144.29
CV%	24.91	4.22	18.58	13.89	7.39	12.45	21.61	17.96	5.54

Means of observations recorded at 15 days interval on 5 plants from each of 10 replications.
Figures in brackets are * $\sqrt{x + 1}$ and ** arc sin transformed values.

Javier and Altieri (1990) reported that maize harbored large number of natural enemies like *Chrysoperla* spp. and *Nabis* sp. in aphid colonies on maize as alternate prey in multiple cropping systems of cotton. Wu *et al*. (1991) observed that intercropping of maize in cotton increased the population of coccinellidae and chrysopidae by 62.80 to 115.77 times as compared to control plots. Burankonda (1999) recorded the increased population of natural enemies such as wasps, aphid consuming flies and lady bird beetles in *Bt* cotton fields compared to conventionally sprayed non-*Bt* cotton fields in China. Kavitha *et al*. (2003) observed that the population of predators like spiders, coccinellids and green lace wings was abundant in cotton plots stripped with maize and sorghum. Saminathan *et al*. (2003) recorded highest count of *Chrysoperla* sp. in cotton intercropped with sunflower and cowpea. Thus, the BIPM practices like planting of paired row of maize on border, maintenance of refugia in *Bt* cotton, inoculative release of *Chrysoperla* conserved and augmented the natural enemies population in the BIPM block of *Bt* cotton.

Effect of BIPM on bollworm : The bollworms species, *Earias vitella* Fab. and *Helicoverpa armigera* Hub. found infesting squares and bolls of cotton in the experimental plots throughout the period of observations. Results indicated that *Bt* cotton with existing package found significantly effective in suppressing the square as well as boll damage during 2003-04 and 2004-05 and it was at par with BIPM package in *Bt* cotton. However, the BIPM package in *Bt* cotton was significantly superior to rest of the treatments in this respect during 2005-06 which showed 0.66 per cent square damage and 0.46 per cent boll damage. Pooled analysis of three years data showed that *Bt* cotton with BIPM package was statistically superior in suppressing the boll damage (3.57%) and it was however, at par with existing package employed in *Bt* cotton in respect of

Table 2. Validation of BIPM practice in *Bt* cotton var. RCH 2*Bt* on farmer's field (2007-08 to 2009-10).

Particulars	2007-08		2008-09		2009-10	
	BIPM module	Farmer's practice	BIPM module	Farmer's practice	BIPM module	Farmer's practice
Sucking pests population (3 leaves^{-1} plant^{-1}) :						
Aphids	19.83	31.54	12.00	14.00	14.54	17.86
Jassids	3.27	3.68	9.00	8.20	2.47	3.02
Thrips	10.50	24.20	11.80	10.30	13.86	15.37
White flies	6.42	7.28	1.70	2.20	3.05	3.71
Mealy bug	22.10	25.15	12.00	18.00	3.49	5.89
Bolloworm damage (%)	3.28	6.32	0.40	1.00	1.12	3.20
Locule damage (%))	4.30	6.80	1.20	2.00	2.32	3.33
Yield of seed cotton (kg ha^{-1})	1850	1678	2420	2030	2114	1686
NEs population						
Coccinellids	5.30	1.20	4.50	0.20	2.17	0.33
Chrysopids	6.10	2.00	6.80	1.80	2.03	0.76
Total receipt (Rs. ha^{-1})	-	-	58,080/-	48,720/-	63,412/-	50,588/-
Cost of cultivation (Rs. ha^{-1})	-	-	16,400/-	19,440/-	21,442/-	17,096/-
Net return (Rs. ha^{-1})	-	-	41,680/-	29,280/-	41,970/-	23,492/-
ICBR	-	-	1 : 3.55	1 : 2.53	1 : 1.96	1 : 0.87

square and boll damage (Table 1).

It seems from the results that the biological components in BIPM package and chemical insecticides employed in existing package could be favourably compared in reducing the boll worm damage in *Bt* cotton. Bhagwat (1997) provided bird perches to encourage predatory birds, and their activity was intense in the plots sprayed with NPV rather than chemical insecticides. Ghode *et al.* (1998) reported that birds could reduce *H. armigera* population from 5-10 larvae plant^{-1} to negligible number (<1%) within a month. Bharpoda et al. (2000) recommended IPM module consisting spray of Delfin, release of *T. chilonis*, maintenance of *Chrysoperla* sp. population, use of pheromones and trap crops for the management of sucking pests and bollworms in cotton fields. Thus, the findings of these workers could support the current observations in this respect.

Effect of BIPM on yield : The yield of seed cotton recorded from various treatment plots showed significant differences during all the three years. The *Bt* cotton with BIPM package found significantly effective in registering maximum of 1815 kg ha^{-1} seed cotton during 2003-04. Whereas, *Bt* cotton with existing package gave highest yield during both subsequent years. Pooled data in Table 1 indicated that the existing package in *Bt* cotton proved to be significantly superior in recording seed cotton yield (1528 kg ha^{-1}) and it was however, at par with BIPM package in *Bt* cotton (1520 kg ha^{-1}). Ameta *et al*. (2004) reported that the mean seed cotton yield in IPM fields was 1806 and 1723 kg ha^{-1} as against 1570 and 1486 kg ha^{-1} in non-IPM fields during 2001 and 2002, respectively. Bambawale *et al.* (2004) registered maximum (12.4 q ha^{-1}) seed cotton yield from IPM block of *Bt* cotton cv. MECH 162. Panchbhai *et al*. (2005) recorded highest cotton yield in chemical control plots (15.45 q ha^{-1}), followed by employment of biological components like release of *T. chilonis* @ 1.5 lakh ha^{-1} + *Chrysoperla carnea* @ 4 eggs plant^{-1} (14.96 q ha^{-1}). Prasad (2005) reported that the existing package in *Bt* cotton gave higher seed *kapas* yield than BIPM practice. It is evident from the studies that though the biological components and chemical control could not directly compete for governing the pest population density and losses caused by them, the BIPM practices in *Bt* cotton stood statistically on par with the existing package influenced with chemical insecticides. Thus, the results of current studies are in corroboration with the findings of earlier workers in respect of suppression of cotton pest complex and enhancement of natural enemies population in BIPM blocks and yield of cotton.

Validation of BIPM package : The BIPM package in *Bt* cotton was validated on farmers' field in villages Ambapur and Morane, Dist. Dhule, Maharashtra covering total village during 2007-08, 2008-09 and 2009-10. The results presented in Table 2 showed that sucking pests population and bollworm damage was consistently recorded low in BIPM blocks as compared to farmer's practice during above three years except jassid and thrip incidence in 2008-09. Moreover, the natural enemies coccinellid and chrysopid population recorded higher in BIPM blocks than farmer's practice plots. The damage to bolls and locules caused mainly by *E. vitella* and *H. armigera* was low in BIPM blocks with higher seed cotton yield as compared to farmer's practice. The ICBR worked out for BIPM plots during 2008-09 (1:3.55) and 2009-10 (1:1.96) was also more than farmer's practice indicating higher net monetory returns.

Thus, it could be surmised that, the BIPM package consisting seed treatment with *T. harzianum* @ 5 g kg^{-1} seeds, growing paired

rows of maize as border crop, release of *Chrysoperla* sp. @ 14,000 grubs ha^{-1}, spraying NPV @ 3 x 10^{12} POBs ha^{-1} mixed with 5 per cent crude sugar, erection of bird perches @ 10 ha^{-1} and sowing of two border rows of refugia in *Bt* cotton could be advocated for biological suppression of *Bt* cotton pest complex and conservation of indigenous natural enemies in cotton ecosystem.

References

Ameta, O.P., Rana, B.S. and Bambawale O.M. 2004. Validation of IPM technology in cotton in Southern Rajasthan. Pestology, 28(11): 27-30.

Bambawale, O. M., Singh, A., Sharma, O. P., Bhosale, B. B., Lavekar, R. C., Dhandapani, A., Kawar, V., Tanwar, R. K., Rathod, K. S., Patange, N. R. and Pawar, V. M. 2004. Performance of *Bt* cotton (MECH 162) under integrated pest management in farmer's participatory field trial in Nanded district, Central India. Current Sci., 86 (86): 1628-1633.

Bhagwat, V. R. 1997. ICRISAT's eco-friendly gift to check chickpea pod borer. SAT News. 20: 6-8

Bharpoda, T. M., Patel, H. P., Patel, U. P., Patel, G. A., Patel, J. J. and Patel, J. R. 2000. Integrated pest management in cotton H-6 cultivated in middle Gujarat. Indian J. Ent., 62 (4): 327-331.

Burankonda, A. 1999. *Bt* cotton is potential economic saviour of Chinese province. Bangkok post, October 26. pp. 6.

Ghode, M. K., Nazyak, U. P., Ghosh, P. K. and Pawar, H. D. 1998. Avian predation of gram pod borer, *Helicoverpa armigera* Hubner in Orissa. J. Advanced Zool., 9: 148.

Godhani, P. H. 2006. Impact of intercropping on the insect pests suppression in hybrid Cotton-10. Ph. D thesis, Anand Agric. Univ., Anand, Gujarat, pp. 118.

Javier, T. A. and Altieri, M. A. 1990. A comparison of aphidophagous arthropods on maize polyculture and monoculture in Central Mexico. Agric. Ecosystem and Environ., 31: 337-339.

Kavitha, G., Ram, P. and Saini, R. K. 2003. Arthropod predatory fauna and its population dynamics in cotton in Haryana. Cotton Res. Dev., 17(2): 167-171.

Natarajan, K. 1990. Natural enemies of *Bemesia tabaci* Gennadius and effect of insecticides on their activity. J. Biol. Control, 4 (2): 86-88.

Panchbhai, P. R., Sharnagat, B. K., Nemade, P. W. Bagade, I. B. and Dangore, S. T. 2005. Combined and independent performance of *Trichogramma chilonis* and *Chrysoperla carnea* against spotted bollworm on cotton. Pestology, 29(1): 24-27.

Prasad, M. T. 2005. Pest complex in transgenic *Bt* cotton and their integrated management. M. Sc. (Agri.) thesis, Mahatma Phule Krishi Vidyapeeth, Rahuri, pp. 71.

Saminathan, V. R., Mahadevan, N. R. and Muthukrishnan, N. 2003. Population ecology of *Chrysoperla carnea*, the green lace wing predator in southern districts of Tamil Nadu. Indian J. Ent., 65(2): 167-169.

Sundaramurthy, V. and Chitra, 1992. Integrated pest management in cotton. Indian J. PI. Prot., 20(1): 117.

Wu, G. Z., Chen, M. Ji, Dong, S., Li, H., An, J. and Shi, J. 1991. Influence of intercropping of corn in cotton field on natural enemies population and its effects on pest control in Southern Shanxi. Chinese J. Biol. Control, 7(3): 101-104.

Xiao, M. M., Xiao, X. L., Zhang, Q. W., Zhao, J. Z., Quing, N. C., Yong, A. M. and Dong, M. C. 2006. Assessment of cotton aphids (*Aphis gossypii*) and their natural enemies on aphid resistant and susceptible wheat varieties in a wheat-cotton relay intercropping system. Entomologica Experimentaiset Applicata, 121: 235-241.

J. Agric. Res. Technol., 37 (2) : 258-263 (2012)

Association Between Self-Esteem of Late Childhood Children : Their Personal and Family Variables

Sonali Yerule[1] and Vishala Patnam[2]
Deptt. of Human Development and Family Studies, Marathwada Krishi Vidyapeeth, Parbhini - 431 402
(Received : 08-07-2011)

Abstract

Majority of the slum and rural late childhood children were found to have middle level self-esteem irrespective of their gender. These children's sell-esteem was not influenced by their gender type and size of family, ordinal position and number of siblings while their area of residence and family's social status found to have significant influence on it.

Key words : Self-esteem, late childhood children.

High self esteem is the key to the success of any individuals in ife. Self-esteem reflects how one feels about oneself. Self-esteem is not bragging about how great one is but she/he knows about one's worthiness of being loved dnd accepted. Self-concept can be viewed as an umbrella which encompasses three components- the self-image, self-ideal and self-esteem of an individual. Self-concept is the sum of the person's desired mental and physical characteristics as well as the person's perceived worthiness from this summation, (Lawrence, 1996). High self-esteem is a child's armor against the challenges he/she encounters in the world. Children who feel good about themselves seem to have an easier time handling conflicts and resisting negative pressures. They tend to smile more readily and enjoy their life. These children are generally realistic and optimistic. In contrast children with low self-esteem can find challenges to be sources of major anxiety and frustration. Those who think poorly of themselves have a hard time finding solutions to problems. By the age of 7 to 8 yrs children form at least three types of separate self-esteem, academic, physical and social which becomes more refined with their increasing age for e.g. academic self worth divides into performance in different school subjects. Social self worth devotes into peer and parenta relationships. Furthermore school age children combine their separate self-evaluation into a general appraisal of themselves on overall sense of self worth (Harter, 1990). Dalgas Relish (2006) reported that student's self-esteem tends to decrease during the transition from elementary school to middle school and therefore, found that it is very important to provide preventive self esteem interventions at school age.

1. P.G. student and 2. Professor and Head.

Materials and Methods

A sample of 200 late childhood children, their parents and teachers were included in the study. One hundred each of them belonged to slum and rural areas of Parbhani taluka and district, Marathwada regiorn of Maharashtra state. Their age group was 9-12 yrs and were from std. III to VI. The data pertaining to the study was collected by administering self-esteem Inventory and revised socio-economic status scale in addition to personally interviewing tne sample children and their parents and teachers.

All the sample children were from low socio-economic status. The collected information of the sample children was pooled and statistically analyzed.

Results and Discussion

Table 1 indicated that with respect to slum children, 60 per cent of them belonged to nuclear families followed by joint families (36%) and extended families (4%).The corresponding percentages of rural children were 36, 60 and 4. With respect to sizes of family of sample children, 82 per cent slum children hailed from middle size families followed by small families (12%) and large families (6%). The corresponding percentages of rural children were 91, 5 and 4. Thirty four to thirty nine per cent both rural and slum children were either middle or last born and the remaining (26-28%) of them were first born. Above 65 to 77 per cent slum and rural children reported to have 1-3 siblings while the remaining (23-35%) found to have 4-7 siblings. All the slum and rural sample children belonged to low SES. Overall there were no significant differences in the personal background of the sample children expect about the type of family they belonged to.

Table 1. Background information of the sample children.

Background variables of children	Area of residence and percentages of the children (200)		
	Slum (100)	Rural (100)	Z values
Types of family :			
Nuclear	60.00 (60)	36.00 (36)	3.49**
Joint	36.00 (36)	60.00 (60)	3.49**
Extended	4.00 (4)	4.00 (4)	-
Sizes of family :			
Small (1-4)	12.00 (12)	5.00 (5)	1.78NS
Middle (4-8)	82.00 (82)	91.00 (91)	1.87NS
Large (>8)	6.00 (6)	4.00 (4)	-
Ordinal position :			
First born	26.00 (26)	28.00 (28)	0.31NS
Middle born	39.00 (39)	34.00 (34)	0.73 NS
Last born	35.00 (35)	38.00 (38)	0.44 N5
Number of siblings :			
1-3	77.00 (77)	65.00 (65)	1.88 NS
4-7	23.0 0(23)	35.00 (35)	1.88 NS
SES of family :			
Low SES	100.00 (100)	100.00 (100)	

Figures in parentheses indicate number of children,
NS - Non-significant, **- Significant at 1% level

Fig. 1 indicated that seventy five per cent of the children assessed to have middle level self-esteem followed by low level self-esteem (19%) and high level self-esteem (6.50%). Sixty nine per cent slum children found to have middle level self-esteem followed by low self-esteem (27%) and high self-esteem (4%).The corresponding percentages of rural children were 80,11 and 9.Significantly a higher percentage of the slum children found to have low level self-esteem as compared to their rural counterparts. However, such significant differences were not recorded in them with regard to high and middle self-esteem

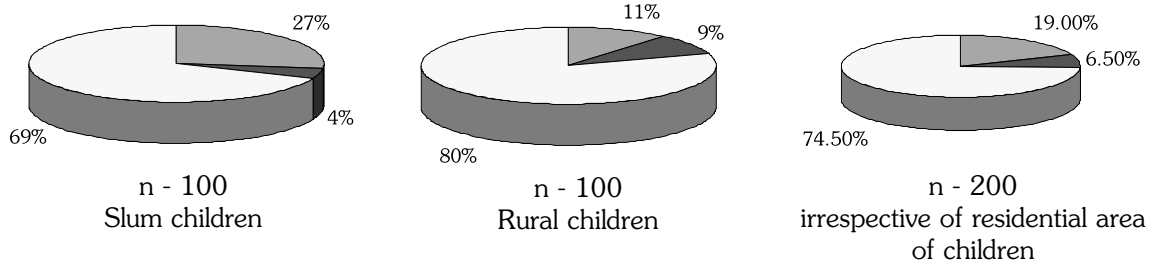

Fig. 1. Self esteem levels of the sample children with respect to their residential area and irrespective of it.

categories. Chi-square values indicated that there was significant association between self-esteem of children and their area of residence. It can be inferred from the results that relatively higher percentage of rural children found to have higher levels of self esteem as compared to their slum counterparts. These results are in line with the findings quoted by Sethi and Calhoun (1986) and Shinde and Patnam (2007).

Table 2 indicated that sixty six per cent of the slum girls found to have middle level self-esteem followed by low level self-esteem (30%) and high self-esteem (4%). The corresponding percentages of slum boys were 72, 24 and 4. The results indicated that only 4 per cent each slum girls and boys assessed to have high self-esteem. The Z values indicated that there is no significant difference in the self esteem levels of slum girls and boys. On the other hand 78 per cent rural girls were rated to have middle level self-esteem followed by high (12%) and low (10%) levels of self-esteem.The corresponding percentages of rural boys were 82, 12 and 6. No significant differences were noted in the self esteem levels of rural girls and boys. The Chi-square values also indicate)that there was no significant association between the self-esteem of sample children and their gender in slum as well as in rural areas which is a positive and appreciable trend with respect to child upbringing and development. However, it is also a matter of great concern that only 4 per cent slum girls and boys and 6-12 per cent rural girls and boys were rated to have high self-esteem. These results are not in agreement with the findings quoted by Vinita, *et al.* (1989) and Richardson and Arther (1987). The results also reflect that there is need to educate slum and rural parents on proper upbringing of late childhood children.

Table 3 indicated that fifty per cent each high self- esteem slum children belonged to nuclear and joint families while only 33 per cent and 67 perr cent rural high self-esteem children belonged to nuclear and joint families respectively. Sixty one per cent of the middle self-esteem slum children belonged to nuclear families followed by joint (35%) and extended families (4%). The corresponding percentages of middle self esteem rural children were 38, 59 and 4. About 59 percent low self-esteem slum girls belonged to nuclear type families followed by joint (37%) and extended (4%) families. The corresponding percentages of low self-esteem rural children were 27, 64 and 9. Significantly a higher percentage of the middle self-esteem slum children belonged to nuclear families as compared to their rural counterparts and it was vice versa with respect to joint type families. Such significant differences were not recorded in high and low self-esteem slum and rural children with respect to type of family. Chi-square values also indicate that there was no

Table 2. Association between children's self-esteem and their gender within groups slum and rural groups.

Classification of self-esteem of children	Secured scores of children on SE scale	Area, gender and percentage of children (200)					
		Slum (100)			Rural (100)		
		Girls (50) (a)	Boys (50) (b)	Z values a vs b	Girls (50) (c)	Boys (50) (d)	Z values c vs d
High	40 - 45	4.00 (2)	4.00 (2)	-	12.00 (6)	6.00 (3)	-
Middle	24 - 39	66.00 (33)	72.0 (36)	65NS	78.00 (39)	82.00 (41)	50NS
Low	13 - 23	30.00 (15)	24.00 (12)	0.67NS	10.00 (5)	12.00 (6)	0.31NS

Figures in parentheses indicate number of children, NS-Non-significant, Chi square value = Slum - 0.46^{NS}, Rural - 1.14^{NS}

significant association between self-esteem levels of slum and rural children and type of family. All (100%) high self-esteem slum children and 89 per cent rural high self-esteem children belonged to middle size of families, while 84-93 per cent slum and rural middle self-esteem children belonged to middle size families, while it was 74-82 per cent for low self-esteem slum and rural children. No significant differences and no significant association was found in different levels of self-esteem of slum and rural children and their size of families. Fifty, 38 and 41 per cent high, middle and low self-esteem slum children were found to be middle born followed by last born (25, 39 and 26%) and first born (25, 23 and 33%) respectively. Forty four, 32 and 36 per cent high, middle and low self-esteem rural children were middle born followed by last born (22, 40 and 36%) and first born (33, 27 and 27%) respectively. No significant differences in their percentages and no significant association were computed between different levels of self-esteem of slum and rural children and their ordinal position. All (100%) high self-esteem slum children and sixty seven per cent high self-

Table 3. Comparison of self-esteem of the children with their background variables.

Background variable	Area, self esteem levels and percentages of the children (200)								
	Slum (100)			Rural (100)			Z values		
	High self esteem (4) a	Middle self esteem (69) b	Low self esteem (27) c	High self esteem (9) d	Middle self esteem (80) e	Low self esteem (11) f	a vs d	b vs e	c vs f
Types of family :									
Nuclear	50.00 (2)	60.86 (42)	59.25 (16)	33.33 (3)	37.50 (30)	27.27 (3)	-	2.87**	-
Joint	50.00 (2)	34.78 (24)	37.03 (10)	66.66 (6)	58.75 (47)	63.63 (7)	-	3.02**	1.50NS
Extended	-	4.34 (3)	3.70 (1)	-	3.75 (3)	9.09 (1)	-	-	-
Sizes of family :									
Small (1-4)	-	11.59 (8)	14.81 (4)	11.11 (1)	3.75 (3)	9.09 (1)	-	-	-
Middle (4-8)	100.00 (4)	84.05 (58)	74.07 (20)	88.88 (8)	92.50 (74)	81.81 (9)	-	1.49NS	0.48NS
Large (>8)	-	4.34 (3)	3.70 (3)	_	3.75 (3)	9.09 (1)	-	-	-
Ordinal position :									
First born	25.00 (1)	23.18 (16)	33.33 (9)	33.33 (3)	27.5 (22)	27.27 (3)	-	0.56NS	-
Middle born	50.00 (2)	37.68 (26)	40.74 (11)	44.44 (4)	32.59 (26)	36.36 (4)	-	0.64NS	-
Last born	25.00 (1)	39.13 (27)	25.92 (7)	22.22 (2)	40.00 (32)	36.36 (4)	-	0.12NS	-
Number of siblings :									
1-3	100.00 (4)	71.01 (49)	88.88 (24)	66.66 (6)	68.75 (55)	36.36 (4)	-	0.39NS	-
4-7	-	28.98 (20)	11.11 (3)	33.33 (3)	31.25 (25)	63.63 (7)	-	0.40NS	-

Figures in parentheses indicate number of children, NS - Non-significant, **- Significant at 1% level

Chi square values

SE of slum children :	X^2 values	SE of slum children :	X^2 values
Types of family	0.51NS	Types of family	1.49NS
Sizes of family	2.79NS	Sizes of family	2.50NS
Ordinal position	2.03NS	Ordinal position	1.14NS
Number of siblings	4.74NS	Number of siblings	4.47NS

SE-Self-esteem, NS-Non-significant

esteem slum and rural children found to have 1 to 3 siblings, while 68-71 per cent middle self-esteem slum and rural children reported to have 1-3 siblings and it was 36-88 per cent for low self-esteem slum and rural children. None of the high self-esteem slum children and thirty, three per cent high self-esteem rural children found to have 4-7 siblings while they were 28-31 per cent for middle self-esteem slum and rural children and 33-63 per cent for low self-esteem slum and rural children. No significant differences in their percentages and no significant association were recorded between slum and rural children's self-esteem and the number of siblings they had. These findings are in line with the finding quoted by Shinde and Patnam (2007).

Table 4 indicated that irrespective of gender of the sample children, 75 and 25 per cent high self-esteem slum children reported to have families having good and fair social status while 14, 59 and 26 per cent middle self-esteem slum children respectively found to have good, fair and poor social status families. The corresponding percentages of low self-esteem slum children were 15, 26 and 59. There were few significant differences in the percentages of children having same magnitude of self-esteem and having different social status families. Similarly 89 and 11 per cent high self-esteem rural children reported to have good and fair social status families, while 24, 64 and 12 per cent middle self-esteem rural children found to have respectively good, fair and poor social status families.

The corresponding percentages of low self-esteem rural children were 27, 18 and 54. Z values indicate that they have few significant differences in the percentages of same level self-esteem rural children having different degrees of social status families. The chi square value indicated that slum and rurnl children's self-esteem was strongly influenced by social status of their families irrespective of their gender and with respect to it. These findings are in the line with the findings quoted by Shinde and Patnam (2007).

It can be concluded from the above results

Table 4. Comparison between children's self-esteem and their families' social status.

Self esteem levels of the children	Gender, area, social status of the families and percentages of children (200)					
	Irrespective of gender (100=100)					
	Slum			Rural		
	Good	Fair	Poor	Good	Fair	Poor
High	75.00 (3)	25.00 (1)	-	88.88 (8)	11.11 (1)	-
Medium	14.49 (10)	59.42 (41)	26.08 (18)	23.75 (19)	63.75 (51)	12.50 (10)
Low	14.81 (4)	25.92 (7)	59.25 (16)	27.27 (3)	18.18 (2)	54.54 (6)
	Girls (50=50)					
High	50.00 (1)	50.00 (1)	-	83.33 (5)	16.66 (1)	-
Medium	15.15 (5)	45.45 (15)	39.39 (13)	30.76 (12)	56.41 (22)	12.82 (5)
Low	6.66 (1)	20.22 (3)	73.33 (11)	40.00 (2)	-	60.00 (3)
	Boys (50=50)					
High	100.0 (2)	-	-	100.0 (3)	-	-
Medium	13.88 (5)	72.22 (26)	13.88 (5)	17.07 (7)	40.73 (29)	12.19 (5)
Low	25.00 (3)	33.33 (4)	41.66 (5)	16.66 (1)	33.33 (2)	50.00 (3)

Figures in parentheses indicate number of children

Chi square values

SE of slum children : Social status of families	25.48**
SE ofrural children : Social status of families	24.67**
SE of children irrespective of : gender and area	53.09**
SE of slum girls families : Social status of families	12.58**
SE of rural girls families : Social status of families	13.06**
SE of slum boys : Social status of families	16.40**
SE of rural boys : Social status of families	12.20**

SE - self-esteem, ** - Significant at 1% level

that, majority of the slum and rural late childhood children were found to have middle level self-esteem irrespective of their gender. These childrens' self-esteem was not influenced by their gender type and size of family, ordinal position and numbers of siblings while their area of residence found to have significant influence on it. Similarly childrens' self-esteem was strongly influenced by social status of their families irrespective of their gender and with respect to it.

References

Anand Kumar. 2009. Battle's Self Esteem Inventory for Children, Publ. by Prasad Psychological Corp. Varanasi.

Dalgas Relish. 2006. Effects of a self esteem intervention programme on school age children. Pediatric Nursing. 32(4), 341-347.

Harter. 1990. Self and Identity Development. In Feldman, S. S. and Elliott, F. R. (Eds) At the Threshold: Adolescent Cambridge, MA: Harvard Univ. Press, 150-180.

Lawrence, D. J. 1996. Enhancing self-esteem in the classroom,(2nd ed), London : PCP Ltd., 110-125.

Patnam, V. N. 2008. Revised Socio-economic status scale of Kuppuswamy, 2-8.

Richardson, K. and Arther, S. 1987. Differences in adolescents' self-esteem across cultures. Psychological Rep., 61(1), 19-22.

Sethi, K. and Calhoun, S. 1986. Comparison of total self esteem scores on Copersmith's Inventory for pupils from India and United States, Psychological Rep., 59(2 P11), 523-526.

Shinde, V. D and Patnam, V. N. 2007. Influence of parenting practices and prenatal history on self-esteem on rural girls. Asian J. of Psychology and Edn. 42,(5-6), 6-10.

Vinita, Ranjini and Nagalakshi. 1989J. Self-esteem in children. J. of NIMHANS 7(1), 33-36.

J. Agric. Res. Technol., 37 (2) : 264-270 (2012)

Instability in Export of Basmati Rice

S. S. Wadkar[1], P. Sangeeta Francis[2] and S. R. Bagade[3]
Dept. of Agricultural Economics, College of Agriculture, Dapoli - 415 712 (India)
(Received : 07-08-2011)

Abstract

Quantity-wise and percentage-wise basmati export showed upward trends during 1987-88 to 1994-95 (I) (0.06 thousand tonnes, 5.22%), 1995-96 to 2006-07 (II) (0.17 thousand tonnes, 8.99%) and at overall level (0.13 thousand tonnes, 8.35%). The export value realized (constant prices) increased significantly in period I (0.12 Rs. million, 9.9%), period II (0.064 Rs. million, 4.17%) and at overall level (0.1 1 Rs. million, 6.82%). The rate of growth was higher during pre-WTO period (1987-88 to 1994-95) at both current and constant prices. The variability in the quantity of basmati rice exported was slightly greater in period II (33.35%), as compared to period I (31.24%) and moderately high at overall level (50.04%). The variability in export value received at current prices was higher in period I (56.05%), as compared to period II (31.76%) and was also high at overall level (63.72%). The variability in quantity of non-basmati rice exported was greater in period I (71.18%), as compared to period II (47.91%) and was also high at overall level (92.23%). The variability in export value received at current prices was higher in period I (71.27%), as compared to period II (48.09%) and was also very high at overall level (95.4%). At both current and constant prices, the exports of non-basmati rice were somewhat competitive during pre-WTO period, but became non-competitive during post-WTO period. It was non-competitive, also, at overall level. This shows that, the price received in domestic markets, for both basmati and non-basmati rice was greater than that in the international markets.

Key words : Instability, variability, post-WTO, pre-WTO, domestic market.

Rice (*Oryza sativa* L.), forms the staple diet of nearly half of the world population. In addition, the cultivation of rice is the principal activity and source of income for millions of households. Two broad classifications of rice recognized all over are basmati and non-basmati rice. Saudi Arabia, UAE, Iran, Kuwait, Bahrain, Oman, Qatar, UK, USA, etc. are the major importers of Indian basmati and non-basmati rice. India's share in the world rice trade in 2006-07 was 13.5 per cent. In the same year, India exported 1.05 million tonnes of basmati rice and 3.70 million tonnes of non-basmati rice earning a foreign exchange of Rs. 2,792 and 4,243 crores, respectively (Autkar *et al*. 1998, Money 2004, Sananse, 2004). World trade in rice is less than 7 per cent of total production. Thailand, Vietnam, India, USA and Pakistan dominate the world rice trade, which consists predominantly of long grain varieties. It is observed that only a miniscule quantity of the global rice production is traded internationally. This situation is poised to change in the near future with rice imports growing at 3.8 per cent vis-a-vis 2.4 per cent annual growth in production. Rice is, thus, a major thrust area for export enjoying high comparative advantage over other cereals. The present study has been conducted to estimate the growth rate and trends in export of Indian basmati rice.

Materials and Methods

Country wise time-series secondary data on rice exports from India to five major zones *viz*. Asian, European, American, Australian and

1. Asso. Professor, 2. M.Sc. (Agri.) student and 3. Jr. Res. Asstt.

Table 1. Statistical parameters, growth rates and instability indices for export of basmati rice (Quantity in '000' tonnes).

Zone	Period	Mean	SD	CV (%)	Instability indices (%)	Regression coefficient	SE (b)	SGR	GM	CGR
Asian	I	285.52	89.28	31.27	-	14.94NS	13.57	0.05NS	273.88	4.51NS
	II	603.98	191.16	31.65	14.98	46.70*	7.94	0.17*	574.72	8.66*
	Overall	476.60	222.97	46.78	20.25	33.97*	3.85	0.11*	427.27	7.70*
European	I	32.38	15.54	48.01	-	4.32 NS	1.90	0.19NS	29.40	12.87NS
	II	95.91	57.27	59.71	27.49	14.10*	2.31	0.30*	82.10	15.67*
	Overall	70.50	54.84	77.80	40.83	7.89*	1.15	0.34*	54.44	11.97*
American	I	12.36	5.79	46.86	-	0.58NS	0.94	0.038NS	10.92	2.06NS
	II	40.76	21.10	51.75	-	-0.3 1NS	1.85	-0.009NS	35.65	2.36NS
	Overall	29.40	21.77	74.03	61.88	2.02*	0.72	0.13*	22.21	9.61*
African	I	1.08	1.70	157.09	-	0.36NS	0.24	1.60NS	0.09	-10.99NS
	II	14.72	9.26	62.88	36.27	2.10*	0.47	0.30*	12.25	16.62*
	Overall	9.27	9.88	106.66	52.04	1.46*	0.19	6.48*	1.70	46.57*
Australia and Oceanic	I	0.48	0.31	66.04	-	-0.01NS	0.05	-0.01NS	0.07	-31.02NS
	II	2.86	2.49	87.12	49.92	0.57*	0.13	0.53*	2.14	20.40*
	Overall	1.91	2.25	118.11	75.12	0.29*	0.06	0.69*	0.55	30.14*
Total basmati	I	333.27	104.11	31.24	-	20.43NS	15.22	0.06NS	320.52	5.22NS
	II	758.38	252.94	33.35	14.47	63.21*	9.62	0.17*	720.27	8.99*
	Overall	588.34	294.43	50.04	20.12	45.57*	4.72	0.13*	521.00	8.35*

* Significant at 5 % level, NS - Non-significant, GM- Geometric Mean

Table 2. Statistical parameters, growth rates and instability indices for export of basmati rice (Current prices in Rs. million).

Zone	Period	Mean	SD	CV (%)	Instability indices (%)	Regression coefficient	SE (b)	SGR	GM	CGR
Asian	I	4436.34	2451.51	55.26	29.18	849.91*	215.76	0.31*	3903.40	20.43*
	II	15694.54	4831.04	30.78	15.34	1161.76*	211.09	0.19*	14858.05	8.94*
	Overall	11191.26	6909.88	61.74	18.19	1116.12*	81.12	0.41*	8704.71	13.50*
European	I	627.09	416.65	66.44	28.83	153.24*	30.14	0.59*	521.90	28.27*
	II	2612.07	1453.80	55.66	24.88	360.70*	56.99	0.31*	2277.82	14.93*
	Overall	1818.08	1510.95	83.11	35.78	230.52*	25.92	0.89*	1263.42	16.14*
American	I	63.68	46.65	73.26	49.92	13.94*	5.30	0.38*	52.24	19.88NS
	II	368.38	322.80	87.62	66.52	58.27*	21.49	0.44*	280.42	17.35*
	Overall	246.50	290.83	117.98	81.85	35.40*	8.04	0.97*	143.17	18.19*
African	I	18.17	28.70	157.97	-	7.55NS	3.66	3.96NS	0.61	-10.61NS
	II	410.01	286.46	69.87	45.57	60.22*	16.39	0.39*	329.26	18.21*
	Overall	253.27	294.28	116.19	63.31	41.71*	6.39	21.89*	26.60	62.07*
Australia and Oceanic	I	9.02	7.24	80.33	-	1.18NS	1.11	0.22NS	0.60	-32.91NS
	II	95.32	84.18	88.31	48.26	19.55*	4.03	0.67*	70.41	22.04*
	Overall	60.80	77.48	127.44	76.06	10.51*	1.84	2.00*	10.48	43.53*
Basmati total	I	5360.73	3004.66	56.05	28.11	1061.23*	251.15	0.33*	4722.06	21.05*
	II	20136.08	6395.52	31.76	12.56	1629.26*	221.78	0.19*	19096.07	9.25*
	Overall	14225.94	9064.15	63.72	15.86	1483.87*	89.92	0.47*	10919.90	14.10*

* Significant at 5 % level, NS - Non-significant, GM- Geometric Mean

African was compiled for value and volume (quantity) for basmati rice from www.apeda.com. the official website of the Agricultural and Processed Foods Export Development Authority, India (APEDA) and various other publications. The data were processed using statistical and analytical tools for arriving at desired conclusions. Further, in order to ascertain the impact of the WTO on the export of rice, the time series data were analyzed for two different periods of pre-WTO (1987-88 to 1994-95) Period I and post-WTO (1995-96 to 2006-07) Period II.

External or international value of Indian rupee is fluctuating. Therefore, considering the year 1993-94 as base year, growth rate at constant price was worked out to give the real picture of export earnings. For converting values of current prices into those at constant prices, suitable indices of export unit values were constructed. The wholesale price index numbers for all commodities were drawn from various Reserve Bank of India (RBI) bulletins and adjusted by the exchange rates of the current year and the base year to derive the unit values indices (Talathi and Thakare, 1995). The formula used for converting the values of current prices received into constant prices is as follows : Deflation factor = Wholesale price indices of the base year / Wholesale price indices of the current year and Year value at constant price = Deflation factor x Actual price in the year.

The trend coefficient was tested for its significance. Whenever, the trend coefficient was found to be significant, the variation around the trend rather than variation around mean was used as an index of instability. The formula suggested by Cuddy and Delia (1978) was used to compute the degree of variation around the trend.

Results and Discussion

Basmati rice : The quantity of basmati rice

Table 3. Statistical parameters, growth rates and instability indices for export of basmati rice (Constant prices in Rs. million).

Zone	Period	Mean	SD	CV (%)	Instability indices (%)	Regression coefficient	SE (b)	SGR	GM	CGR
Asian	I	5197.13	1846.98	35.54	-	499.17NS	230.72	0.1 1NS	4929.03	9.34NS
	II	9669.05	2019.90	20.89	-	297.85NS	150.04	0.06NS	9433.84	3.88NS
	Overall	7880.28	2944.66	37.37	20.24	418.36*	63.56	0.09*	7276.42	6.26*
European	I	715.41	322.52	45.08	23.94	111.57*	28.55	0.25*	659.03	16.46*
	II	1551.75	617.84	39.82	21.40	144.50*	29.13	0.15*	1446.26	9.59*
	Overall	1217.21	660.33	54.25	25.53	98.49*	12.38	0.22*	1056.11	8.99*
American	I	73.92	38.53	52.13	-	8.5 1NS	5.40	0.13NS	65.96	8.84NS
	II	215.97	161.56	74.81	-	25.18NS	11.72	0.23NS	178.04	11.89*
	Overall	159.15	144.07	90.53	67.58	16.20*	4.28	0.26*	119.68	10.65*
African	I	18.93	27.54	145.50	-	6.68NS	3.69	2.03NS	0.75	-19.24NS
	II	242.37	148.39	61.23	46.73	26.60*	9.93	0.21*	209.06	12.72*
	Overall	152.99	160.13	104.67	59.49	22.27*	3.63	6.77*	21.96	52.03*
Australia and Oceanic	I	11.03	7.43	67.41	-	0.18NS	1.24	0.02NS	0.74	-39.39NS
	II	54.43	38.57	70.86	40.09	8.82*	1.91	0.37*	44.70	16.37*
	Overall	37.07	36.85	99.40	58.37	5.04*	0.86	0.56*	8.65	34.64*
Basmati total	I	6262.19	2209.27	35.28	24.82	640.96*	259.05	0.12*	5962.79	9.90*
	II	12361.08	2332.36	18.87	13.55	450.33*	146.85	0.064*	12124.68	4.17*
	Overall	9921.52	3787.44	38.17	16.47	577.54*	65.10	0.11*	9128.13	6.82*

* Significant at 5 % level, NS - Non-significant, GM- Geometric Mean

Table 4. Statistical parameters, growth rates and instability indices for export of non-basmati rice (Quantity in '000' tonnes).

