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Integrated Management of *Ceratocystis fimbriata* Causing Wilt in Pomegranate

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In this experiment 45th day was crucial day for wilting. Branches were rapidly wilted in all treatment. After 45th day gradual yellowing and wilting was noticed very slowly due to effect of chemicals, bio agents and plant product, micronutrientand insecticide. Among the chemicals propiconazole was more effective followed by Difenoconazole. However in bio agents *T. harzianumand P. fluorescens* were effective than alone.Before drenching all plants showing partial wilting and yellowing but none of the plants completely wilted in all treatments. Propiconazole was significantly superior than remaining treatments. Propiconazole treated plants were recovered at 105th day, followed by difenconazole the plants were recovered at 120th day. These two chemicals were effective than remaining treatments. After 120th day propiconazole (0.00%), difenconazole (0.00%) and *T. harzianum* + *P. flourescence* (0.00%) are on par with each other. captan+ carbendazim (16.66%), *T. harzianum* (16.66%), Copper oxychloride (16.66%) and mancozeb (16.66%) were on par with each other. Followed by neemcake (33.34%) and vitavax power (33.34%). In control (83.33%) was showing highest percent of wilting.

Key words: 45th day, 105th day, 120th day, completely wilted plants and partially wilted plants.

Pomegranate (*Punica granatum* L.) is an ancient fruit, belonging to the smallest botanical family punicaceae. Pomegranate is a native of Iran, where it was first cultivated in about 2000 BC. Sweet varieties are mildly laxative, sour types are good for curing inflammation of stomach and heartache. In India, there is a common adage 'EkAnar Sau Bimar' meaning one fruit cures hundred diseases.Area under pomegranate is increasing worldwide because of its hardy nature, wider adaptability, and drought tolerance, higher yield levels with excellent keeping quality and remunerative prices in domestic as well as export market. It thrives well in dry tropics and sub-tropics and comes up very well in soils of low fertility status as well as on saline soil.

In India, it is regarded as a "vital cash crop", grown in an area of 1, 16,000 ha with a production of 89,000 MT with an average productivity of 7.3 MT (Srivastava and Umesh, 2008). Among the different states growing pomegranate, Maharashtra is the largest producer occupying 2/3rd of total area in the country followed by Karnataka, Andhra Pradesh, Gujarat and Rajasthan. Karnataka state has the distribution of cultivating pomegranate under tropical condition

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in an area of 12,042 ha with a production of 1, 29, 547 tonnes. Where this crop has spread across different districts *viz*., Bijapur, Bellary, Bagalkot, Koppal, Chitradurga, Belgaum, Davangere, Tumkur, Bangalore and Gulbarga.

MATERIAL AND METHODS

A field experiment was conducted during January to May 2010 at farmer field, Bandi under irrigated condition to find out the suitable fungicide for the management of wilt. The experiment was laid out in completely randomized block design (RCBD) with 12 treatments and replicated twice. In each treatment six plants were tagged and the efficacy of ten fungicides (four systemic, three non-systemic fungicides and two bio agents, one plant product and one insecticide, one micro nutrient) was tested with one untreated control. The fungicide solutions were prepared by dissolving known quantity of fungicide in water and eight litres per tree drenched. First drenching was taken 3rd January and second drenching with 15 days interval.

The treatments are as follows

S. No.	Treatments	Common name (%)	Conc.
1	T1	Control	-
2	T2	Carbendazim	0.2
3	T3	Vitavax power	0.2
4	T4	Captan+ Carbendazim	0.2+0.2
5	T5	Neem cake	1kg
6	T6	*P. flourescens*+ *T. harzianum*	10^6+10^6
7	T7	*T. harzianum*	10^6
8	T8	Mancozeb	0.3
9	T9	Copper oxy chloride	0.3
10	T10	Difenoconazole	0.2
11	T11	Hexaconazole	0.2
12	T12	Propiconazole	0.2
1	Borax	32ml/tree	
2	Chlorpyriphos	64g /tree	

Design of the layout

The experiment was laid out in a completely randomized block design with two replications. The treatments were randomly allotted to plots. The details are as follows.

Treatments: Twelve

Number of plants tagged/treatment: Six

Spacing : 4.25 m x 3.65m

Variety : Kesar

The area under disease progression curve (AUDPC) was calculated using the formula of Nagarajan and Muralidharan (1995).

$AUDPC = S \frac{1}{2} (Y1 + Yi\text{-}1) \times d$

Yi = Disease incidence at i^{th} day or evaluation

K = Number of successive evaluation

D = Interval between i and i-1 evaluation of disease.

