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Biological control of *Phytophthora* foot-rot of betelvine (*Piper betle* Linn.)

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ABSTRACT: **A multi-location field trials on biological control of *Phytophthora* foot rot was carried out with *Trichoderma viride* at three different centres of All India Co-ordinated Research Project on betelvine during 1992-93 to 1997-98. Bordeaux mixture was used to compare the treatments in preventing the intensity of foot rot.These trials revealed that four soil applications of *Trichoderma* applied through oil cake at quarterly interval significantly reduced the disease intensity and also increased the leaf yield. However, it was less effective than Bordeaux mixture except at Jorhat centre where both the treatments were on par.**

KEY WORDS: Biocontrol, *Phytophthora* spp., *Piper betle*, *Trichoderma*

Phytophthora spp. (*Phytophthora parasitica, P. palmivora, P. capsici*), a perpetual menace to the crop of betelvine, cause leaf and stem rot diseases. The extent of losses varies from 5–90 per cent (Dasgupta and Sen, 1999). Low temperature, high humidity and diffused light, a prerequisite for vine growth that prevail inside the borojes, favoures the pathogen. The disease appears at the onset of monsoon and remains in high intensity throughout the rainy season. It wanes during the winter and very rarely occurs in the off-season.

The foot rot caused by *Phytophthora* sp. was claimed to be ameliorated by soil application of Bordeaux mixture (BM) (Dastur, 1935; Dasgupta, 1993; Dasgupta and Sen, 1999). Saksena (1977) reported that the foot-rot was completely checked when cuttings were dipped in streptomycin solution and the plants were sprayed with BM (1%) twice a month. Dasgupta *et al.* (1988) showed that fosetyl-Al and Bordeaux mixture were effective in controlling *Phytophthora* rot of betelvine. However, considering the mode of consumption of the leaves, attempts were made by many workers to replace application of fungicides with biocontrol agents. Earlier work on biocontrol of stem rot disease (Tiwari and Mehrotra, 1968; Mehrotra and Tiwari, 1976) showed that dipping of cuttings in a *Trichoderma viride* cell suspension effectively

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reduced the disease. Similarly, use of corn straw and *til* oil cake (*Sesamum indicum*) also reduced the disease (Mehrotra and Tiwari, 1976). D'Souza *et al.* (2001) from a comprehensive field trial, reported significant reduction of disease with the use of an isolate of *T. harzianum*.

The present investigation was undertaken in the centers of All India Coordinated Research Project on Betelvine to study the effect of different biocontrol agent in the management of foot-rot of betelvine with a view to develop an integrated management strategy for the disease.

MATERIALS AND METHODS

The trials were conducted in a randomised block design at Kalyani, Johrhat and Trichy for 6 years (1992-93 to 1997-98). Before the start of the experiment all the infected plants in treatment rows were removed. Two rows containing 200–250 vines at Kalyani and Jorhat and 100 vines at Trichy were considered as a treatment and there were three replications for each treatment. Each treatment was separated by a buffer row.

The *Trichoderma viride* isolated from betelvine gardens was grown on oil-cake media (mustard oil cake in Kalyani and Johrhat; neem oil cake at Trichy) and incubated for 35 days at 28±1°C for chlamydospore production. The antagonist was then mixed with moist mustard oil-cake in 1:10 ratio and kept for seven days after covering it with Polyethylene sheet. The antagonist was then placed within rows and covered with soil.

The treatments were as follows :

1. One application of inoculated oil cake (500 Kg / ha inoculated oil cake) at pre-monsoon + three applications of uninoculated oil cake at 500 Kg / ha applied at quarterly interval
2. Two application of inoculated oil cake (500 Kg / ha inoculated oil cake) at pre and post monsoons + two applications of uninoculated oil cake at 500 Kg / ha applied at quarterly interval
3. Four application of inoculated oil cake (500 Kg / ha inoculated oil cake) at quarterly interval
4. Bordeaux mixture (4 drenches + 8 sprays at monthly and fortnightly intervals respectively) + four split doses of oil cake at 500 Kg / ha
5. Control (four split doses of oil cake at 500 Kg / split / ha).

The mortality of vines, fresh weight of 100 leaves and yield per ha in each treatment were recorded 30 days after last application of bicontrol agents.The diseases incidence and mortality of vines were calculated by using McKinney's (1923) formula. The results obtained were pooled for years and subjected to analysis of variance.