Zone	Period	Mean	SD	CV (%)	Instability indices (%)	Regression coefficient	SE (b)	SGR	GM	CGR
Asian	I	134.59	131.10	97.41	57.41	43.24*	12.88	1.32*	73.47	53.21*
	II	1596.21	865.52	54.22	-	-51.15NS	74.17	-0.0171NS	1393.77	-1.81NS
	Overall	1011.56	989.82	97.85	79.63	97.23*	32.09	2.96*	429.49	26.55*
European	I	30.51	44.37	145.42	-	11.56NS	5.69	288.93NS	5.17	86.98NS
	II	1073.98	662 .41	61.68	-	99.19NS	48.90	0.07NS	811.67	9.44NS
	Overall	656.59	727.89	110.86	67.76	97.38*	17.732	434.41*	107.39	52.79*
American	I	52.32	91.00	173.94	-	-6.42NS	14.94	-11.11NS	8.33	12.77NS
	II	55.68	38.01	68.26	-	-0.70NS	3.33	-0.008NS	40.14	-1.23NS
	Overall	54.34	62.37	114.79	-	-0.3 1NS	2.48	-0.54NS	21.40	12.57NS
African	I	10.14	25.45	251.03	-	1.42NS	4.20	18.95NS	0.25	25.37NS
	II	43.03	35.80	83.20	-	-4.84NS	2.74	-0.06NS	31.14	-9.77NS
	Overall	29.87	35.41	118.54	-	1.42NS	1.37	18.97NS	4.50	40.68*
Australia and Oceanic	I	0.01	0.03	190.82	134.81	0.01*	0.003	7.46*	0.002	45.06NS
	II	4.91	8.42	171.56	131.73	1.50*	0.57	9.07*	1.51	46.83*
	Overall	2.95	6.86	232.63	189.12	0.68*	0.22	675.41*	0.10	80.10*
Non-Basmati total	I	248.40	176.81	71.18	47.04	54.17*	19.47	1.62*	172.50	43.16*
	II	2776.43	1330.32	47.91	-	44.84NS	115.81	0.0 1NS	2422.74	2.81NS
	Overall	1765.22	1628.08	92.23	64.90	195.54*	45.64	5.83*	841.97	24.53*

* Significant at 5 % level, NS - Non-significant, GM- Geometric Mean

Table 5. Statistical parameters, growth rates and for instability Indices for export of non-basmati rice (Current prices in Rs. million).

Zone	Period	Mean	SD	CV (%)	Instability indices (%)	Regression coefficient	SE (b)	SGR	GM	CGR
Asian	I	1035.36	1032.57	99.73	49.10	366.92*	84.73	1.77*	521.36	61.77*
	II	15366.17	7322.61	47.65	-	-275.79NS	636.29	-0.01lNS	13816.36	-0.65NS
	Overall	9633.84	9127.97	94.75	72.24	998.27*	277.29	4.81*	3724.69	30.41*
European	I	197.08	295.40	149.89	-	78.56NS	37.35	372.77NS	32.31	100.35NS
	II	10713.88	7570.14	70.66	55.35	1305.19*	520.07	0.12*	7845.77	11.71NS
	Overall	6507.16	7819.96	120.17	73.62	1044.73*	190.864	957.13*	872.01	59.07*
American	I	316.71	536.70	169.46	-	-35.88NS	88.24	-6.19NS	61.51	19.72NS
	II	535.05	362.35	67.72	-	-4.40NS	31.75	-0.005NS	402.84	-1.10NS
	Overall	447.72	440.66	98.42	-	12.55NS	17.31	2.16NS	189.96	15.56*
African	I	62.99	154.00	244.49	-	8.64NS	25.42	15.69NS	1.55	13.66NS
	II	365.43	330.62	90.47	-	-34.00NS	26.93	-0.05NS	231.90	-2.51NS
	Overall	244.45	308.43	126.17	-	15.06NS	11.76	27.36NS	31.25	43.95*
Australia and Oceanic	I	0.19	0.40	206.03	-	0.11NS	0.05	32.68NS	0.010	51.26NS
	II	92.23	176.27	191.11	145.54	31.69*	11.77	13.15*	24.47	49.45*
	Overall	55.42	141.88	256.01	211.85	13.46*	4.68	3846.95*	1.06	97.17*
Non-Basmati total	I	1727.82	1231.46	71.27	33.25	444.68*	95.75	2.08*	1151.68	50.89*
	II	27099.31	13031.70	48.09	-	1031.30NS	1095.44	0.03NS	23756.16	4.28NS
	Overall	16950.71	16170.98	95.40	61.85	2081.18*	417.67	9.73*	7079.43	28.85*

* Significant at 5 % level, NS - Non-significant, GM- Geometric Mean

exported (Table 1) to the Asian zone was more stable in period II (14.98%) as compared to overall level (20.25%). The export value (Table 2) realized (current prices) was relatively stable (Table 3) during period I (29.18%), and stable in period II (15.34%) and at overall level (18.19%). The export value received was more stable post-WTO. The export value realized (constant prices) was stable at overall level (20.24%).

The quantity of rice exported to European zone was stable during period II (27.49%), but unstable at overall level (40.83%). The export value realized (current prices) was fairly unstable during period I (28.83%), nearly stable for period II (24.88%) and unstable at overall level (35.78%). The export value realized (constant prices) was fairly stable during period I (23.94%), period II (21.4%) and at overall level (25.53%). Instability decreased marginally post-WTO, at current and constant prices.

The quantity of rice exported to American zone was highly unstable at overall level (61.88%). The export value realized (current prices) was unstable during period I (49.92%). The instability was higher during period II (66.52%) and at overall level (81.85%). The export value realized (constant prices) was highly unstable at overall level (67.58%).

The quantity of rice exported to Australia and Oceanic zone was unstable during period II (49.92%) and very unstable at overall level (75.12%). The export value realized (current prices) was unstable during period II (48.26%) and highly unstable at overall level (76.06%). The export value realized (constant prices) was unstable during period II (40.09%) and at overall level (58.37%).

The quantity of rice exported to African zone was nearly stable during period II (36.27%) and unstable at overall level (52.04%). The export value realized (current

Table 6. Statistical parameters, growth rates and instability indices for export of non-basmati rice (Constant prices in Rs. million).

Zone	Period	Mean	SD	CV (%)	Instability indices (%)	Regression coefficient	SE (b)	SGR	GM	CGR
Asian	I	1101.74	999.17	90.69	52.91	331.31*	97.15	0.92*	658.34	46.87*
	II	10001.55	5639.54	56.39	-	-692.38NS	443.52	-0.03NS	8772.43	-5.27NS
	Overall	6441.63	6228.24	96.69	84.36	514.43*	216.50	1.44*	3113.53	22.09*
European	I	204.42	272.04	133.08	-	69.28NS	35.44	190.36NS	40.80	81.90NS
	II	6445.93	3825.27	59.34	-	413.81NS	308.93	0.05NS	4981.53	6.52NS
	Overall	3949.33	4282.58	108.44	71.56	543.88*	112.601	494.43*	728.93	48.91*
American	I	433.98	745.17	171.71	-	-55.59NS	122.11	-5.55NS	77.68	8.70NS
	II	347.81	240.67	69.19	-	-25.81NS	19.47	-0.03NS	255.78	-5.70NS
	Overall	382.28	489.89	128.15	-	-15.28NS	19.18	-1.53NS	158.79	8.19NS
African	I	73.87	183.78	248.79	-	9.07NS	30.40	9.54NS	1.93	2.90NS
	II	249.10	263.98	105.97	-	-38.13NS	19.77	-0.07NS	147.24	-7.04NS
	Overall	179.01	246.06	137.46	-	5.02NS	9.73	5.28NS	26.01	34.84*
Australia and Oceanic	I	0.18	0.36	195.81	-	0.10NS	0.042	16.97NS	0.012	36.65NS
	II	48.23	87.29	180.97	137.35	15.76*	5.81	7.96*	15.54	42.50*
	Overall	29.01	70.67	243.58	199.35	6.86*	2.30	1135.73*	0.88	84.95*
Non-Basmati total	I	1943.13	1216.37	62.60	39.83	383.07*	129.01	1.04*	1454.29	36.99*
	II	17106.60	8417.36	49.21	-	-322.24NS	731.18	-0.01NS	15083.52	-0.57NS
	Overall	11041.21	9982.61	90.41	70.80	1049.41*	311.44	2.84*	5917.82	20.62*

* Significant at 5 % level, NS - Non-significant, GM- Geometric Mean

prices) was unstable during period II (45.57%) and highly unstable at overall level (63.31%). The export value realized (constant prices) was unstable during period II (46.73%) and at overall level (59.49%).

The quantity of total Basmati rice exported was stable during period II (14.47%) and quite stable at overall level (20.12%). The export value realized (current prices) was fairly stable during period I (28.11%) and decidedly stable during period II (12.56%) and at overall level (15.86%). The export value realized (constant prices) was fairly stable during period I (24.82%) and decidedly stable during period II (13.55%) and at overall level (16.47%). Export value received for basmati rice as a whole, at current and constant prices, stabilized post-WTO. Similar results were reported by Walkar (1984) in sorghum, Chand and Tiwari (1991) and Borate *et al.* (2003) in cut flowers.

Non-Basmati rice : The quantity of non-basmati rice exported (Table 4) was unstable during period I (57.41%) and highly unstable at overall level (79.63%). The export value (Table 5) received (current prices) was unstable during period 1 (49.1%) and highly unstable at overall level (72.24%). The export value (Table 6) received (constant prices) was unstable during period I (52.91%) and highly unstable at overall level (84.36%).

The quantity of rice exported was highly unstable for African zone at overall level (67.76%). The export value received (current prices) was unstable during period II (55.35%) and highly unstable at overall level (73.62%). The export value received (constant prices) was highly unstable at overall level (71.56%). As the regression coefficients for period I and period II were non-significant, the instability around the trend was not worked out.

As the regression coefficients for period I, period II and at overall level, for quantity of non-basmati rice exported to European zone, export value received (current prices) as well as export value received (constant prices) were non-significant, the instability around the trend was not estimated.

As the regression coefficients for period I, period II and at overall level, for quantity of non-basmati rice exported to American zone, export value received (current prices) as well as export value received (constant prices) were non-significant, the instability around the trend was not computed.

The quantity of rice exported to Austrlia and Oceanic zone was exceedingly unstable during period I (134.81%), period II (131.73%) that further increased at overall level (189.12%). Instability was marginally lower post-WTO. The export value received (current prices) was exceedingly unstable during period II (145.54%); which increased even more at overall level (211.85%). The export value received (constant prices) was exceedingly unstable during period II (137.35%); which further increased at overall level (199.35%).

The quantity of total non-basmati rice exported was unstable during period I (47.04 %) and highly unstable at overall level (64.9%).

The export value received (current prices) was moderately unstable during period I (33.25%) and highly unstable at overall level (61.85%). The export value received (constant prices) was moderately unstable during period I (39.83%) and highly unstable at overall level (70.8%). Thus, a fairly high degree of instability was observed in the quantity exported and value realized at both current and constant prices, in the year-to-year export of non-basmati rice.

It is concluded that subsantial degree of instability was observed in the quantity of basmati rice exported as well as the export value received at current and constant prices.

The non-basmati exports also exhibited a high degree of instability in the quantity exported and the value received at current and constant prices at an overall level. The instability decreased after the WTO in some cases, while it increased for others, for both basmati and non-basmati rice. This may be due to different policies adopted by different countries after signing the WTO. Our export policy needs to be more aggressive in order to thwart competition from countries like Pakistan, Thailand and Vietnam. We need to improve our image as a regular and efficient exporter, exporting high quality basmati and non-basmati rice. Government should regularly survey the rice growers, traders and exporters in order to take stock of the real situation on the domestic and export front and formulate policies accordingly. It should also keep track of the changes in the international rice market. Development of a dedicated Rice Export Board could be of immense utility for this purpose. Although India ranks high in total production, we are far behind in productivity. Countries such as Thailand and Vietnam are fast catching up on us with their uncompromising production strategies. We urgently need to increase our productivity to the level of China, Egypt and Australia, by developing more intensive and efficient technologies and high yielding rice varieties. This will also enable the farmers to reap higher output at lesser costs and inputs. Similar results were also reported by Pal (1992), Velavan (2002) and Rave Kumar (2004).

References

Autkar, V. N., Marwar, S. S., Joshi, C. K. and Dhope, A. M. 1998. Prospects of Agricultural Export. Indian J. of Agric. Marketing, Conference issue, 12(3): 55.

Borate, V. V., Wadkar, S. D., Mulik, S. M. and Thorat, K. S. 2003. Growth and Instability in Cut Flower Export from India, The Bihar J. of Agri. Marketing, 10(4): 381-389.

Chand, R. and Tiwari, S. O. 1991. Growth and Instability of Indian Exports and Imports of agricultural commodities. Indian J. of Agril. Econ. 46(2): 159-165.

Money, K. S. 2004. APEDA's Role in Augmenting Rice Exports. SAARC Rice Expo-2004, pp. 150-158.

Pal, S. 1992. Agricultural exports of India: Issues of growth and Instability. Indian J. Agril Econ. 47(2): 185-194.

Rave Kumar, K. N., Radical Rain and Rio, K. P. C. 2004. Export performance in the liberalization perspective, Agril. Exten. Rev., 16(5): 20-26.

Sananse, S. L., Jambhale, N. D., Ingale, B. V., Jadhav, S. N. and Patil, H. K. 2004. Export Scenario of Indian basmati rice in post-WTO era. Agril. Situation in India, July'04, pp. 195-199.

Velavan, C. 2002. Growth and direction of export of marine products. Bihar J. of Agri. Mktg., 10(2): 153-164.

Walker, T. S. 1984. HYVs and instability in sorghum and pearl Millet production in India. Econ. Programme Progress Rep. 63. ICRISAT.

J. Agric. Res. Technol., 37 (2) : 271-277 (2012)

Maketing of Paddy in Raigad District (M.S.)

S. S. Wadkar[1], S. P. Redekar[2] and S. R. Bagade[3]
Dr. Balasaheb Sawant Konkan Krishi Vidyapeeth, Dapoli - 415 712 (India)
(Received : 07-08-2011)

Abstract

At the overall level, per farm area was 1.245 ha with production of paddy 33.79 q and having productivity 27.14 q. The per farm disposal pattern revealed that, the majority of produce (59.51%) was marketable surplus and sold in the market. The total per quintal marketing expenses incurred by market functionaries was highest in channel IV (Rs.190.96) i.e., 18.54 per cent. The producer's share in consumer's rupee was highest 82.69 per cent (Rs.851.78) in channel IV. Further, it is revealed that, the involvement of large number of intermediaries particularly wholesaler, commission agent, processors have decreased the producers share in consumer's rupee to considerable extent. The paddy cultivators supported for improving the market efficiency as transportation cost should be low on the basis of weight (87.50%), condition of roads should be improved (66.25%), APMC should provide grading/storage facilities at minimum charges (66.25%), reasonable rice milling charges ensured at processor level (70.00 %), market yard at APMC strengthened with adequate infrastructure facilities (43.75%). However, the instability in monthly arrivals and prices were more or less stable in selected market.

Key words : Production, disposal, marketing channel, marketable surplus, marketing efficiency.

In Maharashtra the area under paddy is about 15.29 lakh ha. Production about 28.34 lakh tones and productivity is 1.85 tone ha^{-1}. The position of Maharashtra in rice production is comparatively poor. In the state, rice is grown in the districts with varying extent. The Konkan region occupies area about 4.32 lakh hectares under paddy with production of about 10,39 lakh tones with a productivity of around 2.40 tones ha^{-1}. The area under paddy in Raigad district is 1.30 lakh ha with a production of 2.72 lakh tones of paddy with productivity of 1.95 tones ha^{-1}, which is the highest in Konkan region (Anonymous 1985).

Materials and Methods

Raigad distict was selectsd purposively being highest area, production and productivity in paddy. Pen and Alibag Tahsils of Raigad district were selected for this study as maximum area under paddy is in these two tahsils. From each of the village, 10 paddy cultivators were selected randomly. Thus the final sample consisted of 80 cultivator from 8 villages selected randomly.

Pen and Alibag Agriculture Produce Market Sub Committee working in the study area were selected. From the register number of five commission agent operating in the Pen and Alibag APMC market were selected randomly and five each wholesaler, retailer and processor selected randomly from the study area. The data and information for the present study is pertained to the agriculture year 2008-09.

The information on arrivals and prices of paddy was obtained from APMC Pen and Alibag. The degree of instability in monthly

1. Associate Professor, 2. M.Sc. (Agri.) student and 3. Jr. Research Assistant.

arrivals and average monthly prices of selected paddy around their mean was studied using the coefficient of variation (c.v.), as measure of variability C.V. = $\sigma / \bar{x} \times 100$.

Where, σ - standard deviation of monthly series, $\bar{x}$ - Arithmetic mean of the series.

Producer share in consumer rupee (PSCR) is the percentage of the price received by the producer-seller (NPP) to the price paid by the consumer or selling price of retailer (SPR) PSCR = NPP/SPR x 100.

The index of Marketing Efficiency (ME) in each channel is measured by using modified Shepherd's formula (Shepherd's approach). Higher the ratio, higher the efficiency and vice-versa. Modified shepherd's formula MEI = (V/I - 1) x 100

Where, ME - Index of marketing efficiency. V - Value of the good sold/consumers price (Rs. q^{-1}), I - Total marketing cost (Rs. q^{-1}).

Results and Discussion

To have detail information about production and disposal of paddy by different categories, the sample cultivators were classified into three different categories with the help of statistical tools, mean and standard deviation.

The composition of cultivators (Table 1), indicated that, out of 80 paddy cultivators selected from Pen and Alibag tahsils of Raigad district, 14 (17.50%)belonged to small group, 48 (60.00%) to medium group and 18 (22.50%) belonged to large group on the basis of size of holding.

At the overall level (Table 2) the proportion of farmers growing Ratna variety was the highest (75.00%) followed by Jaya (62.50%), Suvarna (10.00%) and Karjat variety (8.75%) indicated the varietal preference at the farmers.

The levels of production and disposal pattern determine the marketing of paddy. To know the quantity of paddy production and part of that used to have consumption and other purpose, the groupwise production and disposal was studied and results are presented here under.

Production pattern : The major determinant of the producer's surplus is the production level. At the overall level (Table 3) productivity per hectare was found ranging from 30.08 q for Ratna variety to 19.80 q for Karjat variety. The level of productivity in the case of Ratna, Jaya, Suvarna, and Karjat was 30.08, 29.23, 19.80 and 17.68 q hectare^{-1}, respectively. The productivity of Ratna variety on medium farms (36.00 q ha^{-1}) was higher than on small and large group farms. The productivity ha-1 of paddy was 12.02, 29.50 and 62.16 q in small, medium and large farms respectively. With an overall average of production of paddy was 33.79 q ha^{-1}.

Table 1. Composition of sample farmers.

Group	Size of holding	Cultivators
Small	Up to 0.62 ha	14 (17.50)
Medium	0.63 to 2.14 ha	48 (60.00)
Large	2.15 and above	18 (22.50)
Total		80 (100)

Figures in the parentheses indicate percentage to the total

Table 2. Group-wise distribution of sample cultivators according to variety of paddy grown.

Name of paddy variety	Group			Over-all N=80
	Small N=14	Medium N=48	Large N=18	
Ratna	6 (42.86)	36 (75.00)	18 (100.00)	60 (75.00)
Jaya	5 (35.71)	30 (62.50)	15 (83.33)	50 (62.50)
Suvarna	1 (7.14)	3 (6.25)	4 (22.22)	8 (10.00)
Karjat	3 (21.43)	4 (8.33)	-	7 (8.75)

Figures in the parentheses indicate percentage to the number of cultivators in the group

Table 3. Group-wise production pattern of paddy.

Name of paddy variety	Small N=14			Medium N=48			Large N=18			Overall N=80		
	Area (ha.)	Production (q.)	Productivity (q ha^{-1})	Area (ha.)	Production (q.)	Productivity (q ha^{-1})	Area (ha.)	Production (q.)	Productivity (q ha^{-1})	Area (ha.)	Production (q.)	Productivity (q ha^{-1})
Ratna	0.178	4.14 (34.36)	23.26	0.340	12.24 (41.49)	36.00	1.207	31.90 (51.39)	26.43	0.507	15.25 (45.20)	30.08
Jaya	0.165	4.68 (38.84)	28.36	0.311	10.09 (34.20)	32.44	0.953	25.19 (40.52)	26.43	0.429	12.54 (37.17)	29.23
Survana	0.048	1.23 (10.21)	25.63	0.335	6.09 (20.64)	18.18	0.192	5.07 (8.16)	26.41	0.253	5.01 (14.85)	19.80
Karjat	0.078	2.00 (16.60)	25.64	0.070	1.08 (3.66)	15.43	-	-	-	0.056	0.99 (2.93)	17.68
Total	0.469	12.05 (100)	25.69	1.056	29.50 (100)	27.94	2.352	62.16 (100)	26.43	1.245	33.79 (100)	27.14

Figures in parentheses indicate percentage to the total

Disposal pattern : The overall level, 59.51 per cent (Table 4) of the total produce was marketable as surplus. The proportion of produce used for home consumption was 26.93 per cent. The paddy given on gift accounted for 1.81 per cent. While loss of paddy was 6.39 per cent and storage for seed was 5.36 per cent. The marketable surplus of paddy was increased with increase in size of holding. It was 5.86, 16.66 and 40.39 q in small, medium and large group, respectively, at overall level, it was found that 20.11 q. The marketable surplus in study area was substantial.

Scale pattern : In the overall cultivators (Table 5), maximum 31 (38.75%) cultivators preferred to sell their produce through processor/miller, followed by commission agent i.e. 28(35%) and 21 cultivators sold paddy to wholesaler. The total quantity sold was 1608.8 q. of which, maximum quantity (41.89%) was sold to commission agent and 34.42 per cent to processor. Least quantity (23.69%) was marketed through wholesaler. Average per quintal price of paddy at the overall, was Rs. 790.87 followed by Rs.800.02, Rs. 778.49 and Rs.803.78 in small, medium and large group, respectively. The per quintal price received by paddy cultivators was maximum when sold through wholesaler (Rs.850.00) followed by processor (Rs.800.00) and commission agent (Rs.750.00) as reported by Gangar and Pandey (1985) and Prasad *et al*. (1985).

Marketing channels : Generally, the cultivators choose the channel as per their

Table 4. Per farm disposal pattern of paddy (quintals).

Particulars	Groups			
	Small (N=14)	Medium (N=48)	Large (N=18)	Overall (N=80)
Production	12.05 (100.00)	29.50 (100.00)	62.16 (100.00)	33.79 (100.00)
Disposal :				
Consumption	5.30 (43.98)	8.76 (29.70)	12.96 (20.85)	9.10 (26.93)
Gift to relatives	0.10 (0.81)	0.50 (1.70)	1.31 (2.11)	0.61 (1.81)
Losses	0.45 (3.82)	2.04 (6.92)	3.83 (6.16)	2.16 (6.39)
Seed	0.34 (2.82)	1.54 (5.22)	3.67 (5.90)	1.81 (5.36)
Marketable surplus	5.86 (48.63)	16.66 (56.47)	40.39 (64.98)	20.11 (59.51)

Figures in the parentheses indicate percentage to total

Table 5. Sale of paddy through different marketing functionaries.

Particulars	Functionaries involved			
	Wholesalers	**Commission agents**	**Processor**	**All functionaries**
Small :				
No. of farmers	3 (21.43)	3 (21.43)	8 (57.14)	14 (100.00)
Quantity sold (q)	22.04 (26.86)	26.00 (31.69)	34.00 (41.44)	82.04 (100.00)
Price quintal^{-1} (Rs.)	850	750	800	800.02
Value (Rs.)	18734 (28.63)	19500 (29.80)	27200 (41.57)	65634 (100.00)
Medium :				
No. of farmers	12 (25.00)	21 (43.75)	15 (31.25)	48 (100.00)
Quantity sold (q)	138.00 (17.26)	480.00 (60.27)	179.68 (22.47)	799.68 (100.00)
Price quintal^{-1} (Rs.)	850	750	800	778.49
Value (Rs.)	117300 (18.84)	361500 (58.07)	143744 (23.09)	622544.00 (100.00)
Large :				
No. of farmers	6 (33.33)	4 (22.22)	8(44.44)	18 (100.00)
Quantity sold (q)	221.02 (30.40)	166.00 (22.83)	340.00 (46.77)	727.02 (100.00)
Price quintal^{-1} (Rs.)	850	750	800	803.78
Value (Rs.)	187867 (32.15)	124500 (21.31)	272000 (46.56)	584367 (100.00)
Overall :				
No. of farmers	21 (26.25)	28 (35.00)	31 (38.75)	80 (100.00)
Quantity sold (q)	381.06 (23.69)	674.0 (41.89)	553.68 (34.42)	1608.8 (100.00)
Price quintal^{-1} (Rs.)	850	750	800	790.87
Value (Rs.)	323901.00 (25.46)	505500.00 (39.73)	442944.00 (34.81)	1272345.00 (100.00)

Table 6. The per quintal marketing expenses of paddy incurred by market functionaries (Rs. q^{-1}).

Item of cost	**Producer**	**Commission agent**	**Wholesaler**	**Processor**	**Retailer**
Grading	2.30 (7.99)	2.00 (5.35)	-	3.10 (7.18)	-
Bagging	6.26 (21.77)	8.15 (21.79)	11.73 (28.06)	9.25 (21.41)	8.35 (23.59)
Transport	5.40 (18.78)	4.78 (12.78)	6.40 (15.31)	5.82 (13.47)	4.24 (11.98)
Loss in transport and storage	3.20 (11.13)	6.17 (16.50)	5.22 (12.49)	4.10 (9.49)	3.36 (9.49)
Loading and unloading	3.26 (11.34)	3.10 (8.29)	3.30 (7.89)	2.80 (6.48)	3.00 (8.47)
Electricity charges	-	2.80 (7.49)	2.40 (5.74)	4.63 (10.72)	3.42 (9.66)
Depreciation on capital assets	1.42 (4.94)	2.10 (5.61)	2.65 (6.34)	3.10 (7.18)	3.60 (10.17)
Interest on capital assets	1.50 (5.22)	3.15 (8.42)	2.80 (6.70)	3.60 (8.33)	2.25 (6.36)
Wages	1.30 (4.52)	1.80 (3.21)	2.40 (5.74)	2.10 (6.25)	2.38, (6.72)
Storage charges (Godown)	1.72 (5.98)	1.20 (3.21)	2.30 (5.50)	2.70 (6.25)	2.65 (7.49)
Other charges-Market fees, weight balance	2.40 (8.34)	2.15 (5.75)	2.60 (6.22)	2.00 (4.63)	2.15 (6.07)
Total	28.76 (100.00)	37.40 (100.00)	41.80 (100.00)	43.20 (100.00)	35.40 (100.00)

Figures in the parentheses indicate percentages to total

convenience and considering the per unit price received by them. The main channels in marketing of paddy identified in the study area were Channel I : Producer - Processor - Wholesaler(B) - Retailer - Consumer, Channel II : Producer - Commission agent - Processor - Retailer - Consumer, Channel III : Producer - Commission agent - Wholesaler - Processor - Consumer and Channel IV : Producer - Wholesaler(A) - Processor - Wholesaler(B) - Retailer - Consumer.

(N.B.: Wholesaler A stands for collection of paddy and B stands for sale of rice).

Marketing expenses : It is observed from Table 6 that, among the items of marketing expenses the major expenditure incurred by functionaries was on bagging followed by transport cost, loss in transport and storage, and loading and unloading. Marketing expenses incurred by producer, commission agent, wholesaler, processor and retailer were 63.02, 59.36, 63.75, 50.85 and 53.53 per cent, respectively. The per quintal total marketing expenses accounted for Rs. 28.76, Rs. 37.40, Rs. 41.80, Rs. 43.20, Rs. 35.40 to producer, commission agent, wholesaler, processor, retailer, respectively. Amongst the various items of marketing expenses, bagging cost was maximum for wholesaler, processor, and retailer, commission agent i.e. Rs. 11.73, Rs. 9.25, Rs. 8.35, and Rs. 8.15 respectively. Whereas, transportation cost was maximum Rs. 6.40 in case of wholesaler followed by cost of loss in transport and storage is Rs. 6.17, 5.22, 4.10, 3.36 and Rs. 3.20 for commission agent, wholesaler, processor, retailer and producer respectively. Other charges were market fees and weight balance Rs.2.60, Rs.2.40, Rs.2.15 and Rs. 2.00. For wholesaler,

Table 7. Channel-wise per quintal price-spread in marketing of paddy.

Particular	Channel I	Channel II	Channel III	Channel IV
Net price received by producer	697.40 (79.79)	753.89 (81.06)	741.43 (80.59)	851.78 (82.70)
Marketing expenses incurred by producer	28.76 (3.29)	28.76 (3.09)	28.76 (3.13)	28.76 (2.79)
Price paid by commission agent	-	782.65 (84.16)	770.19 (83.72)	-
Marketing expenses incurred by Commission agent	-	37.40 (4.02)	37.40 (4.07)	-
Marketing margin by C.A	-	7.25 (0.78)	8.65 (0.94)	-
Price paid by wholesaler (A)	779.86 (89.23)	-	816.04 (88.70)	823.02 (79.90)
Marketing expenses incurred by wholesaler(A)	41.80 (4.78)	-	41.80 (4.54)	41.80 (4.06)
Marketing margin by wholesaler (A)	6.40 (0.73)	-	6.48 (0.70)	8.16 (0.79)
Price paid by wholesaler (B)	-	-	-	929.86 (90.28)
Marketing expenses incurred by wholesaler (B)	-	-	-	41.80 (4.06)
Marketing margin by wholesaler (B)	-	-	-	9.22 (0.90)
Price paid by processor	726.16 (83.08)	827.30 (88.96)	864.16 (93.93)	872.98 (84.76)
Marketing expenses incurred by processor	43.20 (4.94)	43.20 (4.65)	43.20 (4.70)	43.20 (4.19)
Marketing margin by processor(Rice+byproduct)	5.10+6.40 (1.32)	5.20+7.10 (1.32)	5.28+7.00 (1.33)	7.40+6.28 (1.33)
Price paid by retailer	828.06 (94.74)	882.08 (94.85)	-	980.88 (95.23)
Marketing expenses incurred by retailer	35.40 (4.05)	35.40 (3.81)	-	35.40(3.44)
Marketing margin by retailer	10.54 (1.21)	11 .80 (1.27)	-	13.72 (1.33)
Total marketing expenses	149.16 (17.07)	144.76 (15.57)	151.16 (16.43)	190.96 (18.54)
Total marketing margin	28.44 (3.25)	31.35 (3.38)	27.02 (2.94)	35.56 (3.45)
Total marketing cost	183.60 (21,00)	176.11 (18.94)	178.18 (19.37)	226.52 (21.99)
Price paid by consumer	874.00 (100.00)	930.00 (100.00)	920.00 (100.00)	1030.00 (100.00)
Marketing efficiency (ME) (%)	376.03	428.08	416.33	354.71

Figures in parentheses indicate percentages to consumers purchase price

producer, commission agent, retailer and processor. Finally, the maximum per quintal marketing expenses were incurred by processor (Rs.43.20) followed by wholesaler, commission agent, retailer and minimum (Rs.28.76) for producer. The results are in agreement with those reported by George and Choukidar (1972) and Elema Job and Nandmohan (2004).

Price spread : The price spread refers to the difference between the price paid by the consumer and the net price received by the producer for an equivalent quantity of farm produce. This spread consists of marketing expenses and margin of intermediaries, which ultimately determines the overall effectiveness of a marketing system and efficiency of the marketing system.

The total per quintal marketing expenses incurred (Table 7) by market functionaries were highest in channel IV (Rs. 190.96) i.e., 18.54 per cent, followed by 17.07 per cent, 16.43 per cent and 15.57 per cent of consumer purchase price in channel I, channel III and channel II, respectively. The increases in number of intermediaries in the channel increased the marketing expenses and reduce the share of producer's in consumer's rupee and vice-versa.

The producer's share in consumer's rupee was highest 82.70 per cent (Rs.851.78) in channel IV followed by 81.06 per cent (Rs.753.89) in channel II, 80.59 per cent (Rs.741.43) in channel III and 79.79 per cent (Rs. 697.40) in channel I. Further, it is revealed that, the involvement of large number of intermediaries particularly wholesaler, commission agent, processor has decreased the producers share in consumer's rupee to considerable extent.

The total marketing margin of all intermediaries was highest (3.45%) in channel IV followed by 3.38 per cent, 3.25 per cent and 2.94 per cent of consumer's price in channel II, I and III, respectively.

The total marketing cost was found to be highest (21.99%) in channel IV followed by 21.00 per cent, 19.37 per cent and 18.94 per cent of consumer's purchase price in channel I, III and II, respectively.

It is observed that, price per quintal paid by the consumer was Rs.874, Rs.930, Rs.920, Rs.1030. in channel I, II, III and IV, respectively.

The marketing efficiency (ME) in channel II was highest (428.08%) whereas, it was 416.33 per cent in channel III, 376.03 per cent in channel I and 354.71 per cent in channel IV. This revealed that, the marketing margin was highest in channel IV followed by channel II, I and III. The marketing efficiency revealed that, channel II was relatively efficient as compared to other channels. Eventhough, the price received by producers in channel II, III and IV was higher than channel I, the marketing efficiency was observed to be low. Whereas, in channel III, though the price received by producer was comparatively low, than channel IV, the marketing efficiency was higher. Similar observations were reported by Suryaprakash *et al*. (1979) and Visawadiya *et al*. (2008).

The instability in monthly arrivals and prices (Table 8) was less than one per cent indicating that monthly arrivals of paddy and it's prices were more or less stable in selected market.

Table 8. Monthly arrivals and prices of paddy.

Arrivals of prices	Coefficient of variation
Monthly arrivals (q.)	0.743 %
Monthly minimum price (Rs)	0.893 %
Monthly maximum price (Rs.)	0.829 %
Monthly average price (Rs.)	0.782 %

References

Anonymous. 1985. Price structure of rice and producer's share in consumer is rupee in Haryana Indian J. of Agril. Econ., 40(3): 395.

Dubal, V. S., Patil, N. N., and Borude, S. G. 1986. Study on marketable and marketed surplus of rice in Ratanagiri district. (Maharashtra). J. of Maharashtra agric. Univ., 11(3): 335-337.

Elema, Job and Nandamohan, V. 2004. Rice production in Kerala, trend and instability analysis. Agril. Situation in India, 3: 135-139.

Gangwar, A. C. and Pandey, K. N. 1985. Price structure of rice and producer's share in consumer's price in Harayana. Indian J. ofAgril, Econ., 40(3): 359.

George, P. S. and Choukidar, V. V. 1972. Marketing of paddy in west Godavari district. Agril. Marketing, 14(4): 21.

Prasad, P. S., Dinger, S. M. and Singh, C. P. 1985. Net price spread of paddy/rice in regulated and unregulated market system. Indian J. of Agril. Econ., 40(3): 422.

Suryaprakash, S. J., Venkatraman and Ramann, R. 1979. Comparative study of price spread of selected agriculture commodities in Karnataka. Indian J. of Agril. 34(4): 142-149.

Visawadiya, H. R., Ardeshna, N. J. and Shiyani, R. L. 2008. Price spread and marketing efficiency of chilli in regulated and unregulated markets in Saurashtra of Gujarat state. Agril. Develop. and policy. 18(1 and 2): 73-78.

J. Agric. Res. Technol., 37 (2) : 277-280 (2012)

An Economic Analysis of Risks Involved in Onion Production and Marketing

M. S. Hasanabadi[1], J. A. Handigol[2], M. T. Doddamani[3] and V. A. Ramchandra[4]
Dept. of Agricultural Economics, University of Agricultural Sciences, Dharwad - 580 005 (India)
(Received : 07-08-2011)

Abstract

The insured farmers were facing mainly the risk of drought and price variation, which were causing the maximum losses to their income in production and marketing respectively. The yield variation was maximum in last 3 years as compared to last 5 and 10 years. Similarly, rainfall was also having more coefficient of variation in last 3 years as compared to last 5 and 10 years. The price variation was more in post harvest period as compared to pre-harvest period and price variation increased over the years. Drought was the major effect on crop production for the sample farmers followed by plant diseases. In case of marketing of onion, price variation was the major risk faced by the sample farmers in Dharwad district.

Key words : Price variation, pre-harvest and post harvest periods, yield variation insured.

Onion crop is highly sensitive to weather conditions, pests and diseases and it requires heavy expenditure during the production period. Further more, the farmer is not assured of a disease free crop and good quality produce, which is essential for obtaining remunerative income. The present study was undertaken with the objective of identifying and analysing the risks involved in production and marketing of onion.

Materials and Methods

The data were collected from both primary and secondary sources. Dharwad district was

1. M.Sc. (Agri.) student, 2., 3. Asso. Professors and 4. Ph.D. student.

purposively selected as study area as it was one of the important onion growing areas of the state. On the basis of the total number of onion insured farmers, two talukas *viz*., Dharwad with highest and Navalgund with lowest concentration of onion insured farmers were selected. From each taluka three villages were selected on the basis of highest concentration of onion insured farmers during *kharif* 2003. From each village 10 insured and 10 non-insured farmers were selected. Thus primary data were collected from 120 farmers (60 insured and 60 non-insured) from the six villages. The month-wise data on prices of onion in Dharwad district over a period of 20 years were collected from Agriculture Produce Market Committee, Hubli. as the Hubli APMC market was the major onion market in Dharwad district. Similarly, yield; rainfall data of 20 years were collected from District statistical office situated at district head quarters. The present study made use of different analytical techniques such as averages, standard deviation, coefficient of variation, percentages, and ratios.

Results and Discussion

Table 1 depicts the yield variation of onion crop in Dharwad district. The coefficient of variation in yield of onion was 30.84 per cent in last 3 years. It was decreased to 24.32 per cent, 18.08 per cent in last 5 years and 10 years respectively. The mean yield was maximum in last 15 years to the tune of 3666 kg hectare^{-1} and this was minimum (3413.20 kg hectare^{-1}) in last 20 years.

Rainfall variation in Dharwad district is indicated in Table 2. The average rainfall in the growing period of onion was minimum in last 3 years i.e 93.38 mm and was maximum in last 20 years about 114.21 mm. The coefficient of variation in rainfall was 26.21 per cent in last 3 years. It was decreased to 25.42 per cent in last 5 years and 19.3 per cent in last 10 years. The coefficient of rainfall again enhanced to 29.52 per cent in last 15 years and was again decreased to 28.41 during last 20 years.

The month wise price data of onion crop over 20 years were collected and mean, standard deviation and coefficient of variation were calculated for last 3, 5, 10, 15 and 20 years respectively (Table 3). The coefficient of variation of prices in pre-harvest period was 12.85 per cent in last 3 years, which was increased to 22.59, 52.87, 61.53 and 71.27 per cent in last 5, 10, 15 and 20 years

Table 1. Yield variations of onion crop in Dharwad district.