RESULTS

The results of the field experiment conducted in a farmer's field at Bandi village, Yalburga taluk (Koppal District) are presented in Table 1.In this experiment 45th day was crucial day for wilting (Plate 1). Branches were rapidly wilted in all treatment. After 45th day gradual yellowing and wilting was noticed very slowly due to effect of chemicals, bio agents and plant product, micronutrient insecticide. Among the chemicals propiconazole was more effective followed by Difenoconazole. However in bio agents *T. harzianumand P. fluorescens* were effective than alone. From the Table 1 results indicates that propiconazole was significantly superior than remaining treatments. Propiconazole treated plants were recovered at 105th day, followed by difenconazole the plants were recovered at 120th day. These two chemicals were effective than remaining treatments. Carbendazim (57.89%), vitavax powers (58.82%) are on par with each other and showed least efficacy. Captan + carbendazim (44.45%), *T. harzianum* (44.11%) Copper oxychloride (44.44%) are on par with each other. Followed by neemcake (52.94%) and *T. harzianum* + *P. fluorescence* (48.48%) are on par with each other. The control showing maximum percent of wilting (97.61%).

From the Table 2 results indicate that before drenching all plants showing partial wilting and yellowing but none of the plants completely wilted in all treatments. After 120th day propiconazole (0.00%), difenconazole (0.00%) and *T. harzianum* + *P. flourescence* (0.00%) are on par with each other. captan+ carbendazim (16.66%), *T. harzianum* (16.66%), Copper oxychloride (16.66%) and mancozeb (16.66%) were on par with each other. Followed by neemcake (33.34%) and vitavax

power (33.34%). In control (83.33%) was showing highest percent of wilting.

DISCUSION

Protection of crop plants from disease causing agents has been the focal point of the scientists in dealing with plant pathogens. In-depth analysis and realization about the startling features of microbial ecology have impelled workers to replace term control with management. No single method of pest control has given a lasting solution. Prohibitive costs of chemicals and their adverse ecological impact a major compulsion for diversions of research priorities from chemical methods to other alternatives. The successive shifting of priorities from chemical to cultural and currently integrated management demonstrates the elasticity of scientific ideas (Khan and Parvatha Reddy, 1993).

Present study clearly indicated that the - propiconazole was significantly superior to all other treatments followed by difenoconazole and *T. harzianum* + *P. fluorescens,* because out of six plants six plants were completely green. In propiconazole plant recovery was faster than other treatments. In *T. harzianum* one plant was wilted and four were remain as green. In carbendazim + captan only one plant was wilted two plants remain as green out of six plants on par with mancozeb, Copper oxy chloride and hexaconazole. In vitavax power two plants were died and three plants remain as green on par with Neem cake. In carbendazim three plants were died and single plant remain as green. Controls Out of six plants 5 plants were died and only one branch remains as yellow, 1st

Table 1. Field efficacy of different fungicides, bioagents and botanicals against wilt complex, parameter: per cent of branches wilted

S. No.	Treatments	Before drenching	After treatments (days) 30	45	60	75	90	105	120
1	Control	14.28 (22.17)	38.09 (38.04)	52.38 (46.34)	57.14 (49.08)	69.00 (56.15)	80.10 (63.48)	95.23 (77.35)	97.61** (89.07)
2	Carbendazim	10.52 (18.91)	18.42 (25.41)	36.84 (37.95)	42.10 (40.43)	44.73 (41.95)	45.23 (42.24)	52.63 (46.48)	57.89 (57.89)
3	Vitavax power	11.76 (20.04)	26.47 (30.95)	26.47 (30.95)	35.29 (36.43)	35.29 (36.43)	44.11 (41.60)	52.94 (46.66)	58.82 (50.05)
4	Captan + Carbendazim	11.12 (19.46)	13.89 (21.87)	33.34 (35.25)	36.12 (36.92)	38.89 (38.56)	38.89 (38.56)	41.67 (40.18)	44.45 (41.79)
5	Neem cake	8.82 (17.27)	8.82 (17.27)	20.58 (26.96)	29.41 (32.82)	32.35 (34.65)	41.17 (39.89)	47.05 (43.27)	52.94 (46.66)
6	*T. harzianum* + *P. fluorescens*	12.12 (20.36)	15.15 (22.90)	27.27 (31.46)	27.27 (31.46)	33.33 (35.24)	36.36 (37.06)	39.39 (38.85)	48.48 (44.11)
7	*T.harzianum*	11.76 (20.04)	17.64 (24.82)	17.64 (24.82)	29.47 (32.86)	35.29 (35.62)	35.29 (36.43)	41.17 (39.89)	44.11 (41.60)
8	Mancozeb	11.76 (20.04)	11.76 (20.04)	17.64 (24.82)	29.47 (32.86)	32.35 (35.62)	38.23 (38.17)	38.23 (38.17)	41.17 (39.89)
9	Copper oxy chloride	11.12 (19.46)	11.12 (19.46)	16.66 (24.08)	27.77 (31.78)	27.77 (31.78)	33.33 (35.24)	44.44 (41.79)	44.44 (41.79)
10	Difenconazole	9.38 (17.82)	12.50 (20.70)	12.50 (20.70)	12.50 (20.70)	9.38 (17.82)	9.38 (17.82)	6.25 (14.47)	0.00 (0.00)
11	Hexaconazole	10.52 (18.91	13.15 (21.25)	15.78 (23.39)	21.05 (27.29)	21.00 (27.25)	23.68 (29.10)	36.84 (37.35)	42.10 (40.43)
12	Propiconazole	12.50 (20.69)	15.62 (23.27)	15.62 (23.37)	12.50 (20.70)	9.37 (17.81)	6.25 (14.47)	0.00 (0.00)	0.00 (0.00)
SE m± 0.03		0.19	0.26	0.36	2.65	2.65	2.65	4.05	
CD @ 5%		0.09	0.56	0.77	0.10	8.34	8.34	8.34	12.60

