

Evaluation of fungicides and biocontrol agents for potential application in *Fusarium* wilt management of banana cv Bantal

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Received: 12.5.2017/Accepted: 17.5.2017

ABSTRACT

Banana is the most widely consumed and exported fruit in the world and is the staple food for millions of people in the developing countries of tropics. Among the production constraints *Fusarium* wilt caused by the fungus *Fusarium oxysporum* f sp *cubense* (Foc) is the most devastating disease affecting commercial and subsistence of banana production throughout the banana producing areas of the world. The experiment was conducted at the Horticultural Research Station, Orissa University of Agriculture and Technology during 2013-14 to study the efficacy of fungicides and biocontrol agents in *Fusarium* wilt management. The treatments consisted of fungicides, biocontrol agents and neem cake used through sucker treatment, soil drenching and soil application methods. Application of *Trichoderma viride* and *Pseudomonas fluorescens* both as sucker treatment @ 20 g/l for 30 minutes and soil drenching @ 20 g/l at 60 and 180 days after planting were found very effective in controlling the disease.

Keywords: Fungicides; biocontrol agents; *Fusarium* wilt; banana

INTRODUCTION

India is the largest producer of banana in the world producing 29.22 MT from an area of 0.821 Mha with a productivity of 34.2 tonnes/ha (Anon 2015). Although India accounts for only 11.1 per cent area it has 32.6 per cent of world production. *Fusarium* wilt of banana (*Musa* spp) caused by *Fusarium oxysporum* f sp *cubense* (EF Smith) Snyder and Hansen is a serious and destructive disease on many cultivars in the world (Ploetz et al 1990). It is a classic vascular wilt disease in which the fungus gains entry to the water conducting xylem vessels and then proliferates within the vessels causing water blockage. The typical symptoms include wilting and death of the leaves followed by death of the whole plant. In India *Fusarium* wilt susceptible varieties roughly occupy one fourth of the total area under banana where yield losses may go up to 90 per cent by the incidence of the disease (Thangavelu et al 1999). The culinary cv Bantal has good demand in the market but it is highly susceptible to this disease. In the present experiment some fungicides, biocontrol agents and neem cake were

evaluated for their efficacy against *Fusarium* wilt of banana.

MATERIAL and METHODS

The investigations were carried out at the Horticultural Research Station, Orissa University of Agriculture and Technology during 2013-15. The experiment was laid out in completely randomized block design with ten treatments replicated thrice each treatment in a replication having five banana plants. *Fusarium* wilt-infected one month old suckers of cv Bantal verified from laboratory were used as planting material. The different treatments comprised fungicides, biocontrol agents and neem cake used through sucker treatment, soil drenching and soil application methods. Suckers were planted at 2.2 x 2.2 m spacing. No other plant protection measures except treatments were adopted to control any disease. The treatments used were T₁ (Sucker treatment for 30 minutes with carbendazim 50 WP 0.2% + blitox 50 WP 0.3% + bleaching powder 0.015%), T₂ (Sucker treatment for 30 minutes with captan 50 WP 0.3% + vitavax power

75 WP 0.5% + bleaching powder 0.015%), T₃ (Sucker treatment with *Trichoderma viride* + *Pseudomonas fluorescens* @ 20 g/l for 30 minutes), T₄ (T₁ + soil drenching with T₁ chemicals at 60 days after planting (DAP) and 180 DAP), T₅ (T₂ + soil drenching with T₂ chemicals at 60 and 180 DAP), T₆ (T₃ + soil drenching with *T viride* + *P fluorescens* at 60 and 180 DAP), T₇ (T₄ + soil drenching with T₂ chemical alternatively at 60 and 180 DAP), T₈ (Soil application with *T viride* + *P fluorescens* at 30 and 180 DAP), T₉ (Neem cake application @ 250 kg/ha at planting and 180 DAP), T₁₀ (Control having no treatment).