Particulars	Mean (kg ha^{-1})	Standard deviation (mm)	Coefficient of variation (%)
Last 3 years (2000-01 to 2002-03)	3617.00	1115.44	30.84
Last 5 years (1998-99 to 2002-03)	3555.40	864.76	24.32
Last 10 years (1993-94 to 2002-03)	3425.20	619.27	18.08
Last 15 years (1988-89 to 2002-03)	3666.00	1335.57	36.43
Last 20 years (1983-84 to 2002-03)	3413.20	1237.31	36.25

Table 2. Rainfall variations in Dharwad district during growing period of onion from 1985 to 2004.

Particulars	Mean of three months* (mm)	Standard deviation (mm)	Coefficient of variation (%)
Last 3 years (2002 to 2004)	93.38	24.47	26.21
Last 5 years (2000 to 2006)	96.13	24.43	25.42
Last 10 years (1995 to 2004)	103.69	20.04	19.33
Last 1 5 years (1 990 to 2004)	116.63	34.43	29.52
Last 20 years (1985 to 2004)	114.21	32.45	28.41

* - June, July and August months

Table 3. Price variation of onion crop in Dharwad district during pre and post harvest.

Particulars	Pre-harvest			Post-harvest		
	Mean (Rs. q^{-1})	Standard deviation (Rs. q^{-1})	Coefficient of variation (%)	Mean (Rs. q^{-1})	Standard deviation (Rs. q^{-1})	Coefficient of variation (%)
Last 3 years (2002 to 2004)	434.44	55.84	12.85	495.00	120.84	24.41
Last 5 years (2000 to 2004)	406.00	91.73	22.59	478.33	119.35	24.95
Last 10 years (1995 to 2004)	458.00	242.12	52.87	586.17	446.38	76.15
Last 15 years (1990 to 2004)	374.11	230.19	61.53	473.96	395.41	83.43
Last 20 years (1985 to 2004)	316.00	225.22	71.27	400.18	364.38	91.05

Pre-harvest period - June to August; Post harvest period - September to Novernber

respectively. Similarly in post harvest period the coefficient of variation of price of onion was 24.41 per cent in last 3 years, which was increased to 24.95, 76.15, 83.43 and 91.05 per cent in last 5, 10, 15, 20 years respectively.

The composite scores were given in order to identify and analyse the risks in onion production and marketing by the insured and non insured farmers. Among the insured farmers, as seen from Table 4 almost all the farmers opined that drought was a major risk in onion production with a score of 4.97. Plant disease was the second risk with a score of 2.75 and the low quality of seed or inputs also had a score of 1.03 with a frequency of 20, whereas in the case of excess rain the frequency was 38. Insects and lack of water in critical stages had almost the same scores of 0.88 and 0.77 respectively but the frequency was 37 in insects as against 26 in case of lack of water in critical stages.

Marketing risks in the case of insured farmers were depicted in the Table 4. The price variation had a highest score of 4.97 with highest frequency of 60. Storage had the score of 1.12 with a frequency of 17, which occupied the second position. Commission also played an important role in marketing with a frequency of 24 resulting into a score of 1.03 and the transportation was the least factor affecting the marketing with a score of 0.73.

The Table 4 showed that drought was a major risk factor causing heavy losses in the yield, which was expressed by 51 farmers in the study area with a composite score of 4.18. Plant diseases was the second risk factor with a score of 2.38 and insects, excess rain and lack of water in critical stages were having almost similar effects with a scores of 0.55, 0.51 and 0.58, respectively. Low quality of seed or

Table 4. Risks in onion production and marketing of insured farmers.

Factors	Insured farmers		Non-insured farmers	
	Freq-uency	Com-posite score	Freq-uency	Com posite score
Production risks :				
Plant diseases	41	2.75	35	2.38
Insects	37	0.88	1.1	0.55
Excess rain	38	1.68	8	0.51
Drought	60	4.97	51	4.18
Lack of water in critical stages	26	0.77	7	0.58
Low quality of seed/input	20	1.03	9	0.45
Marketing risks :				
Price variation	60	4.97	60	4.91
Transportation	28	0.73	10	0.63
Storage	17	1.12	19	1.18
Commission	24	1.03	18	1.08

inputs was not a major risk for the non-insured farmers, which attained a least score of 0.45. Similarly in marketing risks, price variation was the major risk faced by the non-insured farmers with a score of 4.91 followed by storage with a score of 1.18 and commission with a score of 1.08.

The coefficient of variation in the yield of onion was maximum in last 3 years as compared to last 5, 10, 15 and 20 years with the same coefficient of variation. This indicated that there was high risk in yield of onion as depicted in Table 1. This high coefficient of variation in the yield of onion for the last 3 years was due to prevalence of drought situation in the district. Looking to the rainfall variation in Dharwad district, there was a high coefficient of variation in rainfall in last 3 years as compared to last 5 and last 10 years and the mean rainfall over the years was decreasing from last 20 to last 3 years (Table 2).

Regarding price variation of onion crop in Dharwad district between pre-harvest and post-harvest period the coefficient of variation was more in post-harvest period as compared to pre-harvesting period of onion (Table 3). The reason attributed was that the arrivals were stable in pre-harvest season and arrivals increased in the post-harvest season. The coefficient of variation of prices in both pre-harvest and post-harvest periods was increased with the increase in the number of years, which indicated the involvement of more risk in the price of onion.

Drought was having the maximum effect on production of onion with the composite score of 4.97 of insured farmers. At the same time plant disease was also a major problem in onion cultivation, which was having a score of 2.75 of insured farmers as, indicated by Table 4. Excess rain had some impact on the onion production because it was sensitive to water logging conditions and similarly low quality of seed or input also had little effect on production of onion, whereas insects and lack of water during critical stages had negligible effect on onion cultivation. In marketing of onion, price variation was the major risk factor causing heavy losses in the income of the farmers which was having a score of 4.97 followed by storage commission with some effect. But transportation was not a problem in marketing of onion of insured farmers.

Drought was the major factor, which caused heavy losses in yields of the most of the non-insured farmers, which was having a maximum composite score of 4.18 as depicted in Table 4. This was followed by plant disease, which was a major problem of onion growers which accounted to a score of 2.38. Excess rain and lack of water during critical stages were having almost similar effects on production of onion but quality of seed/input had little impact on onion production. Similarly in marketing of onion, price variation was the major risk faced by the farmers with a composite score of 4.91 followed by storage, commission charges which also had some amount of effect on marketing of onion but transportation had negligible effect on marketing of onion.

References

Awasthi, P. K., Atkare, P. and Shrivastava, A. 1987. Risk and uncertainty in paddy production. Agri. Situation in India, 42(7): 611-614.

Kalirajan, K. and Huysman, A. 1984. An econometric analysis of production risk using farm level panel data the Philippines. Indian J. of Agric. Econo., 39(4): 614-629.

Rajgopalan, V. and Varadarajan, S. 1978. Impact of risk and uncertainty on farm production and income in the hills of Nilgiris. Tamil nadu. Indian J. of Agric. Econ., 33(4): 35-42.

Catherine Greene and Amy Kreman. 2004. Risk and risk management in organic agriculture: views of organic farmers, renewable agriculture and food systems. 19(4): 218-227.

Singh, A. J. and Jain, K. K. 1983. Farm planning under risk and uncertainty: An application of parametric linear programming. Indian J. of Agric. Econ. 38(2): 208-215.

J. Agric. Res. Technol., 37 (2) : 281-285 (2012)

Knowledge of Farmers About National Agricultural Insurance Scheme

J. G. Kale[1] and R. P. Kadam[2]
Dept. of Extension Education, College of Agriculture, Parbhani - 431 402 (India)
(Received : 18-09-2011)

Abstract

Majority of the respondents were young aged, literate, having medium annual income, medium social participation with medium use of source of information and medium risk orientation. Majority of the respondents were having semi-medium land holding and belonged to medium socio-economic status. Most of the respondents (60.83%) possessed medium knowledge about National Agricultural Insurance Scheme. It was revealed that attributes like education, socio-economic status, source of information were having significant and positive relationship with knowledge at 0.01 level of significance. The results further revealed that age had negatively significant relationship with knowledge at 0.01 level of significance and attributes like land holding, annual income, social participation and risk orientation were having non significant relationship with knowledge.

Key words : Knowledge, insurance scheme, socio economic status.

There is growing uncertainty and risk resulting in huge losses in agricultural production. Under heavy loss circumstances, the insurance of crop against such risk can be of immense value for farmers. National Agricultural Insurance Scheme (NAIS), aims to provide the social security, helps in maintaining dignity, reduces risk burden of farmers. Hence, study will be helpful to understand knowledge of farmers towards NAIS in Parbhani district. The present study was conducted with the objectives to study personal, socio-economic and psychological characteristics of the respondents, their knowledge about NAIS and relation between them.

Materials and Methods

The present study was conducted in Parbhani District of Marathwada region of Maharashtra state during the year 2010-11. Parbhani, Palam, Gangakhed and Purna taluka of Parbhani district were selected randomly for the study. Three villages from each talukas were selected randomly as this scheme is being implemented in these villages. Thus total 12 villages were selected for the study from Parbhani district. Ten beneficiary farmers from each village were selected randomly. Thus from twelve selected villages the total sample constituted, 120 respondents. The respondents were interviewed with the help of well structured interview schedule. The percentage was worked out to describe the profile of the respondents and analyzed by using suitable statistical techniques like, mean, frequency, percentage, standard deviation and correlation.

Results and Discussion

Socio economic status : Age : It was observed from Table 1 that half of the respondents (49.17%) were from young age group, followed by 37.50 per cent from middle age group, whereas 13.33 per cent respondents were from old age group.

Education : The majority of respondents

1. M.Sc. (Agri.) student and 2. Asstt. Professor.

(55.837%) were educated upto secondary school, followed by 15.83 per cent respondents were educated upto primary school. About 14.17 per cent respondents were educated up to graduation level, while 10.00 per cent respondents were educated up to high school level, 3.34 per cent of them were illiterate and very meager percentage i.e. 0.83 per cent respondents can only read and write.

Land holding : About 38.33 per cent respondents had semi-medium land holding, 35.00 per cent had small land holding while 13.34 per cent of them had medium land holding, while 9.17 per cent of respondents had large land holding and 4.16 per cent of respondents had marginal land holding.

Annual income : The 81.67 per cent of the respondents had medium annual income (Rs. 83593 to Rs. 221607) while 12.50 per cent of respondents had low annual income (below Rs. 83593) and 5.83 per cent of respondents had high annual income (Rs. 221608 and above).

Social participation : The 50.83 per cent of the respondents participated in social organization to a medium extent followed by 41.67 per cent of them in lower category of social participation and 7.50 per cent of them participated in various social organization to a higher extent.

Socio-economic status : The 75.83 per cent of respondents were from medium socio-economic status, 12.50 per cent and 11.67 per cent of respondents were from high and low socio-economic status respectively.

Sources of information : It was found that more than half (77.50%) of the respondents were making medium use. of sources of information followed by 13.33 per cent respondents who had high exposure to sources of information and only 9.17 per cent of the respondents were found in low category of using sources of information.

Table 1. Personal, socio-economic and psychological characteristics of the respondents (N=120).

Categories	Frequency	Percentage
Age :		
Young	59	49.17
Middle	45	37.50
Old	16	13.33
Education :		
Illiterate	04	3.34
Only can read and write	01	0.83
Primary school level (1^{st}-4^{th} class)	19	15.83
Secondary school level (5^{th}-10^{th} class)	67	55.83
High School level (11^{th}-12^{th} class)	12	10.00
Graduation level (above 12^{th} class)	17	14.17
Land holding :		
Marginal (0-1 ha.)	05	4.16
Small (1.01-2 ha.)	42	35.00
Semi-medium (2.01-4 ha.)	46	38.33
Medium (4.01-6 ha.)	16	13.34
Large (above 6.01 ha.)	11	9.17
Annual income :		
Low (Upto Rs. 83592)	15	12.50
Medium (Rs. 83593 to Rs. 221607)	98	81.67
High (Rs. 221608 and above)	07	5.83
Social participation :		
Low (upto 1)	50	41.67
Medium (2 to 8)	61	50.83
High (9 and above)	09	7.50
Socio-economic status :		
Low (upto 27)	14	11.67
Medium (28 to 34)	91	75.83
High (35 and above)	15	12.50
Sources of information :		
Low (upto 13)	11	9.17
Medium (14 to 21)	93	77.50
High (22 and above)	16	13.33
Risk orientation :		
Low (upto 19)	13	10.84
Medium (20 to 22)	77	64.16
High (23 and above)	30	25.00

Table 2. Distribution of the respondents according to knowledge about NAIS (N=120).

Particulars	Respondents	
	No.	%
Crops included in NAIS	120	100.00
Name of implementing agency of scheme	120	100.00
Whether participation in NAIS is compulsory for all	120	100.00
Under which calamities crop losses should be granted in NAIS	120	100.00
Which type of land holding farmers get 10% subsidy in NAIS	62	51.66
Level of risk for crops other than cotton and sugarcane	77	64.16
How many : crops should be insured at a time in NAIS	120	100.00
Shares of central and state government in funding of NAIS	10	8.33
Starting of NAIS	29	24.16
Name of agency which co-operate in implementation of NAIS	5	4.16
Bank account should be there in bank while taking crop insurance through NAIS	115	95.83
Average percentage of farmer's yield upto which crop can be insured	100	83.33
Level of risk for sugarcane crop	3	2.50
Last date of crop insurance for NAIS in Kharif season	99	82.50
Last date of Crop insurance for NAIS in Rabi season	62	51.66
General percentage of crop insurance for NAIS	3	2.50
Level of risk for cotton in NAIS	1	0.83

Risk orientation : The majority (64.16%) of the respondents found in medium risk orientation category followed by 25.00 per cent and 10.84 per cent of the respondent were from high and low risk orientation category, respectively.

NAIS knowledge : It was observed (Table 2) that all the respondents possessed knowledge about crops included in scheme, name of implementing agency, whether there is compulsion about participation in scheme, under which calamities crop losses should be granted in scheme, how many crops should be insured at a time in NAIS. The 95.83 per cent respondents possessed knowledge about need of bank account for taking crop insurance, 83.33 per cent respondents knows about average percentage of farmer's yield upto which crop can be insured, 82.50 per cent respondents had knowledge about last date of crop insurance in *kharif* season, 64.16 per cent respondents knows about level of risk for crops other than cotton and sugarcane, 51.66 per cent knows about subsidy for marginal farmers and last date of crop insurance in rabi season. Similarly, 24.16 per cent respondents possessed knowledge about starting of scheme, 8.33 per cent knows about shares of central and state governments in funding of NAIS. The 4.16 per cent respondents possessed knowledge about name of agency which co-operate in implementation of NAIS, 5 per cent respondents knows about level of risk for sugarcane crop and general percentage of crop insurance for NAIS. The 0.83 per cent

Table 3. Distribution of the respondents according to their knowledge level.

Category	Respondents	
	Frequency	Percentage
Low (upto 8)	27	22.50
Medium (9 to 11)	73	60.83
High (12 and above)	20	16.67
Total	120	100.00

respondents possessed knowledge about level of risk for cotton in NAIS.

Table 3 revealed that 60.83 per cent of respondents had middle level of knowledge, while 22.50 and 16.67 per cent had low and high level of knowledge respectively. These findings are similar with Dixit and Veerabhadraiah (1999), Shinde (2002), Surve (2002), Barkule (2008) and Thore (2008).

Relationship : The attributes like education, socio-economic status, sources of information were having significant and positive relationship with knowledge at 0.01 level of significance. The results further revealed that age had negatively significant relationship with knowledge and attributes like land holding, annual income, social participation and risk orientation were having non significant relationship with knowledge.

It was concluded that, majority of the respondents were young aged, literate, having medium annual income, medium social participation with medium use of source of information, medium risk orientation. Majority of the respondents were having semi-medium land holding and belonged to medium socio-economic status. Most of the respondents possessed medium knowledge about National Agricultural Insurance Scheme. The attributes like education, socio-economic status source of information were having significant and positive relationship with, knowledge at 0.01 level of significance. An age had negatively significant relationship with knowledge at 0.01 level of significance and attributes like land holding, annual income, social participation and risk orientation were having non significant relationship with knowledge. This finding stresses the need to equip farmers with detailed knowledge and various provisions about NAIS through statewise and regionwise campaigns. If possible special information cell at Panchayat Samiti and Zilha Parishad as well as at Agricultural Offices should be opened. The farmers should be informed with the changes incorporated, if any, in the present scheme through mass media communication channels. This information should be reinforced by mobilizing personal sources of information. The findings regarding the suggestions should be taken into consideration for the effectiveness of the scheme. Crop cutting experiments should be conducted in the presence of villagers/insurance company's representatives. So there will be no confusion of farmers about crop cutting experiments. All these measures may accelerate the knowledge of the farmers about NAIS and indirectly better operational response of the farmers.In this way it will help in successful running of the scheme.

Table 4. Relationship between personal socio-economic and psychological characteristics of the respondents and their knowledge.

Independent variable	Coefficient of correlation
Age	-0.247**
Education	0.302**
Land Holding	0.135
Annual income	0.136
Social participation	0.006
Socio-economic status	0.259**
Sources of information	0.340**
Risk orientation	-0.071

** Significant at 0.01 level of significance

References

Barkule, S. R. 2008. Knowledge and adoption of selected Government Development Schemes by farmers. M.Sc. (Agri.) thesis, M.A.U. Parbhani.

Dixit Sreenath and Veerbhadraiah, V. 1999. Social forestry programme. Knowledge, attitude and adoption. Agri. Extn. Review, pp. 29-31.

Shinde, P. S., Satpute, S. K. and Maskesar, A. D. 2002. Utility perception of farmers towards National Agricultural Insurance Scheme. Agresco Report, held at DBSKKV, Dapoli on 26th to 28th May.

Singh, B. B. and Prasad, R. B. 2000. Effect of integrated rural development programme and socio-economic status of beneficiaries. Maharashtra J. Extn. Edn., XIX: 164-167.

Survey, R. N. 2002. A study on attitude of the farmers towards National Agricultural Insurance Scheme. M.Sc. (Agri.) thesis MAU, Parbhani.

Thore, V. V. 2008. Knowledge and attitude of beneficiaries towards National Horticultural Mission in Marathwada region. M.Sc. (Agri.) thesis MAU, Parbhani.

J. Agric. Res. Technol., 37 (2) : 285-288 (2012)

Effect of Drip Irrigation and Fertigation Levels on Growth and Yield of Gerbera under Polyhouse Conditions

N. N. Firake[1], R. L. Takte[2], A. B. Bhosale[3] and D. D. Jagtap[4]
Precision Farming Development Centre, Dr. A. S. College of Agri. Engineering,
Mahatma Phule Krishi Vidyapeeth, Rahuri - 413 722 (India)
(Received : 06-07-2009)

Abstract

The experiment was conducted in fan-pad polyhouse with three irrigation levels *viz*., 0.80, 0.60 and 0.40 PE (pan evaporation) and three fertigation levels *viz*., 120, 100 and 80 per cent recommended dose (RD) to determine suitable irrigation level and fertigation dose for gerbera under polyhouse cultivation. It was observed that the stalk thickness, length and number of flowers plant^{-1} year^{-1} were maximum due to 0.40 PE level of irrigation and 80 per cent R.D. of fertigation. The economic analysis of gerbera production revealed that the treatment combination of 0.60 PE x 80 per cent R.D, has resulted into maximum B:C. ratio of 1.59, followed by 1.57 in 0.40 PE x 80 per cent R.D. and 0.60 PE x 100 per cent R.D.

Key word : Gerbera, polyhouse, irrigation levels, fertigation levels, water requirement, yield, economics.

Fertigation which combines irrigation with fertilizer is well recognized as the most effective and convenient means of maintaining optimal fertility levels and water supply according to specific needs of each crop and type of soil. The technique applies both water and fertilizer at a low rate to the vicinity of the plant root zone, resulting in higher yield and better quality of produce. There is continuous substantial growth in use of fertilizer in liquid form in the developing countries. Research work has been carried out in various countries including India on the efficiency of soluble fertilizers. The yields have increased (18.13%) besides fertilizer saving (30% N and 20% P and K) when water soluble fertilizers are applied to pomegranate (Firake and Kumbhar, 2002).

Ambad *et al*. (2002) reported that the application of soluble NPK fertilizers (20:10:24 g plant^{-1} year^{-1}) to gerbera planted in polyhouse resulted in significantly increased yield of 275.4 flowers m^{-2} year^{-1} with better quality. Fertigation with soluble fertilizers @ 80 per cent of the recommended dose gave improved growth and flower production of gerbera under low cost polyhouse (Sujatha *et al*. 2002). They reported significantly higher yield of gerbera (14.90 flowers m^{-2} month^{-1}). Atre *et al*. (2005) reported that application of drip irrigation @ 70 per cent of pan

1. Principal Investigator, 2. Sr. Res. Asstt. (Agril. Engg.), 3. Sr. Res. Asstt. (Hort) and 4. Asstt. Prof. of Hort.

evaporation to capsicum resulted in 24.09 per cent increase in yield and 24.38 per cent water saving over drip irrigation @100 per cent of pan evaporation under polyhouse conditions.

The cultivation of cucumber under polyhouse conditions and irrigated by drip with water application equal to 70 per cent of pan evaporation resulted into 30 per cent saving of water, 300 per cent increase in yield and 100 per cent increase in water use efficiency over open field cultivation (Gorantiwar *et al*. 2003). It has been reported (Anonymous, 2008) that the daily drip irrigation @ 60 per cent of pan evaporation gave the maximum yield of carnation under polyhouse. However, it was noticed on par with that of 80 per cent of pan evaporation level of irrigation.

This experiment was conducted with objective to determine optimum dose of water soluble fertilizers, suitable irrigation level in form of pan evaporation, seasonal water requirement and economics of gerbera production under polyhouse conditions.

Materials and Methods

The investigation was carried out at the Research-cum-Demonstration Farm of Precision Farming Development Centre, Mahatma Phule Krishi Vidyapaeeth, Rahuri (M.S) during 2006-07. The experiment was carried out in a factorial randomized block design with 9 treatments, replicated 4 times, in the polyhouse of 252 m^2 size. The transplanting of gerbera was done at the spacing of 30 x 30 cm on March 3, 2006 as per recommendation. The said media used was made up of red soil (30%), FYM (30%), sand (30%) and rice husk (10%) as per recommendation (Kadam *et al*. 2007). The nine treatments were the combination of irrigation levels of 0.80, 0.60 and 0.40 PE (pan evaporation) and fertigation levels of 120, 100 and 80 per cent R.D. (recommended dose).

Water soluble fertilizers were scheduled weekly through drip irrigation as per different fertigation levels of the recommended dose of fertilizers (18.50:9.25:22.25 g m^{-2} $month^{-1}$), 3 weeks after planting (establishment period). The irrigation water was applied daily to the crop through drip irrigation system and soluble fertilizers were applied by using ventury tube assembly. The irrigation scheduling was done as per treatment on the basis of daily pan evaporation.

Table 1. Biometric observations and yield of gerbera under irrigation and fertigatlon levels.

Treatment	Stalk length (cm)	Stalk thickness (cm)	Dia. of flower (cm)	Yield	
				Flowers $plant^{-1}$ $year^{-1}$	Flowers m^{-2} $year^{-1}$
Irrigation levels (PE) :					
I_1 (0.80)	50.32	0.59	10.59	15.33	170.35
I_2 (0.60)	52.53	0.65	11.56	17.92	199.05
I_3 (0.40)	53.99	0.68	11.60	18.25	202.76
S.E.±	0.170	0.002	0.019	0.170	1.883
C.D. at 5%	0.496	0.006	0.057	0.495	5.497
Fertigation levels (% of RD) :					
F_1 (120)	50.65	0.63	11.10	15.50	172.20
F_2 (100)	53.00	0.65	11.32	17.83	198.13
F_3 (80)	53.17	0.65	11.34	18.17	201.83
S.E.±	0.170	0.002	0.019	0.170	1.883
C.D. at 5%	0.496	0.006	0.057	0.495	5.497
Interaction (I x F) :					
$I_1 \times F_1$	49.46	0.58	10.40	13.50	149.98
$I_1 \times F_2$	50.66	0.60	10.69	15.75	174.98
$I_1 \times F_3$	50.82	0.61	10.70	16.75	186.09
$I_2 \times F_1$	50.81	0.63	11.37	15.75	174.98
$I_2 \times F_2$	53.25	0.66	11.66	19.00	211.09
$I_2 \times F_3$	53.25	0.66	11.66	19.00	211.09
$I_3 \times F_1$	51.69	0.66	11.54	17.25	191.65
$I_3 \times F_2$	55.10	0.68	11.61	18.75	208.31
$I_3 \times F_3$	55.17	0.69	11.65	18.75	208.31
S.E.±	0.294	0.003	0.034	0.294	3.262
C.D. at 5%	0.859	NS	0.098	0.857	9.521

NS = Non-significant

The depth of water (d, mm) applied plant^{-1} was calculated by using the formula, d = C x PE x Sr x Sp, where C is treatment factor; PE is pan evaporation of previous day, mm; Sp is plant spacing, m; and Sr is row spacing, m. The volume of water to be applied for each treatment plot was computed by the equation V=d x A, where V is volume of water, lit; d is depth of water, mm; and A is area of plot, m^2. The time of operation (hr) of drip irrigation system for each treatment was calculated by the equation To = V/q.n.EU, where To is time of operation of drip irrigation unit for respective treatment (hr); V is volume of water to be applied irrigation^{-1}, lit; q is average discharge of emitters in respective treatments, (Iph) and E is emission uniformity of drip irrigation unit (0.90) and n is number of emitters plot^{-1}. The flowers were harvested for 10 months.

Results and Discussion

Stalk length : Among the irrigation levels, 0.40 PE recorded maximum stalk length (53.99 cm), which was on par with that of 0.60 PE. The fertigation level of 80 per cent R.D. resulted into maximum stalk length (53.17 cm) which was on par with 100 per cent R.D. The interaction effect of irrigation and fertigation levels was significant, indicating that the maximum and significantly superior stalk length was obtained due to 0.40 PE x 80 per cent R.D. except that of 0.40 PE x 100 per cent R.D. which was on par.

Stalk thickness : Irrigation level of 0.40 PE (I_3) resulted into maximum and significantly superior stalk thickness (0.68 cm) over others. Fertigation levels of 80 and 100 per cent R.D. created same thickness of stalk of gerbera i.e. 0.65 cm, which were significantly superior over that of 120 per cent R.D. The interaction effect between irrigation and fertigation levels was non significant.

Diameter of flower : The results in case of irrigation and fertigation levels were similar as that of stalk length as far as average diameter of flower was concerned (Table 1). However, the diameter of flower was significantly superior in I_1 x F_2, I_1 x F_3, I_2 x F_3, I_3 x F_3 and I_2 x F_2 over rest of the treatment combinations.

Yield : The number of flowers of gerbera produced plant^{-1} year^{-1} were maximum (18.25) due to 0.40 PE (I_3), which was on par with that of 0.60 PE (I_2) i.e. 17.92. The 0.80 PE irrigation level produced lowest number of flowers plant^{-1} year^{-1}. The fertigation level of 80 per cent R.D. produced maximum (18.17)

Table 2. Water requirement, water use efficiency and B:C. ratio of gerbera under polyhouse.

Treatment	Seasonal water requirement		Water saving in I_2 and I_3 over I_1 (%)	Yield m^{-2} year^{-1} (Nos.)	Water use efficiency (flowers m^{-2}-mm)	B.C ratio
	mm	lit. plant^{-1}				
I_1 x F_1 (0.80 PE x 120% RD)	1183.92	106.55	-	149.98	0.127	1.10
I_1 x F_2 (0.80PE x 100% RD)	1183.92	106.55	-	174.98	0.148	1.30
I_1 x F_3 (0.80PE x 80% RD)	1183.92	106.55	-	186.09	0.157	1.40
I_2 x F_1 (0.60PE x 120% RD)	887.94	79.91	25.00	174.98	0.197	1.08
I_2 x F_2 (0.60PE x 100% RD)	887.94	79.91	25.00	211.09	0.238	1.57
I_2 x F_3 (0.60 PE x 80% RD)	887.94	79.91	25.00	21.1.09	0.238	1.59
I_3 x F_1 (0.40PE x 120% RD)	591.96	53.28	50.00	191.65	0.324	1.40
I_3 x F_2 (0.40 PE x 100% RD)	591.96	53.28	50.00	208.31	0.352	1.55
I_3 x F_3 (0.40 PE x 80% RD)	591.96	53.28	50.00	208.31	0.352	1.57

number of flowers plant^{-1} year^{-1}, which was at par with that of 100 per cent of R.D. level.

The interaction effects of I x F produced maximum number of flowers plant^{-1} year^{-1} i.e. (19.00) in the treatments of 0.60 PE x 80 per cent R.D. and 0.60 PE x 100 per cent R.D. which was on par with that of 0.40 PE x 80 per cent R.D. and 0.40 PE x 100 per cent R.D. (i.e. 18.75). The similar results were obtained for yield m^{-2} year^{-1}.

Water use : The seasonal water requirement of gerbera under polyhouse conditions was found to be 1184, 888 and 592 mm under 0.80 PE (I_1), 0.60 PE (I_2) and 0.40 PE (I_2) irrigation levels, respectively (Table 2). The seasonal water requirement of gerbera plant^{-1} was observed as 107, 80 and 53 litres, respectively, under irrigation levels of 0.80, 0.60 and 0.40 PE. The water use efficiency (WUE) of gerbera was found maximum in 0.40 PE x 80 per cent R.D. and 0.40 PE x 100 per cent R.D. i.e. 0.35 flowers m^{-2}-mm. The WUE decreased considerably with increase in the levels of ferti-irrigation.

Economics : The economic analysis (Table. 2) of gerbera production under polyhouse conditions under different levels of irrigation and fertigation revealed that, the treatment combination of 0.60 PE x 80 per cent R.D. has resulted into maximum B:C ratio of 1.59, followed by B:C ratio of 1.57 in 0.40 PE x 80 per cent R.D. and 0.60 PE x 100 per cent R.D. The values of B:C ratio in all the treatments were noticed on lower side as in first year the flowers started after 3 months from planting.

Thus, on the basis of economics, the study revealed that, the drip irrigation scheduled daily @ 0.60 pan evaporation and the soluble fertilizers applied weekly @80 per cent of recommended dose (18.50:9.25:22.25 g m^{-2} month^{-1}) to gerbera under polyhouse conditions resulted into maximum benefit:cost ratio of 1.59 over other treatments under study.

References

Ambad, S. N., Takte, R. L. and Bankar, M. C. 2002. Effect of fertigation on gerbera. Natl. Sympo. on 'Indian Floriculture in the New Millennium' Feb. 25-27, Uttakmand, pp. 9.

Anonymous. 2008. Development of precision farming techniques for carnation under polyhouse. Annual Rep., Precision Farming Development Centre, MPKV, Rahuri (M.S.), pp. 07-10.

Atre, A. A., Gorantiwar, S. D., Patil, H. M. and Bhoi, D. V. 2005. Yield and water use efficiency of capsicum grown under polyhouse. All India Sem. on 'Potential and Prospects for Protected Cultivation', Dec. 12-13, Ahmednagar. pp. 142-144.

Firake, N. N. and Kumbhar, D. B. 2002. Effect of different levels of N,P and K fertigation on yield and quality of pomegranate. J. Maharashtra agic. Univ., 27(2): 146-148.

Gorantiwar, S. D., Barai, V. N., Patil, H. M., Ghorge, V. D., Jadhavrao, K. S. and Mane, R. B. 2003. Effect of polyhouse, shadenet and open cultivation on yield and water use efficiency of cucumber. All India Sem. on 'Potential and Prospects for Protected Cultivation', Dec. 12-13. Ahmednagar, pp. 179-184.

Kadam, U. S., Takte, R. L. and Deshmukh, M. R. 2007. Effect of different media on performance of gerbera under polyhouse, J. Maharashtra agic. Univ., 32(3): 329-331.

Sujatha, K. J., Narayana Gowda and Khan, M. M. 2002. Effect of different fertigation levels on gerbera under low cost greenhouse, J. Orn. Hort., 5(1): 54-59.

J. Agric. Res. Technol., 37 (2) : 289-294 (2012)

Effect of Moisture Content on Various Physical Properties of Lathyrus (*Lathyrus sativus* L.)

R. N. Kenghe[1], P. M. Nimkar[2], S. S.Shirkole[3] and I. L. Pardeshi[4]
Department of Agricultural Process Engineering,
Dr. Panjabrao Deshmukh Krishi Vidyapeeth, Akola - 444 104 (India)
(Received : 15-06-2011)

Abstract

The moisture dependent physical properties of ten lathyrus varieties were studied at various moisture regimes 9.42 to 21.03 and 9.10 to 20.71 per cent (d.b.). The grain size, thousand grain weight and angle of repose were found increased linearly and the average increase was found to be 8.07, 15.11 and 21.32 per cent. The bulk density and true density values decreased linearly and the average decrease was found to be 15.01 and 13.71 per cent respectively, with the corresponding increase in moisture content. The sphericity and porosity increased initially and found decreased with further increase in moisture content. The best fit equations and coefficient of determination (R^2) was determined for the different levels of simulated moisture content.

Key words : Physical property, lathyrus, grain size, true density, bulk density, sphericity, porosity.

Physical properties of grains and their dependence on moisture content are of paramount importance in designing equipment for handling, storing and processing. The lathyrus (*Lathyrus sativus* L.) is food, feed and fodder legume (pulse) crop. To design a machine for handling, cleaning, conveying, storing and milling, the physical properties at different moisture contents must be known (Tabatabaeefar, 2003). It is revealed from the literature that the data on moisture dependent physical properties of lathyrus have not been reported so far. Therefore, present study was planned with objective to determine different moisture dependent physical properties of lathyrus.

Materials and Methods

The lathyrus samples of ten varieties *viz*., Ratan, Pratik, Mahateora, BIOR-231, Pusa-28, NLK-05, NLK-73, NLK-48, NLK-40 and NLK-36) were procured from All India Co-ordinated Research Project on Lathyrus, Nagpur. Physical properties of raw lathyrus were investigated in the simulated moisture range of 7.90 to 19.40, 6.75 to 18.30, 9.48 to 21.02, 9.79 to 21.34, 9.52 to 21.04, 9.03 to 20.61, 9.91 to 21.49, 9.22 to 20.83, 9.42 to 21.03 and 9.10 to 20.71 per cent (d.b.) respectively, The samples of desired moisture contents were prepared by adopting the method suggested by Yalcin (2006).

The grain size, sphericity and true density of the samples were calculated using the methods given by Mohsenin (1986). The bulk density of the grain sample was calculated using the procedure given in IS: 4333 (Part lll)-1967. The procedure as described in IS:4333 (Part IV) - 1968 was adopted to determine the values of thousand grain weight. The angle of repose was determined with standard equipment developed by the department. The porosity was calculated as the ratio of the difference in true density and bulk density to the true density value and expressed in percentage.

1. Assistant Professor, 2. Associate Dean, 3. PG student and 4. Asso. Professor.

The results obtained were analyzed by using completely randomized design for the analysis of variance showing the effect of moisture content on these physical properties. The treatment effects were analyzed using ANOVA PROC of SPSS software.

Results and Discussion

Grain size (D_m) : The grain size increased linearly with increase in moisture content (M) as shown in Fig. 1. The average pen cent increase in grain sizes of these lathyrus grains were 8.07 per cent. The results showing increase in grain size with increase in moisture content were in agreement with the earlier findings for lentil seeds (Amin *et al*. 2004), minor millets (Balasubramanian and Viswanathan, 2010) and for lathyrus (Zewdu and Solomon, 2008).

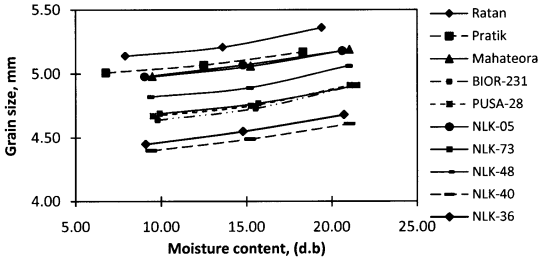

Fig. 1. Effect of moisture content on grain size of different varieties of lathyrus.

The variation in grain sizes with moisture content could be represented by following equations.

Ratan	D_m=4.975 + 0.13M	(R^2=0.9590)	(1)
Pratik	D_m=4.909 + 0.13M	(R^2=0.9800)	(2)
Mahateora	D_m=4.799 + 0.18M	(R^2=0.9810)	(3)
Pusa-28	D_m=4.458 + 0.020M	(R^2=0.9650)	(4)
BIOR-231	D_m=4.396 + 0.023M	(R2=0.9650)	(5)
NLK-05	D_m=4.820 + 0.01M	(R^2=0.9970)	(6)
NKL-73	D_m=4.491 + 0.019M	(R^2=0.9760)	(7)
NLK-48	D_m=4.612 + 0.020M	(R2=0.9450)	(8)
NLK-40	D_m=4.224 + 0.018M	(R^2=0.9930)	(9)
NLK-36	D_m=4.265 + 0.019M	(R^2=0.9950	(10)

Thousand grain weight (wt) : The linear increase in thousand grain weight with increase in the moisture content was observed as shown in Fig. 2. The average percentage increase was found to be 15.11 per cent. Similar results of effect of grain moisture on thousand grain weight have been reported for wheat (Karimi *et al*. 2009), for bay laurel seeds (Yurtlu *et al*. 2010) and sunflower seed (Javad *et al*. 2011). The relationship between thousand grain weight and moisture content could be represented by the following equations.

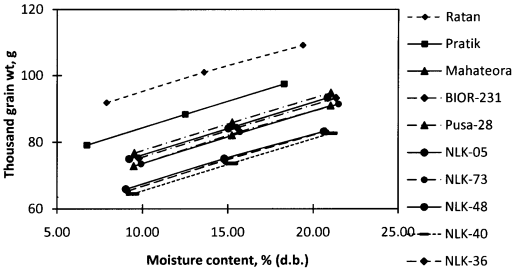

Fig. 2. Effect of moisture content on thousand grain weight of different varieties of lathyrus.

Ratan	wt=80.08 + 1.506M	(R^2=0.9985)	(11)
Pratik	wt=68.54 + 1.580M	(R^2=1)	(12)
Mahateora	wt=58.04 + 1.576M	(R^2=0.9999)	(13)
Pusa-28	wt=61.85 + 1.568M	(R^2=0.9999)	(14)
BIOR-231	wt=60.00 + 1.558M	(R^2=0.9999)	(15)
NLK-05	wt=52.66 + 1.492M	(R^2=0.9986)	(16)
NLK-73	wt=58.40 + 1.547M	(R^2=0.9981)	(17)
NLK-48	wt=60.51 + 1.573M	(R^2=1)	(18)
NLK-40	wt=49.86 + 1.559M	(R^2=1)	(19)
NLK-36	wt=51.51 + 1.537M	(R^2=0.9993)	(20)

Angle of repose (Φ) : The angle of repose showed an increasing trend with moisture content as shown in Fig.3. The average per cent increase in angle of repose was 21.32 per cent. At higher moisture content within the experimental range, grain might tend to stick

together resulting in better stability and less flowability, which increased the value of angle of repose. Similar results have been reported for sorghum grain (Mahapatra *et al*. 2002) and for soybean (Kibar and Ozturk, 2008).