** Figures in parenthesis arc sine transformed values

Table 2. Field efficacy of different fungicides, bioagents and botanicals against wilt complex, Parameter: Per cent of completely wilted plants

S. No.	Treatments	Before drenching	After treatments (days) 30	45	60	75	90	105	120
1	Control	0.00 (0.00)	0.00 (0.00)	16.66 (24.08)	33.34 (35.25)	50.00 (44.98)	66.66 (54.70)	66.66 (54.70)	83.33** (65.87)
2	Carbendazim	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	33.34 (35.25)	33.34 (35.25)	50.00 (44.98)	50.00 (44.98)	50.00 (44.98)
3	Vitavax power	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	16.66 (24.08)	16.66 (24.08)	33.34 (35.25)	33.34 (35.25)	33.34 (35.25)
4	Captan + Carbendazim	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	16.66 (24.08)	16.66 (24.08)	16.66 (24.08)	16.66 (24.08)	16.66 (24.08)
5	Neem cake	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	16.66 (24.08)	16.66 (24.08)	33.34 (35.25)	33.34 (35.25)	33.34 (35.25)
6	*T. harzianum* + *P. fluorescens*	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)
7	T.harzianum	0.00 (0.00)	0.00 (0.00)	16.66 (24.08)	16.66 (24.08)	16.66 (24.08)	16.66 (24.08)	16.66 (24.08)	16.66 (24.08)
8	Mancozeb	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	16.66 (24.08)	16.66 (24.08)	16.66 (24.08)	16.66 (24.08)	16.66 (24.08)
9	Copper oxy chloride	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	16.66 (24.08)	16.66 (24.08)	16.66 (24.08)	16.66 (24.08)	16.66 (24.08)
10	Difenconazole	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)
11	Hexaconazole	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	16.66 (24.08)	16.66 (24.08)	16.66 (24.08)	16.66 (24.08)	16.66 (24.08)
12	Propiconazole	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)
SE m+		NS	NS	NS	NS	2.64	2.64	2.64	
CD @ 5%							8.24	8.24	8.24

** Figures in parenthesis arc sine transformed values

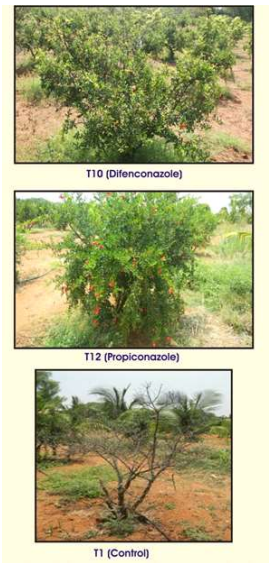

Plate 1. General view of experimental plot

plant wilted at 45th day. Similar findings were observed, the soil application of bacterial culture, *Bacillus subtilis* was effective in reducing pomegranate wilt incidence under field conditions (Somasekhara, 2002). Raghuvanshi (2007) reported soil application of *Trichoderma* sp. + *Paecilomyces* sp. at 25 g with 2 kg well decomposed farm yard manure around the trunk of pomegranate trees helps to prevent wilt infections. The reasons for the reduced wilt incidence and severity and increased yield may attributed to the *Trichoderma* spp. Application of *P. lilacinus* and *P. fluorescens* at 10-20 g/m2 resulted in effective reduction of the root knot nematode population (Mhase, 2007). *T. harzianum* + *P. fluorescens* and neem cake were found effective in reducing the disease incidence of wilt complex (Shreeshail *et al*., 2010). Sampang (1989) published the first report of biological control of *C. paradoxa* on sugarcane. Guevarra

(1992) conducted field trials in sugarcane. He found that when the setts were treated with *Gliocladium delinquescens* and *G. fimbriata* alone followed by treatment with the pathogen *C. paradoxa*, gave significant reduction in yield when sown in soils infected with the pathogen.

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