J. Agric. Res. Technol., 49 (2) : 324-328 (2024)

Nutrient Availability and Nutrient Uptake and Economics of Ridge Gourd (*Luffa acutangula* L.) under Drip Fertigation in Summer Season

H. P. Patil, K. D. Kale, M. S. Mane, D. D. Khedkar and N. J. Danawale
Inter faculty Dept. of Irrigation Water Management, Mahatma Phule krishi Vidyapeeth, Rahuri - 413 722 (India)
(Received : 05.02.2024 Accepted : 08.03.2024)

Abstract

A field experiment entitled, "Response of Ridge Gourd to fertigation in Summer Season" was conducted during the year 2022-23. The experiment was carried out in Randomized Block Design with nine treatments replicated three times.The results indicated that, the treatment of DIwith application of nutrientsas persoil test valuesthrough ferigation (T_7) significantly enhanced the yield and yield contributing characters. The treatment of DI with application of nutrients as per soil test values through fertigation (T_7) produced significantly higher yield (27.55t ha^{-1}) than all other treatments. Application of water soluble fertilizers through drip irrigation resulted into more nutrient availability than conventional fertilizers. On the basis of the results obtained, it can be concluded that drip irrigation with 80 per cent RDF through fertigation as per growth stages is the best treatment for higher yield, nutrient availability and uptake, and monetary returns from ridge gourd crop (var. Aarti) cultivated in medium deep soil of Maharashtra with 20 per cent fertilizers saving.

Key words : Drip fertigation, Ridge gourd productivity, economics.

Ridge gourd [*Luffa acutangula* (L.) Roxb.], popularly known as Angled gourd, Chinese okra, Ribbed gourd, Turai, Dodkaand Kalitori. This crop belongs to genus Luffa of "Cucurbitaceae" family. Ridge gourd is known to have originated in India and is cultivated in the tropics and sub-tropics for its tender edible fruits both on commercial scale and in kitchen gardens throughout the country and in some other parts of the world. Ridge gourd is cultivated in Bangladesh, China, Indonesia, Malaysia, Myanmar, Philippines, Sri Lanka and Taiwan and different region of India such as Maharashtra, Assam, West Bengal, Uttar Pradesh, Karnataka, Andhra Pradesh, Kerala, Tamil Nadu and Maharashtra (Bose and Some, 1986).

Fertigation with drip irrigation practices is gaining higher momentum in present day crop production. Though India has the largest irrigation network and farmers are using the much more fertilizer, the irrigation efficiency and nutrient efficiency is low, hence it is need of hour to maximize the production per unit of water and nutrient. Therefore, while giving fertigation, it is very important to consider how much fertilizer to be given and when to give the fertigation and also crop stage and its nutrient demand, thereby one can achieve higher water and nutrient efficiency, higher yield and economic return. Hence the present study was laid out to study the response of ridge gourd under fertigation in summer season.

Material and methods

A field experiment conducted at the Research Farm of Interfaculty Department of Irrigation water Management, Post Graduate Institute, Mahatma Phule Krishi Vidyapeeth, Rahuri, Dist. Ahmednagar, Maharashtra, India, during summer season of 2022-2023. The experiment comprised of nine treatments, T_1 - Drip with 100% recommended dose of fertilizer through fertigation as per schedule, T_2 - Drip with 80% recommended dose of fertilizer

through fertigation as per schedule, T_3 -Drip with 60% recommended dose of fertilizer through fertigation as per schedule, T_4 -Drip with 100% recommended dose of fertilizer through conventional fertilizer as per schedule (N and K-drip and P- soil), T_5 - Drip with 100% recommended dose of fertilizer through conventional fertilizeras perschedule (Soil), T_6 - Drip with 100% recommended dose of fertilizer ofwater soluble fertilizer through fertigationin 15 equal weeklysplits, T_7 - Dripwith application of nutrients as per soil test values through ferigation, T_8 - Drip with no fertigation, T_9 - Surface irrigation with 100% recommended dose of fertilizerthroughconventional fertilizer.

The soil samples were mixed thoroughly and dried in shade, grind in mortal and pestle and sieved through 2 mm sieve. The periodical available nitrogen, available phosphorus and available potassium were determined by using standard methods. The observational ridge gourd plants and fruits were collected at harvest for chemical analysis. These plant samples were sundried and then in oven at 65°C till constant weight. The samples are then grinded into fine powder and used for analysis of total nitrogen, phosphorus and potassium content. The standard methods were used for determination of nutrient content in plant sample.

