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Evaluation of New Fungicides and Bioagents Against Fruit Rot Disease of Custard Apple (*Colletotrichum gloeosporioides* L.)

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Abstract

Custard apple (*Annona squamosa* L.) is a resilient dry land horticulture crop with significant export potential and good economic rewards. Fruit rot, caused by *Colletotrichum gloeosporioides* Penz, is one of the major custard apple disease that can cause significant losses. The *in vivo* studies regarding efficacy of fungicides against *C. gloeosporioides* revealed that the new generation combi-fungicides were found most effective than sole fungicides. Tebuconazole 50% + Trifloxystrobin 25% WG was found most effective fungicide as it showed lowestincidenceandintensity,highestdiseasereduction andhighestnumberofmarketablefruits per plant, yield per plant and yield per ha. Among bio-control agents studied in vivo, MPKV consortia @5% had lowest incidence and intensity of the disease with maximum number of marketable fruits per plant, yield per plant and yield per ha.

Key words : Custard apple, Fruit rot *Colletotrichum gloeosporioides*, MPKV consortia, Tebuconazole 50% + Trifloxystrobin 25% WG.

Custard apple (*Annona squamosa* L.) is an important dryland fruit in India. It comes from the tropical region of America and is a member of the Annonaceae family. In the sixteenth century, the Portuguese brought the custard apple to India. This subtropical fruit was said to grow well in the Deccan plateau. In the Southern Tropical Plateau of India, custard apples have been cultivated for a very long period (Hayes, 1953; Venkataratnam and Satyanarayanaswamy, 1958; Venkataratnam, 1959). Among biotic and abiotic factors responsible for reduction in yield, diseases caused by various pathogens are one of the major factor. Fruit rot (*Fusarium, Phytophthora, Phoma, Pestalotia*, etc.), Diplodia rot (*Botryodiplodia theobromae*), Black canker (*Phomopsisa nnonacearum*), Leaf spot (*Alternaria* spp.), Cercospora leaf spot (*Cercospora annonae*), and anthracnose/fruit rot (*Colletotrichum gloeosporioides*) were among the diseases that affected custard apples. (Mukarji and Bhasin, 1986). The most serious of them is fruit rot caused by *Colletotrichum gloeosporioides* L.

Materials and Methods

Chemicals : The chemicals used for different studies were analytical grade and standard firms' *viz*. Rallis India Ltd., Syngenta India Ltd., Indofil Chem. Co., Mumbai, UPL India Ltd and Bayer Crop Science, SAS, France.

Bioagents : All biocontrol-agents except MPKV Consortium were evaluated against C. gloeosporioides; the pure cultures of these bioagents were obtained from Biological Nitrogen Fixation Scheme, College of Agriculture, Pune. MPKV Consortium was obtained from Department of Plant Pathology and Agril. Microbiology, MPKV, Rahuri.

Biocontrol-agents were used for *in-vivo* evaluation *viz*. MPKV Consortium, *Trichoderma viride*, *Trichoderma harzianum* and *Bacillus subtilis.*

Fungicides

Trade name	Common name	Chemical name	Source
Bordeaux Mixture	Bordeaux Mixture 1%	$CuSO_4$ + Ca $(OH)_2$ in equal	-
Blitox-50	Copper oxychloride 50 WP	Copper oxychloride containing 50% metallic copper	RallisIndia Ltd., Mumbai
Score	Difenoconazole 25% EC	1-((2-(2-Chloro-4-(4-chlorophenoxy) phenyl)-4-methyl-1,3-dioxolan-2-yl) methyl)-1 H-1,2,4-triazole	SyngentaIndia Ltd.
IndofilM 45	Mancozeb 75% WP	Zincion and manganese ethylenebisdithiocarbamate	Indofil Chem.Co., Mumbai
SAAF	Carbendazim12%+ Mancozeb 63% WP	Methyl 1H benzimidazol-2- ylcarbamate + Manganeseethylenebis (dithiocarbamate) (Polymeric) complex with zinc salt	UPLIndia Ltd.
Avancer Glow	Azoxystrobin 8.3% + Mancozeb 66.7% WG	methyl (E)-2-[2-[6-(2-cyanophenoxy) pyrimidin-4-yl]oxyphenyl]-3- methoxyprop-2-enoate zinc; manganese(2+); N-[2-(sulfidocarbo-thioylamino) ethyl]carbamodithioate	UPL India Ltd.
Nativo	Tebuconazole 50% +Trifloxystrobin 25% WG	Triazole class of fungicides + Storbulin class of fungicides	Bayer Crop Science, SAS, France