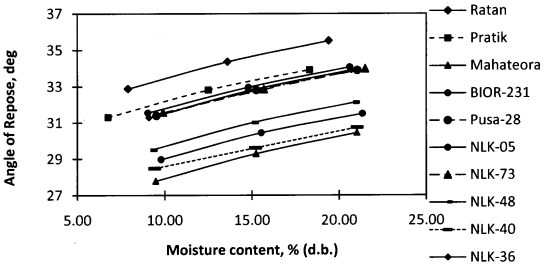

Fig. 3. Effect of moisture content on angle of repose of different varieties of lathyrus.

The following general expressions can be used to describe the relationship between moisture content and angle of repose.

Ratan	Φ=31.31 + 0.228M	(R^2=0.9933)	(21)
Pratik	Φ=29.84 + 0.226M	(R^2=0.9918)	(22)
Mahateora	Φ=25.64 + 0.23M	(R^2=0.9942)	(23)
Pusa-28	Φ=29.38 + 0.271M	(R^2=0.9943)	(24)
BIOR-231	Φ=26.89 + 0.219M	(R^2=0.9903)	(25)
NLK-05	Φ=29.64 + 0.217M	(R^2=0.9949)	(26)
NLK-73	Φ=29.53 + 0.208M	(R^2=0.9986)	(27)
NLK-48	Φ=27.48 + 0.225M	(R^2=0.9924)	(28)
NLK-40	Φ=26.64 + 0.194M	(R^2=1)	(29)
NLK-36	Φ=29.30 + 0.225M	(R^2=0.9926)	(30)

Bulk density (ρb) : A linear decreasing trend was observed in values of bulk density as shown in Fig. 4. The average per cent decrease in bulk density of these lathyrus grains was 15.1 per cent.

The relative reduction in the densities at high moisture content could be attributed to less weight gain due to the added moisture in relation to the concomitant volumetric expansion of the grain. Similar trend has been

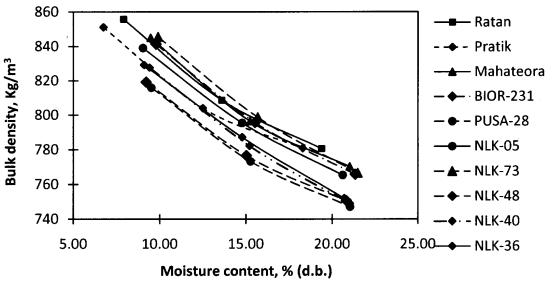

Fig. 4. Effect of moisture content on bulk density of different varieties of lathyrus.

observed for pigeonpea (Baryeh and Mangope, 2002), minor millets (Subramanian and Viswanathan, 2006), and for wheat kernels (Dziki *et al*. 2010). The bulk density was found to bear the following relationship with moisture content.

Ratan	ρb=904.2 - 6.537M	(R^2=0.9970)	(31)
Pratik	ρb=888.0 - 6.080M	(R^2=0.9601)	(32)
Mahateora	ρb=902.5 - 5.475M	(R^2=0.9700)	(33)
Pusa-28	ρb=869.9 - 5.967M	(R^2=0.9800)	(34)
BIOR-231	ρb=902.5 - 6.535M	(R^2=0.9840)	(35)
NLK-05	ρb=894.3 - 6.368M	(R^2=0.9880)	(36)
NLK73	ρb=910.6 - 6.818M	(R^2=0.9880)	(37)
NLK-48	ρb=870.9 - 5.915M	(R^2=0.9800)	(38)
NLK-40	ρb=889.5 - 6.779M	(R^2=0.9910)	(39)
NLK-36	ρb=888.3 - 6.651M	(R^2=0.9960)	(40)

True density (ρt) : The true density values decreased linearly with increase in moisture content as shown in Fig. 5. The average per cent decrease in bulk density of these grains was 13.71 per cent.

The decrease in true density value for the lathyrus grain with increase in moisture content might be attributed to the relatively higher true volume as compared to corresponding mass of the grain attained due to absorption of water. Similar trends were reported for sorghum seeds (Mwithiga and Sifuna, 2005) and for rough rice (Araghi *et al*. 2010). The relationship between true density and moisture content could be

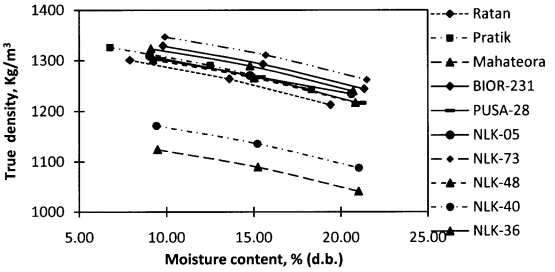

Fig. 5. Effect of moisture content on true density of different varieties of lathyrus.

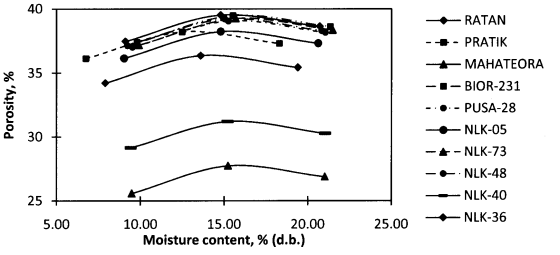

Fig. 6. Effect of moisture content on true porosity of different varieties of lathyrus.

represented with the following equations.

Ratan	$\rho t=1364 - 7.725M$	($R^2=0.9930$)	(41)
Pratik	$\rho t=1377 - 7.261M$	($R^2=0.9920$)	(42)
Mahateora	$\rho t=1195 - 7.223M$	($R^2=0.9920$)	(43)
Pusa-28	$\rho t=1378 - 7.584M$	($R^2=0.9900$)	(44)
BIOR-231	$\rho t=1403 - 7.394M$	($R^2=0.9920$)	(45)
NLK-05	$\rho t=1367 - 6.460M$	($R^2=0.9990$)	(46)
NLK-73	$\rho t=1422 - 7.361M$	($R^2=0.9920$)	(47)
NLK-48	$\rho t=1371 - 7.344M$	($R^2=0.9920$)	(48)
NLK-40	$\rho t=1240 - 7.164M$	($R^2=0.9920$)	(49)
NLK-36	$\rho t=1391 - 7.245M$	($R^2=0.9900$)	(50)

Porosity (ε) : The variations in porosity with moisture content are graphically shown in Fig. 6. This indicated that the porosity of lathyrus grain increased initially and then decreased with increase in moisture content. The initial increase in porosity value might be due to the higher decrease in true density value than bulk density value. It also indicated that porosity of seeds of different crops could respond differently for changes in the moisture content, which could be attributed to the relative changes in length, width and thickness, and associated bulk and true densities.

This observed trend was in conformity with the results reported for lathyrus and soybean by Zewdu and Solomon (2008) and Kibar and Ozturk (2008), respectively.

The relationship between porosity and moisture content for different varieties of lathyrus is described by second degree polynomial equations. The results obtained showed that the moisture content and the porosity values of lathyrus grains are poorly correlated.

Ratan	$\varepsilon=26.24 + 1.380M - 0.46M^2$	($R^2=1$)	(51)
Pratik	$\varepsilon=29.91 + 1.226M - 0.044M^2$	($R^2=1$)	(52)
Mehateora	$\varepsilon=15.52 + 1.487M - 0.045M^2$	($R^2=1$)	(53)
Pusa-28	$\varepsilon=27.21 + 1.451M - 0.044M^2$	($R^2=1$)	(54)
BIOR-231	$\varepsilon=27.12 + 1.485M - 0.044M^2$	($R^2=1$)	(55)
NLK-05	$\varepsilon=26.86 + 1.434M - 0.045M^2$	($R^2=1$)	(56)
NLK-73	$\varepsilon=26.67 + 1.502M - 0.044M^2$	($R^2=1$)	(57)
NLK-48	$\varepsilon=27.71 + 1.431M - 0.044M^2$	($R^2=1$)	(58)
NLK-40	$\varepsilon=19.38 + 1.455M - 0.044M^2$	($R^2=1$)	(59)
NLK-36	$\varepsilon=28.35 + 1.398M - 0.043M^2$	($R^2=1$)	(60)

Sphericity (S) : The results indicated (Fig. 7) that the sphericity of lathyrus grains at different moisture content increased initially and further decreased with increase in moisture content.

The initial increase of sphericity could be due to relatively proportional increase in length, width and thickness. However, beyond second moisture content there was relatively greater increase in length as compared to width and thickness which might probably be resulted in slight reduction in sphericity (Zewdu and Solomon, 2008). This indicates that different grains might behave differently in terms of the

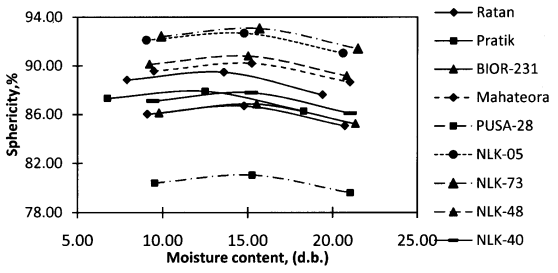

Fig. 7. Effect of moisture content on true porosity of different varieties of lathyrus.

relative changes in length, width and thickness which could affect sphericity. The sphericity and the moisture content of the lathyrus could be correlated as

Ratan	$S=83.95 + 0.913M - 0.037M^2$	($R^2=1$)	(61)
Pratik	$S=83.82 + 0.742M - 0.033M^2$	($R^2=1$)	(62)
Mahateora	$S=83.73 + 0.927M - 0.033M^2$	($R^2=1$)	(63)
Pusa-28	$S=74.81 + 0.887M - 0.031M^2$	($R^2=1$)	(64)
BIOR-231	$S=79.61 + 1.004M - 0.034M^2$	($R^2=1$)	(65)
NLK-05	$S=86.82 + 0.882M - 0.032M^2$	($R^2=1$)	(66)
NLK-73	$S=85.87 + 1.003M - 0.034M^2$	($R^2=1$)	(67)
NLK-48	$S=84.28 + 0.948M - 0.034M^2$	($R^2=1$)	(68)
NLK-40	$S=80.95 + 0.986M - 0.035M^2$	($R^2=1$)	(69)
NLK-36	$S=80.33 + 0.935M - 0.034M^2$	($R^2=1$)	(70)

From the results of the study it could be concluded that the grain size, thousand grain weight and angle of repose increased linearly with increase in moisture content. The bulk density and true density decreased linearly with increase in moisture content. Whereas, the sphericity and porosity exhibited an initial increase followed by a decrease with increase in moisture content for different varieties of lathyrus.

Acknowledgements

The authors acknowledged the financial support provided by Sakal India Foundation, Pune for conducting this experiment.

References

Amin, M. N., Hossain, M. A. and Roy, K. C. 2004. Effect of moisture content on some physical properties of lentil seeds. J. Food Eng. 65: 83-87.

Araghi, H. A., Sadeghi M., and Hemmat A. 2010. Physical properties of two rough rice varieties affected by moisture content. Int. Agrophysics. 24: 205-207.

Balasubramanian, S. and Viswanathan, R. 2010. Influence of moisture content on physical properties of minor millets. J. Food Sci. and Technol. 47(3): 279-284.

Baryeh, E.A. and Mangope, B.K. 2002. Some physical properties of pigeon pea (cv. QP-38) J. Food Eng. 56: 59-65.

Dziki, D., Laskowski, J., Siastala, J. and Biernacka, B. 2010. Influence of moisture content on wheat kernel. Int. Agrophysics. 24: 237-242.

ISI. 1968. IS: (4333 Part-IV) Methods of analysis for food grains. Weight of 1000 grains, Indian Std. Inst., New Delhi

ISI. 1967. IS: (4333 Part-III) Methods of analysis for food grains. Determination of hectoliter weight. Indian Standard Institution, New Delhi.

Javad, T., Asghar, M., Meysam, K. and Rad, 2011. Moisture-dependent engineering properties of sunflower (cv. Armaviriski). Australian J. Agric. Eng. 2(2): 40-44.

Karimi, M., Kheiralipour, K., Tabatabaeefar, A., Khoubakht, G., Naderi, M. and. Heidarbeigi, K. 2009. The effect of moisture content on physical properties of wheat. Pakistan J. Nutrition 8(1): 90-95.

Kibar, H. and Ozturk, T. 2008. Physical and mechanical properties of soybean. Int. Agrophysics. 22: 239-244.

Mahapatra, A. K., Patrick, C. and Diau, P. 2002. Effect of moisture content on some physical properties of sorghum (cv. Mahube) seeds. J. Agric. Eng. 11(1): 1-10.

Mohsenin, N. N. 1986. Physical properties of plant and animal materials, 2nd edn. Gordon and Breach Sci. Publ., New York.

Mwithiga, G. and Sifuna, M.M. 2005. Effect of moisture content on the physical properties of three varieties of sorghum seeds. J. Food Eng. 75: 480-486.

Subramanian, S. and Viswanathan, R. 2006. Bulk density and friction coefficients of selected minor millets and flours. J. Food Eng. 81(1): 118-126.

Tabatabaeefar, A. 2003. Moisture dependent physical

properties of wheat. Int. Agrophysics. 17: 207-211.

Yalcin, I. 2006. Physical properties of cowpea seed. J. Food Eng. 79: 59 -62.

Yurtlu, Y. B., Yesiloglu, E. and Arslanoglu, F. 2010. Physical properties of bay laurel seeds. Int. Agrophysics. 24: 325- 328.

Zewdu, A. and Solomon, W. 2008. Moisture dependent physical properties of grass pea (*Lathyrus sativus* L.) seeds. Int. J. Agric. Eng. (CIGR e-journal) Manuscript, FP 06 027 10, 102-109.

J. Agric. Res. Technol., 37 (2) : 294-299 (2012)

Studies on Ground Water Pollution due to Sewage Water

R. G. Bhagyawant[1], D. D. Khedkar[2], R. G. Naik[3], and P. G. Popale[4]
Marathwada Krishi Vidyapeeth, Parbhani - 431 402 (India)
(Received : 31-12-2011)

Abstract

Initial analysis of sewage water sample found strongly' alkaline in nature with cations followed decreasing order of $Na^+ > Ca^{++} > Mg^{++} > K^+$. Whereas, anions followed decreasing order of $HCO_3^- > Cl^- > SO_4^- > CO_3$. The sewage water was classified under C_3S_1 irrigation class, at which indicated marginal salinity and safe use for irrigation purpose under well drained condition of soil. After passing through soil column pH decreased and EC increased. In respect of cations leachate showed increase in Ca^{++} and Mg^{++} and decrease in Na^+ ions. The calcium and bicarbonate dominated ions may have increased the soil pH and affected structure of soil. Average value of hydraulic conductivity of soil irrigated by well water was 1.01 m day^{-1} and soil irrigated by bore well water was 0.7678 m day^{-1}.

Key words : Irrigation, sewage water, water pollution, soil column, EC, pH etc.

Many problems are associated with the use of sewage water for irrigation. Soils continuously irrigated with sewage water that leads to the closing of soil pores by the colloidal particles and suspended solids present in sewage water leading to anaerobic conditions in the soil. In view of above facts it was proposed to study the ground water pollution due to sewage water in Parbhani city. The main objectives of present study were to study the characteristics of sewage water and ground water and its effect on soil properties.

1. Associate Professor, 2. Assistant Professor, 3. and 4. M.Tech. student.

Materials and Methods

The experimental site selected for the study was start from outlet of sewage water near railway bridge in Parbhani to the outlet of Pingalgad nala and also the outlet of sewage water start from in left of Horticulture College to outlet of Pingalgad nala. The total 15 samples were collected from groundwater in which 10 from well and 5 from bore well along right and left side of waste water stream as well as Pingalgad nala. These samples were analysed for pH, electrical conductivity (EC), cations (Ca^{++}, Mg^{++}, Na^+, K^+) as well as anions (CO_3^-, Cl^-, SO_4^-). From cations and anions, the derived parameters like Sodium

Adsorption Ratio (SAR) and Residual Sodium Carbonate (RSC) were calculated.

The soil samples were collected from the two fields, one from well irrigated field and another from bore well irrigated field, with a view to study the movement of pollutants through soil column. The leachate obtained after passing the groundwater and wastewater through soil column and soil were analyzed for pH, electrical conductivity, cations (Ca^{++}, Mg^{++}, Na^{+}, K^{+}) as well as anions (CO_3^{-}, HCO_3^{-}, Cl^{-}, SO_4^{-}).

Soil column study : Two columns i.e. one column of 13.30 cm diameter and other column of 10.20 cm diameter were used for experimental study purpose. The columns were constructed with the PVC pipes of 1mm thick and different diameters i.e. 13.30 and 10.20 cm of 100 cm height. The one end of these PVC pipe column was pack with perforated end cap for passing out leachate and another end was kept open to fill the soil, sewage water and groundwater. Filter paper was placed at the bottom of the end cap. The mixture of coarse and fine sand layer (10 cm) was placed above the filter paper and another filter paper was placed above these coarse and fine sand layer. The soil was filled in column up to height of 40 cm.

Results and Discussion

Important agricultural water quality parameters include a number of specific properties of water that are relevant in relation to the yield and quality of crops, maintenance of soil productivity and protection of the environment. These parameters mainly consist of certain physical and chemical characteristics of water.

Total dissolved salts : Total Dissolved Salts (TDS) are one of the most important agricultural water quality parameters. It was observed (Table 1) that, total dissolved salts of sewage water sample were found in the range of 646.50 to 912.40 mg L^{-1} with an average value of 779.45 mg L^{-1}. It indicated slight salinity hazard (TDS in between 500-1000 mg L^{-1}) in using this water for agricultural purpose.

Electrical conductivity (EC) : The municipal waste water indicated that the EC value of range between 1.28 to 1.59 dSm^{-1} with an average value of 1.435 dSm^{-1} with low SAR. That means this water can be used for irrigation purpose without treatment.

pH : pH is an indicator of acidity or alkalinity of water. The normal pH range for irrigation water is 6.5 to 8.4. pH values outside this range are a good warning that the water is abnormal in quality. It was found from the analysis of sewage water that the pH value ranged from 7.40 to 7.81 with an average value of 7.605 indicating that this water is of normal quality.

Total cation concentration : The sodium was dominant cation observed in sewage water samples ranging form 11.50 to 13.70 me L^{-1} with an average value of 12.60 me L^{-1}. As the concentration of sodium in sewage water is greater than 9 me L^{-1}, it may cause the severe problem for its use as an irrigation water. The calcium, magnesium and potassium content varied from 4.10 to 5.40,0.25 to 3.40 and 0.24 to 1.21 me L^{-1} respectively. The average value of the calcium, magnesium and potassium content was found 4.75, 1.82 and 0.725 me L^{-1} respectively. The cations were observed in the order $Na^{+} > Ca^{++} > Mg^{++} > K^{+}$.

The normal cations in irrigation water are $Ca^{++} > Mg^{++} > Na^{+} > K^{+}$, but this water dominated by Na^{+} cations which may have detrimental effect on soil which affects germination of seeds of bajara, wheat, soybean etc. in black soils.

Total anion concentration : The chloride was dominant anion observed in all samples ranging from 3.50 to 9.60 me L^{-1} with an average value 6.55 me L^{-1}. The concentration of chloride in sewage water sample in between 4-10 me L^{-1}, it may cause the problem for its use as irrigation water. The carbonate, bicarbonate and sulphate varied from 0.8 to 2, 2.90 to 4.30 and 0.65 to 5.65 me L^{-1} respectively. The average value of the carbonate, bicarbonate and sulphate content was found 1.4, 3.60 and 3.15 me L^{-1} respectively. The anions were observed in order $Cl^- > HCO_3^- > SO_4^- > CO_3$. Chloride type salinity was observed in water which reflects the accumulation of salts of chloride on surface of soil which affect the plant growth (Naik, 2011).

Sodium adsorption ration (SAR) : The SAR of sewage water ranges from 7.79 to 6.53 with an average value of 6.95. As per the classification suggested by Richards (1954) waste water is of S_1 class (SAR < 10) and can be used for irrigation of shallow to medium well drained black soil.

Irrigation class : The overall analysis of sewage water indicated that the sewage water was marginal salinity and safe use for irrigation purpose and required controlled use of water in combination with salt tolerant crops.

EC : The electrical conductivity (EC) of ground water samples were ranged from 1.36 to 2.51 dSm^{-1} with an average value of 1.93 dSm^{-1}. As per classification suggested by Richards (1954) groundwater is of poor quality

Table 1. Effect of sewage water on quality of groundwater (well water and bore well water) from six months.

Well/ bore well water	Side	Distance from sewage water stream (m)	pH	EC (dS m^{-1})	Cation concentration (me L^{-1})				Anion concentration (me L^{-1})				SAR	TDS (mg L^{-1})
					Na	Ca	Mg	K	HCO_3	SO_4	CO_3	Cl		
Well	Right	10.0	15.0	7.21	2.18	5.87	9.70	11.33	0.40	10.90	9.02	1.72	12.51	1.9
Well	Right	16.5	7.79	2.12	6.12	9.68	12.62	0.45	8.22	6.44	2.30	13.78	1.80	2123.3
Well	Right	28.0	7.53	1.80	5.09	8.05	11.91	0.34	10.69	6.45	1.99	10.06	1.66	1666.0
Well	Right	32.2	7.54	2.19	5.33	8.93	12.35	1.66	10.3	7.35	1.62	13.87	1.65	2078.2
Well	Left	82.0	7.45	1.95	5.22	7.63	8.73	0.18	7.04	5.03	2.28	8.18	1.91	3140.8
Bore well	Left	106.0	7.78	1.69	4.71	6.60	9.22	0.44	7.19	6.44	3.78	9.48	1.88	1402.3
Well	Left	149.0	7.55	2.40	4.97	7.53	12.02	0.32	6.70	7.61	1.45	11.15	1.67	2118.9
Well	Right	194.6	7.34	2.51	5.71	8.01	13.11	0.47	5.65	7.00	1.87	11.4	1.85	1892.2
Well	Right	210.5	7.86	1.86	5.15	7.3	9.55	0.59	7.52	7.10	2.30	10.8	1.78	2369.5
Bore well	Right	326.5	7.15	1.43	5.16	8.41	10.83	0.39	8.37	7.16	2.06	11.72	1.78	2139.1
Well	Left	385.0	7.11	1.67	5.23	8.01	12.1	0.24	6.55	6.25	2.36	10.8	1.74	1623.0
Bore well	Right	449.3	7.39	2.06	4.73	7.45	10.61	0.64	8.27	6.30	1.9	13.78	1.68	1552.0
Well	Left	479.5	7.41	1.91	5.94	9.79	11.99	0.59	8.91	6.71	1.70	12.25	1.85	1452.5
Bore well	Left	490.0	6.93	1.36	4.93	7.05	9.99	0.46	6.16	5.27	1.66	7.56	1.86	1092.3
Bore well	Left	541.7	7.06	1.72	5.64	7.75	10.78	0.53	8.09	5.56	1.85	9.98	1.90	1336.6
Maximum			7.86	2.51	6.12	9.79	13.11	1.66	3.78	10.90	9.02	13.87	1.91	3140.8
Minimum			6.93	1.36	4.71	7.05	8.73	0.18	1.45	5.65	5.03	7.56	1.65	1092.3
Mean			7.39	1.93	5.41	8.42	10.92	0.92	2.61	8.27	7.025	10.71	1.78	2116.6
SE±			0.29	0.26	0.33	1.03	1.77	0.11	1.01	1.65	0.35	1.65	0.15	563.4
CD at 5%			NS	NS	NS	NS	NS	NS	2.82	NS	NS	NS	NS	NS

(EC > 2.25 dSm^{-1}) with high salinity.

Total cation concentration : The magnesium was dominant cation observed in all samples ranging from 8.73 to 13.11 me L^{-1} with an average value of 10.92 me L^{-1}. The calcium, sodium and potassium content varied from 7.05 to 9.79, 4.71 to 6.12 and 0.18 to 1.66 me L^{-1} respectively. The average value of the calcium,sodium and potassium content was found 8.42,5.41 and 0.92 me L^{-1} respectively. The cations were observed in the order of $Mg^{+} > Ca^{++} > Na^{+} > K^{+}$. The normal cations in irrigation water are $Ca^{++} > Mg^{++} > Na^{+} > K^{+}$, but this water dominated by Mg^{++} cations which may behave like sodium in which magnesium causes detrimental effect on clay type of soil reflecting effect on germination on many millet seed (Naik, 2011).

Total anion concentration : The chloride was dominant anion observed in all samples ranging from 7.56 to 13.87 me L^{-1} with an average value 10.71 me L^{-1}. The carbonate, bicarbonates and sulphate content varied from 1.45 to 3.78, 5.65 to 10.90 and 5.03 to 9.02 me L^{-1} respectively. The average values of carbonate, bicarbonates and sulphate content was found 2.61, 8.27 and 7.025 me L^{-1} respectively. The anions were observed in the order of $Cl^{-} > HCO_3 > SO_4^{-} > CO_3$ which may cause encrustation of chloride salts on surface of soil.

Sodium adsorption ratio (SAR) : The SAR of ground water (well and bore well water) ranges from 1.65 to 1.91 with an average value of 1.78. As per the classification suggested by Richards (1954) ground water is of S_1 class (SAR < 10) having low sodium and can be used for irrigation under good drainage condition.

Total dissolved salts : The total dissolved salts concentration of groundwater (well and bore well water) samples ranges from 1092.3

Table 2. Chemical properties of sewage water before and after column study.

Parameter	Sewage water (before)	Sewage water (lechate)	Unit
Chemical parameters :			
pH	8.7	8.28	-
EC	1.72	2.43	dSm^{-1}
TDS	1194.60	1540.20	Mg L^{-1}
Concentration of cations :			
Calcium	1.95	9.30	me L^{-1}
Magnesium	1.7	7.60	me L^{-1}
Sodium	8.6	6.30	me L^{-1}
Potassium	0.18	0.14	me L^{-1}
Concentration of anions :			
Carbonate	0.60	0.84	me L^{-1}
Bicarbonate	6.50	7.50	me L^{-1}
Chloride	5.35	10.24	me L^{-1}
Sulphate	3.87	5.67	me L^{-1}
SAR	6.36	2.18	-
Irrigation class	C_3S_1	C_4S_1	-

Table 3. Chemical properties (well water) before and after column study.

Parameters	Well water (before)	Well water (lachate)	Unit
Chemical parameters :			
pH	7.69	7.57	-
EC	887.45	1119.10	me L^{-1}
TDS	1.39	1.97	dSm^{-1}
Concentration of cations :			
Calcium	8.4	9.3	me L^{-1}
Magnesium	4.8	7.23	me L^{-1}
Sodium	4.49	2.07	me L^{-1}
Potassium	0.09	0.24	me L^{-1}
Concentration of anions :			
Carbonate	1.5	0.72	me L^{-1}
Bicarbonate	8.80	7.28	me L^{-1}
Chloride	5.0	11.20	me L^{-1}
Sulphate	1.90	7.37	me L^{-1}
SAR	1.74	0.720	-
Irrigation class	C_3S_1	C_3S_1	-

to 3140.8 mg L^{-1} with an average value 2116.55 mg L^{-1}. It indicated moderate hazard (TDS in between 1000-2000 mg L^{-1}) for use of water to agricultural crop under restricted drainage condition.

Sewage water analysis before and after passing through soil column : It was revealed from Table 2 that the pH of sewage water after passing through soil column was decreased from 8.7 to 8.28 whereas, electrical conductivity increased from 1.72 to 2.43 dSm^{-1}. During column study, lechate showed slightly increase in Ca^{++}, Mg^{++} (1.95 to 9.3 and 1.7 to 7.6 me L^{-1}) and decrease in Na^{+} and K^{+} (8.6 to 6.3 and 0.18 to 0.14 me L^{-1}) ions. Before passing sewage water through soil column the cations followed decreasing order of $Na^{+} > Ca^{++} > Mg^{++} > K^{+}$, whereas, after passing through soil column the cations followed decreasing order of $Ca^{++} > Mg^{++} > Na^{+} > K^{+}$. This might be due to moderate alkaline condition and precipitation of Ca^{++} and Mg^{++} take place and leached from the soil whereas, Na^{+} adsorbed on soil clay complex. In respect of anions during column study the lechate showed increase in HCO_3^-, CO_3, Cl^- and SO_4^- (6.5 to 7.5, 0.6 to 0.84, 5.35 to 10.24 and 3.87 to 5.67 meL^{-1}) (Naik, 2011). Before passing sewage water through soil column the anions followed decreasing order of $HCO_3^- > Cl^- > SO_4^- > CO_3$ whereas, after passing sewage water through soil column the anions followed decreasing order of $Cl^- > HCO_3^- > SO_4^- > CO_3$. The chloride and bicarbonate increased after passing sewage water through soil column. This might be due to higher solubility and mobility of chloride in the soil column.

The SAR decreased from 6.36 to 2.18 after passing sewage water through soil column. The total dissolved salt was found increased from 1194.60 to 1540.27 mg L^{-1}.

Characterization of groundwater (well water and bore well water) before and after passing through soil column : It is revealed from Table 3 and 4 that the pH of well water and bore well water after passing through soil column was decreased (well water 7.69 to 7.57 and bore well water 7.63 - 6.25). It was decreased due to chemical ingredients normalized after sewage water passing through different soil columns (Naik, 2011). Whereas, electrical conductivity of well and bore well water slightly increased (well water from 1.39 to 1.97 dSm^{-1} and for bore well water 0.90 to 2.34 dSm^{-1}).

During column study, lechate showed slightly increase in Ca^{++}, Mg^{++} and K^{+} (8.4 to 9.3, 4.8 to 7.23 and 0.09 to 0.24 me L^{-1}) and decrease in Na^{+} (4.49 to 2.07 me L^{-1}) ions for well water (5.2 to 10.20, 3.9 to 6.2 and 0.03 to 0.133 me L^{-1}) and decrease in Na^{+} (4.41 to 2.29 me L^{-1}) for bore well water. Before passing groundwater (well water) through soil

Table 4. Chemical properties (bore well water) before and after column study.

Parameters	Bore well water (before)	Bore well water (lachate)	Unit
Chemical parameters :			
pH	7.63	6.25	me L^{-1}
EC	689.90	867.20	dSm^{-1}
TDS	0.90	2.34	
Concentration of cations :			
Calcium	5.2	10.20	me L^{-1}
Magnesium	3.9	6.2	me L^{-1}
Sodium	4.41	2.29	me L^{-1}
Potassium	0.03	0.133	
Concentration of anions :			me L^{-1}
Carbonate	1.62	0.93	me L^{-1}
Bicarbonate	7.20	6.00	me L^{-1}
Chloride	4.00	12.67	me L^{-1}
Sulphate	2.00	7.49	me L^{-1}
SAR	2.06	0.799	-
Irrigation class	C_3S_1	C_4S_1	-

column the cations followed decreasing order of $Ca^{++} > Mg^{++} > Na^{+} > K^{+}$ and for bore well water cation follow decreasing order $Ca^{++} > Na^{+} > Mg^{++} > K^{+}$. Whereas, after passing well and bore well water through soil column the cations followed decreasing order of $Ca^{++} > Mg^{++} > Na^{+} > K^{+}$. From this it is indicated that, calcium increased and sodium decreased after passing the groundwater through soil column for well and bore well water, this might be due to increased soluble salts through groundwater.

In respect of anions during column study the lechate showed increase in Cl^{-} and SO_4^{-} both for well water and bore well water (well water 5 to 11.20 and 1.90 to 7.37 me L^{-1} and for bore well water 4 to 12.67 and 2 to 7.49 me L^{-1} ions and decreased in bicarbonate (8.80 to 7.28 me L^{-1} for well water and 7.2 to 6.00 me L^{-1} for bore well water). Also carbonate decreased for well water from 1.5 to 0.72 me L^{-1} and bore well water from 1.62 to 0.93 me L^{-1}. Before passing groundwater (well and bore well water) through soil columns, the anions followed decreasing order of $HCO_3^{-} > Cl^{-} > SO_4^{-} > CO_3$. Whereas, after passing it through soil column, the anions followed decreasing order of $Cl^{-} > SO_4^{-} > HCO_3^{-} > CO_3$. From this it indicated that chloride and sulphate increased for well water and bore well water and bicarbonate decreased after passing the well water and bore well through soil column this might be due to higher solubility and mobility of Cl^{-} and SO_4^{-} in soil.

The SAR decreased for well water from 1.74 to 0.720 and for bore well water 2.06 to 0.799 whereas, total dissolved salts were found increased for well water from 887.45 to 1119.10 mg L^{-1} and for bore well water from 689.90 to 867.20 mg L^{-1}.

Conclusion : The sewage water which is having marginal salinity was found average value of hydraulic conductivity of soil irrigated by well water was 1.01 m day^{-1} and soil irrigated by bore well water was 0.7678 m day^{-1}.

References

Naik, R. G. 2011. M.Tech thesis submitted to Marathwada Krishi Vidyapeeth, Parbhani.

Richards, L. A. 1954. Diagnosis and improvement of saline sodic soil. USDA Handbook No. 60 Washington 69-82.

Richards, L. A. 1968. Diagnosis and improvement of saline and alkali soils United State Salinity Lab. L. Staff. Agril. Handbook. No. 60. Oxford and IBH. Publ. Co. Calcutta, pp. 1-56.

J. Agric. Res. Technol., 37 (2) : 300-305 (2012)

Probability Models for Prediction of Rainfall at Solapur, Maharashtra

C. M. Pradeep[1], Yasmin[2] and S. R. Bhakar[3]
Dept. of Soil and Water Engineering,
College of Technology and Engineering, Udaipur - 313 001 (India)
(Received : 08-07-2011)

Abstract

The analysis indicated that normal (0.17), log-normal (0.19), pearson type III (0.19) and log-pearson type III (0.19) distributions were best fitted for the maximum one day rainfall with minimum D-index values. Pearson type III distribution was best fit for the maximum weekly, monthly, seasonal (*kharif*) and annual rainfalls but the distribution was unfit for the seasons of *rabi* and zaid. From the result it is concluded that exponential distribution is not fit for the study area.

Key words : Exponential, log-normal, normal, pearson type III, log-pearson type III distributions and rainfall prediction.

Solapur (17°42' N latitude and 75°48' E longitude and 457 m above mean sea level altitude) located on the south east edge of the state and lies entirely in Bhima and Seena basins. The entire district is drained by the Bhima river. The average rainfall of the station is about 732.4 mm. but the rainfall is highly erratic and irregular.

Probability analysis can be used for prediction of occurrence of future events from available records of rainfall with the help of statistical methods (Kumar and Kumar, 1989). Using the theoretical probability distributions, it would be possible to forecast the rainfall of various magnitudes with different periods. Several distributions have been used for hydrological analysis as given by Chow *et al*. (1988). Probability analysis of one day rainfall has been attempted for different places (Sharda and Bhushan, 1985; Agrawal *et al*. 1988; Mohanty *et al*. 2000 and Pradeep and Maheshwara Babu, 2010). An attempt has been made in present study to estimate the probable maximum one day, weekly, monthly, seasonal (i.e. *kharif*, *rabi* and zaid) and annual rainfall for different per cent of probability for Solapur by five probability distribution functions so as to select the best one.

1. M.E. student, 2. M.E. student CAE, Raichur and 3. Associate Professor.

Materials and Methods

The daily rainfall data of last 22 years (1987-2008) collected at Dry Farming Research Station; Solapur is used for this study. The values of maximum daily, weekly, monthly, seasonal (i.e. *kharif*, *rabi* and zaid) and annual rainfall of 22 years from 1987 to 2008 were arranged in descending order and the probability of exceedence P was obtained using WeibulP s formula

$$P=m/N+1 \quad \text{.....(1)}$$

Where P is the probability, N is the total number of years of record and m is the rank of observed rainfall values. The return period of rainfall is the reciprocal of the calculated probability of exceedence. The maximum one day, maximum weekly, maximum monthly, seasonal (i.e. *kharif*, *rabi* and zaid) and annual rainfall of Solapur were fitted to five probability distribution functions i.e. normal, log-normal,

exponential, pearson type III and log-pearson type III to predict maximum one day, maximum weekly, maximum monthly, seasonal (i.e. kharif, rabi and zaid) and annual rainfall. One day maximum, weekly maximum, seasonal maximum and annual rainfalls were determined manually. Probability distribution at different levels has been determined through computer software package VTFIT.

All five probability distribution functions are compared by D-index, which is adopted for verifying fitness of rainfall probability distributions. The test statistic was calculated from the relationship.

$$\text{D-Index} = \sum_{I=2}^{N} \frac{|\, x_i \text{ Observed} - x_i \text{ Extimated} \,|}{X} \quad (2)$$

Where, X = mean of the observed rainfall,

Table 1. Comparison of observed and estimated maximum one day rainfall for different probability distribution functions.

Probability of exceedance (%)	Observed rainfall (mm)	Estimated rainfall (mm)				
		Normal	Log normal	Expone-ntial	Pearson type III	Log pearson type III
10	111.56	102.17 (9.39)	104.72 (6.84)	171.22 (59.66)	111.31 (0.25)	103.85 (7.71)
25	87.45	89.00 (1.55)	87.21 (0.24)	103.08 (15.63)	88.57 (1.12)	87.31 (0.14)
50	73.8	74.36 (0.56)	71.17 (2.63)	51.54 (22.26)	68.73 (5.07)	71.62 (2.18)
75	60.7	59.72 (0.98)	58.08 (2.62)	21.39 (39.31)	54.08 (6.62)	58.40 (2.30)
90	46.44	46.55 (0.11)	48.37 (1.93)	7.83 (38.61)	44.76 (1.68)	48.37 (1.93)
Mean	75.99					
D - Index		0.17	0.19	2.31	0.19	0.19
Fitting condition		Best fit	Best fit	Unfit	Best fit	Best fit
SD		22.22	22.57	66.90	26.84	22.22
C.V. %		0.29	0.30	0.88	0.35	0.29

Note: The values in parenthesis represent the absolute deviation of observed and estimated rainfall

Table 2. Comparison of observed and estimated maximum weekly rainfall for different probability distribution functions.

Probability of exceedance (%)	Observed rainfall (mm)	Estimated rainfall (mm)				
		Normal	Log normal	Expone-ntial	Pearson type III	Log pearson type III
10	203.95	187.36 (16.59)	185.54 (18.41)	290.99 (87.04)	207.55 (3.60)	187.55 (16.40)
25	157.00	158.48 (1.48)	150.09 (6.91)	175.20 (18.20)	147.36 (9.64)	149.00 (8.00)
50	111.90	126.38 (14.48)	118.58 (6.68)	87.60 (24.30)	104.64 (7.26)	116.90 (5.00)
75	89.43	94.28 (4.85)	93.69 (4.26)	36.36 (53.07)	82.43 (7.00)	92.92 (3.50)
90	74.95	65.39 (9.56)	75.79 (0.84)	13.32 (61.63)	74.21 (0.74)	76.42 (1.47)
Mean	127.45					
D - Index		0.37	0.29	1.92	0.22	0.27
Fitting condition		Unfit	Normal fit	Unfit	Normal fit	Normal fit
SD		48.73	43.98	113.70	55.01	44.56
C.V. %		0.38	0.35	0.89	0.43	0.35

Note: The values in parenthesis represent the absolute deviation of observed and estimated rainfall

mm; and i = series of rainfall amounts at 10, 25, 50, 75 and 90 per cent probabilities of exceedence (Weerasinghe, 1989).