Results and Discussion

Yield and yield contributing characters: The data regarding yield of ridge gourd in tonnes per hectare was found maximum in treatment of DI with application of nutrients as per soil test values through fertigation (T_7) (27.55 t ha^{-1}). However, it was at par with treatment of Drip with 100% RDF through fertigation as per schedule (T_1), Drip with 100 RD of WSF Through fertigation in 15 equal weekly splits (T_6) and Drip with 80% RDF through fertigation as per schedule (T_2).The minimum fruit yield is observed in the treatment T_8 (14.42 t ha^{-1}) which is DI with no fertigation. The maximum per cent increase in yield over T_5 was observed in T_7 (31.82%) followed by T_1 (28.32%), T_6 (26.70%) and T_2 (21.43%). The maximum yield of ridge gourd in fertigation treatment might be due to the frequent application of fertilizer to the root zone through fertigation coupled with better root activity increases the availability of the nutrient in the soil and thus increases the uptake

Table 1. Yield and yield attributing characters of ridge gourd

Treatments	Av. wt. of fruits vine^{-1} (kg)	Fruit yield (t ha^{-1})	% of yield increased over T_5
T_1 - Drip with 100%RD through fertigation as per schedule	4.473	26.82	28.32
T_2 - Drip with 80%RD through fertigation as per schedule	4.310	25.38	21.43
T_3 - Drip with 60%RD through fertigation as per schedule	2.871	19.38	-
T_4 - Drip with 100% RD through CF as per schedule (N and K- drip and P- soil)	3.160	22.44	7.37
T_5 - Drip with 100% RDF of CF applied through soil	3.112	20.90	0.00
T_6 - Drip with 100%RD of WSF through fertigation in 15 weekly splits	4.376	26.48	26.70
T_7 - DIwith application of nutrientsas persoil test values through fertigation	4.515	27.55	31.82
T_8 - DI with no fertigation	1.664	14.42	-
T_9 - Surface irrigation with 100% RDF through CF	2.652	19.59	-
S.E m (±)	0.07	0.78	
CD at 5%	0.23	2.29	
General mean	3.46	22.56	

of nutrients to the plant. The leaching loss of nutrients under drip is lower as compare to soil application of fertilizers (Hebber *et al*., 2004).

Soil nutrient availability

Available nitrogen in soil : At harvest the significantly higher nitrogen availability of 178.57 kg ha^{-1} is recorded in Drip with 100% RDF of CF applied through soil (T_5), however it is at par with the treatment of Surface irrigation with 100% RDF through CF (T_9), Drip with 100% RD through CF as per schedule (N and K- drip and P Soil) (T_4). The higher availability of nitrogen under Drip with 100% RDF of CF applied through soil (T_5) is might be due to its low uptake of nitrogen as compare to fertigation treatments. These results are in close conformity with those reported by Ananda *et al*., (2020) in ridge gourd and Varughese *et al*., (2014) in okra crop.

Available phosphorus in soil : At harvest, the significantly higher phosphorus (19.35kg ha^{-1}) availability is recorded in Drip with 100% RDF of CF applied through soil (T_5), however, it is at par with the treatment of Surface irrigation with 100% RDF through CF (T_9), Drip with 100% RD through CF as per schedule (N and K- drip and P Soil) (T_4). The higher availability of phosphorus under Drip with 100% RDF of CF applied through soil (T_5), is might be due to its low uptake of nutrient as compare to fertigation treatments. These results are in close conformity with those reported by Ananda *et al*., (2020) in ridge gourd, Madhusoodana (2016) in cotton crop.

Available potassium in soil : At harvest the significantly higher potassium (303.86 kg ha^{-1}) availability is recorded in Drip with 100% RDF of CF applied through soil (T_5), however, it is at par with the treatment of Surface irrigation with 100% RDF through CF (T_9), Drip with 100% RD through CF as per schedule (N and K- drip and P Soil) (T_4). The higher availability of potassium under Drip with 100% RDF of CF applied through soil is might be due to its low uptake of potassium as compare to fertigation treatments. These results are in close conformity with those reported by Ananda *et al.*, (2020) in ridge gourd and Varughese *et al*., (2014) in okra crop.

