Biological control of mulberry root rot disease (*Fusarium* spp) with antagonistic microorganisms

N. Dhahira Beevi and S. M. H. Qadri

ABSTRACT

Mulberry (*Morus indica* L.), a commercially important crop, raised for its nutritious leaves required for production of most valued silkworm cocoons is currently encountering a serious problem due to rampant incidence of root rot disease caused mainly by species of *Fusarium* spp. resulting in excessive damage and reduction in acreage. The conventional chemical control measures are unable to provide total control. Hence, antagonistic microorganisms were evaluated individually and in combinations for their bio-control potential against *Fusarium sp* under sick plot condition. The combination of *Trichoderma harzianum* + *T.viride* + FYM (1:1:50) + Effective microorganisms (EM) as soil application at an interval of 30 days for three times recorded the highest degree of survival of the plant (72.00%) thus bringing down the disease incidence and further spread. The treatment was more effective, when the application of biocontrol agents were taken up at the initial stages of infection.

Key words: Effective microorganisms (EM), survival, mulberry, biocontrol agents, *Fusarium* spp.7

INTRODUCTION

Mulberry, *Morus indica* Linn. is one of the most important commercial crops grown extensively as food plant for silkworm, *Bombyx mori* L. Twenty diseases caused by fungi, bacteria, viruses, mycoplasma and nematodes have been reported so far in mulberry. The diseases cause 5 to 10% loss in leaf yield by defoliation and an additional loss of 20 to 25% by deterioration in leaf quality (Sukumar and Padma, 1999). Being a perennial crop soil borne diseases are widely prevalent and are a serious constraint for the production of quality leaf for feeding silkworm. The problem is observed both in nursery and established fields (Philip *et al.*, 1995). Among the diseases, root rot caused by soil borne fungi like *Fusarium oxysporum* Schlecht and *Rhizoctonia solani* Kuhn is more alarming due to the ability to thrive well in soil and fast spread of disease once occurred besides absence of disease resistant varieties and inadequate control measures against this disease (Vineet *et al*., 1998). Many fungicides are known to be effective against soil borne diseases. But of late due to environmental pollution issues, imbalance in soil ecosystem as well as potential threat to silkworms the biological control method has been considered as a promising approach for the management of soil borne diseases. Towards management of this disease microbial antagonists and useful microorganisms like VAM *etc*., were tested singly and also in combination with effective microorganisms.

MATERIALS AND METHODS

The experiment was laid out in a sick plot located at Pallipatty village in Salem district in a randomised Block Design comprising 14 treatments with 3 replications with variety V-1. The microbial antagonists like *Trichoderma harzianum* were obtained from Central Sericultural Research and Training Institute, Mysore and *T.viride* and *Pseudomonas fluorescens* were obtained from, Centre for Plant Protection Studies (CPPS), Tamil Nadu Agricultural University, Coimbatore. One kg of microbial pesticide was mixed with 50 Kg of well decomposed finely powdered Farm Yard Manure (FYM) and kept under shade for a week to enhance the multiplication of colonies of antagonistic organisms. The combination of different microbial agents as per the treatment were also mixed and kept for multiplication. The mixture was maintained at 30% moisture level. Fresh saplings were planted in the pits of size 1'x1'x1' incorporating 500 gm of the corresponding microbial mixture in each pit followed by the application of EM solution @ 30 ml per pit followed by irrigation. In the case of VAM treatment soil based inoculum was applied @ 100gm/ pit (20 VAM spores/ g of dry soil) and then the fresh saplings were planted. The treatments were repeated thrice at one month interval. The survival percentage of the plants on 60, 90 and 150 days after planting was recorded and the mean was worked out.

RESULTS

The result of the field experiment conducted using the antagonistic microorganisms in combination with effective microorganisms and the survival percentage recorded on 60, 90 and 150 days after planting (DAP) is presented in Table 1.

Table 1. Effect of certain effective microorganisms on the management of root rot disease under sick plot condition