Bio-efficacy of fungicides and bio-agents against fruit rot disease of custard apple caused by *C. gloeosporioidesin* natural conditions (*in vivo*).

Chemical and biological control based on timely disease forecasting system has been found to be successful and economical plant protection method adopted in various countries. Before recommendinganyfungicideandbio-controlagent, it is very essential to test its efficacy, dosage, time of treatment, phytotoxicity if any and economics. With these views, the experiments under natural field conditions were under taken to find out efficacy of various fungicides and bio-control agents in controlling fruit rot (*C. gloeosporioides*) of custard apple.

The trial on bioefficacy of fungicides was conducted under natural conditions on twelve years old commercial plantation of Purandar local variety of custard apple in *kharif* season of 2000 at AICRP on Fig and Custard apple, Jadhavwadi, Tal. - Purandar, Dist. - Pune.

The experiment was conducted in RBD with three replications by marking two trees per treatment. The plant and field sanitation measures were not adopted in order to provide maximum infection foci for better disease development. As and when required light irrigations were given forbetterfruitdevelopment whichalsohelpedtoprovidefavorablemicroclimate (high humidityfor disease development. The sprays with test fungicides and bio-control agents at given concentration were taken with the help of ASPEE Knapsack Sprayer. Only one lance waskeptto have better pressure with fine droplet size. The spray pump was flushed thoroughly with clean water everytime before spraying next fungicide. Atmost care was taken to avoid spray drift from one treatment plant to another. A sticker, Sandovit (0.1%), was added into all fungicides, except Bordeaux mixture, to have better spread and adhesion of fungicide on plant surface.

Test fungicides and bio-control agents

SN	Fungicides/Bio-controlagents dose (%)	Dose (%)
T-1	Bordeaux mixture	1.00
T-2	Copperoxychloride 50% WP	0.25
T-3	Difenoconazole 25% EC	0.10
T-4	Mancozeb 75% WP	0.25
T-5	Carbendazim 12% + Mancozeb 63% WP	0.25
T-6	Azoxystrobin 8.3% + Mancozeb 66.7% WG	0.20
T-7	Tebuconazole 50% + Trifloxystrobin 25% WG	0.10
T-8	MPKV consortium	5.00
T-9	*Trichoderma viridae*	5.00
T-10	*Trichoderma harzianum*	5.00
T-11	*Bacillus substillis*	5.00
T-12	Untreated control	-

Spraying schedule : The first spray was taken immediately after disease appearance on leaves / flowers / fruits and subsequent two sprays at 15 days interval thereafter. A sufficient waiting period was kept between last spray and first harvesting of fruits.

Observations recorded

Observations werer ecorded as bellows.

a) **Incidence :** Number of infected fruits out of total examine dones.

b) **Severity :** The observation on fruit rot severity were recorded as per 0-7 grade score scaleas described under 3.2.1.2. The percent disease incidence and intensity were calculated by using the formula givenin 3.2.1.1.

c) **Yield :**

1. Fruitweight - Fruit weight from selected plants at each picking,

2. Number of fruits - Total as well as marketable fruits (grade wise) of each treatment plot at each harvest.

d) **Economics :** Economics was worked out on the basis of grade wise rates of marketable fruits and existing market rates of inputs and labour charges as suggested by Dhondyal (1978).