The suckers were dipped in fungicidal and biocontrol agents for 30 minutes. In 20 kg of well rotted and powdered FYM 200 g fresh stock of each of *T viride* and *P fluorescens* was mixed separately. This mixture was wetted and covered with polyethylene sheet for two days and stirred regularly with proper moisture content for three weeks. After the incubation period the mixture was applied at the base of banana plants @ 10 q/ha at 30 and 180 DAP. Similarly powdered neem cake was applied to the plants @ 250 kg/ha at planting. Soil drenching was done at 60 and 180 DAP. Observations on growth, disease related and yield characters were recorded at fixed intervals. Weight of the bunch from individual plant was taken as yield parameter.

RESULTS and DISCUSSION

Growth related characters

Data in Table 1 show that the maximum plant height of 149.28 cm was recorded in T₆ (T₃ + soil drenching with *T viride* + *P fluorescens* at 60 and 180 DAP) and lowest of 109.11 cm in control (T₁₀) at 60 and 180 DAP. T₆ also exhibited maximum values for plant girth (46.64 cm) and total leaf area (4.58 m²) at full growth stage and there was 31.7 and 60.7 per cent increase in these characters respectively over the control. This increase in growth characters was possibly due to biocontrol treatment of suckers and soil drenching at 60 and 180 DAP. T₈ (Soil application with *T viride* + *P fluorescens* at 30 and 180 DAP) was observed to be at par with T₆ at the final stage of observation. These findings are confirmed by the work of Thangavelu and Mustaffa (2010) and Selvaraj et al (2014).

Yield characters

Yield was found to be highly variable among the treatments which ranged from a significantly lowest of 3.857 kg/plant (T₁₀) to a highest of 10.309 kg/plant (T₆). The treatment T₈ (9.008 kg/plant) was at par with T₆. Similar results have also been reported by Raguchander et al (1997) who used antagonistic microorganisms for the management of *Fusarium*.

Table 1. Effect of fungicides and biocontrol agents on plant growth characters and yield

Treatment	Plant growth character			Average bunch yield (kg/ plant)
	Plant height (cm) at 270 DAP	Plant girth (cm) at 270 DAP	Total leaf area (m ²) at 270 DAP	
T ₁	121.15	38.79	3.55	5.263
T ₂	142.24	41.95	3.83	8.705
T ₃	139.85	40.92	3.71	7.127
T ₄	137.22	42.53	3.91	6.075
T ₅	140.61	40.82	3.88	7.547
T ₆	149.28	46.64	4.58	10.309
T ₇	136.54	39.49	3.51	6.994
T ₈	144.05	44.09	4.46	9.008
T ₉	130.32	36.11	3.19	7.988
T ₁₀	109.11	35.42	2.68	3.857
SEm±	6.59	1.85	0.24	0.505
CD _{0.05}	19.57	5.50	0.72	1.502

T₁ (Sucker treatment for 30 minutes with carbendazim 50 WP 0.2% + blitox 50 WP 0.3% + bleaching powder 0.015%), T₂ (Sucker treatment for 30 minutes with captan 50 WP 0.3% + vitavax power 75 WP 0.5% + bleaching powder 0.015%), T₃ (Sucker treatment with *Trichoderma viride* + *Pseudomonas fluorescens* @ 20 g/l for 30 minutes), T₄ (T₁ + soil drenching with T₁ chemicals at 60 days after planting (DAP) and 180 DAP), T₅ (T₂ + soil drenching with T₂ chemicals at 60 and 180 DAP), T₆ (T₃ + soil drenching with *T viride* + *P fluorescens* at 60 and 180 DAP), T₇ (T₄ + soil drenching with T₂ chemical alternatively at 60 and 180 DAP), T₈ (Soil application with *T viride* + *P fluorescens* at 30 and 180 DAP), T₉ (Neem cake application @ 250 kg/ha at planting and 180 DAP), T₁₀ (Control having no treatment)