RESULTS AND DISCUSSION

Percent disease incidence

The results (Table1) showed that in all the centres the lowest disease was recorded in four drenchings and eight sprayings of Bordeaux mixture treatment and it was statistically on par with the treatment where antagonists were applied at quarterly interval at Jorhat and Trichy centres. At Kalyani centre, *Trichoderma* treatment was the second best treatment after Bordeaux mixture.

Leaf yield (Lakh/ha)

The highest leaf yield was recorded in treatment where four drenchings and eight sprayings of Bordeaux mixture were applied at all the centers. However, it was statistically on par with quarterly application of *Trichoderma* at Jorhat and Trichy centers. The lowest leaf yield was recorded in control treatment and it was statistically on par with the treatment where *Trichoderma* was applied at pre-monsoon at Trichy centre. In other centres, Jorhat and Kalyani, leaf yield was minimum in control and other treatments were statistically superior to control treatment (Table 2).

Table 1. Biological control of phytophthora foot-rot of betelvine

Tr. no.	Treatment	Per cent disease incidence		
		AAU	TNAU	BCKV
T_1	Application of *Trichoderma* at pre-monsoon	16.19 (24.32)	38.39 (38.12)	20.31 (26.58)
T_2	Application of *Trichoderma* at Pre-and Post monsoon	9.67 (18.08)	32.77 (34.65)	16.57 (23.90)
T_3	Application of *Trichoderma* at quarterly interval	4.59 (12.12)	24.39 (29.04)	13.37 (21.23)
T_4	Bordeaux mixture (4 drenches + 8 sprayings at monthly and fortnightly intervals, respectively) Bordeaux mixture 1% as soil drench and 0.5% as foliar spray	4.05 (11.47)	21.48 (26.98)	10.29 (18.40)
T_6	Control	21.23 (27.45)	43.43 (39.48)	28.94 (32.08)
SEM ±		0.82	1.29	0.53
CD(P=0.05)		2.42	3.88	1.46
CV (%)		10.74	8.64	9.87

Figure in parentheses are angular transformed values of percentage data.

Table 2. Biological control of phytophthora foot-rot of betelvine

Tr. no.	Treatment	Leaf yield (lakh/ha)		
		AAU	TNAU	BCKV
T_1	Application of *Trichoderma* at pre-monsoon	27.55	27.56	34.43
T_2	Application of *Trichoderma* at Pre-and Post monsoon	36.70	29.96	38.22
T_3	Application of *Trichoderma* at quarterly interval	41.68	34.57	41.09
T_4	Bordeaux mixture (4 drenches + 8 sprayings at monthly and fortnightly intervals, respectively) Bordeaux mixture 1% as soil drench and 0.5% as foliar spray	42.16	35.23	45.43
T_6	Control	18.04	25.28	27.60
SEM ±		1.79	1.09	0.90
CD(P=0.05)		5.37	3.27	2.49
CV (%)		12.06	8.00	11.06

Table 3. Biological control of phytophthora foot-rot of betelvine

Tr. no.	Treatment	Fresh weight of 100 leaves (g)		
		AAU	TNAU	BCKV
T_1	Application of *Trichoderma* at pre-monsoon	333.67	215.12	205.2
T_2	Application of *Trichoderma* at Pre-and Post monsoon	333.64	219.95	213.93
T_3	Application of *Trichoderma* at quarterly interval	337.17	225.29	220.65
T_4	Bordeaux mixture (4 drenches + 8 sprayings at monthly and fortnightly intervals, respectively) Bordeaux mixture 1% as soil drench and 0.5% as foliar spray	335.21	226.34	249.77
T_6	Control	326.46	213.45	197.86
SEM ±		3.42	3.46	4.03
CD(P=0.05)		NS	NS	11.10
CV (%)		2.51	3.85s	8.48

Fresh wt. of 100 leaves

The highest fresh Weight of 100 leaves was recorded in treatment in Bordeaux mixture treated plots in all the locations. At Jorhat and Trichy centres, the treatment differences were statistically non-significant. At Kalyani centre, the above treatment was statistically superior to all the treatments. The lowest fresh weight of 100 leaves was recorded in control treatment (Table 3).

These results are in aggreement with the findings of Mohanty, 1997, Anonymous, 1997-98 and Mohanty *et al.* (2000). Results also revealed that although biological control approach was not superior to chemical control in terms of yield, PDI and fresh weight of leaves in some centre, yet, it was on par in majority of the centers. Therefore, use of biological control agents is recommended to control *Phytophthora* foot rot of betelvine looking at the long term prospects and to avoid the possibility of health hazards due to consumption of betel leaf if the chemical pesticides are used to control the disease.

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