Table 2. Available NPK content in soil and nutrient use efficiency as influenced by different treatments at harvest

Treatments	Available nitrogen at harvest (kg ha^{-1})	Available phospho-rous at harvest (kg ha^{-1})	Available potassium at harvest (kg ha^{-1})	NUE (kg yield/ kg nutrient)
T_1 - Drip with 100%RD through fertigation as per schedule	166.44	16.10	299.45	62.00
T_2 - Drip with 80%RD through fertigation as per schedule	162.66	15.56	296.29	68.50
T_3 - Drip with 60%RD through fertigation as per schedule	159.72	14.35	292.63	41.33
T_4 - Drip with 100% RD through CF as per schedule (N and K- drip and P- soil)	172.77	18.10	300.52	40.10
T_5 - Drip with 100% RDF of CF applied through soil	178.57	19.35	303.86	32.40
T_6 - Drip with 100%RD of WSF through fertigation in 15 weekly splits	166.78	17.35	286.71	60.03
T_7 - DIwith application of nutrientsas persoil test values through fertigation	171.51	17.63	290.44	61.79
T_8 - DI with no fertigation	150.82	15.80	276.60	0.00
T_9 - Surface irrigation with 100% RDF through CF	175.66	18.55	302.50	25.85
S.E m (±)	2.17	0.42	1.27	
CD at 5%	6.50	1.25	3.89	
General mean	167.21	16.98	294.33	

Nutrient use efficiency : The highest nutrient use efficiency is observed in the treatment of Drip with 80% RD through fertigation as per schedule (T_2) i.e. 68.50 kg yield kg^{-1} nutrient followed by T1 (62.00 kg yield kg^{-1} nutrient). The minimum fertilize use efficiency is observed in the treatment of Surface irrigation with 100% RDF through CF (T_9) i.e. 25.85 kg yield kg^{-1} nutrient. These results are in confirmation with research findings of Bharambe *et al.*, (1997) in hybrid cotton.

Total nitrogen uptake : At harvest the highest uptake of nitrogen (75.62 kg ha^{-1}) is recorded in the treatment of DIwith application of nutrientsas persoil test values through fertigation (T_7) over all other treatments. The increase in nitrogen uptake in T_7 may due to the better availability of nutrients in the root zone as a result of frequent application of nutrients through fertigation. Similar observations of increased nutrient uptake as a result of water soluble fertilizers have resulted in lesser leaching of N and K is reported by Singhandhupe *et al.*,(2003) and Patil *et al.*, (2009).

Total phosphorus uptake : At harvest the maximum uptake of phosphorus (24.59 kg ha^{-1}) is observed in treatment T_7. The significantly maximum nutrient uptake in the fertigation treatments might be due to availability of nutrients and sufficient moisture in root zone of the crop as per growth stages. Similar results were reported by Imamsaheb *et al.*, (2011) in tomato.

Total potassium uptake : At harvest the maximum uptake of potassium (90.22 kg ha^{-1}) is observed in treatment of DI with application of nutrientsas persoil test values through fertigation (T_7) and it is at par with the treatment of 100% RD through fertigation as per schedule (T_1), Drip with 100% RD of WSF through fertigation in 15 equal weekly splits (T_6) and Drip with 80% RD through fertigation as per schedule (T_2).

Economics : The maximum cost was involved in the treatment T_1 and T_6 (Rs.114226.95) followed by DI with application of nutrients as per soil test values through fertigation T_7 (Rs.112643.27). The lowest cost is involved in the treatment T_9 (Rs.81483.15). However by the treatment of DI with application

Table 3. NPK uptake as influenced by different treatment at harvest

Treatments	Nitrogen uptake at harvest (kg ha^{-1})	Phospho-rous uptake at harvest (kg ha^{-1})	Potassium uptake at harvest (kg ha^{-1})
T_1 - Drip with 100%RD through fertigation as per schedule	74.74	24.44	88.04
T_2 - Drip with 80%RD through fertigation as per schedule	72.36	23.51	86.18
T_3 - Drip with 60%RD through fertigation as per schedule	65.23	21.80	77.67
T_4 - Drip with 100% RD through CF as per schedule (N and K- drip and P- soil)	69.33	23.05	82.28
T_5 - Drip with 100% RDF of CF applied through soil	68.14	22.06	79.22
T_6 - Drip with 100%RD of WSF through fertigation in 15 weekly splits	73.41	24.04	87.43
T_7 - DIwith application of nutrientsas persoil test values through fertigation	75.62	24.59	90.22
T_8 - DI with no fertigation	62.94	17.76	69.98
T_9 - Surface irrigation with 100% RDF through CF	63.50	21.83	78.14
S.E m (±)	1.12	0.37	1.83
CD at 5%	3.37	1.12	5.48
General mean	69.47	22.56	82.13