Table 2. Effect of fungicides on disease characters

Treatment	Plants showing prominent wilt symptoms (%)		Disease affected area of leaves/plant (%)		Dead leaves/plant (%)	
	330 DAP	360 DAP	330 DAP	360 DAP	345 DAP	360 DAP
T ₁	40.00 (39.23)	53.67 (47.10)	33.70 (35.46)	30.90 (33.74)	38.60 (38.39)	44.50 (41.70)
T ₂	40.00 (39.23)	41.00 (39.82)	27.40 (31.45)	37.30 (37.54)	37.50 (37.75)	38.60 (38.34)
T ₃	40.00 (39.23)	40.33 (39.43)	34.60 (36.00)	40.00 (39.36)	47.10 (43.35)	49.00 (44.40)
T ₄	46.67 (43.08)	39.67 (39.04)	29.60 (32.95)	32.10 (34.51)	44.30 (41.70)	52.60 (46.50)
T ₅	46.67 (43.08)	31.33 (34.06)	31.50 (34.15)	33.30 (35.19)	43.80 (40.81)	44.40 (41.78)
T ₆	30.00 (30.23)	30.00 (33.21)	22.00 (27.96)	29.20 (32.68)	30.00 (32.57)	31.00 (33.77)
T ₇	46.67 (43.08)	45.33 (42.27)	33.50 (35.22)	41.10 (39.29)	46.30 (42.87)	56.10 (48.53)
T ₈	33.33 (35.01)	36.00 (36.87)	26.20 (30.55)	30.20 (33.21)	37.10 (37.53)	35.90 (36.78)
T ₉	66.67 (54.99)	72.00 (58.00)	29.10 (32.66)	36.00 (36.84)	38.70 (38.36)	44.70 (44.74)
T ₁₀	80.00 (63.44)	100.00 (90.00)	35.20 (36.30)	43.90 (41.49)	57.10 (49.08)	58.10 (49.65)
SEm±	3.510	3.65	2.108	1.710	2.789	2.583
CD _{0.05}	10.427	10.85	6.264	5.079	8.288	7.673

T₁ (Sucker treatment for 30 minutes with carbendazim 50 WP 0.2% + blitox 50 WP 0.3% + bleaching powder 0.015%), T₂ (Sucker treatment for 30 minutes with captan 50 WP 0.3% + vitavax power 75 WP 0.5% + bleaching powder 0.015%), T₃ (Sucker treatment with *Trichoderma viride* + *Pseudomonas fluorescens* @ 20 g/l for 30 minutes), T₄ (T₁ + soil drenching with T₁ chemicals at 60 days after planting (DAP) and 180 DAP), T₅ (T₂ + soil drenching with T₂ chemicals at 60 and 180 DAP), T₆ (T₃ + soil drenching with *T. viride* + *P. fluorescens* at 60 and 180 DAP), T₇ (T₄ + soil drenching with T₂ chemical alternatively at 60 and 180 DAP), T₈ (Soil application with *T. viride* + *P. fluorescens* at 30 and 180 DAP), T₉ (Neem cake application @ 250 kg/ha at planting and 180 DAP), T₁₀ (Control having no treatment)

Disease characters

The least (30%) and highest (100%) wilt symptoms were recorded in T₆ and control respectively at 360 days after planting (Table 2). Similar reports have been observed by Sivamani and Gnanamanickam (1988). Lowest (29.20%) disease affected area in leaves was recorded in T₆ followed by 30.90 per cent in T₁ (Sucker treatment for 30 minutes with carbendazim 50 WP 0.2% + blitox 50 WP 0.3% + bleaching powder 0.015%). Dowling and O'Gara (1994) also obtained similar results where they could obtain antifungal metabolites from *P. fluorescens* which caused inhibition of fungal cell multiplication of the pathogenic fungi. T₆ resulted in minimum (31.00%) dead leaves followed by T₈ (35.90%) as compared to control (58.10%). Treatments T₃ (Sucker treatment with *Trichoderma viride* + *Pseudomonas fluorescens* @ 20 g/l for 30 minutes) and T₈ were found at par with T₆ in production of dead leaves. These findings are supported by the study conducted by Garcia de

Salamone et al (2001) and Saravanan and Muthusamy (2006).

CONCLUSION

Sucker treatment with *T. viride* + *P. fluorescens* @ 20 g/l for 30 minutes followed by soil drenching with *T. viride* + *P. fluorescens* at 60 and 180 DAP was found to be the best treatment in reducing the *Fusarium* disease incidence and intensity in banana thereby increasing the yield. This treatment was followed by the treatment soil application of *T. viride* and *P. fluorescens*. The study showed that biocontrol agents were highly useful in tackling the menace of *Fusarium* wilt disease in banana.

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