The D-Index value of less than 0.20 is considered as a best fit, 0.20 to 0.30 is normal fit and above 0.30 will be an unfit distribution as adopted by earlier investigators (Willmott 1981 and 1982; and Cohen, 1988).

Results and Discussion

The computation of observed and estimated rainfall at different probabilities of exceedence for maximum one day, maximum weekly, maximum monthly, seasonal (i.e. *kharif*, *rabi* and zaid) and annual rainfall using different distributions namely normal, log-normal, exponential, pearson type III and log-pearson type III are described below and also their

Table 3. Comparison of observed and estimated maximum monthly rainfall for different probability distribution functions.

Probability of exceedance (%)	Observed rainfall (mm)	Estimated rainfall (mm)				
		Normal	Log normal	Expone-ntial	Pearson type III	Log pearson type III
10	380.17	351.15 (29.02)	343.73 (36.44)	549.26 (169.09)	383.02 (2.85)	348.26 (31.91)
25	260.98	297.81 (36.83)	281.32 (20.35)	330.69 (69.71)	283.21 (22.23)	275.19 (14.21)
50	212.40	238.54 (26.14)	225.17 (12.77)	165.34 (47.06)	206.13 (6.27)	218.08 (5.68)
75	191.58	179.28 (12.30)	180.23 (11.34)	68.62 (122.95)	159.36 (32.22)	177.95 (13.63)
90	140.86	125.94 (14.92)	147.51 (6.65)	25.13 (115.73)	137.07 (3.79)	151.73 (10.87)
Mean	237.20					
D - Index		0.50	0.37	2.21	0.28	0.32
Fitting condition		Unfit	Unfit	Unfit	Normal fit	Unfit
SD		89.98	78.61	214.61	100.46	78.92
C.V.%		0.38	0.33	0.90	0.42	0.33

Note: The values in parenthesis represent the absolute deviation of observed and estimated rainfall

Table 4. Comparison of observed and estimated seasonal (*kharif*) rainfall for different probability distribution functions.

Probability of exceedance (%)	Observed rainfall (mm)	Estimated rainfall (mm)				
		Normal	Log normal	Expone-ntial	Pearson type III	Log pearson type III
10	918.74	815.66 (103.08)	811.00 (107.74)	1237.36 (318.62)	885.84 (32.90)	822.77 (95.97)
25	624.45	683.84 (59.39)	644.25 (19.80)	744.96 (120.51)	637.20 (12.75)	644.42 (19.97)
50	507.25	537.38 (30.13)	498.86 (8.39)	372.48 (134.77)	452.22 (55.03)	494.23 (13.02)
75	336.925	390.92 (53.99)	386.29 (49.36)	154.59 (182.33)	347.24 (10.31)	381.46 (44.54)
90	320.6	259.10 (61.50)	306.86 (13.74)	56.62 (263.98)	302.28 (18.32)	303.78 (16.82)
Mean	541.59					
D - Index		0.57	0.37	1.88	0.24	0.35
Fitting condition		Unfit	Unfit	Unfit	Normal fit	Unfit
SD		222.36	202.13	483.47	239.42	208.16
C.V. %		0.41	0.37	0.89	0.44	0.38

Note: The values in parenthesis represent the absolute deviation of observed and estimated rainfall

mean, standard deviation (S.D.) and coefficient of variation (C.V.) for one day maximum, maximum weekly, maximum monthly, seasonal (i.e. *kharif rabi* and zaid) and annual rainfall over the study area, were calculated.

Maximum one day rainfall : The estimated one day maximum rainfall at different probabilities is presented in Table 1. The numerical value deviation was observed to be high in exponential distribution when compared to all other distributions. The D-Index value was found to be minimum for normal (0.17) distribution followed by log-normal distribution (0.19), pearson type III (0.19) and log-pearson type III (0.19). Hence, normal, followed by log-normal distribution, pearson type III and log-rearson type III were found to be best fit and

Table 5. Comparison of observed and estimated seasonal (*rabi*) rainfall for different probability distribution functions.

Probability of exceedance (%)	Observed rainfall (mm)	Estimated rainfall (mm)				
		Normal	Log normal	Expone-ntial	Pearson type III	Log pearson type III
10	92.02	74.35 (17.67)	226.12 (134.10)	70.96 (21.06)	79.73 (12.29)	83.45 (8.57)
25	51.45	53.73 (2.28)	54.65 (3.20)	42.72 (8.73)	41.91 (9.54)	46.03 (5.42)
50	15.65	30.82 (15.17)	11.28 (4.37)	21.36 (5.71)	16.50 (0.85)	17.27 (1.62)
75	6.95	7.91 (0.96)	2.33 (4.62)	8.87 (1.92)	4.64 (2.31)	4.37 (2.58)
90	2.12	0.00 (2.12)	0.56 (1.56)	3.25 (1.13)	0.98 (1.14)	0.87 (1.25)
Mean	33.64					
D - Index		1.14	4.40	1.15	0.78	0.58
Fitting condition		Unfit	Unfit	Unfit	Unfit	Unfit
SD		31.08	95.98	27.73	32.69	34.57
C.V. %		0.92	2.85	0.82	0.97	1.03

Note: The values in parenthesis represent the absolute deviation of observed and estimated rainfall

Table 6. Comparison of observed and estimated seasonal (zaid) rainfall for different probability distribution functions.

Probability of exceedance (%)	Observed rainfall (mm)	Estimated rainfall (mm)				
		Normal	Log normal	Expone-ntial	Pearson type III	Log pearson type III
10	252.33	271.72 (19.39)	265.40 (13.07)	378.05 (125.72)	296.36 (44.03)	268.09 (15.76)
25	212.6	220.78 (8.18)	200.67 (11.93)	227.61 (15.01)	203.17 (9.43)	198.16 (14.44)
50	142.8	164.19 (21.39)	147.08 (4.28)	113.81 (28.99)	132.86 (9.94)	144.17 (1.37)
75	97.125	107.59 (10.47)	107.81 (10.68)	47.23 (49.89)	91.93 (5.20)	106.82 (9.69)
90	78.26	56.66 (21.60)	81.51 (3.25)	17.30 (60.96)	73.67 (4.59)	82.81 (4.55)
Mean	156.62					
D - Index		0.52	0.28	1.79	0.47	0.29
Fitting condition		Unfit	Normal fit	Unfit	Unfit	Normal fit
SD		85.92	73.84	147.72	91.21	74.46
C.V. %		0.55	0.47	0.94	0.58	0.48

Note: The values in parenthesis represent the absolute deviation of observed and estimated rainfall

Table 7. Comparison of observed and estimated annual rainfall for different probability distribution functions.

Probability of exceedance (%)	Observed rainfall (mm)	Estimated rainfall (mm)				
		Normal	Log normal	Expone-ntial	Pearson type III	Log pearson type III
10	1257.15	1059.19 (197.96)	1053.54 (203.61)	1686.37 (429.22)	1145.14 (112.01)	1061.15 (196.00)
25	881.88	904.38 (22.51)	863.92 (17.96)	1015.30 (133.42)	864.85 (17.02)	857.86 (24.02)
50	658.20	732.38 (74.18)	692.98 (34.78)	507.65 (150.55)	644.20 (14.00)	684.84 (26.64)
75	526.90	560.38 (33.48)	555.87 (28.97)	210.69 (316.21)	505.81 (21.09)	552.89 (25.99)
90	450.87	405.58 (45.29)	455.82 (4.95)	77.16 (373.71)	436.35 (14.52)	460.46 (9.59)
Mean	755.00					
D - Index		0.49	0.38	1.86	0.24	0.37
Fitting condition		Unfit	Unfit	Unfit	Normal fit	Unfit
SD		261.14	239.44	658.92	288.88	240.75
C.V. %		0.35	0.32	0.87	0.38	0.32

Note: The values in parenthesis represent the deviation of observed and estimated rainfall

considered reliable methods to estimate the one day maximum rainfall. It also confirmed with the help of coefficient of variance. The exponential distribution is unfit for the one day maximum rainfall.

Maximum weekly rainfall : The estimated maximum weekly rainfall at different probabilities is presented in Table 2. It was observed that the pearson type III (0.22) followed by log-pearson type III (0.27) and log-normal (0.29) distributions are found to be normally fit for the maximum weekly rainfall and other two distributions were unfit for the maximum weekly rainfall.

Maximum monthly rainfall : The estimated maximum monthly rainfall is shown in Table 3. Pearson type III (0.28) distribution was identified as normally fit for the maximum monthly rainfall and other four distributions were unfit for the maximum monthly rainfall.

Seasonal rainfall : The estimated *kharif*, *rabi* and zaid seasonal rainfall at different probabilities is presented in Table 4, 5 and 6, respectively. It was observed that the pearson type III (0.24) distribution was normally fit for the *kharif* season, log-normal (0.28) and log-pearson type III (0.29) distributions were normally fit for the zaid season but no one method fit for the *rabi* season.

Annual rainfall : The estimated annual rainfall at different probabilities is presented in Table 7. The D-Index was found to be minimum in Pearson type III (0.24) distribution. From the results, it could be inferred that the log-pearson type III distribution normally fitted for annual rainfall to give the reliable estimates in the selected study area and also found that other four distributions namely normal, log-normal exponential and pearson type III distributions are unfit for the study area.

References

Agrawal, M. C., Katiyar, V. S. and Ram Babu. 1988. Probability analysis of annual maximum daily rainfall of U.P. Himalaya. Indian J. of Soil Conserv. 16(1): 35-42.

Bhakar, S. R., Iqbal, M., Devanda, M., Chhajed, N. and Bansal, A. K. 2008. Probability analysis of rainfall at Kota. Indian J. of Agric. Res. 42(3): 201-206.

Chow, V. T., Maidment, D. R. and Mays, L. W. 1988. Applied Hydrology, Mc Graw Book Co. 11,12: 371-415.

Cohen, J. 1988. Statistical power analysis for the behavioral sciences. Second Edn. Hillsdale, NJ: Lawrence Erlbaum Asso., Publ.

Kumar, D. and Kumar, S. 1989. Rainfall distribution pattern using frequency analysis. J. of Agri. Eng., 26(1): 33-38.

Mohanty, S., Marathe, R. A. and Shyam Singh. 2000. Probability models for prediction of daily maximum rainfall for Nagpur. Indian J. of Soil and Water Conserv. 44(1): 38-40.

Pradeep, C. M. 2009. Probability analysis of rainfall modeling at Chandraband. B.E. Thesis submitted in the College of Agricultural Engineering, Raichur, Karnataka.

Pradeep, C. M. and Maheshwara Babu, B. 2010. Rainfall probability modeling for Chandrabanda area of Raichur, Karnataka (India). J. of Agrome., 12(2): 245-247.

Sharda, V. N. and Bhushan. 1985. Probability analysis for prediction of annual maximum daily rainfall for Agra. Indian J. of Soil Conserv. 13(1): 16-20.

Weerasinghe, K. D. N. 1989. The rainfall probability analysis of Mapalana and its application to agricultural production of the area. J. of Natural Sci., 17(2): 173-186.

Willmott, C. J. 1981. On the validation of models, Phys. Geogr. 2: 184-194.

Willmott, C. J. 1982. Some comments on the evaluation of model performance, Bull, of American Meteorol. Soc., 63: 1309-1313.

J. Agric. Res. Technol., 37 (2) : 305-308 (2012)

Reproduction Performance of Phule Triveni Crossbred Cows under Field Conditions

U. Y. Bhoite[1], Y. G. Fulpagare[2] and S. U. Bhoite[3]
Dept. of Animal Science and Dairy Science, Mahatma Phule Krishi Vidyapeeth, Rahuri - 413 722 (India)
(Received : 25-09-2011)

Abstract

The present investigation was undertaken on the basis of records of reproduction traits of Phule Triveni crossbred cows maintained under field condition. The least squares means of age at first service, age at first calving, service period, dry period and calving interval in Phule Triveni crossbred cows was 600.45±18.88, 755.32±32.11, 158.13±24, 71.76±1.27 and 437.84±3.82 days respectively. The effect of season of birth was non significant on AFS and significant on AFC. The influence of season of calving on S. P., D. P. and C. I. was non significant. The lactation order significantly ($P<0.05$) affected dry period.

Key word : Correlation, reproduction traits, Phule Triveni.

The lifetime milk yield, number of lactations completed in lifetime and production performance of cows depends on their reproduction efficiency. The profitable milk production in dairy cattle can be brought by high degree of reproductive efficiency of cows. The performance of crossbred cows under farm condition does not give exact picture of their potentiality. It is essential to test their performance under field conditions. The information on reproduction performance of crossbred cows under field condition is scanty. Hence, the present study was conducted.

Materials and Methods

The data pertained to some reproduction

1. Asso. Professor, 2. Head of Deptt. and 3. Asstt. Professor (Math.)

traits of Phule Triveni crossbred cows (50% HF + 25% Jersey 25% Gir and their interbreds) developed at Research-cum-Development Project on Cattle, MPKV, Rahuri and maintained by livestock owners during 1997 to 2002 was utilized for the present study. The least squares means of age at first service (AFS), age at first calving (AFC), service period (SP), dry period (DP) and calving interval (CI) were estimated by considering season of birth/ calving, period of birth/calving and lactation order effects (Harvey, 1990). The Duncan's Multiple Range Test (DMRT) modified by Kramer (1957) was used to make pair wise comparison of mean values. On the basis of climatic condition the birth/calving were divided into three seasons *viz*., summer (February-May), rainy (June-September) and winter (October-January) season. The period of births were divided as P_1 (1997-1998), P_2 (1999-2000) and P_3 (2001-2002). Similarly, lactation order effect was considered for estimation of post partum reproduction traits. Simultaneously, the correlation among some reproduction traits was also worked out (Snedecor and Cochron, 1975).

Results and Discussion

The overall least squares means of age at first service, age at first calving, service period, dry period and calving interval of Phule Triveni crossbred cow under field condition are presented in Table 1.

Table 1. Least squares means (days) of some reproduction traits in Phule Triveni crossbred cattle.

Traits	n	Mean ± S. E.
Age at first service	29	600.45 ± 8.88
Age at first calving	37	755.32 ± 21.11
Service period	177	158.14 ± 2.24
Dry period	102	71.764 ± 1.27
Calving interval	102	437.84 ± 3.82

The overall least squares means of AFS in Phule Triveni crossbred cows under field condition was 600.45±8.8 days. These values were in close agreement with Sharma *et al*. (1986) reported in Friesian x Ongole halfbreds.

The effects of season of birth and period of birth on AFS were non significant. The non-significant effects of SOB and FOB on AFS might be due to similar feeding and management of crossbred heifers during the period under study.

The mean age at first calving of Phule Triveni cows was 755.32+32.11 days. The influences of SOB ($P<0.01$) and POB ($P<0.05$) on age at first calving were significant. Similar

Table 2. Least squares means (days) of some prepartum reproduction traits.

Traits/Effect	Age at first service			Age at first calving		
	n	Mean	SE±	n	Mean	SE±
Population mean	29	597.37	10.58	37	697.94	32.79
Season of birth						
S_1	6	595.46	20.42	7	587.40^c	68.67
S_2	13	598.9	14.52	22	820.61^a	37.61
S_3	10	597.73	17.16	8	685.82^b	62.58
Period of birth						
P_1	14	608.77	21.49	10	591.05^c	68.14
P_2	8	597.56	19.35	11	767.15^a	52.54
P_3	7	588.78	19.62	16	735.62^b	46.91

Means under each class in the same column with different superscripts differed significantly

results were reported by Nagare and Patel (1997) in Gir triple crosses.

In present study the AFC (days) of cows (Table 2) born during different seasons differed significantly from each other. It was highest in cows born during winter (820.6±37.6) followed by those born in summer (685.82±62.58) and rainy (587.40±68.67) season. The AFC of cows born during P2 (767.15±52.54) was significantly higher than those born in P_1 and P_3, which also differed significantly from each other.

In Phule Triveni crossbred cows the mean service period was 158.13± 2.33 days. Similar SP was reported by Rao *et al*. (1984) in 50 per centr BS + 25 per cent HF +25 per cent Ongole triple crosses. The variations due to SOC and LO on service period were nonsignificant (Table 3).

The overall mean dry period in Phule Triveni crossbred cows under field condition was 71.76±1.27 days. The effect of lactation,order on dry period was significant ($P<0.01$). These results did not agree with Dalal *et al.* (1991) observed in halfbreds of Friesian, Jersey and Brown Swiss with Gaolao and Hariana cows.

The dry periods (days) of crossbred cows calved during L_2 (76.79±2.23) and L_4 (76.88±51.08) were significantly higher than those born in L_1 (68.92±12.69) and L_3 (67.85±4.80). The differences in AFC between cows of L_2 and L_4 and L_1 and L_3 groups were non-significant. The difference due to SOC on dry period was non-significant.

The overall least squares means of calving interval in crossbred cows under field condition was 437.53±3.82 days. These results were in close agreement with Jagtap (1989) reported in 50 per cent HF + 25 per cent Jersey + 25 per cent Gir triple cross cows.

The analysis of variance indicated significant ($P<0.05$) influence of lactation order on calving interval of crossbred cows. The C.I. (days) of cows calved during L_2 (443.33±6.62) and L_3 (446.74+13.50) were significantly higher than calved in L_1 (436.59±12.13) and L_4 (334.31±36.86), which did not differed significantly from each other. The lower values of C.I. in L_4 group might be due to the physiological maturity of crossbred cows. The variation due to SC on C.I. was non significant.

In crossbred cows the correlation of service period with dry period (0.020) and calving

Table 3. Least squares means (days) of some post partum reproduction traits.

Traits/Effect	Service period			Dry period			Calving interval		
	n	Mean	SE±	n	Mean	SE±	n	Mean	SE±
Population mean	177	155.67	5.29	102	72.61	12.70	102	415.24	10.08
Lactation order :									
L_1	88	157.92	7.32	61	68.92	12.69	59	436.59^b	12.13
L_2	58	161.43	5.31	32	76.79	2.24	33	443.33^a	6.62
L_3	25	157.72	8.12	7	67.85	4.81	8	446.74^a	13.50
L_4	5	145.63	18.14	2	76.88	51.08	2	334.31^b	36.86
Season of calving :									
S_1	44	159.92	11.32	22	70.34	25.99	21	420.22	21.10
S_2	65	153.72	6.48	39	73.00	12.58	39	408.01	11.27
S_3	68	153.37	6.37	41	74.50	12.90	42	417.42	10.41

Means under each class in the same column with different superscripts differed significantly.

interval (0.088) was positive but non significant (Table 3). These results corroborated with the results of Singh and Tomar (1991) in crossbred cows. The association between dry period and calving interval of cows was positive and highly significant (0.906), which indicated that the calving interval in crossbred cows can be reduced by effective selection of cows on the basis of lower dry period.

The correlation of service period, dry period and calving interval with lactation length and lactation milk yield in Phule Triveni crossbred cows under field conditions was positive and significant ($P<0.05$) and the correlation values were 0.231, 0.269, 0.149, 0.172 and 0.220 and 0.239 respectively. The results revealed that the lactation milk yield in crossbred cows can be increased by higher reproductive traits of cows. However, this will also increase the calving interval thereby reducing the number of lactations, productive life as well as the life time milk production of crossbred cows.

Acknowledgement

We are thankful to Senior Scientist, Research Cum-Development Project on Cattle, MPKV, Rahuri for providing the data for conducting research.

References

Dalal, D. S., Arora, K. C. and Rathi, S. S. 1991. Evaluation of performance traits in halfbred cattle. Indian J. Dairy Sci., 44(7): 401-405.

Harvey, W. R. 1990. Least square analysis of data with unequal subclass number. ARS: H4, U.S.D.A.

Jagtap, D. Z. 1989. Genetic divergence and classification of various genetic groups of crossbred (Temperate x Zebu) Cattle at MPAU, Rahuri. Ph.D. thesis, MPKV, Rahuri.

Karmer, C. V. 1957. Extension of multiple range test to group related adjusted mean. Biometric, 13: 13-20.

Nagare, W. K. and Patel, A. M. 1997. Comparative performance of Gir crossbreds under M. S. condition. Indian Vet. J., 76(4): 338-339.

Rao, K. B., Sivaiah, K. and Rao, L. S. 1984. Some reproductive traits among three breed crossbred heifers. Indian J. Anim. Sci., 54(2): 201-203.

Sharma, G. P., Reddy, G. P., Satyanaryan, Y. K. and Murthy, A. S. 1986. Phenotypic correlations among the first lactation trials of Friesian x Ongole crossbreds. Indian J. Dairy Sci., 39(4): 453-455.

Singh, R. and Tomar, S. S. 1991. Performance characteristics of Karan Fries cows. Indian J. Anim. Sci., 61(2): 192-195.

Snedecor, G. W. and Cochran, W. G. 1973. Statistical Methods. 2edn. 7 pp. 286-87. Iowa State Univ. Press, Ames IOWA, U.S.A.

RESEARCH NOTES

J. Agric. Res. Technol., 37 (2) : 309-311 (2012)

Estimation of Variability and Genetic Diversity in Indian Mustard Germplasm (*Brassica juncea* L.)

Diverse parents are expected to yield higher frequency of heterotic hybrids in addition to generating a broad spectrum of variability in segregating generations. The D^2 statistic is useful multivariate statistical tool for effective discrimination among various genotypes on the basis of genetic diversity (Murthy and Arunachalam, 1962). An Attempt has been made in this study with an objective to assess the variability and diversity in Indian mustard gerrnplasm to identify divergent parents for hybridization.

The present experiment was conducted comprising 41 genotypes collected from National Research Center for Rapeseed and Mustard, Bharatpur, Rajasthan at Crop Research Farm, Department of Genetics and Plant Breeding, Allahabad during *rabi*, 2007-08. The seeds of each entry were sown in two row plot with 30x10 crn of inter- and intra-row spacing. Fertilizers were applied @ 60:40:40 NPK (kg ha^{-1}). The other intercultural operations were done to raise the crop uniformly. Data for all characters were recorded on five randomly selected competitive plants for each treatment in each replication for twelve characters *viz*., days to 50 per cent flowering, days to maturity, plant height (cm), number of primary branches, number of secondary branches, number of siliqua $branch^{-1}$, number of siliqua $plant^{-1}$, number of seeds $siliqua^{-1}$, biological yield $plant^{-1}$ (g), harvest index, test weight (g) and seed yield $plant^{-1}$ (g). The mean data over three replications was used for statistical analysis. The genetic parameters were estimated following Burton (1952) and Johnson *et al*. (1955). Further, the data was subjected to multivariate analysis as suggested by Mahalanobis (1936) and genotypes were grouped into different, clusters by Tocher's method (Rao, 1952).

High magnitude of phenotypic coefficient of variation was recorded for siliqua $plant^{-1}$ (45.36) followed by harvest index (41.59) and

Table 1. Estimates of genetic parameters for different quantitative characters in Indian mustard germplasm.

Characters	GCV	PCV	Heritability (%)	Genetic advance	Genetic gain
Days to 50% flowering	6.60	7.75	72.53	5.67	11.58
Plant height (cm)	8.67	8.77	97.84	35.26	17.67
Primary branches	17.14	24.64	48.42	1.26	24.57
Secondary branches	30.47	33.05	85.03	5.83	57.86
Siliqua $branch^{-1}$	20.17	20.87	93.44	15.97	40.17
Siliqua $plant^{-1}$	44.80	45.36	87.53	29.24	91.15
Days to maturity	3.07	3.20	92.03	7.63	6.07
Seeds $siliqua^{-1}$	12.22	13.86	87.88	2.87	22.18
Biological yield $plant^{-1}$	39.79	39.94	99.26	61.90	81.66
Harvest index (%)	40.86	41.59	96.52	22.99	82.70
Test weight (g)	12.84	43.58	88.88	1.46	25.00
Seed yield $plant^{-1}$ (g)	29.03	30.62	89.80	9.45	56.70

biological yield (39.94). Number of primary branches (24.64) and siliqua branch^{-1} (20.87) showed moderate value and days to 50 per cent flowering (7.75) depicted least phenotypic coefficient variation as reported by Das *et al*. (1998).

High magnitudes of GCV were recorded for siliqua plant^{-1} (44:80) followed by harvest index (40.86) and biological yield plant^{-1} (39.79) while days to 50 per cent flowering (6.60) exhibited least genotypic coefficient of variation (Table 1).

High estimates of heritability (above 75%) in broad sense were recorded for all the twelve characters studied. High heritability was recorded for biological yieid plant^{-1} (99.26%) followed by plant height (97.84%) and harvest index (96.52%) and low heritability was calculated for primary branches (48.42%). High values indicate that heritability may be due to higher contribution of genotypic component as reported by Prasad *et al*. (2003).

A perusal of genetic advance revealed that high values were recorded for biological yield (61.90) followed by the plant height (35.26) and siliqua plant^{-1} (29.24). Moderate estimates of siliqua branch^{-1} (15.97), whereas low value recorded for primary branches plant^{-1} (1.16). High genetic gain estimates were registered for siliqua plant^{-1} (91.15), harvest index (82,70) and biological yield plant^{-1} (81.66).

In the present study, the significant 'V' statistic at 480 degree of freedom, revealed the presence of differences among the genotype means for all characters. Forty one genotypes were grouped into seven clusters. Cluster II had maximum number of genotypes (13) followed by cluster I(8), cluster V(7), cluster IV(6), cluster III(4), cluster. VIL(2) and cluster VI(1). An inter, cluster distance was ranged from 321.64 to 2809.44. The inter cluster D^2 value was maximum between cluster III and VI (2809.44) followed by cluster VI and VII (2625. 07) and cluster III and VII (2134.39), suggesting that the genotypes present in these clusters may be used as parents for hybridization programme to develop desirable types. Minimum inter cluster distance was observed between IV and V (321,64) as described by Kumar *et al*. (2007).

Wide range of variation was observed in cluster mean performance for all twelve characters studied, indicating the presence of appreciable amount of variability among the genotypes. Cluster VII had high mean values for secondary branches plant^{-1} (16.16), seeds siliqua^{-1} (15.44), harvest index (55.62), test weight (6.68) and seed yield plant^{-1} (28.53). Cluster VI had low mean value for days to maturity (112.66), indicating early maturity. Cluster V had maximum mean value for siliqua pef branch (46.20), Cluster IV had the maximum mean values for primary branches plant^{-1} (6.08), cluster III had the maximum mean values for biological yield plant^{-1} (133.16) and cluster II had the maximum mean values for days to 50 per cent flowering (50.6) and siliqua plant^{-1} (341.55). Cluster I had the maximum mean values for the plant height (217.42) followed by the cluster III (204.41) and cluster VI (203.22) as reported by Kumar *et al*. (2007).

It has been well established fact that more the genetically diverse parents used in hybridization programe, greater will be the changes of obtaining high heterotic hybrids and broad spectrum variability in segregating generations (Arunachalam, 1981). It has also been observed that the most productive hybrids may come from high yielding parents with a high genetic diversity. The genetically divergent genotypes present in cluster VI (NDRE-4) and VII (Urvashi and Ganga Kaveri Vijay) may be utilized as parents in future breeding programme. The characters which exhibited high GCV and PCV, heritability and genetic

advance should be given top priority durihg selection.

Diman Singh
G. Roopa Lavanya

Dept. of Genetics and Plant Breeding,
Allahabad School of Agriculture,
Allahabad - 211 007 (India)
June 10, 2010.

References

Arunachalam, V. 1981. Genetic distance in plant breeding, Indian J. of Genet. 41(2): 226-234.

Burton, G. W. 1952. Quantitative inheritance in grasses. Proc. Sixth Internat. Grassland Cong. J. 1277-283.

Das, K., Barua, P. K. and Hazarika, G. N. 1998. Genetic variability, heritability and genetic advance in Indian mustard (*Brassica juncea*). J. Agric. Sci. Soc. of North East 84: 189-194.

Johnson, H. W., Robinson, H. F. and Comstock, R. E. 1955. Estimates of genetic and environmental variability in soybean. Agron. J. 47: 314-318.

Kumar, M., Singh,. K.. P. and Singh, D. 2007. Genetic divergence analysis for seed yield, its parameters and oil content in Indian mustard. Res. on Crops. 8(1): 183-185.

Mahalanobis, P. G. 1936. On the generalized distance in statistics. Proc. cf Nat. Inst. of Sci. 2:49-55.

Murthy, B. R. and Arunachalam, V. 1966. The nature and divergence in relation to breeding system in some crop plants. Indian J. of Genet. 26: 188-198.

Prasad, L., Singh, M., Shrivastava, R. L. and Dixit, R. K. 2003. Studies on heritability and genetic advance in Indian mustard (*Brassica juncea*). Indian Acad. of Plant Sci. 16(1): 263-266.

Rao, C. R. 1952. Advanced Statistical Methods in Biometrical Research. John Wiley and Sons Inc., New York.

J. Agric. Res. Technol., 37 (2) : 311-313 (2012)

Impact of Sowing Dates on Linseed (*Linum usitatissimum* L.) Varieties

Very little work on production technology of linseed has been done in Maharashtra. Therefore, an experiment was conducted to identify suitable varieties and optimum sowing time for linseed crop in winter season.

A field experiment was conducted at Agricultural College Farm, Latur, Marathwada Agricultural University, during *rabi* season, 2007-08. The soil of experimental site was deep black in colour with good drainage. The soil was clayey in texture, low in available nitrogen (265.20 kg ha^{-1}), medium in available phosphorus (15.70 kg ha^{-1}), high in available potassium (941.92 kg ha^{-1}) and slightly alkaline in reaction (pH 7.4). The field was fallow in *kharif* season and present investigation was taken in *rabi* season of 2007-08. The experiment was laid out in a split plot design with three replications, with eighteen treatment combination of date of sowing (D_1 - 40th MW, D_2 - 41st MW, D_3 - 42nd MW, D_4 - 43rd MW, D_5 - 44th MW and D_6 - 45th MW) in main plot and three varieties (V_1 - Kiran, V_2 - Garima and V_3 - RLC-4) in sub plot. Sowing of crop was done by dibbling method as per the treatments. The gross and net plot size of experimental unit was 6.4 x 3.6 m and 5.4 x 2.4 m respectively with a inter row spacing of 30 cm and intra row spacing of 10 cm. Basal dose of NPK @ 50:25:0 kg ha^{-1} in the form of urea and single super phosphate were applied uniformly to all the plots at the time of sowing.

The highest number of capsule $plant^{-1}$ (42), seed $capsule^{-1}$ (9), grain weight $plant^{-1}$ (2.1 g)

and thousand grain weights (7.6g) were recorded significantly superior in D_1 date of sowing at 40th MW than other date of sowing which was followed by D_2 date of sowing at 41st MW (Table 1). The results are in conformity with the findings of Verma and Pathak (1993). The significantly highest grain yield (889 kg ha^{-1}) and straw yield (2109 kg ha^{-1}) was recorded when the crop was sown in 40th MW (D_1) followed by 41st MW than rest of sowing dates. The sowing of linseed in 45th MW (D_6) reduced the seed as well as straw yield. Similar trends also observed by Samui and Bandopadhayay (1992). Harvest index (29.7%), oil content (40.9%) and oil yield (349 kg ha^{-1}) were more when the crop was sown in 40th MW (D_1) followed by 41st MW (D_2). Protein content was significantly more in sixth (D_6) date of sowing at 45th MW than other date of sowing but it was at par with fifth (D_5) date of sowing at 44th MW. The oil content in seed was higher in early sowing. It may be attributed to the fact that seeds in late sown crop did not develop fully and also contain more protein (Table 1). The present findings were in agreement with the findings of Rajput and Gautam (1993). Protein content was negatively correlated with the oil content.

The significantly highest number of capsule $plant^{-1}$ (33), seed per capsule (7.9), grain weight $plant^{-1}$ (1.7g) and thousand grain weight (7.1 g) were recorded in variety Garima than variety RLC-4 and Kiran (Table 1). Garima yielded significantly higher seed yield (656 kg ha^{-1}), straw yield (1773 kg ha^{-1}) and oil yield (258 kg ha^{-1}) than rest of two varieties. The result confirms the findings of Dubey and Srivastava, (1986). Variety RLC-4 recorded more oil and protein content in per cent followed by Garima.

The variety Garima (V_3) and Kiran (V_1) gave

Table 1. Effect of sowing dates and varieties on yield attributes, yield and quality of linseed.

Treatment	Capsule $plant^{-1}$	Seed cap-sule^{-1}	Grain wt. $plant^{-1}$ (g)	1000 grain wt. (g)	Grain yield (kg ha^{-1})	Straw yield (kg ha^{-1})	Harvest index (%)	Oil yield (kg ha^{-1})	Oil content (%)	Protien content (%)
Date of sowing :										
D_1	42	9	2.1	7.6	889	2109	29.7	349	40.9	16.3
D_2	41	7.9	1.9	7.2	823	1999	29.2	332	40.6	16.4
D_3	38	8.3	1.6	7.1	654	1999	24.7	266	40.3	16.6
D_4	27	7.4	0.9	7.1	543	1540	26.1	217	39.9	16.7
D_5	23	7.6	0.9	7.1	473	1582	23	188	39.8	17.1
D_6	11	4.6	0.3	7.1	334	979	25.4	134	39.6	17.4
S.E.±	0.46	0.1	0.03	0.07	7.33	10.48	1.55	5.4	0.12	0.33
CD at 5%	1.46	0.31	0.09	0.23	23.12	33.05	3.5	17.2	0.38	0.37
Varieties :										
V_1	27	7.3	0.9	7.2	613	1619	27.5	248	39.7	16.7
V_2	33	7.9	1.7	7.1	656	1773	27	258	40.3	16.8
V_3	31	7.2	1.1	7.2	588	1712	25.6	237	40.5	16.9
S.E.±	0.31	0.08	0.02	0.03	6.4	6.8	1.26	3.58	0.06	0.09
CD at 5%	0.91	0.24	0.06	NS	19.2	19.92	NS	10.5	0.19	NS
Interaction (D x V) :										
S.E.±	0.77	0.2	0.05	0.08	15.8	16.7	3.1	8.8	0.16	0.23
CD at 5%	2.4	0.6	0.14	NS	46.3	48.8	NS	25.6	0.46	NS

significantly higher seed yield when they were sown in 40th MW (D_1) and 41st MW (D_2), respectively. The treatment combinations D_1V_2 and D_2V_1 were found significantly superior than other treatment combinations but they were at par with D_1V_1 and D_2V_2 and D_1V_3 combinations, respectively. The lowest seed yield was obtained in combination D_6V_3 but it was found at par with D_6V_1 combination.

F. G. Shaikh
D. N. Gokhale
H. D. Pawar
N. K. Kalegore
B. D. Thakur

Department of Agronomy,
College of Agriculture,
Latur - 413512 (India)
July 21, 2010.

References

Dubey, R. N. and Srivastava, A. N. 1986. Three new linseed varieties. Indian Fmg. : 3-5

Rajput, R. L. and Gautami, D. S. 1993. Response of sowing dates and nitrogen levels on growth, yield and quality of linseed. Gujarat Agric. Univ. Res. J., 19(1): 88-93.

Samui, R. C. and Bandopadhyay, Pintoo. 1991. Influence of date of sowing on linseed (*Linum usitatissmum*) varieties. Indian J. of Agron., 37(3): 599-601.

Verma, K. P. and Pathak, R. K. 1993. Response of linseed (*Linum usitatissmum*) varieties to, different date of sowing. Indian J. of Agron., 38(1): 60-63.

J. Agric. Res. Technol., 37 (2) : 313-315 (2012)

Effect of Washing and Cooking of Brinjal Fruits on Pesticide Residues

In order to combat the insect pest problem in brinjal, lot of pesticides is being used by the vegetable growers. For better yield and quality, insecticides are repeatedly applied during the entire period of growth and sometimes even at the fruiting stage. It accounts for 13-14 per cent of total pesticides consumption, as against 2.6 per cent of cropped area (Sardana, 2001). Indiscriminate use of pesticides particularly at fruiting stage and non adoption of safe waiting period leads to accumulation of pesticide residues in consumable vegetables. Contamination of vegetables with pesticide residues has been reported by several researchers (Madan *et al*. 1996; Kumari *et al.* 2002 and 2003). The aim of this study was to evaluate the pesticide residues of two different molecules i.e., spinosad and emamectin benzoate in brinjal to assess the effect on residues of some household processes like washing and boiling/cooking.

Reduction of pesticide residues on brinjal fruit sample was worked out by studying the residues after subjecting the fruit sample for washing alone under tap water and by following the washing as well as cooking in water. The difference in residue levels on unprocessed and processed sample was worked out to further calculate the per cent reduction in residues. The analytical procedure outlined by AINP on Pesticide , Residue, Kalyani (West Bengal) with some modifications was used for analysis of residues (Kale, 2003). However, the effect of the stated home processes was carried out in respect of fruit samples drawn one day after last spray. Brinjal fruits from treatment plots of spinosad sprayed at the dose of 90 and 180 g a.i. ha^{-1} $spray^{-1}$ and emamectin benzoate at the dose of 25 and 125 g a.i. ha^{-1} $spray^{-1}$ were

Table 1. Residue levels of spinosad and emamectin benzoate before and after processing of brinjal fruits.

Particular	Residue levels			
	Spinosad		Emamectin benzote	
	90 g a.i. ha^{-1}	180 g a.i. ha^{-1}	12.5 g a.i. ha^{-1}	25 g a.i. ha^{-1}
Residues in PPM (1 DAS)	0.297	0.565	0.07	0.15
Residues in PPM found in samples after washing	0.049	0.065	BDL	BDL
Reduction of residues after washing (%)	83.50	88.49	100	100
Residues in PPM found in samples after washing and cooking	0.035	0.056	BDL	BDL
Reduction in residues after washing and cooking (%)	88.21	90.08	100	100

harvested and randomly sampled separately for each replicate. The samples collected from the replications for each treatment were pooled together and they were made into two replicates for residue analysis. The simple process such as washing and cooking are very helpful in removing the residues from fruits and vegetables. The effect of home processes on decline of residues on fruits was assessed in experiment of summer season.

The residue level (Table 1) due to the process of washing was reduced in the range of 83.50 and 88.49 per cent in spinosad at 90 and 180 g a.i. ha^{-1} respectively. In case of emamectin benzoate, it was 100 per cent at lower and higher doses. Combining effect of washing and cooking further reduced the residue levels in the range of 88.21 and 90.08 in spinosad and remained 100 per cent in emamectin benzoate at lower and higher doses. Thus, it is clear that routine process of washing as well as cooking, before the consumption certainly helps in minimizing load of pesticide residues on the vegetable fruits. Earlier studies on other pesticides also exhibited similar results in respect of various other vegetables (Agnihotri, 1999). Hotellier (1982) reported that deltamethrin residues reduced appreciably on cooking. Reduction of fenvalerate residues to an extent of 27-56 per cent in brinjal was reported by Sharma and Kumar (1993). Reduction of alphamethrin in the range of 25-32 per cent in brinjal and tomatoes and 12-17 per cent in cauliflower was reported by Gill *et al*. (2001) and Holland *et al*. (1994) reported appreciable reduction in pesticide residues in different commodities by using different processing methods. Hence, the present results are in consistent with the earlier results.

Aparna Kalawate
M. D. Dethe

Department of Entomology
Mahatma Phule Krishi Vidyapeeth,
Rahuri - 413 722 (India)
November 10, 2010.