Table 4. Cost of cultivation, gross monetary returns, net monetary returns and B:C ratio as influenced by different treatments

Treatments	Cost of cultivation (Rs. ha^{-1})	Gross monetary return (Rs. ha^{-1})	Net monetary return	B:C ratio
T_1 - Drip with 100%RD through fertigation as per schedule	114226.95	375480	261253.05	3.29
T_2 - Drip with 80%RD through fertigation as per schedule	110878.15	355320	244441.85	3.20
T_3 - Drip with 60%RD through fertigation as per schedule	107529.35	271230	163700.65	2.52
T_4 - Drip with 100% RD through CF as per schedule (N and K- drip and P- soil)	103486.15	314160	210673.85	3.04
T_5 - Drip with 100% RDF of CF applied through soil	104886.15	292600	187713.85	2.79
T_6 - Drip with 100%RD of WSF through fertigation in 15 weekly splits	114226.95	370720	256493.05	3.25
T_7 - DI with application of nutrientsas persoil test values through fertigation	112643.27	385700	273056.73	3.42
T_8 - DI with no fertigation	96150.15	201880	105729.85	2.10
T_9 - Surface irrigation with 100% RDF through CF	81483.15	274260	192776.85	3.37

of nutrients as per soil test values through fertigation (T_7) recorded maximum B:C ratio (3.42) was recorded as compared to all other treatments. The B:C ratio ranged from 2.10 to 3.42. The lowest B:C ratio recorded in the treatment with no fertigation T_8 (2.10).

Conclusions

On the basis of the results obtained,it is concluded that theDrip Irrigation with 80% recommended dose (80:40:40 N:P_2O_5:K_2O kg ha^{-}1) of fertigation as per growth stages is the best treatment for higher yield, nutrient use and monetary returns from ridge gourd crop cultivated in medium deep soils of Maharashtra with 20% fertilizer saving.

References

Ananda Murthy, H. C., Nair, A. K., Kalaivanan, D., Anjanappa, M., Shankara, Hebbar, S. and Laxman, R. H. 2020. Effect of NPK fertigation on post-harvest soil nutrient status, nutrient uptake and yield of hybrid ridge gourd (*Luffa acutangula*) Arka Vikram. International Journal of Chemical Studies, 8(4): 3064-3069.

Bharambe, P. R., Narwade, S. K., Oza, S. R., Vaishnava, V. A., Shelke, D. K. and Jadhav, G. S. 1997. Nitrogen management in cotton through drip irrigation. Journal of Indian Society of Soil Science, 45: 705-709.

Bose, T. K., and Some, M. G. 1986. Vegetable crops in India, Horticulture Publication 64: 700-806.

Hebber, S. S., Ramachandrappa, B. K., Nanjappa, H. V. and Prabhakar, M. 2004. Studies on NPK drip fertigation in field grown tomato. Advances in Fertigation for Micro Irrigation in India, 173.

Imamsaheb, S. J., Patil, M. G. and Harish, D. K. 2011. Effect of different levels of fertigation on productivity, nutrient uptake in processing tomato genotypes. Research Journal of Agricultural Sciences, 2(2): 217-220.

Madhusoodana S. 2016. Standardization of fertigation schedule for bt. Cotton under extended period. M.Sc. (Agri.) thesis submitted to Mahatma Phule Krishi Vidyapeeth Rahuri (M.S.) India.

Patil, V. C., Helemani, H. L., Hallikeri, S. S., Bandiwaddar, T. T. and Nooli, S. S. 2009. Response of hybrid cotton to drip irrigation and fertigation. Journal of Indian Society of Cotton Improvement, 62(1): 28-33.

Singandhupe, R. B, Rao, G. G. S. N., Patil, N. G. and Behera, M. S. 2003. Fertigation studies and irrigation scheduling in drip irrigation system in tomato crop (*Lycopersicon esculentum* L.). European Journal of Agronomy,19: 327-340.

Varughese, A., Menon, J. S. and Mathew, E. K. 2014. Effect of fertigation levels and drip system layout on performance of okra under plastic mulch. Journal of Agricultural Engineering, 51(4): 28-32.