Treatments	Survival (%)			Average
	60 DAP	90 DAP	150 DAP	survival (%)
T-1: *T. harzianum* +EM	56.00(48.45)	47.75(43.68)	43.74(41.38)	49.13(44.50)
T-2: *T. viride* +EM	59.30(50.36)	54.72(47.70)	52.33(46.32)	55.43(48.13)
T-3 *P.fluorescens* + EM	49.01(44.43)	42.74(40.80)	39.36(38.82)	43.67(41.35)
T-4:*T.h* + *T.viride* + *P.f* +EM	67.30(55.12)	62.31(52.12)	56.72(48.85)	62.10(52.03)
T-5: *T.harzianum* + *T.viride* +EM	73.30(58.89)	71.00(57.42)	72.00(58.05)	72.10(58.12)
T-6:*T.h*+*P.fluorescens* +EM	65.00(53.73)	59.32(50.36)	59.06(50.18)	61.10(51.42)
T-7: *T.viride*+ *P.fluorescens* +EM	68.30(55.73)	61.39(51.53)	59.39(50.36)	62.97(52.54)
T-8: *T.harzianum* + VAM + EM	70.13(56.85)	69.30(56.35)	69.01(56.17)	69.43(56.46)
T-9: *T.viride* + VAM + EM	57.31(49.20)	55.33(40.04)	51.03(45.57)	54.53(44.94)
T-10 :*P.fluorescens* + VAM +EM	45.02(42.13)	41.00(39.82)	40.04(39.23)	42.00(40.39)
T-11: VAM + EM	51.35(45.74)	48.32(44.03)	47.32(43.45)	48.97(44.41)
T-12: EM alone	64.09(53.13)	61.09(51.36)	61.03(51.36)	62.00(51.95)
T-13: VAM alone	48.71(44.26)	47.04(43.28)	43.31(41.15)	46.33(42.89)
T-0: Control (No inoculation)	34.47(24.88)	22.30(28.18)	17.70(35.97)	24.83(29.68)
SED	1.42 (1.38)	1.37 (1.34)	1.12 (1.15)	—
±CD @ 5%	3.01(2.85)	2.89(2.76)	2.45(2.36)	—
CV%	2.90	3.09	2.77	—

Figures in parenthesis indicate arcsine transformed values; DAP: Days After Planting

Variation among the treatments was evident. The highest degree of survival of saplings was recorded in the treatment T5 (73.30%) and it was significantly superior to other treatments followed by T8 (70.13%). T8 was on a par with T7 (68.30%). The lowest degree of survival (34.47%) was recorded in T0 the untreated control. Higher degree of survival (71.00%) was recorded in T5 (*T.harzianum* + *T.viride* + EM (soil application) and was on a par with T8 (69.30%). Next best treatment was T4 (*T.harzianum*+ *T.viride*+ *P. fluorescens* + EM as soil application) recording 62.31 percent survival. At 150 DAP also, the highest level of survival was found in the treatment T5 (72.00%) which was statistically on a par with T8. Lowest survival (17.70%) was observed in T0.

DISCUSSION

In the present study, the treatment *T.harzianum* + *T.viride* + EM (T5) recorded higher survival of plants under sick soil condition. The reduction in root rot disease by *Trichoderma* species might be due to higher antagonistic potential like antibiosis, parasitism and production of lytic enzymes which is in accordance with the findings of Singh *et al*. (2004). Volatile and non volatile antibiotics produced by *T.harzianum* are responsible for the inhibitor action against root pathogen, *Fusarium culmorum* (Iqbal *et al.*, 1994) and *F.oxysporum* (Michrina *et al.*, 1995). Prashanthi *et al*. (1997) also reported that seed treatment with *T. harzianum* and *T.viride* was more effective in controlling *Rhizoctonia solani* in *Phaseolus vulgaris* under both green house and field conditions.

Effective microorganisms applied in to the soil has the capacity to assert a powerful regenerative effect on soil helping to re-establish a balanced soil ecology (Higa, 1994) and combat oxidative stress in plants. The EM when mixed with organic manure like compost or FYM activates and the beneficial microbes proliferate, fermenting the waste in to nutrient and antioxidant rich compost that competitively excludes pathogenic bacteria and fungi (Higa, 1991). A combination of microorganisms applied to the soil has much higher chance of establishing itself than that of inoculation of single strain (Higa, 1995) which is in accordance with the present findings.

The next best treatment was T8 (*T. harzianum* +VAM + EM) recording survival of 70.13, 69.30 and 69.01 percent on 60, 90 and 150 DAP. It may be that the improved nutritional status of plants with mycorrhiza and higher amount of total phenol content makes the plants more resistant to certain root diseases (Rajeswari *et al*., 1998).The dual inoculation of *T.viride* + *Glomus mosseae* has earlier reduced the disease incidence and showed maximum effect on growth characters of *Coleus barbatus* (Boby, 2000). VAM fungi are also known to increase resistance of plants to pathogen by modification of cell wall, production of antimicrobial compounds and altered rhizosphere microflora (Bagyaraj and Padmavathi**,** 1993**).** The present findings are in conformity with the afore said earlier reports and hence the two antagonistic fungi in combination with VAM and EM could be used as effective component in the development of Integrated Disease

Management (IDM) package for the management of root rot disease in mulberry.

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