References

Agnihotri, N. P. 1999. Pesticide safety evaluation and monitoring. AICRP on pesticide residues. Div. of Agric. Chem. IARI, New Delhi.

Gill, Kanta, Kumari, Beena and Kathpal, T. S. 2001. Dissipation of alphamethrin residues in/on brinjal and tomato during storage and processing conditions. J. Food Sci. Technol. (38)1: 43-46.

Holland, P. T., Hamilton, D., Ohlin B. and Skidmore M.W. 1994. Effects of storage and processing on pesticide residues in plant products (Technical Report). Pure and Applied Chem. 66(2): 335-356.

Hotellier, M. L. 1982. Deltamethrin residues in food crops and some animal products. Deltamethrin Momograph Roussel Vcalf: 285-315.

Kale, V. D. 2003. Studies on thiamethoxam, fipronil, abamectin and spinosad against pests of okra, Ph.D. (Agri.) thesis Mahatma Phule Krishi Vidyapeeth, Rahuri, Dist. Ahmednagar, M.S., India.

Kumari Beena, Madan V. K., Kumar, R. and Kathpal, T. S. 2002. Monitoring of seasonal vegetables for pesticide residues. Environ,Monit.Assess. 74: 263-270.

Kumari Beena, Kumar R., Madan, V. K., Singh Rajvir, Singh Jagdeep and Kathpal T. S. 2003. Magnitude of pesticidal contamination in winter vegetables from Hisar, Haryana. Environ. Monit. Assess. 87: 311-318.

Madan, V. K., Kumari B., Singh R. V., Kumar, R. and Kathpal, T. S. 1996. Monitoring of pesticide from farmgate samples of vegetables in Haryana. Pestic. Res. J. 8(1): 56-60.

Sardana, H. R. 2001. Integrated pest management in vegetables. In: Training manual-2, Training on IPM for Zonal Agric. Res. Stations. May 21-26. pp. 108-118.

Sharma, P. L. and Kumar, N. R. 1993. Dissipation patteren of fenvalerate in/on brinjal fruits under midhill conditions. Pestology. 17(10): 20-21.

J. Agric. Res. Technol., 37 (2) : 315-317 (2012)

Genetic Variability Studies in Sesamum (*Sesamum indicum* L.)

Sesamum (*Sesamum indicum* L.) also known as til or gingerly is an important and ancient oil-yielding crop. The sesamum seed is a rich source of edible oil. It is also used for anointing the body and for medicinal purposes. The success of any crop improvement programme essentially depends on the nature and magnitude of genetic variability present in the crop. For this a better understanding of the characters showing variability along with their genetic advance and heritability and their interactions for obtaining a high yielding genotypes is most important.

Fifty sesamum genotypes, which represent a wide spectrum of variation for various agronomic and morphological characters, were grown in a randomized block design with three replications at Department of Agricultural Botany, College of Agriculture, Dapoli during *kharif* 2008. Data was recorded on five randomly selected plants in each replication for days to first flowering, days to 50 per cent flowering, days to maturity, plant height, number of primary branches, number of secondary branches, leaf area, number of internodes, number of capsules, capsule length, capsule diameter, number of seeds in capsule, 1000 seed weight, oil percentage, harvest index and seed yield. Analysis of variance was done as suggested by Panse and Sukhatme (1985). GCV, PCV, heritability and genetic advance were estimated as per procedure given

Table 1. Analysis of variance in sesamum.

Characters	Mean sum of squares		
	Replication (2)	Treatment (49)	Error (98)
Days to first flowering	18.20	19.78**	2.01
Days to 50 per cent flowering	10.01	23.36**	2.00
Days to maturity	10.43	159.39**	8.63
Plant height (cm)	59.87	392.55**	91.26
Primary branches plant^{-1}	0.34	1.26**	0.16
Scondary branches plant^{-1}	0.094	0.678**	0.084
Leaf area (cm^2)	12.07	123.82**	11.49
Internodes plant^{-1}	6.40	15.27**	3.83
Capsules plant^{-1}	185.23	405.53**	43.09
Capsule length (cm)	0.471	0.145**	0.042
Capsule diameter (mm)	0.075	1.165**	0.437
Seeds capsule^{-1}	12.56	74.41**	4.85
1000 seed weight (g)	0.074	0.439**	0.012
Oil percentage	0.344	20.48**	0.925
Harvest index (%)	88.11	31.77**	6.92
Seed yield plant^{-1} (g)	0.267	1.81**	0.143

** Significant at 1% level, Figures in parentheses denotes degrees of freedom

by Burton and De Vane (1953) and Johnson *et al.* (1955).

The variance for all the characters was highly significant indicating presence of considerable amount of variability among genotypes (Table 1). The range, mean, coefficient of variation, heritability, genetic advance, and genetic advance as percentage of mean for all the characters under study are presented in Table 2. In the present investigation phenotypic coefficient of variation was higher than the respective genotypic coefficient of variation for all the characters studied, indicating the role of environment in the total variance. The highest phenotypic and genotypic coefficient of variation was observed for number of secondary branches plant^{-1} followed by number of primary branches plant^{-1}, leaf area (cm^2), number of capsules plant^{-1}, harvest index and seed yield plant^{-1} suggesting good amount of variability for these characters. The lowest GCV and PCV were observed for oil percentage followed by days to 50 per cent flowering indicating narrow range of variability for these characters. In the overall observations PCV follows the trend of GCV for all the characters under study. Similar results were also recorded by Singh *et al*. (2000), Manjunatha *et al*. (2008) and Saravanan *et al*. (2003). The traits, which are less influenced by environment, are days to first flowering, days to maturity, 1000 seed weight and oil percentage. The traits which are most influenced by environment are number of primary branches plant^{-1}, number of secondary branches plant^{-1}, plant height and number of capsules plant^{-1}. These results were in agreement with Singh *et al.* (2000). The effectiveness of selection for any character depends not only on the extent of genetic variability present in the population but also on the extent to which it will be transferred from one generation to the next. The highest heritability was observed for 1000 seed weight followed by oil percentage, days to maturity, number of seeds capsule^{-1} and seed yield

Table 2. Estimates of genetic parameters for various characters in sesamum.

Characters	Range	General mean	PCV (%)	GCV (%)	H^{2}b.s (%)	GA	GAM (%)
Days to first flowering	28.33-39.67	34.61	8.14	7.03	74.60	4.33	12.51
Days to 50 per cent flowering	35.67-50.00	42.15	7.16	6.33	78.07	4.85	11.52
Days to maturity	85.33-117.67	96.30	7.96	7.36	85.33	13.48	14.00
Plant height (cm)	100.07-157.00	137.29	10.08	7.29	52.38	14.92	10.88
Primary branches plant^{-1}	1.48-4.03	2.51	28.99	24.20	69.71	1.04	41.63
Secondary branches plant^{-1}	0.00-2.10	0.68	78.38	65.65	70.15	0.76	113.28
Leaf area (cm^2)	14.50-51.47	25.89	27.00	23.63	76.52	11.02	14.59
Internodes plant^{-1}	18.00-29.67	24.94	11.09	7.83	49.86	2.84	11.39
Capsules plant^{-1}	24.67-69.00	49.79	25.71	22.07	73.70	19.43	39.04
Capsule length (cm)	1.63-3.12	2.33	11.83	7.92	44.84	0.25	10.93
Capsule diameter (mm)	4.13-7.53	5.95	13.86	8.27	35.66	0.60	10.18
Seeds capsule^{-1}	34.67-55.00	42.78	12.37	11.25	82.67	9.01	21.08
1000 seed weight (g)	2.17-4.39	2.98	13.16	12.66	92.52	0.74	25.09
Oil percentage	38.67-49.00	44.45	6.13	5.74	87.57	4.92	11.07
Harvest index (%)	9.90-25.91	16.25	24.00	17.71	54.45	4.37	26.92
Seed yield plant^{-1} (g)	2.55-5.89	3.96	21.14	18.86	79.59	1.37	34.66

PCV = Phenotypic coefficient of variation, GCV = Genotypic coefficient of variation, H^{2}b.s = Broad sense heritability, GA = Genetic advance, GAM = Genetic advance as percentage of mean

plant^{-1}. While lowest heritability recorded for capsule diameter followed by capsule length and number of internodes plant^{-1}. High heritability with high genetic advance was recorded for number of capsules plant^{-1}, plant height, days to maturity, number of seeds capsule^{-1} and Leaf area. It indicated additive gene action and made it suitable for direct selection. These results were in conformation with Mukhekar *et al*. (2002), Babu *et al*. (2004} and Ganpathy *et al*. (2007) and Manjunatha *et al*. (2008). High heritability with low genetic advance was noticed for oil percentage and 1000 seed weight, which indicated that for improvement of these characters hybridization technique may be rewarding. The genetic advance as percentage of mean ranged from 10.18 for capsule diameter to 113.28 for number of secondary branches plant^{-1}. High genetic advance expressed as percentage of mean coupled with high heritability in characters such as number of secondary branches plant^{-1}, number of primary branches plant^{-1}, number of capsule plant^{-1}, 1000 seed weight and number of seeds capsule^{-1} indicated the most effective condition for selection. These results are in agreement with those recorded by Mukhekar *et al*. (2002) and Saravanan *et al*. (2003).

S. B. Patil
B. L. Thaware
H. A. Shivade

Department of Agricultural Botany,
Dr. Balasaheb Sawant Konkan Krishi Vidyapeeth,
Dapoli - 415 712 (India).
December 20, 2010.

References

Babu, J. S., Reddy, C. D. and Reddi, N. S. 2004. Studies on genetic variability in sesame (*Sesamum indicum* L). Ann. Agri.Bio.Res. 9(1): 7-11.

Burton, G. W. and De Vane, E. H. 1953. Estimating heritability in tall Fesche (*Festuca arundinaceae*) from replicated clonal material. Agron. J. 45: 478-481.

Ganpathy, S., Ganesh, S. K., Vivekanandan, P. and Bharthi, K. 2007. Variability, heritability and genetic advance in sesame (*Sesamum indicum* L.) Res. on Crops. 8(3): 641-643.

Johnson, H. W., Robinson, H. F. and Comstock, R. E. 1955. Genetic and environmental variability in soybean and their implication in selection. Agron. J. 47: 314-318.

Manjunatha, M. H., Suverna, Manjunath, A. and Shankar, M. A. 2008. Estimation of genetic variability, association and path coefficient analysis in sesame (*Sesamum indicum* L.) over locations during late kharif. Res, on Crops. 9(1): 159-164.

Mukhekar. G. D., Bangar, N. D., Lad, D. B., Bhor, T. J. and Mungse, H. B. 2002. Genetic variability and correlation studies in sesame (*Sesamum indicum* L). J. Maharashtra agric. Univ. 27(3): 284-285.

Panse, V. G. and Sukhatme, P. V. 1985. Statistical Methods for Agricultural Workers. ICAR, New Delhi, pp. 145-148.

Saravanan, S. J., Nandarajan, N. and Kumari, R. U. 2003. Variability studies in sesame. Crop Res. 25(2): 325-327.

Singh, H. C., Nagaicry, V. P. and Singh, S. K. 2000. Genetic variability for dry matter production in sesame (*Sesamum indicum* L.). Ann. agric. Res. 21(3): 323-327.

J. Agric. Res. Technol., 37 (2) : 318-320 (2012)

High Profitable Cultivation of Coloured Capsicum Hybrids (*Capsicum annum* L.) under Polyhouse Conditions

Greenhouse protects the crop from extreme high temperature and excessive rainfall and facilitates timely harvest as per demand and better quality of produce (More 1998). The use of polyhouses for commercial production of vegetables and maximum net returns has been most common in western countries (Chandra, 1985). In order to increase the production per unit area, the present investigation was undertaken to study the effect of plant spacing on coloured capsicum hybrids under polyhouse conditions.

The present investigation was carried out at Hi-Tech Floriculture and Vegetable Project, College of Agriculture, Pune in *kharif* season of 2007- 08. The experiment was laid out in a factorial randomised block design with four replications in the naturally ventilated polyhouse on raised beds of red soils having a pH of 7.5. There were six treatment combinations comprising of two coloured capsicum hybrids (Bomby and Orbelle) and three spacings (45 x 45 cm, 60 x 45 cm and 60 x 60 cm). The solution of water soluble fertilizers (nitrogen, phosphorus, potassium and calcium) were prepared and applied through drip irrigation system. It was applied in the ratio of 2:05:1:05 (N: P: K: Ca) up to three months from transplanting (during vegetative growth stage) and 1:05:2:05 (N:P:K:Ca) three months onward (during fruiting season). The electric conductivity was kept constant between 1.6 to 1.8 mmhos per mole of prepared solution automatically through fertigation by computerised operated system. During irrigation neutral pH (7.5) was maintained by adding Nitric acid (HNO_3) to irrigation water automatically by computerised operated system.

The growth components *viz*.; plant height, number of branches plant^{-1}, leaf area plant^{-1} and dry matter production plant^{-1} differed significantly due to different capsicum hybrids. Significantly higher values of plant height (215.00 cm), number of branches plant^{-1} (69.05), leaf area plant^{-1} (21.33 dm^2) and dry matter plant^{-1} (0.19 kg) were observed in Orbelle. Whereas, the yield components *viz*., number of fruits plant^{-1}, length of fruit and diameter of fruit was not differed significantly due to different capsicum hybrids. However, the fruit yield was significantly more (957.36 q ha^{-1}) in case of Orbelle (Table 1). This might be due to its genetic makeup, morphological characters and inherent genetic yield potential ability and more responsive to polyhouse condition.

The growth characters *viz*., plant height, number of branches plant^{-1}, leaf area plant^{-1} and dry matter production plant^{-1} were also differed significantly due to different planting geometry. Except, equal dry matter production plant^{-1} with spacing (60 x 45 cm), the wider spacing (60 x 60 cm) showed significantly superior values of plant height (220.95 cm), number of branches plant^{-1} (71.82), leaf area plant^{-1} (24.66 dm^2) and dry matter production plant^{-1} (0.19 kg) than 45 x 45 cm and 60 x 45 cm. This might be due to availability of more space, nutrients, moisture, light etc. to each and every plant which contributed in phasic growth and development of plant. Similar increase in the growth parameters at wider spacing were noticed and reported by Faiza-Aman *et al*. (2002), Nyambi *et al.* (2003) and Choudhary and Singh (2006) in sweet pepper.

Similarly, the yield attributes *viz*., number of

fruits plant^{-1}, length of fruit and diameter of fruit were found to be non significant in all spacing geometry. However, the fruit yield (1082.48 q ha^{-1}) was significantly highest in case of closer spacing (45 x 45 cm) and it was 9.78 and 28.50 per cent more than intermediate (60 x 45 cm) and wider spacing (60 x 60 cm), respectively. The maximum fruit yield in closer spacing (45 x 45 cm) might be due to higher plant density per unit land area. Increase in optimum plant density have been reported to increase in the total fruit yield of capsicum by Al-Gharibi and Abu-Awwad (2005), Chaudhary and Singh (2006) and Agarwal *et al*., (2007) in pepper. The interaction between capsicum hybrid and spacing combination was found to be non significant in all growth and yield characters and fruit yield.

The coloured capsicum hybrid Orbelle gave significantly maximum gross returns (Rs. 38.30 lakh ha^{-1}) and net returns (Rs. 22.77 lakh ha^{-1}) as against the cost of cultivation of crop (Rs. 15.53 lakh ha^{-1}), as a result of that the B:C ratio was also highest (2.46) than Bombay (2.39). This leads due to higher fruit yield obtained from Orbelle and cost of cultivation was similar of both the hybrids.

The closer spacing of 45 x 45 cm showed significantly highest values of gross returns (Rs. 43.30 lakh ha^{-1}), net returns (Rs. 27.35 lakh ha^{-1}) and B:C ratio (2.71) than intermediate (60 x 45 cm) and wide spacing (60 x 60 cm) (Table 1). This might be due to higher plant density in narrower spacing which was resulted into the increased fruit yield. Ultimately, the gross and net monetary returns and B:C ratio was highest. Similar results were reported by Gaye *et al.* (1992) in pepper and Channabasvanna (2002) in capsicum. However, the interaction

Tabel 1. Effect on growth, yield characters, fruit yield and economics of different coloured capsicum hybrids due to different spacing's.

Treatment	Plant height (cm)	Branches plant^{-1}	Dry matter plant^{-1}	Fruits plant^{-1}	Diameter of fruit (cm)	Fruit yield (q ha^{-1})	Cost of cultivation (in lakh Rs. ha^{-1})	Gross monetary returns (in lakh Rs. ha^{-1})	Net monetary returns (in lakh Rs. ha^{-1})	B:C ratio
Hybrids :										
Bomby (H_1)	212.70	66.37	0.18	18.14	5.98	931.33	15.53	37.25	21.72	2.39
Orbelle (H_2)	215.00	69.05	0.19	18.05	5.63	957.36	15.53	38.30	22.77	2.46
SE±	0.63	0.71	0.002	0.28	0.11	8.56	-	0.34	0.34	0.02
CD at 5%	1.96	2.21	0.009	NS	NS	23.97	-	0.96	0.96	0.06
Spacing's (cm) :										
45 x 45 (S_1)	206.67	62.30	0.16	17.91	5.77	1082.48	15.95	43.30	27.35	2.72
60 x 45 (S_2)	213.93	69.01	0.19	18.12	5.79	976.56	15.50	39.06	23.56	2.52
60 x 60 (S_3)	220.95	71.82	0.19	18.22	5.86	774.00	15.15	30.96	15.81	2.04
SE±	0.77	0.87	0.003	0.34	0.14	10.48	-	0.42	0.42	0.02
C.D.at 5%	2.40	2.71	0.01	NS	NS	29.36	-	1.12	1.12	0.08
Interaction :										
(H x S)										
SE±	1.09	1.23	0.005	0.49	0.19	14.82	-	0.59	0.59	0.04
C.D.at 5%	NS	NS	NS	NS	NS	NS	-	NS	NS	NS

Sale rate of capsicum @ Rs. 40 kg^{-1}.

between capsicum hybrid and spacing combination was found to be non significant.

A. G. Jadhav
S. L. Jangale
Y. J. Patil

Division of Agronomy,
College of Agriculture,
Pune - 411 005 (India).
January 09, 2011.

References

Agarwal, A., Gupta, S. and Ahmed, Z. 2007. Influence of plant densities on productivity of bell pepper (*Capsicum annum* L.) under greenhouse in high altitude cold desert of ladakh. ActaHort. (ISHS) 756: 309- 314.

Al-Gharibi, E. R. and Abu Awwad, A. M. 2005. Effect of irrigation water quantities and planting spacing on hot pepper yield and efficient water use. Dirasat agric. Sci. 32(1): 27-37.

Chandra, P. 1985. Application of greenhouse technology. Proceed. of Summer Inst. on Greenhouse Design and Environmental Control. Tech. Rep. CIAE/ENT/ 85/35 A: 21-31.

Channabasvanna, A. S. 2002. Effect of spacing and fertilizer levels on productivity and economics of/chilli cv. Vietnam- 2. J. Maharashtra agric. Univ. 27(3): 330-331.

Choudhary, A. S. and Singh, R. L. 2006. Effect of spacing, nitrogen and phosphorus on growth and yield of capsicum hybrids. Hariyana J. Horti. Sci. 35(1-2): 124-125.

Faiza-Aman, Muhammad-Ishtiaq, Wadan, H. D. and Shah, Muzammil. 2002. Effect of different levels of nitrogen and plant spacing on growth and yield of sweet pepper cv. Yellow wonder. Sarhad J. of agric. 18(3): 275-279.

Gaye, M. M., Jolliffe, P. A. and Maurer, A. R. 1992. Row cover and population density effects on yield of bell pepper in South Costal British Columbia. Can. J. Plant Sci. 72: 901-909.

More, T. A. 1998. Cultivation of vegetable under greenhouse. Plastic culture technology training class, MPKV, Rahuri.

Nyambi, G.N., Koona, P., Egunjobi, J. K. and Awodoyin, R. O. 2003. Growth and yield of *Capsicum annum* L. cv. Atarodo in response to weeding frequency and plant spacing. Trop. Sci. 44(2): 92-94.

J. Agric. Res. Technol., 37 (2) : 320-322 (2012)

Bioefficacy of Newer Miticides Against Two Spotted Spider Mite (*Tetranychus urticae* Koch.) on Gerbera under Polyhouse Condition

Persual of literature revealed that inspite of heavy losses caused by mites (Bhattachary, 1997, Jhansi Rani and Mohan, 1997 and Gill and Sanderson 1998) no systemic work was carried out and their control continues to be a major problem due to pesticide resistance. Therefore, the investigation was undertaken on bioefficacy of newer miticides against two spotted spider mite, *Tetranychus urticae* Koch, on gerbera under polyhouse condition.

The experiment was laid out at Hi-Tech Floriculture and Vegetable Projects, College of Agriculture, Pune (Maharashtra) during last week of March 2008 to last week of October 2008 on gerbera cultivar Full-moon in a randomized block design with three replications and ten treatments. Three sprays of each miticide were given at fortnight interval. To record the pre and post treatment observations, five plants from each treatment were randomly selected and tagged. Observations were recorded in morning hours. Pre treatment counts of mite population were recorded one day before application of spray and observation on post treatment were recorded on one, third, seventh and twelth days after each spraying.

One flower and three leaves each from lower, middle and upper part of each randomly selected and tagged plants were considered for recording the observations. The surviving mite population was recorded with the help of 10X magnifying lens as per the methodology followed by Hole and Salunkhe (2005).

The treatment with abamectin (0.005%) found to be significantly superior (Table 1) over other treatments with 90.06 per cent efficacy and recorded minimum of 3.73 average survival mites per leaf. The treatment with fenazaquin (0.02%) was at par with it, recorded 4.58 average survival mites leaf^{-1} with efficacy 87.52 per cent. The next best treatment was bifenazate (0.03%) recorded 6.85 average survival mites leaf^{-1} with 81.79 per cent efficacy. Propargite (0.16%) was at par with it, recorded 7.89 average survival mites leaf^{-1} with 78.83 per cent efficacy. The treatment fenpyroximate (0.02%), dicofol (0.05%) and fenpropathrin (0.02%) were at par recorded 8.02, 8.78 and 9.02 average survival mites leaf^{-1} with 78.22, 76.44 and 75.35 per cent efficacy, respectively. Milbemectin (0.01%) was found to be less effective recorded 9.60 survival mites per leaf with 74.48 per cent efficacy.

Table 1. Efficacy of different miticides against mite, *Tetranychus urticae* Koch, on gerbera under polyhouse condition.

Treatment	Survival mites leaf^{-1} mean	Survival mites flower^{-1} mean	Cumulative mean
Fenazaquin (0.02%)	4.58 (2.25)	3.59 (2.02)	4.12 (2.15)
Bifenazate (0.03%)	6.85 (2.71)	5.41 (2.43)	6.13 (2-57)
Fenpyroximate (0.02%)	8.02 (2.92)	6.71 (2.69)	7.36 (2.80)
Propargite (0.16%)	7.89 (2.90)	5.89 (2.53)	6.89 (2.72)
Fenpropathrin (0.02%)	9.02 (3.09)	7.62 (2.85)	8.32 (2.97)
Abamectin (0.005%)	3.73 (2.04)	2.03 (1.59)	2.88 (1.84)
Dicofol (0.05%)	8.78 (3.06)	5.99 (2.55)	7.39 (2.81)
Milbemectin (0.01%)	9.60 (3.18)	9.08 (3.10)	9.34 (3.14)
Amitraz (0.02%)	9.39 (3.14)	8.14 (2.94)	8.76 (3.04)
Control	37.23 (6.15)	24.40 (4.99)	30.81 (5.60)
S.E±	0.07	0.08	0.07
C.D. at 5%	0.20	0.23	0.21

Figures in parentheses indicates $x + \sqrt{0.5}$ transformed values.

The treatment with abamectin (0.005%) found to be significantly superior over other treatments with 91.93 per cent efficacy and recorded minimum of 2.03 average survival mites flower^{-1}. Fenazaquin (0.02%) was the next best treatment recorded 3.59 average survival mites flower^{-1} with efficacy 85.29 per cent. It was followed by bifenazate (0.03%), recorded 5.40 average survival mites flower^{-1} with 78.20 per cent efficacy. The treatment propargite (0.16%) and dicofol (0.05%) were at par with it, recorded 5.89 and 5.99 average survival mites flower^{-1} with 76.36 and 75.71 per cent efficacy, respectively. The treatment milbemectin (0.01%) was found to be less effective recorded 9.08 average survival mites flower^{-1}, with 64.11 per cent efficacy.

The efficacy of miticidal treatments on leaf and flowers revealed that all the treatments were significantly superior over untreated control. However, the treatment abamectin (0.005%) recorded 2.88 average survival mite population and observed to be effective treatment in controlling mite population both on leaf as well as flower and found significantly superior over all other treatments. Fenazaquin (0.02%) recorded 4.12 average survival mite and proved to be next effective treatment. This was followed by bifenazate (0.03%) recorded 6.13 average survival mites. The treatment

propargite (0.16%), fenpyroximate (0.02%) and dicofol (0.05%) were at par with it, recorded 6.89, 7.36 and 7.39 overall average survival mites, respectively. The least effective treatment was milbemectin (0.01%) recorded 9.34 average survival mites.

The present finding in respect of effectiveness of abamectin and fenazaquin against mites are similar with result of Akashe (2004) and Jagtap (2004). The other treatments fenazaquin, dicofol, amitraz results are also in line with the result of Dhar *et al*. (2000), Jagtap (2004) and Akashe (2004).

V. D. Dhage
M. M. Suryawanshi
A. S. Dhane
S. S. Shelke

Department of Entomology
College of Agriculture,
Pune - 411 005 (India)
February 27, 2011.

References

Akashe, V. B. 2004. Management of two spotted spider mite (*Tetranychus urticae* Koch.) of rose during summer season. J. Maharashtra agric. Unin., 29(1) : 96-97.

Bhattacharya, H. K. 1997. Floriculture management. Floriculture Today Mag. Dec. pp. 15-23.

Dhar, T., Dey and Sarkar, P. K. 2000. Influence of abiotic factors on population build up of *Tetranychus urticae* on okra. Evaluation of some new pesticides for their control. Pestology. 3(9): 4.

Gill , S. and Sanderson, J. 1998. Mites In : Ball identification guide to greenhouse pests and beneficial. Ball Publ., 335, North River Street. Batavai Illionis 60570 , USA. pp. 167-212.

Hole, U. B. and Salunkhe, G. N. 2005. Studies on the relative resistance of rose cultivars to two spotted spider mite (*Tetranychus urticae* Koch.) J. Maharashtra agric. Uni., 30(3) : 316-317.

Jagtap, L. M. 2004. M.Sc. (Agri.) thesis submitted to M.P.K.V., Rahuri, Maharashtra.

Jhansi Rani, B. and Jagan Mohan, N. 1997. Pest management in gerbera. Novenyvendelen. 35(9): 443-457.

J. Agric. Res. Technol., 37 (2) : 322-324 (2012)

Influence of Genotypes and Planting Layouts on Quality Parameters of Fodder Sorghum

Sorghum is one of the major warm season crops which is widely used for forage production. The quality aspect in case of fodder is one of the most important criteria to judge the nutritive value of fodder. The present investigation comprised of effect of planting layouts on various quality parameters of sorghum fodder. The experiment was laid out in a factorial randomized block design with four replications at Agronomy Farm, College of Agriculture, Pune during summer 2006-07 and 2007-08. The fodder sorghum genotypes *viz*., Ruchira, Phule Amruta, SSG 59-3 and Maldandi-35-1 were taken as main plot treatments while three planting layouts *viz*., flat beds, ridges and furrows and broad bed furrows as sub plot treatments. The planting distance was 30 x 60 cm in all treatments. The crude protein percentage, crude fibre percentage, total ash content, ether extract percentage and nitrogen free extract was determined for each cut.

The variety SSG 59-3 produced significantly the highest crude protein content (Table 1) in both the cuts. Similar results were recorded by

Baig *et al*. (1979) and Nikam (2004). The crude protein content was significantly higher when varieties were sown on broad bed furrows than other layouts. Interaction effect was also found significant only first cut, where the best treatment combination was sowing of variety SSG 59-3 on broad bed furrows.

The crude fibre content was recorded significantly higher in variety Ruchira under both the cuts, while, it was varied significantly due to planting layouts at second cut only (Nikam 2004). The highest crude fibre was recorded with the varieties sown on flat beds. The interaction effect was significant only at second cut. The significantly higher crude fibre was recorded in variety Ruchira sown on flat beds while less crude fibre content was recorded in variety Phule Amruta sown on broad bed furrows.

The highest ether extract percentage was recorded in variety Phule Amruta at both the cuts (Nikam, 2004), while, it differed significantly due to planting layouts at first cut only. Significantly the highest ether extract was recorded when varieties were sown on broad bed furrows. The interaction effect was significant under first cut only and the best treatment combination was growing of variety Phule Amruta on broad bed furrows.

The highest total ash content was recorded in variety M-35-1 at both the cuts, while, it was recorded the highest when varieties were grown on broad bed furrows at both the cuts. Interaction effect was significant at first cut only.

The nitrogen free exract in variety Phule Amruta was significantly higher over rest of the varieties at first cut, while, it was at par with variety SSG-59-3 at second cut. The nitrogen free extract was higher in first than second cut in all the varieties due to longer duration of second cut. Similar results were recorded by Srivastava and Kushwaha (1971). The significantly higher nitrogen free extract was

Table 1. Quality parameters as influenced by genotypes and planting layouts (Pooled mean over 2006-07 and 2007-08).

Treatment	Crude protein (%)		Crude fibre (%)		Ether extract (%)		Total ash (%)		Nitrogen free extract	
	I cut	II cut	I cut	II cut	I cut	II cut	I cut	II cut	I cut	II cut
Varieties :										
Ruchira	7.30	6.06	32.41	32.83	1.72	1.65	9.47	9.92	48.93	49.65
Phule Amruta	6.68	5.66	28.30	28.78	2.04	2.00	9.48	9.49	53.41	54.07
SSG-59-3	7.37	6.12	29.60	29.87	1.76	1.72	8.20	8.66	52.97	53.62
Maldandi-35-1	7.19	6.00	30.80	30.82	1.87	1.80	9.66	10.0	50.43	51.64
S.E.±	0.04	0.04	0.28	0.003	0.008	0.017	0.024	0.06	0.30	0.07
C.D. at 5%	0.12	0.12	0.80	0.009	0.024	0.051	0.069	0.18	0.87	0.20
Planting layouts :										
Flat bed	7.04	5.85	29.90	30.53	1.80	1.77	9.08	9.38	50.73	51.67
Ridges and furrows	7.11	5.90	30.29	30.55	1.85	1.80	9.21	9.51	51.53	52.20
Broad bed furrows	7.26	6.13	30.65	30.83	1.89	1.89	9.31	9.66	52.04	52.64
S.E.±	0.04	0.03	0.24	0.003	0.007	0.015	0.021	0.05	0.26	0.06
C.D. at 5%	0.11	0.10	N.S.	0.008	0.021	N.S.	0.061	0.15	0.75	0.17
Interaction :										
S.E.±	0.07	0.07	0.48	0.005	0.014	0.03	0.06	0.10	0.52	0.12
C.D. at 5%	0.21	N.S.	N.S.	0.015	0.042	N.S.	0.18	N.S.	N.S.	N.S.
Mean	7.14	5.96	30.28	30.58	1.85	1.79	9.20	9.52	51.43	52.17

recorded under broad bed furrows at both the cuts while the interaction effect was found to be non significant at both the cuts.

P. K. Sawant
A. A. Shaikh
V. R. Pawar
T. D. Dalvi

College of Agriculture
Pune - 411 005 (India)
February 27, 2011.

References

Baig, M. I., Tinge, S. A. and Gaffar, M. A. 1979. Studies on chemical composition of jowar fodder. Livestock Advisor. 4(7): 17-18.

Nikam, D. B. 2004. Studies on forage, nutrient yield, chemical composition and in vitro dry matter digestibility of sorghum (*Sorghum bicolor*) varieties. M.Sc. (Agri.) thesis, M.P.K.V., Rahuri.

Srivastava, R. P. and Kushwaha, N. S. 1971. Studies of various nutrients in jowar (*Sorghum angropagon*) at different stages of maturity. Indian Vet. J. 48(8): 833-843.

J. Agric. Res. Technol., 37 (2) : 324-327 (2012)

Response of Coloured Capsicum to Nutrients under Protected Cultivation

Taking into consideration the importance of Hi-Tech production of capsicum, the research trial was proposed under protected cultivation with the objectives to study the effect of various nutrients on growth attributes and fresh fruit yield of coloured capsicum and to find out the optimum dose of various nutrients.

An experiment was conducted at Hi-Tech Vegetable and Floriculture Project, College of Agriculture, Pune during 2003-04 and 2004-05 to study the growth, yield contributing characters and yield of capsicum F_1 hybrid Orbelle (Yellow) in naturally ventilated polyhouse. The experiment was carried out in a split plot design with three replications. The raised beds sterilized with formalin were prepared with 40 per cent red lateratic soil, 20 per cent sand and 40 per cent FYM. The seedlings raised in nursery were transplanted at the age of 35 days after sowing. Irrigation water and water soluble fertilizers as per treatments were applied through computer controlled Vanvalvet machine and ventury by using PVC pipeline periodically. To each irrigation, EC was maintained in the range of 1.6 to 2.0 dSm^{-1} and pH 5.2 to 5.8 for easy availability of nutrients to the crop. The chemical dose of fertilizer was started one month after transplanting of capcisum seedlings and stopped one month before final harvest of the crop. The first picking of capsicum fruit was done at 65-75 DAT and further pickings were done at an interval of 7-8 days and graded capsicum fruits were marketed. The periodical observations on growth, yield contributing characters and yield of capsicum were taken.

An application of macro and micronutrient levels significantly influenced all the growth attributes (Table 1) during both the years except that application of micronutrient levels showed non significant results for number of branches, functional leaves $plant^{-1}$ and leaf area during both the years.

Application of 400:300:300 kg $N:P_2O_5:K_2O$ ha^{-1}, recorded significantly higher value

for the capsicum plant height as compared with all the lower levels of macronutrient application during both the years. Micronutrient level 125:50:1.5 kg ha^{-1} Ca:Mg:Fe and 60 g ha^{-1} boron was found significantly superior for the plant height over lower levels during both the years but at par with the application of 100:37.5:1.0 kg ha^{-1} Ca:Mg:Fe with 40 g ha^{-1} boron during second year.

The macronutrient level 400:300:350 was at par with 350:250:300 and 300:200:250 kg $N:P_2O_5:K_2O$ ha^{-1} and recorded the higher number of branches $plant^{-1}$ over all the period of observation compared to the rest of the macronutrient levels during first year. During 2004-05, 400:300:350 kg $N:P_2O_5:K_2O$ ha^{-1} application recorded significantly the highest number of branches $plant^{-1}$. The higher levels of $N:P_2O_5:K_2O$ enhanced the profuse vegetative growth of capsicum. The higher dose of nitrogen is associated with the massive vegetative growth of the crop. The phosphorus is associated with root growth for absorption of nutrients and it is useful for photosynthesis, increased induction of leaves and reduced the flower drop. The potassium is beneficial for translocation of organic constituents from the place of their synthesis to the part of plant at which it is utilized. The cumulative effect of NPK forced the plants to full vegetative growth and increased the number of functional leaves and leaf area $plant^{-1}$ in capsicum (Revanappa *et al*. 1998 and Nassar *et al*., 2001).

The application of 400:300:350 was at par with 350:250:300 kg $N:P_2O_5:K_2O$ ha^{-1} and recorded the higher number of functional leaves $plant^{-1}$ and leaf area $plant^{-1}$ as compared to rest of the macronutrient levels applied to capsicum during both the years of experimentation. These results are in accordance with the findings of Patil and Biradar (2001).

The application of macronutrient level of 300:200:250 kg $N:P_20_5:K_2O$ ha^{-1} recorded

Table 1. Effect of macronutrient and micronutrient levels on growth, yield attributes and yield of coloured capsicum under protected cultivation.

Treatment	Plant height (cm)	Branches $plant^{-1}$	Functional leaves $plant^{-1}$	Leaf area (dm^2)	Dry stover yield $plant^{-1}$ (g)	Fresh fruits $plant^{-1}$	Dry fruit weight $plant^{-1}$ (g)	Total fresh fruit yield (t ha^{-1})	Dry stover yield (t ha^{-1})
Macronutrients ($N:P_2O_5:K_2O$ (kg ha^{-1})) :									
F_1 - 150:50:100	186.40	45.68	163.49	16011.13	146.29	11.09	64.83	71.73	36.90
F_2 - 200:100:150	204.38	59.49	150.89	14246.70	159.32	13.76	72.53	100.14	39.67
F_3 - 250:150:200	205.81	78.28	200.72	19930.37	194.30	14.87	80.10	127.56	47.86
F_4 - 300:200:250	209.37	73.04	198.91	19750.54	192.47	15.79	83.09	133.75	48.15
F_5 - 350:250:300	203.96	104.70	224.97	22336.63	191.61	12.94	74.37	97.81	47.03
F_6 - 400:300:350	225.64	84.51	240.98	23927.48	165.07	13.99	73.63	104.44	41.02
S.E.(m)±	1.53	2.44	9.08	1167.53				3.91	0.08
CD. at 5 %	4.59	7.09	26.47	3401.35				11.39	0.25
Secondary nutrients with micronutrients (Ca:Mg:Fe (kg ha^{-1}) : B (g ha^{-1})) :									
M_1 - 75:25:0.5:20	197.46	75.37	191.33	18998.12	171.17	12.86	71.50	93.64	43.06
M_2 - 100:37.5:1.0:40	206.59	74.01	200.18	19397.42	179.61	14.94	79.74	123.01	44.56
M_3 - 125:50:1.5:60	213.73	73.48	198.46	19705.88	173.74	13.41	73.04	101.06	42.69
S.E.(m)±	1.76	3.62	6.72	773.76				4.43	0.09
CD at 5 %	5.28	10.25	NS	2321.28				12.53	0.28

significantly higher number of fresh fruit plant^{-1}, dry fruit weightier plant during both the years and dry stover yield during first year than the rest of the macronutrient levels however, it was found at par with the application of 250:150:200 kg N:P_2O_5:K_2O ha^{-1} for dry stover yield plant^{-1} during first year and for dry fruit weight plant^{-1} during second year of experimentation. However, during 2004-05, macronutrient level of 250:150:200 kg ha^{-1} recorded significantly higher dry stover yield plant^{-1} as compared with rest of the macronutrient levels under study. The number of fresh fruit plant^{-1}, dry fruit weight plant^{-1} and dry stover, dry fruit weight significantly increased with the levels of micronutrients 100:37.5: 1.0 kg ha^{-1} Ca:Mg:Fe and 40 g ha^{-1} boron compared to higher and lower levels during both the years. The application of boron to capsicum enhanced the pollen viability as well as formation of sugar borate complexes and transported from the source to sink. This phenomenon might have increased the number of fruits plant^{-1} in capsicum. The calcium and magnesium nutrition might be associated with the strengthening of peduncle of capsicum fruit which in turn reduced the flower and fruit drop and increased more fruit bearing. Similar increase in the fruit number in capsicum plant was recorded due to the application of micronutrients like Ca and B by Santosh Kumari (2005) with the application of 100 ppm boron in tomato.