Results and discussion

Bio-efficacy of different fungicides and bio-control against *C. gloeosporioides* fruit rot under natural field conditions

Incidence and Severity of fruit rot disease : The fruit rot data (Table1) indicated that the treatment differences due to fungicides and bio-control agents were statistically significant. The lowest incidence (23.00%) and intensity (6.27%) of fruit rot were noticed in the treatment with Tebuconazole 50% + Trifloxystrobin 25% WG (0.10%) that showed highest disease reduction of 76.55 per cent. However, it was followed by Azoxystrobin 8.3% + Mancozeb 66.7% WG (0.20%) where in incidence (44.27%) andi ntensity (8.63%) with 67.69 per cent fruit rot reduction over control. Among bio-control agents, MPKV consortia (5%) had lowest incidence (63.43%) and intensity (19.27 %) and thereby recorded disease reduction of 27.89 per cent. But it was at par with *Trichoderma viridae* (5%) and *Trichoderma harzianum* (5%) those recorded 24.78 and 24.28 per cent fruit rot reduction over control, respectively. The untreated control had significantly highest incidence of 82.28 per cent and severity of 26.72 per cent of the disease.

SimilarresultswereobtainedbyAnnetal.(2017) whoreportedspraysofTebuconazole 50% + Trifloxystrobin 25% WGwere effective in controllingthe development of both leaves anthracnose and black berries disease caused by *Colletotrichum gloeosporioides* in black pepper. Vani and Somashekhara (2018) also reported efficacy of Tebuconazole 50% + Trifloxystrobin 25% WGin controlling C. gloeosporioidesunder *in vitro* conditions.

Similarly Mimrot *et al.* (2020) also reported the sprays of Azoxystrobin 8.3% + Mancozeb 66.7% WG at 4 per cent and *T. viride* at 10 per cent concentration were effective in management of anthracnose caused by *Colletotrichum gloeosporioides* of pomegranate.

Effect of fungicide and bio-control agent sprays on yield of custard apple : The data presented in Table 1 reveal that the treatment differences due to yield parameters were statistically significant. The treatment with Tebuconazole 50% + Trifloxystrobin 25% WG (0.10%) showed maximum number of marketable fruit (100.33 plant^{-1}), yield per plant (29.23 kg) and yield per ha (18.27 t) therebyr ecorded highest i.e. 82.53 per cent increase in yield over control, respectively. However, it was at par with Azoxystrobin 8.3% + Mancozeb 66.7% WG (0.20%) where in marketable fruit (95.00 plant^{-1}), yield per plant (27.67 kg) and yield per ha (17.29 t) were recorded. Among bio-control agents, MPKV consortia (5%) showed maximum number of marketable fruit (73.00 plant^{-1}), yield per plant (21.26 kg) and yield per ha (13.29 t) thereby recorded highest i.e. 32.74 per cent increase in yield over control, respectively. The untreated control had significantly least number of marketable fruit (55.00 plant^{-1}), yield per plant (16.02 kg) and yield per ha (10.01 t).

Table 1. Efficacy of fungicides and bio-control agents against fruit rot of custard apple

Treatment details	Dose (%)	Fruit rot (%)		
		Incidence	PDI	Reduction
Bordeaux mixture	1.00	53.40 **46.93**	13.23 **21.20**	**50.47**
Copperoxychloride 50% WP	0.25	60.33 **50.96**	15.53 **23.19**	**41.87**
Difenoconazole 25% EC	0.10	56.34 **48.63**	12.63 **20.74**	52.72
Mancozeb 75% WP	0.25	68.27 **55.72**	16.07 **23.61**	39.87
Carbendazim 12% + Mancozeb 63% WP	0.25	46.50 **42.97**	9.98 **18.40**	62.65
Azoxystrobin 8.3% + Mancozeb 66.7% WG	0.20	44.27 **41.69**	8.63 **17.06**	67.69
Tebuconazole 50% +Trifloxystrobin 25% WG	0.10	23.00 **28.61**	6.27 **14.44**	76.55
MPKVconsortium	5.00	63.43 **52.79**	19.27 **26.02**	27.89
Trichoderma viridae	5.00	66.77 **54.79**	20.10 **26.62**	24.78
Trichoderma harzianum	5.00	71.53 **57.77**	20.23 **26.72**	24.28
Bacillus substillis	5.00	74.47 **59.66**	22.73 **28.46**	14.92
Control	-	82.28 **65.11**	26.72 **31.10**	-
SE(m)±		1.27	0.79	
C.D. (0.05)		3.74	2.33	
C.V. (%)		5.35	5.91	

