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Management of rot diseases of vanilla (*Vanilla planifolia* Andrews) using bioagents

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Rot diseases in vanilla (*Vanilla planifolia* Andrews) caused by *Fusarium oxysporum* and *Phytophthora meadii* were observed in several vanilla plantations of Southern India (Thomas and Vijayan, 2003). Rotting of various plant parts such as basal stem, root, beans, stem and vine tip are the common fungal diseases (Suseela Bhai and Joseph Thomas, 2000; Thomas *et al*., 2003; Srilakshmi *et al*., 2007). These diseases are controlled by adopting plant sanitation coupled with fungicide application. The management of diseases through chemical fungicides is not cost effective as well as environmentally safe. In recent years thrust is being given to biocontrol agents as a component of integrated disease management to reduce cost, environmental pollution, residual effects in the crop etc. Fungal pathogens have been successfully managed by using antagonists in crops like cotton, beans (Elad *et al*., 1980) and small cardamom (Joseph Thomas *et al*., 1993; Vijayan *et al*., 1994; Dhanapal *et al*., 2006) but no work has been reported on the use of biocontrol agents to manage the fungal diseases of vanilla. Therefore, an integrated disease management approach using bordeaux mixture as well as eco-friendly bioagents was carried out for management of rot diseases in vanilla in the field.

The experiment was conducted in a two year old vanilla plantation (raised as a mono crop), prone to diseases, in Idukki district, Kerala during the monsoon periods of 2005-06 and 2006-07. The trial was laid out with five treatments in Randomized Block Design and each treatment was replicated four times with 12 plants per plot. The plots were maintained following standard agronomical practices. The treatments were: i) *Trichoderma harzianum* as foliar spray and basal drenching (cfu × 10^9 ml^{-1}), ii) *Pseudomonas fluorescens* as foliar spray and basal drenching (cfu × 10^9 ml^{-1}), iii) *Trichoderma harzianum* (cfu × 10^9 ml^{-1}) as basal application + *Pseudomonas fluorescens* (cfu × 10^9 ml^{-1}) as foliar spray and soil drenching, iv) Bordeaux mixture (1%) as foliar spray and basal drenching and v) control without any bioagents or fungicides. Bioagents used are native isolates of vanilla plantations of Idukki district. First round of application of bioagents (@ 2 l/plant) and Bordeaux mixture (@ 2 l/plant) was done before monsoon rains during July and repeated twice at 30 days intervals. Plots sprayed with water served as control. All the plants in the trial plots were given vermicompost @ 2 kg per plant. In all the cases, spray and soil drenching with respective treatments were given after phytosanitation. Per cent rot disease incidence was calculated by counting the total number of plants in each plot and number of plants showing initial rot symptoms. Population levels of bioagents such as *T. harzianum* and *P. fluorescens* in the treated plots were also recorded after 30 days of imposition of treatments. The data were statistically analysed.

The results of pooled data for the two years (2005-06 and 2006-07) presented in Table 1 indicate that foliar spray and basal drenching of *Pseudomonas fluorescens* combined with basal application of *Trichoderma harzianum* significantly reduced the incidence of rot disease in the field. As compared to the control plots without application of any treatments, there was significant disease reduction in all the plots treated either with the bioagents or Bordeaux mixture during the first and the second year of the trial. The pooled data also

Table 1. Effect of bioagents and Bordeaux mixture on rot disease incidence in vanilla

Treatments	Concentration	Mean disease incidence (%)		Pooled mean	Disease control (%)
		2005-06	2006-07		
T1-*Trichoderma harzianum*	10^9cfuml^{-1}	50.0 (45.0)	22.5 (34.7)	41.3 (40.0)	18.3
T2-*Pseudomonas fluorescens*	10^9cfuml^{-1}	20.8 (27.1)	23.5 (28.9)	22.2 (28.1)	56.1
T3-*Trichoderma harzianum* +*Pseudomonas fluorescens*	10^9cfuml^{-1}	18.7 (25.6)	18.2 (25.2)	18.5 (25.4)	63.5
T4-Bordeaux mixture	1 %	22.2 (28.5)	21.5 (27.6)	22.2 (28.1)	56.0
T5- Control		60.4 (51.5)	40.5 (39.5)	50.5 (45.3)	-
CD (P = 0.05%)		7.6	3.8	3.5	

*Figures in parenthesis are transformed values

revealed that the maximum disease control of 63.5 % was recorded with the application of consortium of bioagents which was followed by spray and basal drenching of *P. fluorescens* alone (56.1 %). Bordeaux mixture treatment was on par with the bacterial bioagent *P. fluorescens* alone in the field.

The results of present findings indicate that application of consortium of bioagents is a promising treatment in the effective management of rot diseases of vanilla followed by application of *P. fluorescens* alone. Further, the population levels of *T. harzianum* and *P. fluorescens* were significantly higher in the treated plots (Table 2). It has been suggested that *P. fluorescens* strains have the ability to synthesize hydrogen cyanide, which is known to inhibit the expression of pathogenic fungi (Voisard *et al*., 1989) and also the ability to hydrolyze fusaric acid produced by some *Fusarium* spp (Mauch *et al*., 1988). During the present investigations also the bioagents or consortium of bioagents applied in the field showed antibiosis and enhanced resistance against the pathogens. These treatments increased suppressivity to rot pathogens of vanilla in the field.

Table 2. Survival of antagonistic microorganisms in the vanilla rot affected plots

Treatments	Concentration	Population of microorganisms (Mean cfugm^{-1})	
		T. harzianum (cfu×10^3)	*P. fluorescens* (cfu×10^4)
T1-*Trichoderma harzianum*	10^9cfuml^{-1}	4.3 (2.18) a	0.0(0.71) b
T2-*Pseudomonas fluorescens*	10^9 cfuml^{-1}	0.0 (0.71) b	5.8(2.50) a
T3-*Trichoderma harzianum* +*Pseudomonas fluorescens*	10^9 cfuml^{-1}	3.8 (2.06)a	6.0(2.54) a
T4 - Bordeaux mixture	1 %	0.0(0.71)b	0.0(0.71) b
T5 - Control	-	0.0(0.71)b	0.0 (0.71) b
CD (P = 0.05 %)		0.13	0.23

*Figures in parenthesis are square root transformed values

In column means followed by a common letter do not differ significantly at 5% level by DMRT

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