The application of macronutrients 300:200:250 kg ha^{-1} and 250:150:200 kg ha^{-1} of N:P_2O_5:K_2O were found to be at par with each other but significantly increased fresh fruit yield of capsicum as compared to the higher and lower levels of macronutrients during 2004-05 and in pooled mean data. It was significantly the lowest with the application of 150:50:100 kg N:P_2O_5:K_2O ha^{-1} during both the years and in pooled mean. Nutrient synergism accelerates the physiological and metabolic activities in plant system. The increased fresh fruit yield of capsicum might be associated with the balanced nutrition in the proportion of 1.5:1:1. The assimilated carbohydrates and mineral constituents were translocated from source to sink and utilized for the growth and development. The translocated organic constituents in presence of nitrogen absorption resulted in to profuse vegetative growth. This was reflected in terms of economic fresh fruit yield and stover yield of capsicum. These results are corroborative with the findings of Mishriky and Alphonse (1994), Neary *et al*. (1995) and Raut (2001).

The micronutrient levels 100:37.5:1.0 kg ha^{-1} in combination with 40 g ha^{-1} boron significantly increased higher fresh fruit yield as compared to the application of its higher and lower level during 2003-04, 2004-05 and in pooled mean. The higher fresh yield of capsicum might be ascertained due to magnesium and iron, the main constituents of chlorophyll. The increased chlorophyll synthesis leads to higher photosynthesis and ultimately more assimilation of organic constituents' *viz*., carbohydrates, protein, amino acid etc. The assimilated carbohydrates with boron forms the sugarborates and is transported from source to sink. Similarly, boron enhanced the pollen viability which required for fertilization and fruit setting in capsicum. All these physiological activities resulted into the increased fresh fruit yield and stover yield of capsicum.

N. D. Dalvi
C. B. Gaikwad
A. D. Kadlag
A. S. Jadhav
B. M. Lambade

Dept. of Agronomy,
Mahatma Phule Krishi Vidyapeeth,

Rahuri - 413 722 (India)
February 27, 2011.

References

Mishriky, J. F. and Alphonse, M. 1994. Effect of nitrogen and plant spacing on growth, yield and fruit material composition of pepper. Bulletin of faculty Agric. Univ. Cairo. 42(2): 423-431. (Quoted from CAB Abstract, 12,1995).

Nassar, H. H., Barokat, M. A., El. Masry, T. A. and Osman, A. S. 2001. Effect of potassium fertilization and paclobutrazol foliar application on seed production and seed germinability of sweet pepper. Egyptian J. Hort. 2(1): 101-112.

Neary, P. E., Stolie, C. A. and Paterson, M. A. 1995. Fertilizer requirement for drip irrigation of bell pepper grown in loamy sandy soil. Am. Soc. Agri. Engg.: 187-195.

Patil, K. B., and Biradar, D. P. 2001. Nutrient uptake of chilli as influenced by plant population and integrated nutrient levels in Vertisols. J. Maharashtra. agric. Univ. 26(3): 337-339.

Raut, A. S. 2001. Effect of fertigation levels in capsicum (*Capsicum annuum var. grossum*) under protected conditions. M.Sc. (Agri) thesis submitted to Mahatma Phule Krishi Vidhyapeeth., Rahuri (MS.) India.

Revanappa Nalwadi, U. G. and Sheelvantar, M. N. 1998. Influence of plant density on branching, dry matter production and yield of green chilli. Karnataka J. Agric. Sci. 11(3): 733-736.

Santosh Kumari. 2005. Effect of micronutrient sprays on growth yield and quality of fruit and seed in tomato. M.Sc. (Agri) thesis submitted to Dr. D.Y. Parmar Univ. Hort. and Forestry, Nauni, Solan. (HP) India.

J. Agric. Res. Technol., 37 (2) : 327-329 (2012)

Influence of Integrated Nutrient Management on Yield and Shelf Life of *Kharif* Okra (*Abelmoschus esculentus* (L.) Moench)

The inadequate use of nutrient is an important factor for limiting the yield potential of okra. The use of organic sources will reduce dependence on costly chemical fertilizers and pesticides being ecological sound and ecofriendly in nature. Response of okra to biofertilizer when integrated with organic manures and inorganic fertilizer has not been adequately studied, hence this study was undertaken.

The present investigation was carried out at Krishi Vigyan Kendra farm, Lanja, Ratnagiri during *kharif* 2010. The experiment was laid out in a randomised block design with three replications and twelve treatments. The different treatments composed of T_1 to T_{12} as shown in Table 1. The soil of the experimental field was lateritic and medium in texture with low available nitrogen (321.11 kg ha^{-1}) and high in available potassium (148.90 kg ha^{-1}). The soil was acidic in reaction (pH 5.7). The experimental crop was sown by dibbling at 60 x 20 cm spacing on 17th June 2010 and harvested from 12/08/2010 to 16/10/2010. The variety used was Arka Anamika (hybrid) from IIHR, Bangalore.

Yield of fruits : Fruit yield is an ultimate character of interest with central importance among the characters. The organic sources integrated with inorganic fertilizer showed significant effect on ha^{-1} fruit yield of okra. The treatment inorganic fertilizer alone (T_{12}) which was RDF (100:50:50 kg NPK ha) produced the higher yield (0.3 t ha^{-1}) which was significantly superior over rest of the application of integrated nutrient package under study, followed by the treatment 75 per cent N, full P and K through inorganic + *Azotobacter* (T_{10}) as seed treatment (9.71 t ha^{-1}). The treatment 75 per cent NPK from inorganic (T_6) which has

recorded 6.74 t ha^{-1} and treatment 50 per cent NPK through inorganic + 50 per cent NPK (T_3) through forest litter recorded 6.75 t ha^{-1} fruit yield which was at par with each other. The treatment 100 per cent NPK forest litter + phosphocompost (T_9) has recorded significantly lowest yield (5.36 t ha^{-1}) over rest of the treatments.

Table 1. Effect of integrated nutrient management on fruit yield, physiological wt. loss and shelf life of okra.

Treatment	Yield (t ha^{-1})	Physiological loss in wt. (%) during days							Shelf life (days)
		1	3	5	7	9	11	13	
T_1 - 50% NPK through inorganic (50:25:25 kg NPK ha^{-1} + 50% NPK through glyricidia (3.0 1 ha^{-1})	7.36	0.0	1.5	3.5	6.5	11.0	15.5	-	10.5
T_2 - 50% NPK through inorganic (50:25:25 kg NPK ha^{-1}) + 50% (NPK through vermicompost (3.0 t ha^{-1})	7.89	0.0	1.0	3.0	6.5	11.5	15.0	-	10.5
T_3 - 50% NPK through inorganic (50:25:25 kg NPK ha^{-1}) + 50% NPK through forest litter 5.0 t ha^{-1}) + phosphocompost (0.438 t ha^{-1})	6.45	0.0	1.0	3.0	6.0	11.5	15.0	-	10.5
T_4 - 75% NPK through glyricidia (3.0 t ha^{-1}) + 25% NPK through inorganic (25:12.5:12.5 kg ha^{-1}) + phosphocompost (0.438 t ha^{-1})	5.57	0.0	1.5	3.5	6.0	11.5	15.0	-	11.0
T_5 - 75% NPK through vermicompost (4.5 t ha^{-1}) + 25% NPK through inorganic (25:12.5:12.5 kg ha^{-1})	7.36	0.0	1.0	3.0	6.0	11.0	15.0	-	11.0
T_6 - 75% NPK through forest litter (7.5 1 ha^{-1}) + 25% NPK through inorganic (25:12.5: 12.5 kg ha^{-1}) + phosphocompost (0.415 t ha^{-1})	6.74	0.0	1.5	3.5	6.0	11.5	15.0	-	11.0
T_7 - 100% NPK through glyricidia (4.0 t ha^{-1} + phosphocompost (5.0 t ha^{-1})	6.01	0.0	1.5	3.5	6.5	11.0	15.5	-	15.5
T_8 - 100% NPK through vermicompost (6.0 t ha^{-1})	6.11	0.0	1.0	2.5	5.0	9.0	13.0	15.5	11.5
T_9 - 100% NPK forest litter (10.0 t ha^{-1}) + phosphocompost (0.375 t ha^{-1})	5.36	0.0	1.0	2.5	5.0	9.0	13.0	15.5	11.5
T_{10} - 75% N, full P and K through inorganic 75:50:50 Kg NPK $^{-1}$ + *Azotobacter* as seed treatment @200g /10 kg seed	9.71	0.0	1.0	2.5	5.0	9.0	13.0	15.5	11.5
T_{11} - 33% N through glyricidia (1.207 t ha^{-1}) + 33.3% N through vermicompost (2.083 t ha^{-1}) + 33.3% N through forest litter (3.333 t ha^{-1})	5.78	0.0	1.0	2.5	5.0	9.0	13.0	15.5	11.5
T_{12} - Inorganic fertilizer i.e RDF (100:50:50 kg NPK ha^{-1})	10.31	0.0	2.0	4.5	9.5	13.5	16.0	-	09.5
Mean	7.05								
SE±	1.46								
CD at 5%	4.27								

Shelf life : The vegetable being living entities continues to respire and transpire even after harvest under ambient temperature. The fruits grown on chemical fertilizer (100:50:50 RDF NPK kg ha^{-1}) showed very fast loss in weight more than 15 per cent within 10^{th} day of storage. Whereas fruits from the plants applied with 50 per cent NPK through inorganic + 50 per cent NPK through glyricidia (T_1), 50 per cent NPK through inorganic + 50 per cent NPK through vermicompost (T_2) and 50 per cent NPK through inorganic + 50 per cent NPK through forest litter (T_3) has shown more than 15 per cent loss in weight on 11^{th} day of storage. The fruits from the plant applied with treatment 100 per cent NPK through forest litter + phosphocompost (T_6), 75 per cent N full P and K through inorganic + *Azotobacter* as seed trealment (T_9) and 33 per cent through glyricidia + 33.3 per cent N through vermicompost + 33.3 per cent N through forest litter (T_{11}) noticed very slow loss in weight and more than 15 per cent loss in weight was recorded on 13^{th} day of storage.

The data clearly indicated that the plants applied with treatment RDF (100:50:50 NPK kg ha^{-1}) through inorganic shown lowest (9 days) shelf life. However, increase in the organic content integrated with *Azotobacter* as seed treatment increased the shelf life of okra pods among the different treatments. Nimkar (1993) and Singh *et al.* (1978) reported very less (6 days) shelf life of okra fruits under ambient temperature. Kazi (2001) reported maximum 13 days of shelf life with the cultivars AROH-21 and AK-20. This may be due to differential temperature effects under different agroclimatic condition. Temperature range during the present study was 22.8 to 30.6°C and climate was cloudy due to which loss in weight of fruits was at slower rate, which increased shelf life. Secondly, the variation in the shelf life of okra fruit treated with different integrated nutrient management at ambient temperature may be due to the type and forms of the nutrients applied to the plants.

It is concluded that, the use of inorganic fertilizer in okra crops increased the fruit yield. However, the increase in organic content integrated with biofertilizer i.e. *Azotobacter* as a seed treatment in okra increasod the shelf life of fruits, which will be helpful for the distant marketing.

Acknowledgement

The authors are very much thankful to Dr. Balasaheb Sawant Konkan Krishi Vidyapeeth, Dapoli for providing the facilities and funds to undertake the present investigation.

V. V. Shinde
J. J. Dubale
P. V. Jadhav
V. B. Dalvi

Krishi Vigyan Kendra,
Lanja - 416 712 (India)
March 27, 2011.

References

Kazi, C. N. 2001. Studies on growth, yield and quality of okra (*Abelmoschus esculentus* (L.) Moench) varieties under konkan condition. The M. Sc. (Agri.) thesis is submitted to Dr. B. S. Konkan Krishi Vidyapeeth Dapoli.

Nimkar, C. V. l993. Studies on some aspect of postal harvest handling of important vegetables grown under konkan condition. The M.Sc.(Agri.) thesis submitted to Dr. B. S. Konkan Krishi Vidyapeeth Dapoli.

Singh Kriti, Gill, I. S. and Verma, O. P. 1978. Studies on poultry manure in relation to vegetable production Cauliflower, Indian J. of Hort. 2b (1 and 2).

J. Agric. Res. Technol., 37 (2) : 330-334 (2012)

Effect of Chemical Treatments on Biochemical Constituents of Sapota [*Manilkara achras* (Mill.) Forsberg] Fruits During Storage

Sapota [*Manilkara achras* (mill) Forsberg] is a nutritious fruit. However, it is highly perishable, ripens fast and becomes unconsumable very soon. The present study was, undertaken to investigate the possibilities of prolonging the shelf life of sapota fruits using simple and inexpensive methods like post-harvest chemical dipping.

All the fruits used as samples were treated with 0.2 per cent bavistin. Eleven treatments control, the treatments included under the study were bavistin (0.2%), $KMnO_4$ (0.5 and 1.0%), $CaCl_2$ (1.0 and 2.0%), GA_3 (100 and 200 ppm), wax emulsion (1:1 and 1:2 dilution), and a treatment of film wrapping. Fruits were dipped in respective chemical solution and excess solution was drained off and dried under a ceiling fan. The fruits were then packed in polyethylene bags of 150 guage having 0.1 per cent vents. The experiment was laid out in factorial completely randomized design with two replications using two cultivars *viz*., Kalipatti and Cricket ball.

The experiment was run separately for each

Table 1. Effect of different chemical treatments on biochemical constituents of sapota fruit during storage at ambient temperature.

Treat no.	Reducing sugar (%)						Total sugar (%)					
	Kalipatti			Cricket ball			Kalipatti			Cricket ball		
	3rd day	6th day	9th day	3rd day	6th day	9th day	3rd day	6th day	9th day	3rd day	6th day	9th day
T_1	11.11	14.28	11.62	8.62	11.62	8.77	20.83	24.39	21.27	15.38	19.60	16.39
T_2	10.41	13.88	12.19	8.19	11.36	10.20	19.23	23.25	20.40	14.70	18.51	16.94
T_3	9.25	13.51	13.15	7.46	10.86	9.80	17.24	21.73	23.25	13.33	17.85	16.66
T_4	8.33	12.50	14.70	7.04	8.47	10.86	15.62	20.40	20.83	11.62	13.88	18.18
T_5	9.43	13.15	12.82	7.69	10.63	10.00	17.85	21.73	20.00	14.08	17.85	16.94
T_6	8.92	13.15	14.28	7.24	9.09	11.90	16.66	21.27	24.39	12.34	15.62	20.00
T_7	7.81	12.19	13.88	6.25	7.93	11.62	12.50	17.24	23.80	9.90	12.04	19.23
T_8	7.35	9.61	13.51	5.88	7.14	10.41	11.49	14.49	18.86	9.43	10.98	17.85
T_9	6.17	8.47	10.20	4.85	J5.41	8.19	9.52	12.50	14.70	7.75	9.61	14.92
T_{10}	6.32	8.62	10.63	5.55	6.84	4 8.77	9.80	12.98	15.87	8.77	10.30	15.62
T_{11}	10.63	13.88	12.50	7.81	11.11	9.80	19.60	23.80	20.83	14.28	17.85	16.39
Mean	8.70	12.11	12.68	6.96	9.22	10.03	15.49	19.43	20.38	11.96	14.92	17.19

Factor	3rd day		6th day		9th day		3rd day		6th day		9th day	
	SE±	CD @ 5%	SE±	CD @ 5%	SE±	CD @ 5%	SE±	CD @ 5%	SE±	CD @ 5%	SE±	CD @ 5%
Treatment	0.131	0.374	0.309	0.883	0.240	0.684	0.208	0.594	0.288	0.822	0.508	1.449
Variety	0.056	0.159	0.132	0.376	0.102	0.291	0.089	0.253	0.123	0.350	0.216	0.618
Treatment x Variety	0.227	0.649	NS	NS	NS	NS	0.360	1.029	0.499	1.425	0.879	2.511

cultivar and the observations on chemical analyses were recorded on the 3rd, 6th and 9th day of ambient storage. Standard procedures were followed for determination of various parameters. The sugars were determined by modified method suggested by Ranganna (1977). Ascorbic acid (Vit. C) and polyphenol content were estimated by using A.O.A.C. (1990) and Chavan *et al.* (1979), respectively.

Reducing sugar : The statistical analysis of the data indicated that the control treatment (T_1) recorded maximum per cent reducing sugar content (14.28 and 11.62%) of Kalipatti and Cricket ball, respectively on the 6th day of sampling, which was at par with T_2, T_3 and T_{11}. These treatments showed maximum per cent reducing sugar on 6th day and a decline on 9th day of sampling. The treatments T_4 to T_{10} except T_5 showed a different trend in the per cent reducing sugar content which steadily increased throughout the 9 days of storage, indicating that the ripening wasn't complete even till the 9th day as in the other treatments. This suggests that the treatments T_4 to T_{10} except T_5 have an effect on causing delay in ripening.

Table 1. Contd.

Treat no.	Ascorbic acid (mg^{-100g})						Polyphenol content (%)					
	Kalipatti			Cricket ball			Kalipatti			Cricket ball		
	3rd day	6th day	9th day	3rd day	6th day	9th day	3rd day	6th day	9th day	3rd day	6th day	9th day
T_1	22.32	16.20	12.60	19.08	11.10	6.66	0.47	0.41	0.29	0.17	0.10	0.07
T_2	23.40	17.28	12.96	20.52	12.96	8.88	0.52	0.44	0.33	0.19	0.12	0.08
T_3	22.68	17.28	13.32	21.60	13.68	10.08	0.56	0.48	0.38	0.23	0.17	0.09
T_4	25.56	19.08	14.04	23.40	16.56	11.16	0.62	0.54	0.45	0.26	0.21	0.11
T_5	24.48	18.00	13.32	21.96	14.76	10.44	0.54	0.43	0.36	0.21	0.15	0.10
T_6	24.12	18.36	13.68	22.68	15.84	11.52	0.59	0.51	0.41	0.29	0.24	0.13
T_7	26.64	19.44	14.40	24.12	17.28	12.60	0.65	0.58	0.47	0.33	0.28	0.19
T_8	27.72	20.88	15.84	24.84	18.00	12.96	0.68	0.61	0.53	0.37	0.31	0.22
T_9	30.96	24.00	17.64	26.28	20.16	15.84	0.74	0.67	0.56	0.43	0.36	0.28
T_{10}	29.52	21.60	16.56	25.20	18.36	13.68	0.70	0.62	0.51	0.41	0.34	0.25
T_{11}	22.68	16.36	13.68	19.44	12.60	8.88	0.50	0.45	0.32	0.20	0.14	0.08
Mean	25.46	18.95	14.37	22.65	15.57	11.15	0.60	0.52	0.42	0.28	0.22	0.15

Factor	3rd day		6th day		9th day		3rd day		6th day		9th day	
	SE±	CD @ 5%	SE±	CD @ 5%	SE±	CD @ 5%	SE±	CD @ 5%	SE±	CD @ 5%	SE±	CD @ 5%
Treatment	0.463	1.323	0.426	1.215	0.487	1.391	0.013	0.037	0.013	0.038	0.011	0.0326
Variety	0.198	0.564	0.181	0.518	0.208	0.593	0.006	0.015	0.006	0.016	0.005	0.013
Treatment x Variety	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	0.020	0.056

Treatments detail = T_1 - Control, T_2 - Control + 0.2% Bavistin, T_3 - 0.5% $KMnO_4$, T_4 - 1.0% $KMnO_4$, T_5 - 1.0% $CaCl_2$, T_6 - 2.0% $CaCl_2$, T_7 - 100ppm GA_3, T_8 - 200ppm, T_9 - 1:1 Waxol, T_{10} - 1:2 Waxol, T_{11} - Film wrap (*Initial value of freshly harvested mature fruits of Kalipatti and Cricket ball were reducing sugar - 4.67 and 3.87%, total sugar - 7.4 and 6.66%, Ascorbic acid - 32.4 and 28.8 mg^{-100g}, polyphenol content - 0.78 and 0.47%, respectively.)

The results of the present investigation are in agreement with the results obtained by various other researchers. The increase in reducing sugars of treated sapota fruits till ripening could be attributed to hydrolysis of starch into sugar. The observations were also in accordance with the findings reported by Elahi Khan (1973) and Roy and Pandey (1983). The increase in reducing sugar followed by a decrease was probably due to the utilization of sugar for the physiological processes like respiration during storage of sapota fruits.

The interaction effect between treatments x varieties was significant on 3rd day but was non significant during 6th and 9th day of storage.

Total sugar : The lowest sugar content during the storage period was observed in treatment T_9. At the end of 9 days it was 14.70 and 14.92 per cent in Kalipatti and Cricket ball, respectively. Treatment T_{10} (1:2 waxol) was at par to T_9 and was significantly less than T_1 to T_8 and T_{11} treatments. This suggest that coating of the fruits with waxol (1:1) and (1:2) have delayed the ripening of sapota fruits, and are the best observed treatments which cause delay in the ripening process. Both the varieties Kalipatti and Cricket ball differ significantly from each other and interaction effect between treatments x varieties was significant over the entire storage period.

Ascorbic acid : In Kalipatti cultivar, the data revealed that the maximum ascorbic acid content was seen in T_9 (1:1 waxol) 30.96 mg^{-100g} which decreased to 17.64 mg^{-100g} upon 9 days of storage. Similar trend of decrease in value was observed in all the treatments under study. The treatment T_9 was

Table 2. Effect of different chemical treatments on organoleptic score of sapota fruits during storage at ambient temperature.

Treatment	**Organoleptic score**					
	Kalipatti			**Cricket ball**		
	6th day	**8th day**	**10th day**	**6th day**	**8th day**	**10th day**
T_1 - Control	8.00	6.10	4.25	8.77	6.05	4.65
T_2 - Control + 0.2% Bavistin	7.42	6.24	5.25	7.62	6.07	4.96
T_3 - 0.5% $KMnO_4$	7.25	6.42	5.42	7.35	6.15	5.29
T_4 - 1.0% $KMnO_4$	6.00	8.02	6.32	6.15	8.22	6.66
T_5 - 1.0% $CaCl_2$	7.07	6.84	5.84	7.22	6.50	5.83
T_6 - 2.0% $CaCl_2$	6.82	7.75	6.46	6.97	7.92	6.90
T_7 - 100 ppm GA_3	5.35	6.47	8.21	5.40	7.00	8.62
T_8 - 200 ppm GA_3	5.07	6.32	8.16	5.37	6.82	8.67
T_9 - 1:1 Waxol	4.20	5.67	7.12	5.17	6.12	7.88
T_{10} - 1:2 Waxol	4.70	5.75	7.82	5.22	6.27	7.97
T_{11} - Film wrap	7.65	6.62	4.52	8.02	6.82	4.42
Mean	6.32	6.56	6.31	6.66	6.72	6.53
Factor	**6th day**		**8th day**		**10th day**	
	SE±	**CD @5%**	**SE±**	**CD @5%**	**SE±**	**CD @5%**
Treatment	0.136	0.388	0.109	0.312	0.129	0.367
Variety	0.058	0.165	0.047	0.133	0.055	0.156
Interaction	NS	NS	0.189	0.540	NS	NS

Scale 0-9 rating

found to be significantly superior over the rest of treatment during 3rd, 6th and 9th day of sampling. The data further revealed that the treatment T_{10} was at par with T_9 on the 9th day and the rest of the treatments differ significantly than treatment T_9.

In Cricket ball cultivar, the least ascorbic acid content was observed in treatment T_1 (control). In T_1 (control), on 3rd day of sampling (19.08 mg^{-100g}) it declined to 6.66 mg^{-100g} on 9th days of storage. In all the treatments a gradual fall in ascorbic acid content was observed. Treatment T_9 exhibited highest ascorbic acid value of 26.28 mg^{-100g} on day 3 which declined to 15.84 mg^{-100g} on day 9. The interaction effect between treatments x varieties was non significant for the ascorbic acid content.

The level of ascorbic acid declined till the end of storage period at ambient temperature. The observation is in accordance with these findings reported by Gautam and Chundawat (1990). The decrease in the ascorbic acid was less when treated with 300 ppm GA_3 followed by 100 ppm Kinetin whereas faster reduction of ascorbic acid in the control sapota fruits was recored. This slower rate of oxidation or reduction of ascorbic acid in the GA_3 and Kinetin treated fruits is mainly due to reduced rate of respiration.

Polyphenol content : The polyphenol content amongst the various treatments under study decreased during the entire storage period. The treatment T_9 (1:1 waxol) showed higher polyphenol content value during the entire storage period as compared to the other treatments. The minimum value was exhibited by the control treatment. These results of the present investigation are in conformity with the results of Ingle *et al*. (1982). Both the varieties differ significantly, and the interaction effect between treatment x varieties was non significant at the 3rd and 6th day, but had significant effect on 9th day of storage period.

Organoleptic evaluations : The data on score for organoleptic qualities *viz*., flavour, texture and taste as influenced by different post harvest chemical treatment is given in Table 2. The data indicated that the organoleptic score of the sapota fruits is affected by various treatments on 6th, 8th and 10th day storage. The score was found to range between 4 to 9. The score of 5.5 and above indicated acceptability.

It is observed that on the 6th day of storage the highest score was 8.00, 8.77 in the untreated fruits i.e. control of Kalipatti and Cricket ball, respectively, suggesting that the fruit ripened in this treatment on the 6 day itself. The maximum score on 8th day was obtained for the fruits treated with T_4 (1% $KMnO_4$) followed by T_6 (2% $CaCl_2$). Some treatments delayed the ripening upto the 10 days and the fruits ripened on 10th day. Treatment 100 and 200 ppm GA_3 (T_7) and T_8, T_{10} and T_9 (Waxol 1:2 and 1:1) showed higher organoletpic score, which indicates the delay in ripening due tof these treatments.

P. L. Nikam
N. B. Gokhale

College of Agriculture,
Dapoli - 415 712 (India)
March 27, 2011.

References

A.O.A.C. 1990. Official Method of Analysis, the Association of Official Analytical Chemists, 12th Edn., Washington, D.C.

Chavan, J. K., Kadam, S. S., Ghonsikar, C. P. and Salunkhe, D. K. 1979. Removal of tannins and improvement of *in vitro* protein digestibility of sorghum seeds by soaking in alkali. J. Food Sci., 44: 319-321.

Elahi, M. and Khan, N. 1973. Physico-chemical changes in

some Pakistani Mango varieties during storage and ripening. J. Agri. Food. Chem., 21(2): 229-231.

Gautam, S. K. and Chundawat, B. S. 1990. Post-harvest changes in sapota cv. 'Kalipatti' II-Effect of various post-harvest treatments on physico-chemical attributes. Ind. J. Hort., 47(3): 264-269.

Ingle, G. S., Khedkar, D. M. and Dabhade, R. S. 1982. Effect of growth regulators or ripening of sapota (*Achras sapota*). Indian Fd. Packer, 36(1): 72-76.

Ranganna, S. 1977. Estimation of pectic substances as calcium pectate by methods of analysis for fruits for vegetable production. Tata McGraw Hill Publ. Co., New Delhi.

Roy, S. K. and Pandey, R. M. 1983. Effect of existing method of harvesting on ripening and storage of mango (*Mangifera indica* L.) silver jubilee celebration seminar on plant physiology in coming years. Indian Soc. for Plant physiol. Session I, Abst. 1-22.

J. Agric. Res. Technol., 37 (2) : 334-336 (2012)

Micropropagation Studies in Paradise Tree (*Simarouba glauca* DC.)

In *Simarouba glauca* DC. it is difficult to identify male and female plants before flowering, which requires 4 to 6 years for flowering. At present there are no morphological markers also reported. So for rapid multiplication and maintaining genetic purity of female plants with high yield potential and male plants with longer flowering span, tissue culture technique is the efficient solution. *In vitro* micropropagation of *Simarouba glauca* DC through nodal explant was reported by Rout and Das, (1995).

The investigation was carried out at Plant Tissue Culture Laboratory, MPKV, Rahuri during 2007-08. The explants (Shoot tip, nodal segment) of 1.0-1.5 cm size were excised from mature tree. Surface sterilization was done by agitation in 0.1 per cent $HgCl_2$ for 5-6 min followed by three rinsing with sterilized double-distilled water. The aseptically inoculated explants were incubated under controlled conditions, i.e. temperature 25 ± 2°C and 16/8 hrs photoperiod. For culture initiation, basal MS (Murashige and Skoog, 1962) medium supplemented with 3 per cent sucrose and bactoagar (0.8%) and pH was adjusted to 5.8 prior to autoclaving (121°C for 20 min at 1.06 kg cm^{-2}). Well developed shootlets having length more than 2 cm or four leaf stage were separated from explant and subcultured for rooting on MS basal medium supplemented with NAA and IBA individually. The well rooted seedlings were hardened in vitro in soilrite. The data were analyzed in completely randomized block design as described by Panse and Sukhatme (1985).

The explants showed considerable variations in their shoot initiation response to various phytohormones. The culture response ranged from 45.8 to 94.4 and 37.4 to 90.2 per cent in shoot tip and nodal segment explants respectively (Table 1) from which it is revealed that shoot tip explant has better performance than nodal segment. The growth hormones were found to perform superior in combination, however, with the addition of AS to this combination (3.0 mg^{-1} BAP + 0.1 mg^{-1} NAA + 30 mg^{-1} AS) gave highest shoot initiation percentage for both the explants i.e. shoot and nodal segment.

Shoot tip and nodal segment explants showed similar results for the days required for

Table 1. Effect of medium composition on percent shoot regeneration, days required for initiation and number of shoots per culture in nodal segment explant of Simarouba.

Culture medium				Shoot generation (%)		Days required for initiation		No. of shoots culture^{-1}	
Medium	**BAP**	**NAA**	**AS**	**ST**	**NS**	**ST**	**NS**	**ST**	**NS**
MS	0.5	0.1	-	45.83a (42.6)*	37.49a (37.74)*	30.9g	30.6f	1.3a	1.2a
MS	1.0	0.1	-	51.4b (47.4)	44.44b (41.8)	27.5f	29.5ef	1.5a	1.3ab
MS	1.5	0.1	-	59.7b (50.6)	48.61b (44. 19)	27.3ef	29.0e	1.7a	1.7abc
MS	2.0	0.1	-	72.2 (58.2)	59.72c (50.6)	25.0c	24.8e	2.4bc	2.2cd
MS	2.5	0.1	-	70.8c (57.4)	58.32c (49.81)	26.3de	27.8d	2.3b	2.0cd
MS	3.0	0.1	-	87.5c (69.5)	80.55e (63.87)	23.3b	23.3b	3.7e	3.1c
MS	3.5	0.1	-	69.4c (56.5)	63.88e (53.08)	25.1c	25.1C	2.4bc	1.9bcd
MS	3.0	0.1	20	75c (60.1)	70.83d (57.35)	25.8cd	26.7d	2.9cd	2.2cd
MS	3.0	0.1	30	94.4c (76.5)	90.27f (71.94)	24.7a	21.4a	4.6f	3.8f
MS	3.0	0.1	40	73.6c (59.1)	73.61d (59.09)	25.8cd	27.1d	3.0d	2.4d
CD (0.05)				4.06	3.26	1.02	1.17	0.58	0.6

* Figures in paranthesis are arcsine transformed values, a Means followed by different letters are significantly different at the 5% level, ST = Shoot tip, NS = Nodal segment

the shoot bud initiation. For the treatment MS + 3.0 mg l^{-1} BAP + 0.1 mg l^{-1} NAA + 30 mg l^{-1} AS shoot tip explant took 21.7 days compared to 21.4 days in nodal segment explant.

The number of roots/shoots significantly varied with different concentrations of IBA and NAA. MS nutrient medium supplemented with IBA 1.0 mg l^{-1} proved best. It took minimum of 26.2 days for root induction to shoot and produced 5.0 numbers of roots per shoot with 2.2 cm length. Roots produced in 1.0 mg l^{-1} IBA were healthier than that of higher concentration of IBA and NAA.

Both the explants gave better results for establishment, so they were tested for shoot multiplication. The treatment MS + 3.0 mg l^{-1} BAP + 0.1 mg l^{-1} NAA + 30 mg l-1 AS produced maximum 4.6 and 3.8 shoots/culture in shoot tip and nodal segment respectively.

In vitro shoot multiplication was achieved on MS medium containing 2.5 mg l^{-1} BA with 0.1 mg l^{-1} NAA and a maximum of 5.83 shoots were produced per nodal explant within 6 weeks of culture (Rout and Das, 199.5). The media containing Adenine sulphate stimulated multiplication reported earlier in other plant species (Murkute *et al*. 2008; Parveen, 2008). The media containing auxin stimulated the induction of rooting as reported earlier in other plant species (Kevers *et al*. 1997).

Primary hardening showed 70 per cent survival, while secondary hardening showed 66.66 per cent with good growth. The water stress caused during the acclimatization was found to be a major cause for the reduced survival in hardening process (Brainered and Fuchigami, 1981; Brainered *et al*. 1981). Thus, from the present investigation an efficient regeneration protocol MS + 3.0 mg T1 BAP + 0.1 mg l^{-1} NAA + 3.0 mg l^{-1} AS for establishment and multiplication and MS + 1 mg l^{-1} IBA for rooting of *Simarouba glauca* DC. was developed which can be used further for mass multiplication of this commercial important oil seed plant.

A. S. Gaikwad
N. S. Kute

Y. G. Ban
S. V. Pawar

Department of Botany
Mahatma Phule Krishi Vidyapeeth,
Rahuri - 413 722 (India)
March 27, 2011.

References

Brainered, K. E. and Funchigami, L. H. 1981. Acclimatization of aseptically custard apple plants to low humidity. J. Amer. Soc. Hort. Sci. 106: 515-518.

Brainere, K. E., Funchigami, L. H. and Clark, C. S. 1981. Leaf anatomy and water stress on aseptically cultured Pixy plum under different environments. Hort. Sci., 16: 173-175.

Kevers, C., Hausman, J. F., Favire-Rampant, O., Evers, D. and Gasper, T. 1997 Hormonal control of adventitious rooting. Progress and Questions. Angew. Bot. 71: 71-79.

Murashige, T. and Skoog, F. 1962. A revised medium for rapid growth and bioassays with tobacco tissue culture. Physiol. Plant. 15(3): 473-497.

Murkute, A. A., Satyawati Sharaia and Singh, S. K. 2008. Rapid clonal *in vitro* multiplication of *Citrus jambhiri* and *Citrus karna*. Indian J. Hort. 65(2): 127-133.

Panse, V. G. and Sukhatme, P. V. 1985. Statistical Methods for Agricultural Workers. 4th Edn. ICAR, New Delhi.: 157-165.

Parveen, 2008. *In vitro* techniques for large scale propagation of *Oroxylum indicum* vent, using different explants. Ann. For., 16(2): 245-250.

Rout, G. R. and Das, P. 1995. *In vitro* micropropagation of mature *Simarouba glauca* an oil yielding tree. Bangladesh. J. Bot. 24: 137-141.

J. Agric. Res. Technol., 37 (2) : 336-338 (2012)

Heterosis Studies in Cowpea

Cowpea is one of the important pulse crop, which is also known as poor man's meat because of high protein content. The magnitude of heterosis provide a basis for determining the parents used to exploit the heterosis. Exploitation of heterosis appear to be cheap and easy method for increasing yield in many crops. Mostly work of heterosis was done in cross pollinated crops to exploit hybrid vigour. The present investigation was done to exploit heterosis for yield and it's components in cowpea.

Six genotypes of cowpea were crossed in half diallel. The 15 hybrids along with 6 parents (GC-3, Phule C. P. 05040, CP-22, RC 101, PGCP-1 and TC 301) and two standard checks (Phule pandhari and Konkan Safed) were grown in a randomized block design with three replications during *kharif*, 2010.

Each treatment consisted of single row of three meter length consisting of 20 plants in row with 15 cm distance within row and 45 cm distance between rows. The observations were recorded on five randomly selected plants of each treatments for eleven different growth and yield characters. The estimation of heterosis was done as per Rai (1979). The analysis of variance was done as per standard method suggested by Panse and Sukhatme (1967).

Among the parents Phule C. P. 05040 (41.33 days) and the cross GC-3 x Phule C. P. 05040 (41.93 days) showed less number of days for 50 per cent flowering. The parent GC-3 (77.60 days) and cross GC-3 x Phule C. P. 05040 (73.20 days) was early maturing. The

parent GC-3 (115.80 cm) and cross GC-3 x Phule C. P. 05040 (128.33 cm) was taller than the other. The parent TC 301 (8.80) and the cross CP-22 x TC 301 (9.27) showed more number of branches plant^{-1} and number of pods plant^{-1}. The parent PGCP-1 (2.57) and cross Phule C. P. 05040 x PGCP-1 (2.79) produced more number of pods cluster-1. The parent RC 101 (16.48 cm) and cross CP-22 x RC 101 (18.51 cm) showed maximum pod length. The parent RC 101 (15.69) and cross RC 101 x TC 301 (16.99) showed more number of seeds pod^{-1} and maximum 100 seed weight. The parent RC 101 (20.4 g) and the cross combinations PGCP-1 x TC 301 (23.60 g) showed maximum seed yield plant^{-1}. For protein content the parent GC-3 (19.76%) and the cross GC-3 x PGCP-1 (21.78%) showed maximum mean performance.

Heterosis for days to 50 per cent flowering ranged from -10.09 to 6.46 per cent over better parent with six significant crosses and -20.90 to 5.25 per cent over standard check with ten significant crosses. For days to maturity the heterosis ranged -8.74 to 9.13 per cent over better parent with seven significant crosses and -13.28 to 6.11 per cent over standard check with four significant crosses. Similar observations were also reported by Singh *et al.* (1985) and Bhushana (2000).

The extent of heterosis for plant height ranged from -15.31 to 14.55 per cent over better parent with five significant crosses and -35.54 to 15.52 per cent over standard check with one significant cross. The similar findings were reported by Singh *et al.* (1985). For number of branches plant^{-1} the range of heterosis was -18.1 1 to 3.78 per cent over better parent with one significant cross and -21.83 to -3.52 per cent over standard check. For number of pods cluster^{-1}, the range of heterosis was -10.51 to 16.12 per cent over better parent with four significant crosses and -12.36 to 8.42 per cent over standard check with one significant cross. The present findings are in agreement with Patil and Shete (1986).

In case of pods plant^{-1}, the range of heterosis was from -23.94 to 10.50 per cent over better parent with two significant crosses and -9.50 to 25.37 per cent over standard check with seven significant crosses. The present findings are in agreement with Patil and Shete (1986) and Bhushana (2000). For pod length the percentage of heterosis was from -11.44 to 10.39 over better parent with one significant cross and 0.39 to 37.34 per cent over standard check with eight significant crosses. Bhushana (2000) also found similar results in heterosis for pod length.

The heterosis percentage was from -30.87 to 4.43 over better parent and -27.02 to 11.74 over standard check for number of seeds pod^{-1}. For 100 seed weight, heterosis was ranged -37.09 to -0.30 per cent over better parent and -31.47 to 21.15 per cent over standard check with eight significant crosses. For yield plant^{-1} the range of heterosis was -6.70 to 40.27 per cent over better parent with four significant crosses and -3.79 to 18.99 per cent over standard check with five significant crosses. Danam and Chaudhary (2000) reported the same result. For protein content the heterosis ranged from -1.68 to 11.30 per cent with three significant crosses and -6.71 to 11.47 per cent with two significant crosses.