Table 2. Influence of disease management due to fungicides and bio-control agents on yield of custard apple

Name of fungicides	Dose (%)	Gross monitory returns (Rs. ha^{-1})	Cost of Cultivation (Rs. ha^{-1})	Net monitory returns (Rs. ha^{-1})	B:C ratio	Incremental B:C ratio
Bordeaux mixture	1.00	413000	193031.35	219968.65	2.14	3.9
Copper oxychloride 50% WP	1.00	339120	179040.69	160079.31	1.89	3.7
Difenoconazole 25% EC	0.25	394740	193251.65	201488.35	2.04	3.5
Mancozeb 75% WP	0.10	329520	177013.10	152506.90	1.86	3.7
Carbendazim 12% + Mancozeb 63% WP	0.25	487500	206868.09	280631.91	2.36	4.0
Azoxystrobin 8.3% + Mancozeb 66.7% WG	0.25	605150	230399.63	374750.37	2.63	4.0
Tebuconazole 50% + Trifloxystrobin 25% WG	0.20	785610	266338.33	519271.67	2.95	4.0
MPKV consortium	0.10	305670	172640.60	133029.40	1.77	3.6
Trichoderma viride	5.00	272090	166484.26	105605.74	1.63	3.3
Trichoderma harzianum	5.00	259670	164207.26	95462.74	1.58	3.1
Bacillus substillis	5.00	250010	162436.26	87573.74	1.54	2.9
Control	5.00	200200	149736.47	50463.53	1.34	-

Conclusion

The *in vivo* studies regarding efficacy of fungicides against *C. gloeosporioides* revealed that the new generation combi-fungicides were found most effective than sole fungicides. Tebuconazole 50% + Trifloxystrobin 25% WG was found most effective fungicide as it showed lowest incidence and intensity, highest disease reduction and highest number of marketable fruit per plant, yield per plant and yield per ha.Amongbio-control agents studied *in vivo*, MPKVconsortia (5%) had lowest incidence and intensity of the disease with maximum number of marketable fruits per plant, yield per plant and yield per ha.

References

Ann, Y. C., Mercer, Z. J. A., 2017. Efficacy of tebuconazole and trifloxystrobin against *Colletotrichum gloeosporioides* infestation in black pepper (*Piper nigrum* L.). American Journal of Research Communication 5(1): 98-128.

Hayes, W. B. 1953. Fruit growing in India 3rd edition, 338-357, Kitabistan, NewDelhi.

Mimrot, M. K., Chanderia, U. K. and Dongre, R. 2020b. Evaluation of fungicides, bio agents, plant extract against of anthracnose caused by *Colletotrichum gloeosporioides* (Penz.) Penz of pomegranate. International Journal of Chemical Studies 8(4), pp. 1983-1985.

Mukerji, K. G. and Bhasin, J. 1986. Plant diseases ofIndia:Asource book. Tatta Mc. Grew-Hill Publishing Company Ltd. New Delhi. 468 pp.

Vani, M. and Somashekhara, Y. M., 2018. In vitro study of biocontrol agents, fungicides and botanicals against *Colletotrichum capsici*, causing anthracnose of Capsicum (*Capsicum annuum* L.). International Journal of Pure Applied Bioscience, 6(5), pp. 51-56.

Venkataratnam, L. and Satyanarayanaswamy, G. 1958. Studies on genetic variability in Annona squamosa. Indian J. Hort, 15, p. 228.

Venkataratnam, L. 1959. Sitaphal and other annonaceous fruits in India. Farm Bull, (54).