In present study high x high, high x low and low x high parental combinations given considerable heterosis over better parent and standard check indicating high yielding crosses may not be necessarily produced from high yielding parents. In most of the cases heterosis for seed yield was associated with number of pods plant^{-1}, number of seeds pod^{-1} and 100 seed weight as observed in crosses, Phule C. P. 05040 x RC 101, CP-22 x TC 301 and CP-22

x RC 101. These crosses can be exploited for identification of desirable segregates.

C. B. Bankhele
B. H. Chavan
D. V. Dahat
S. M. Pawar

Dept. of Agricultural Botany,
College of Agriculture,
Pune - 411 005 (India)
June 15, 2011.

References

Bhushana, H. O., Vishwanatha, K. P., Arunachalam, P. And Halesh, G. K. 200. Heterosis in cowpea for seed yield and its attributes. Crop Res., 19(2): 277-280.

Danam, S. and Chaudhari, F. P. 2000. Heterosis studies in cowpea (*Vigna unguiculata* (L.) Walp). Ann. of agric. Res., 21(2): 248- 252.

Panse, V. G. And Sukhatme, P. V. 1967. Statistical ijnethods fiWgricultural Workers. ICAR, New Delhi, 2nd Ed. pp. 96.

Patil, R. B. and Shete, M. M. 1986. Combining ability analysis in cowpea (*Vigna unguiculata* (L.)Walp). J. Maharashtra agric. Univ., 11(3): 239-295.

Rai, B. 1979. Heterosis breeding. Agro-Biological Publ. Delhi-110 005, India. pp. 183.

Singh, R., Singh, S. and Paroda, R. S. 1985. Line x tester analysis in cowpea. Forage Res. 11(2): 101-106.

J. Agric. Res. Technol., 37 (2) : 338-340 (2012)

Correlation and Path Analysis in M_3 Lines of Cowpea

Yield is complex character, which depends upon many determining characters, hence, the information on the correlation between yield and its component characters is prerequisite for crop improvement. The phenotypic correlation indicate the extent of observed relationship between the two characters while genotypic correlation provides information about linkage for the gene controlling the pair of characters. Therefore, the correlation coefficient at genotypic and phenotypic levels were considered. However, they do not provide the exact picture of direct and indirect causes of such association, which can be cleared through path analysis (Dewey and Lu 1959). Thus path analysis is very useful to pinpoint the important yield components which can be utilized for recommending selection indices. In the present studies, attempts was therefore, made to obtain such information in cowpea.

The experimental material for present study was comprised of 138 lines (135 mutants+3 parents) of cowpea (*Vigna unguiculata* (L.) Walp). The field experiment was carried out in a randomized block design with three replication at Botany farm, College of Agriculture, Pune. Each plot consisted of single row of 3 m length with a spacing 15 cm between plants. The recommended package of practices of crop production and protection were followed for successful crop growth.

The observations were recorded on randomly selected five competitive plants from each mutant in each replication for nine characters. The correlation coefficient were worked out to understand the association among characters by adopting method described by Singh and Choudhari (1977) and path analysis was done according to the procedure suggested by Dewey and Lu (1959).

From the correlation studies (Table. 1), it was evident that, the characters *viz*., number of pods plant^{-1}, number of branches plant^{-1}, plant height, 100 seed weight and days to maturity showed positive significant association with seed yield plant^{-1} indicating possibilities of improving these characters simultaneously. Similar results were reported by Sawant (1994) for 100 seed weight, number of branches plant^{-1}, number of pods plant^{-1}, Dumbre *et al*. (1982) for plant height and pods plant^{-1}, Singh *et al*. (1982) for plant height, number of pods plant^{-1}, Natarajaratnam *et al*. (1986) for plant height, Patil and Bhapkar (1987), Naidu *et al*. (1996) for number of pods plant^{-1}. However, the trait days to 50 per cent flowering recorded negative significant association with seed yield plant^{-1}. Confirming the earlier findings of Sharma and Mishra (1987), Tyagi *et al*. (2000). The characters pod length and number of seeds

Table 1. Genotypic (above diagonal) and phenotypic (below diagonal) correlation coefficient of 9 characters in M_3 mutants of cowpea.

Character	Days to 50% flowering (No.)	Plant height (cm)	Branches plant^{-1}	Days to maturity (No.)	Pods plant^{-1}	Pod length (cm)	Seeds pod^{-1}	100 seed weight (g)	Seeds yield plant^{-1} (g)
Days to 50% flowering	1	-0.1603*	0.8509**	-0.6701**	-0.8287**	-0.1683*	-0.012	0.1224	-0.719**
Plant height (cm)	0.0468	1	-0.1422*	0.1235	0.6203**	-0.4476**	0.3408**	0.3872**	0.1403*
Branches plant^{-1}	-0.0190	0.2198**	1	-0.4967**	0.0641	-0.5654**	-0.5742**	-0.391**	0.6656**
Days to maturity	-0.0376	0.0825	0.0537	1	0.1977*	-0.2951**	-0.1974*	0.3274**	0.2712**
Pod plant^{-1}	-0.0587	0.0790	0.0826	0.0841	1	0.1155	-0.0421	0.0518	0.7656**
Pod length (cm)	0.0125	0.0177	0.0074	0.0390	0.0340	1	0.9446**	0.1772*	0.0315
Seeds pod^{-1}	-0.0025	0.0580	0.0016	-0.0626	0.0407	0.3942**	1	0.1629*	0.1115
100 seed weight (g)	0.0175	0.2114*	-0.0318	0.2145**	0.0401	0.1036	0.0881	1	0.4822**
Seed yield plant^{-1} (g)	-0.0402	0.1177	0.1254	0.1247	0.2222**	0.0614	0.0888	0.3882**	1

*,** Significant at 5 and 1 per cent probability level respectively

Table 2. Direct (diagonal) and indirect (above and below diagonal) path effects of different characters toward yield in M_3 mutants of cowpea.

Character	Days to 50% flowering (No.)	Plant height (cm)	Branches plant^{-1}	Days to maturity (No.)	Pods plant^{-1}	Pod length (cm)	Seeds pod^{-1}	100 seed weight (g)	Corr with seed yield plant^{-1} (g)
Days to 50% flowering	-0.1393	-0.3524	0.1391	-0.0077	-0.341	-0.0733	0.00667	0.04889	-0.719**
Plant height (cm)	0.57946	0.8472	-0.4616	0.00141	0.66664	-0.195	-0.1894	0.55407	0.1403*
Branches plant^{-1}	-0.2578	-0.5203	0.07515	-0.0057	0.02637	-0.2463	0.31916	-0.1562	0.6656**
Days to maturity	0.09333	0.01046	-0.0373	0.01144	0.08134	-0.1285	0.10972	0.13077	0.2712**
Pod plant^{-1}	0.11542	0.13727	0.00482	0.00226	0.41143	0.05031	0.0234	0.02069	0.7656**
Pod length (cm)	0.02344	-0.0379	-0.0425	-0.0034	0.04752	0.43559	-0.525	0.07078	0.0315
Seeds pod^{-1}	0.00167	0.02887	-0.0432	-0.0023	-0.0173	0.41145	-0.5558	0.06506	0.1115
100 seed weight (g)	-0.017	0.11752	-0.0294	0.00375	0.02131	0.07719	-0.0905	0.39941	0.4822**

*,** Significant at 5 and 1 per cent probability level respectively

pod^{-1} recorded positive and non significant association with seed yield plant^{-1}, at genotypic levels, suggesting the absence of any relation of these traits with seed yield plant^{-1}.

Association of various characters with the traits of major interest like yield is the consequence of their direct and indirect effect. Therefore, it is essential to partition such association into direct and indirect effect of component traits through path analysis. Results of path analysis revealed (Table 2) that among nine characters studied, pod length exhibited maximum direct effect with seed yield plant^{-1} followed by number of pods plant^{-1} and 100 seed weight. The association between seed yield and all these characters was positive and significant except pod length indicating the true and perfect relationship between these characters. Suggesting direct selection based on these characters would help in selecting high yielding mutants in cowpea. These results were in agreement with the earlier finding of Jana *et al*. (1983), Mishra *et al*. (1994), Golasangi *et al*. (1996) and Nagaraj and Savithramma (2000).

The trait number of seeds pod^{-1} had maximum negative direct effect followed by days to 50 per cent flowering but number of seeds pod^{-1} showed positive non significant association with seed yield plant^{-1} and days to 50 per cent flowering showed negative significant association with seed yield.

S. R. Ingole
B. H. Chavan
D. V. Dahat
S. M. Pawar
A. N. Kshirsagar

Dept. of Agricultutal Botany,
College of Agriculture,
Pune - 411 005 (India)
July 08, 2011.

References

Dewey, D. R. and Lu, H. K. 1959. A correlation and path coefficient analysis of components of crested wheat grass and seed production. Agron. J. 51(6): 515-518.

Dumbre, A. A., Deshmukh, R. B. and Padhye, A. P. 1982. Association of grain yield with other economic characters in cowpea. J. Maharashtra agric. Univ. 7(2): 154.

Golasangi, B. S., Parameswarappa, R. and Biradar, B. D. 1996. Studies on inter character association and cause effect relationship among quantitative characters at different plant densities in cowpea. Annals of agric. Res. 7(3): 217-222.

Jana, S., Som, M. G. and Das, N. D. 1983. Correlation and path vegetable pod yield components in cowpea (*Vigna unguiculata* var *sesquipedalis*). Hariyana J. Hort. Sci. 12(3-4): 224-227.

Mishra, H.P., Ganesh, R., Jha, N. D. and Ram, G. 1994. Correlation and path coefficient studies for yield and yield attributing characters in cowpea (*Vigna unguiculata* L.) Recent Horti. 1(1): 61-67.

Nagaraj, K .M. and Svithramma, D. L. 2000. Correlation and path coefficient analysis in F_2 generation of two crosses in vegetable cowpea J. Cytol. Genet. 1: 153-155.

Naidu, N. V., Satyanarayana, A. and Seenaiah, P. 1996. Inter relationships between yield and yield attributes in cowpea (*Vigna unguiculata* (L.) Walp.). Ann. agric. Res. 17(4): 337-341.

Natarajaratnam, N., Rao, T. V. and Balkrishanan, K. 1986. Path analysis of yield components in cowpea (*Vigna unguiculata* (L.) Walp.). Madras agric. J. 72(5): 259-262.

Patil, R. B. and Bhapkar, D. G. 1987. Correlation studies in cowpea J. Maharashtra agric. Univ. 12(1) (56-59.

Sawant, D. S. 1994. Association and path analysis in cow pea. Ann. Agric. Res. 15(2): 134-139.

Sharma, T. R. and Mishra, S. N. 1997. Genetic divergence and character association studies in cowpea. Crop Res. 13(1): 109-114.

Singh, R. K. and Chaudhary, B. D. 1977. Biometric methods in quantitative genetic analysis. Kalyani Publ. New Delhi. 224-252.

Singh, R., Joshi, B. S. and Singh, S. 1982. Correlation studies in cowpea (*Vigna unguiculata* (L.) Walp.). Tropical Grain Leg. Bull. 26: 3-5.

Tyagi, P. C., Kumar, N. and Agarwal, M. C. 2000. Genetic variability and association of component characters for seed yield in cowpea (*Vigina unguiculata* (L.) Walp.). Leg. Res. 23(2): 92-96.

J. Agric. Res. Technol., 37 (2) : 341-343 (2012)

Effect of Plant Density and Growth Regulators on Yield and Quality of Okra Seed

Spacing is an important factor which influences the yield of various crops considerably. The proper spacing of okra plants for the production of maximum yield is of considerable interest to the cultivators. Widely spaced plants have greater resources i.e. light, nutrients, water and space etc. Seed production in okra is of great importance and a number of plant growth regulators have been used for increasing the production and quality of okra seed. Hence, to access the effective plant growth regulators with its optimum concentration and requisite spacing in okra for maximum and quality seed production, the present investigation was undertaken.

The present investigation was carried out at Horticulture Section, College of Agriculture, Nagpur, during June 2007 to October 2007 to study the effect of plant density and growth regulators on yield and quality of okra seed var. Akola Bahar. Twenty four treatment combinations with four levels of spacing (30 x 30, 45 x 30, 45 x 45 and 60 x 30 cm) and six levels of growth regulators including cycocel (250, 500, 750 ppm) and maleic hydrazide (250, 500, 750 ppm), respectively, were tried in factorial randomized block design with three replications. The seed were sown after receiving the sufficient rains and when adequate moisture was present in the soil. Fertilizer application was done at the time of sowing, as one third dose of nitrogen (33.33 kg ha^{-1}) and full dose of phosphorus (50 kg ha^{-1}). Second dose of one third nitrogen (33.33 kg ha^{-1}) was applied as a top dressing one month after sowing and remaining does of one third nitrogen (33.33 kg N ha^{-1}) was given at 60 days after sowing. Ten plants were selected randomly from each plot for recording preharvest and postharvest observations *viz*., plant height, number of branches $plant^{-1}$, days to 50 per cent flowering, seed yield ha^{-1}, test weight and germination percentage. The data obtained from each observation were statistically analyzed as per the method suggested by Panse and Sukhatme (1967).

Growth parameters : Significantly the highest plant height (102.02 cm) was recorded with closer spacing 30 x 30 cm. However, minimum plant height was recorded in 45 x 45 cm spacing (85.00 cm). The other treatments recorded height of plant in descending order 45 x 30 cm (95.16 cm) and 60 x 30 cm (92.12 cm). The favorable effect of spacing in promoting the growth of okra plant height might be due to the fact that, as closer spacing have higher plant density, so it create competition between the plant for light, which leads to increase in plant height. However, in case of growth regulators, the treatment MH 250 ppm recorded significantly the maximum plant height (98.60 cm) and it was fetmette-be at par with treatment MH 500 ppm (96.85 cm). An application of increased concentration of cycocel also reduced the height of plant significantly. The concentration of 750 ppm recorded lowest height of the plant (86.70 cm). This might be due to the fact that cycocel acts as a growth inhibiting substance. Similar results were obtained by Chhonkar *et al*. (1977) and Buwa *et al*. (2007).

The numbers of branches per plant were significantly influenced by the plant density. Significantly the maximum branches (4.99) recorded in wider plant spacing (45 x 45 cm), while the minimum branches were (3.73) recorded in closer plant spacing (30 x 30 cm).

This might be due to availability of more space and light in widely spaced plant and hence the crop might have produced more branches plant^{-1}. The maximum branches plant^{-1} (4.60) were recorded by the treatment cycocel 750 ppm. While minimum branches (4.00) were notice with the treatment MH 250 ppm. An increase in branches plant^{-1} could be explained on the fact that, all these growth regulators with varying degree of concentration suppressed the apical growth and ultimately resulted into lateral growth. Thus increased the number of branches plant^{-1}. These results are in conformity with result of Birbal *et al*. (1995) and Rathod and Patel (1996).

Flowering parameters : Significantly minimum days for 50 per cent flowering (44.66 days) were recorded in spacing 30 x 30 cm which was followed by the treatment 45 x 30 cm (46.94 days) and 60 x 30 cm (48.99 days). The wider spacing of 45 x 45 cm significantly delayed the 50 per cent flowering as compared to the closer spacing (30 x 30 cm). This might be due to vegetative growth was found more in wider spacing which delayed the maturity. The results are in the conformity with the findings of Singh (2004) and Soni (2005) in okra. In case of growth regulators the treatment cycocel 250 ppm recorded significantly the minimum days for 50 per cent flowering in okra (46.74 days), which was at par with the treatment cycocel 500 ppm (47.41 days) and cycocel 750 ppm (47.66 days). However, the treatment MH 750 ppm have significantly more days for 50 per cent flowering in okra (48.49 days). The results are in conformity with the finding of Gujar and Shrivastava (1972) in okra.

In case of days required for complete harvesting, the closer spacing (30 x 30 cm) required significantly minimum days (142.99 days) as compared to wider spacing 45 x 45 cm (149.77 days). This might be due to the fact that the lateral vegetative growth was found in wider spacing which delayed the maturity. Singh (2004) and Soni (2005) also observed that the seeds fruit^{-1} weight of seeds fruit^{-1} and plant^{-1} were significantly maximum under wider spacing (45 x 45 cm), whereas the seed yield plot^{-1} and hectare^{-1} were found to be maximum with closer spacing (45 x 15 cm) in okra variety Akola Bahar.

However, significantly minimum days required for complete harvesting (142.66 days) in treatment cycocel 250 ppm and it was followed by treatment cycocel 500 ppm (143.74 days). Whereas, significantly maximum days (149.41 days) required for complete harvesting in treatment MH 750 ppm and it was at par with treatment MH 500 ppm (149.33 days) and MH 250 ppm (148.74 days). This might be due to the fact that the reduction in vertical height leads to lateral branching which resulted into delayed reproductive growth and hence maximum days required for compete harvesting of okra crop at higher concentration.

Yield parameters : The results indicated that an every successive decreased in plant density from higher (30 x 30 cm) towards the lower (45 x 45 cm) significantly increased the values of seed yield contributing characters. The maximum seed yield (14.14 q ha^{-1}) was recorded in treatment 30 x 30 cm and it was followed by treatment 45 x 30 cm (13.10 q ha^{-1}). Whereas significantly minimum seed yield hectare^{-1} (10.83 q ha^{-1}) was recorded in treatment 45 x 45 cm which was at par with the treatment 60 x 30 cm (11.17 q ha^{-1}). It revealed that maximum seed yield hectare^{-1} under the higher plant densities was attributed due to significantly more number of plants unit^{-1} area. These results are in conformity with the results of Singh (2004) and Soni (2005) in okra. Whereas significantly maximum seed yield hectare (13.52 q) was recorded in treatment cycocel 750 ppm which was at par

with treatment cycocel 500 ppm (13.11 q) and cycocel 250 ppm (12.94 q). However, significantly minimum seed yield hectare^{-1} (11.00 q) was recorded in treatment MH 250 ppm which was at par with the treatment MH 500 ppm (11.84 q) and MH 750 ppm (11.44 q). Similar results were also recorded by Thakare (2003) and Hameed (2004) in okra.

The test weight of seed and germination percentage was significantly maximum (58.51 g and 79.05% respectively) in plant density 45 x 45 cm. Whereas, lowest test weight of seed (52.73 g) and germination percentage (72.38%) was recorded in plant density 30 x 30 cm. Similar results were reported by Sajjan *et al.* (2002). In case of growth regulators, significantly maximum test weight of seed (58.63 g) and germination percentage (78.91%) was recorded with the application of cycocel 750 ppm. However, significantly minimum test weight of seeds (54.35 g) was recorded with treatment MH 750 ppm which was at par with treatment MH 500 ppm (55.44 g) and MH 250 ppm (54.90 g). Whereas, significantly lowest germination percentage of seed (72.99%) was recorded in treatment MH 250 ppm and it was followed by treatment MH 750 ppm. The increase in germination percentage might have resulted due to the improvement in seed quality in terms of maximum test weight which is a sign of full maturity of seed. The results are in accordance with the findings of Hameed (2004).

N. D. Thorat
N. K. Chopde
P. D. Raut
S. A. Thakre

Horticulture Section, College of Agriculture,
Nagpur - 440 009 (India)
July 08, 2011.

References

Birbal, B. K., Nehara, S. and Malik, Y. S. 1995. Effect of spacing and nitrogen on fruit yield of okra (*Abelmoschus esculentus* (L) Moench) cv. Varsha Uphar.. Haryana agric. Univ. J. Res. 25(1-2): 47-51

Buwa, S. J., Dabhade, R. S., Patil, M. B. and Gharat, S. N. 2007. Effect of plant growth regulators and bioenzymes on growth, flowering and yield of okra (*Abelmoschus esculentus* (L.) Moench). J. Eco-friendly Agric. 2(1): 100-101

Chhonkar, V. S., Singh, P. N., and Mishra, R. S. 1977. Effect of ethrel and cycocel on growth and yield of okra. Indian J. Hort. 34(4): 435-436.

Gujar, K. D. and Shrivastava, V. K. 1972. Effect of maleic hydrazide and apical nipping on okra. Indian J. Hort. 29(1): 63-66

Hameed, B. 2004. Effect of plant growth regulators on seed yield and quality of okra. M. Sc. (Agri.) thesis submitted to Dr. PDKV, Akola.

Panse, V. G. and Sukhatme, P. V. 1967. Statistical Methods for Agricultural Workers, New Delhi, ICAR.

Rathod, P. R. and Patel, D. L. 1996. Effect of irrigation and cycocel on growth and yield of summer okra. GAU Res. J. 22(1): 109-111

Sajjan, A. S., Shekhargouda, M. and Dadanur, V. P. 2002. Influence of date of sowing, spacing and level of nitrogen on yield attributes and seed yield in okra. Karnataka. J. Agril. Sci. 15 (2:267-274).

Singh, D. 2004. Effect of different sowing dates and plant density on seed production of okra variety Parbhani Kranti. Udyanika. 10(l): 42-46.

Soni, N. 2005. Effect of spacing and nitrogen levels on growth and seed yield of okra. M. Sc. (Agri.) thesis submitted at Dr. PDKV, Akola. 122-124

Thakare, C. R. 2003. Effect of.growth retardant and spacing on growth and yield of summer okra. Cv. Parbhani Kranti. M. Sc. (Agri.) thesis submitted at Dr. PDKV, Akola. 56-58.

J. Agric. Res. Technol., 37 (2) : 344-346 (2012)

Influence of Integrated Nitrogen Management on Growth and Yield of Maize (*Zea mays* L.)

Nutrients either through inorganics or bulky organics alone do not sustain the productivity of nutrient exhaustive crops like maize. Supplementing crop through organic sources of nutrient not only conserve the loss of nutrients but also improves physical properties of soil in terms of improvement of water holding capacity, soil aeration, rooting depth etc. Keeping these in view, the present investigation was planned.

The field experiment was conducted at Agronomy Farm, College of Agriculture, Pune during *kharif* 2009-10. The experiment was laid out in a randomized block design with three replications. Nine treatments were formulated consisting of different nitrogen levels with combination of manure and chemical fertilizers (Table 1). The maize variety "African Tall" was sown on ridges at 75 x 25 cm spacing. The soil of the experiment field was clay loam in texture, low in available nitrogen, medium in phosphorus and high in potassium. The full dose of P_2O_5, K_2O and 1/3rd dose of nitrogen was applied as basal dose at sowing. The quantity of FYM was applied before dibbling as per the treatments. The 1/3rd dose of nitrogen was top dressed at 30 DAS and remaining 1/3rd dose of nitrogen was given at 45 DAS. The quantity of nitrogen was worked out on the basis of nitrogen content in FYM and as per the treatments.

The data presented in Table 1 revealed that differences in growth attributes differed significantly due to integrated nitrogen management treatments. The significantly higher plant height (382.7 cm) was recorded by application of GRDF (120:60:40 kg NPK ha^{-1} + 10 tonnes FYM ha^{-1}) than rest of the treatments. The dry matter plant-1 was significantly highest (249.50 g) with GRDF treatment (T_1) except treatment T_2 and T_3 which were found at par with each other. The significantly lowest number of days required for 50 per cent tasselling (64.33 days) were observed with application of GRDF than the rest of the treatments however, treatment T_2 was found at par with each other. Nitrogen, being an integral constituent of photosynthetically active pigment, chlorophyll by virtue of which plants became able to utilize solar energy and enzyme nucleotides leading to accumulation of higher dry matter and crop growth rate of maize plant as compared to lower levels of N application i.e. below 120 kg N ha^{-1}. (Gahlout *et al*., 2010). These results are in agreement with those reported by Shanti *et al*. (1997) and Rajeshwari *et al*. (2007).

The yield attributes *viz*., cobs plant^{-1}, grains weight cob^{-1} and thousand grain weight influenced significantly due to different nitrogen management treatments. The mean number of cobs plant^{-1} was maximum (1.55) with GRDF treatment (T_1) and significantly more than the rest of the treatments except treatment T_2 and T_3. The application of GRDF i.e. T_1 (120:60:40 kg NPK ha^{-1} + 10 tonnes FYM ha^{-1}) being at par with treratment T_2, T_3 and T_4 recorded significantly higher thousand grain weight (378 g) than rest of the treatments under study. The grain weight cob^{-1} (148.10 g) was also significantly higher with application of GRDF than remaining treatments. The increase in yield attributes might have been owing to better utilization of resources under improved N supply, as it is an integral part of proteins the building blocks of plant (Singh *et al*. 2000). The improvement in all these yield attributes might

Table 1. Growth and yield attributes as influenced by different treatments in maize.

Treatment	Plant height (cm)	Dry matter (g)	Days required to 50% tasselling	Cobs plant^{-1}	Grain weight cob^{-1} (g)	Thousand grain weight (g)	Grain yield (q ha^{-1})	Stover yield (q ha^{-1})
T_1	382.7	249.50	64.33	1.55	148.10	378.00	52.96	158.80
T_2	369.9	236.50	66.67	1.51	132.50	368.70	51.46	153.30
T_3	365.1	228.30	67.67	1.48	126.40	356.70	48.92	142.50
T_4	354.3	221.80	68.01	1.37	125.60	353.10	41.51	128.80
T_5	313.4	201.30	68.33	1.21	112.90	339.30	35.17	120.00
T_6	353.5	219.60	68.00	1.38	124.90	346.40	46.14	134.60
T_7	332.9	208.30	69.00	1.29	119.20	342.70	40.39	125.20
T_8	298.1	191.60	69.33	1.18	108.40	324.70	36.92	112.10
T_9	281.5	167.20	71.33	1.15	104.70	322.70	34.46	98.82
S.E.m.±	1.8	7.50	0.51	0.06	2.03	10.51	0.95	4.45
C.D. at 5%	5.3	22.48	1.51	0.10	6.08	31.50	2.85	13.36

T_1 = GRDF (120:60:40 kg NPK ha^{-1} + 10 tonnes FYM ha^{-1}), T2 = 150 % RDF-N (75% RDN fertilizer + 25 % RDN FYM), T_3 = 125 % RDF-N (75% RDN fertilizer + 25% RDN FYM), T_4 = 100 % RDF-N (75 % RDN fertilizer + 25% RDN FYM), T_5 = 75% RDF-N (75% RDN fertilizer + 25% RDN FYM), T_6 = 150% RDF-N (50% RDN fertilizer + 50 % RDN FYM), T_7 = 125% RDF-N (50% RDN fertilizer + 50% RDN FYM), T_8 = 100% RDF-N (50% RDN fertilizer + 50% RDN FYM), T_9 = 75 % RDF-N (50% RDN fertilizer + 50 % RDN FYM)

have been due to favourable effect of nitrogen application on physiological parameters resulting in the increase of photosynthetic efficiency and subsequent translocation of photosynthates into reproductive organs (Kumar *et al*. 2004). These results are in conformity with the findings of Rajeshwari *et al*. (2007).

The differences in respect of grain and stover yield differed significantly due to integrated nitrogen management treatments. The maximum and significantly higher grain and stover yield of 52.96 and 158.80 q ha^{-1} were recorded with application of general recommended dose of fertilizer than rest of the treatments except treatment T_2 (150% RDF-N i.e. 75% RDN through fertilizer + 25% RDN through FYM) which found at par with each other. The higher yields recorded with GRDF treatment (T_1) might be attributed to significant improvement of growth and yield attributes with this treatmentt. Luikham *et al*. (2003) also reported that increased nutrient availability with combination of organic and inorganic N might have increased photosynthetic rate and net assimilation rate, which resulted in more grain yield. The higher accumulation of dry matter in plants might have improved the values of yield attributes at higher levels of nitrogen which resulted in higher stover yield (Kumar, 2009).

The aforesaid results indicated that growing of maize with application of 150 per cent RDF-N (75% RDN through fertilizer + 25% RDN through FYM) showed better proposition for obtaining higher yield.

K. L. Jadhav
R. L. Bhilare
N. T. Kunjir

College of Agriculture,
Pune - 411 005 (India)
July 8, 2011.

References

Gahlout, B., Singh, R. and Lal, G. M. 2010. Effect of levels of nitrogen and sulphur on growth and yield of maize (*Zea mays* L.). J. Maharashtra agric. Univ. 35(1) : 149-151.

Kumar, A. 2009. Influence of varying plant population and nitrogen levels on growth, yield, economics and nitrogen use efficiency of pop corn (*Zea mays* everta sturt). Crop Res. 37(1, 2 and 3): 19-23.

Kumar, S., Saini, S. S. and Sharma, B. D. 2004. Effect of graded levels of nitrogen, phosphorus and plant gromelry on the productivity of spring maize (*Zea mays* L.). Forage Res. 30(1): 62-63.

Luikham, E., Krishna, R. J., Rajendran, K. and Mariam Anal, P. 2003. Effect of organic and inorganic nitrogen on growth and yield of baby corn (*Zea mays* L.). Agric. Sci. Digest. 23(2): 119-121.

Rajeshwari, R. S., Hebsur, N. S., Pradeep, H. M. and Bharamagoudar, T. D. 2007. Effect of integrated nitrogen management on growth and yield of maize. Karnataka J. Agric. Sci. 20(2): 399-400.

Shanti, K. V., Rao, V. P., Reddy Ranga M., Reddy Suryanarayana, M. and Praveen, Rao. 1997. Response of hybrid and composite maize (*Zea mays* L.)to different levels of nitrogen. Indian J. Agric. Sci. 67(8): 326-327.

Singh, D. P., Rana, N. S. and Singh, R. P. 2000. Dry matter production and nitrogen uptake in winter maize (*Zea mays*) based intercropping system under different levels of nitrogen. Indian J. Agron. 45(4): 676-800.

Vadivel, N., Subbian, P. and Velayutham, A. 2001. Effect of integrated nitrogen management practices on the growth and yield of rainfed winter maize (*Zea mays*). Indian J. Agron. 46(2): 250-254.

J. Agric. Res. Technol., 37 (2) : 347-347 (2012)

FORM IV

1.	Place of Publication	:	College of Agriculture, Pune - 411 005 (Maharashtra State) India
2.	Periodicity of its Publication	:	Thrice in a year
3.	Printer's Name Nationality Address	: : :	S. R. Gupta Indian Flamingo Business Systems 19, Laxminagar Commercial Complex No. 1 Shahu College Road, Pune - 411 009
4.	Publisher's Name Nationality Address	: : :	Dr. P. N. Harer Indian College of Agriculture, Pune - 411 005
5.	Editor's Name Nationality Address	: : :	Dr. P. N. Harer Indian College of Agriculture, Pune - 411 005
6.	Names and Address of Individuals, who own the Journal and partners or share holders holding more than one per cent of the total		The Registrar, 1. Mahatma Phule Krishi Vidyapeeth, Rahuri - 413 722 2. Dr. Panjabrao Deshmukh Krishi Vidyapeeth, Akola - 444 104 3. Marathwada Agricultural University, Parbhani - 431 402 4. Dr. Balasaheb Sawant Konkan Krishi Vidyapeeth, Dapoli - 415 712

I, Dr. P. N. Harer, hereby declare that the particulars given above are true to the best of my knowledge and belief.

Date of Issue : May, 2012

Date of Publication : May 01, 2012

P. N. Harer
Editor-in-Chief

J. Agric. Res. Technol., 37 (2) : 348-348 (2012)

ISSN 2230-9705

Journal of Agriculture Research and Technology

College of Agriculture,
Pune 411005 (India)

ARTICLE CERTIFICATE

Article entitled : .....

.....

Title changed to : .....

.....

Authors (names) : .....

It is certified that :

1. The article has been seen by all the authors (signatures given below), who are satisfied with its form and content.
2. The sequence of names of authors in the by-line is as per their relative contribution to this experiment, given due credit to all the scientists who made notable contribution to it.
3. The address of the organization where the research was conducted is given in the by-line (change of author's address is given at the footnote).
4. The experiment was carried out during the year..... and the article is submitted within 10 years, after completion of the experiment.
5. The article is exclusive for this journal and the results reported here have not been sent (and will not be sent during its consideration by this journal) for publication in any other Journal.
6. The article has not been rejected for publication in any other journal/rejected in ....whose comments are attached (Such a rejection does not disqualify the article for consideration in this journal).
7. It is based/not based on a part/complete M.Sc./Ph.D. thesis of the first author, who submitted the thesis in the year ..... to the ..... (University, place).
8. Correct data and facts are presented in the article.
9. I/We agree to abide by the objective comments of referees and do agree to modify the article into a short note where ever the referee so recommended for publication in the Journal of Agriculture Research and Technology.
10. If published in Journal of Agriculture Research and Technology the copyright of this article would rest with the Editor-in-Chief of the Journal who will have the right to enter into any agreement with any organization in India or abroad engaged in reprography, photocopying, storage and dissemination of information contained in it and neither we nor our legal heirs will have any claims on royalty.
11. I/We promise to pay the annual subscription when the article/note is accepted for publication in the Journal. Signature of all authors, their names, designations and present correspondence addresses.

Signature with date	Name in full and designation	Present official address
1.		
2.		
3.		
4.		
5.		

The above certificate is correct to the best of my knowledge and I have no objection to the publication of the article cited above in The *Journal of Agriculture Research and Technology*.

Signature and address of
Head of the Section/Department/Institute

TABLES - Type tables in double-space on separate pages, each one referred to in the text and numbered with Arabic numerals (e.g. Table 1). The title of each table should identify its contents so that reference to the text is not necessary. Title and column heading should be brief. Unnecessary descriptive matter should be avoided. Column and row heading with footnotes should be self explanatory. Capitalize only the first letter of the first word of each column and row heading. Use lower case letter from the end of alphabet (x,y,z) to identify tabular footnotes. Use lower case letters from the beginning of alphabet (a,b,c) or asterisks with explanatory footnotes at 5% level, capitals for significance at 1% level.

FIGURES - Identify graphs, line drawings and photographs with consecutive Arabic numbers, as Fig. 1, Fig. 2. Place figures after tables. Photographs must be clear, glossy prints. Original graphs and drawings must be in Indian ink or equivalent on plain, white drawing paper. Letter in Indian ink with a lettering guide large and bold enough to permit reduction. Each figure should be referred to in the text. The title of paper and fig. number should be placed in pencil on the back of each fig. for identification.

TRADE OR BRAND NAMES - Trade or brand names are not used in permanent literature. State trade or brand names only in parentheses. The active ingredient, chemical formula, purity and diluent or solvent may be stated in the text. Capitalize the first letter of trade or brand names.

ABBREVIATION - In both text and tables except for the first word in a sentence long words or terms used repeatedly should be abbreviated usually without a period (e.g. a.m. ppm. m. °C, N, P, K, K_2SO_4). Use standard abbreviations. Names of organic chemicals and other terms, abbreviated for the reader's convenience should be spelled out first with parenthetical abbreviation used.

ARABIC NUMERICALS - Use Arabic numericals in all cases except the beginning of sentence or where the use would be unclear.

SEPARATES / REPRINTS - Ten copies will be supplied free of cost.

ADVERTISEMENT - Advertise of Agro-based industries will be published on Cover Page No. 2 and 3 full page at the cost of Rs. 4000/- and 3000/- respectively.

CORRESPONDENCE - Business correspondence, remittances, subscriptions, change of address etc. should be addressed to **The Editor-in-Chief, Journal of Agriculture Research and Technology, College of Agriculture, Pune - 411 005, INDIA.**

The correspondence regarding exchange of journal should be done with the Dean, Faculty of Agriculture of respective Agricultural University in Maharashtra State (India).

Journal of Agriculture Research and Technology is published thrice in a year preferably in the month of January, May and September. The Journal is devoted to papers on original research in any branch of Agricultural Sciences. The contribution of papers is open to the subscribers only.

A company dealing in Fertilizers, Agricultural Equipments, Pesticides, Insecticides, Fungicides, etc. and paying an amount of Rs. 15,000/- and above can become a Sustaining Associate of the Journal. The Sustaining Associates will be allowed to publish free of cost a full page advertisement once in a year. The Life Members, Patrons and Sustaining Associates will be supplied free of cost a copy of each number of a volume.

Registered with the Registrar of Newspaper for India under R.No. 27971/76

PREPARATION OF MANUSCRIPT

Authors are urged to have one or more colleagues, read the manuscript critically prior to submission. Submission implies non-submission elsewhere and if accepted, no future publication without the consent of the Editorial Board.

Submit with a covering letter one original and one copy of the manuscript typewritten on one side, on bond paper (22x28 cm) and double space including title, abstract, text, literature cited, tables, headings and figure legends. One copy should be without author's name, address and acknowledgement. Footnotes should be avoided. Liberal margins should be left for Editorial marking. Number the pages of title, text, literature cited, tables and figures in that order. Tables and captions of figures should be separate and every sheet of manuscript should be numbered. A serial number, assigned to each new manuscript accompanies its acknowledgement to the author who submitted it. Refer to that number in all subsequent correspondence.

MODE OF SUBMISSION - Authors should submit the review / research article / note alongwith prescribed "Article Certificate" directly to the Journal with a copy of it to the Director of Research / Dean / Head of the Institution and, after its publication, a copy of reprint of the paper for his record.

TITLE - The title should be unique and concise description of the paper. It should not exceed 10 to 15 words. Names of the authors should be centered directly below the title. The name and location of the senior author/institution (The institution where most of the research work is conducted) is centered below the author's name. The designations and addresses of the author/s are foot noted.

ABSTRACT - The abstract is placed on the next line after Institution's name on page 1. It should be a concise summation of the findings and should include names of organisms, effects of major treatments and major conclusions. It should not exeed 5 per cent of the length of the paper.

KEY WORDS - A list of additional Key words may be included below the abstract.

HEADINGS - Centre and capitalize first letters of main headings of the paper i.e. Abstract, Materials and Methods, Results and Discussion and References. Do not centre secondary headings. Place the secondary headings with the first letter of the word capitalized at the beginning of the paragraph.

STYLE - Manuscripts must conform to current standards of English style and usage. The first person pronoun is accepted and often preferred for clarity. Main clauses should usually be stated first. The introduction without a heading should state clearly why the research was conducted with reference to earlier work. Give enough information on methods to indicate how the research was conducted so that the reader will have confidence in the validity of the result. Omit details unless it is method paper. Present results succinctly with emphasis on main effects. Use tables and figures to illustrate the text, interprete the results in discussion. Brief conclusion can terminate the discussion. Complex conclusions should form a separate section. Underline the botanical/scientific names.

RERERENCES - List citations alphabetically by names of authors and type them after the text. The form should be in the order of names of the authors, year, subject title, name of publication (in Roman), Vol. and inclusive page numbers.

EXAMPLES :

Dorsey, M.J. and Bushnall, J.W. 1920. The hardiness problem. Proc. Amer. Soc. Hort. Sci. 17:210-224.

Snedecor, G.W. 1956. Statistical Methods. 5th Edn. Iowa State Univ. Press, Ames, Iowa, pp.534.

Whiteside, W.F. 1973. A study of light as influenced by time and planting date on growth of onion (*Allium cepa* L.) in the glasshouse and the field. Ph.D. thesis, Univ. of Illinois at Urbana-Champaign, pp.53.

(Continued on inside back cover)

Edited and Published by Dr. P. N. Harer at College of Agriculture, Pune 411 005.
Typeset Processed and Printed by : Flamingo Business System, 19, Laxminagar Comm. Complex-1, Pune-411 009. Tel. : 24214636

Date of Issue : May, 2012
Date of Publication : May 01, 2012