MANAGEMENT OF COCOA POD ROT AND STEM CANKER CAUSED BY *PHYTOPHTHORA PALMIVORA* USING ECOFRIENDLY BIOCONTROL AGENTS

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Introduction

In Tamil Nadu, the area under cocoa is 3428.5 ha with a production of 200 metric tonnes. Cocoa is at risk from many pests and diseases which thrive in the essential warm humid climate in which it is grown. Among the various diseases, black pod rot and stem canker are the most destructive of all the fungal diseases of cocoa. It is most common in all the cocoa growing areas. Black pod was first reported from Guyana and West Indies in 1897. The disease occurs in 59 countries where cocoa is grown. In India it was reported for the first time in 1965. The disease occurs in rainy season when the humidity is high with a constant low temperature. Losses due to black pod rot disease may be upto 10 per cent of world production. In India black pod disease incidence varied from 12.9 to 40.9 per cent.

The black pod rot and stem canker is caused by the pathogen *Phytophthora palmivora*. Several workers have connected black pod rot disease with the stem canker. They found that the infection spreads from pod to peduncle and then to the cushions and bark. For the management of diseases, the traditional chemical control has been by spraying copper compounds with wide concentrations. Application of fungicides on the surface of pods affect the beans in terms of residue toxicity and causes direct effect to human health since cocoa beans are used for making eatables. Therefore to alleviate all these ill effects environmentally safe, long lasting and ecofriendly biologicals are the need of the day and of the future in plant disease management. Biocontrol of plant disease using *Trichoderma viride*, *Pseudomonas fluorescens* and *Bacillus subtilis* gained greater importance (Begey, 1978). The antifungal activity of *P. fluorescens* and *T. viride* against several pathogens has been well documented (Schmutter, 1995 and Conventy and Allen, 2001). The epiphytic bacterium *Pseudomonas fluorescens* from the surface of healthy pods has been found to be more effective than copper oxide or chlorothalonil in controlling black pod disease (Galindo, 1992).

Materials and Methods

A new experiment on the management of cocoa pod rot and stem canker caused by *Phytophthora palmivora* using ecofriendly biocontrol agents was laid out on 14.05.09 at farmers field at Sethumadai with the following treatment combinations.

Treatment details

T1 - *Pseudomonas fluorescens* talc formulation 100 g/tree + 2 kg of FYM + Foliar spray with *Pseudomonas fluorescens* (@0.5% as pre monsoon spray)

T2 - *Trichoderma viride* talc formulation 100 g/tree + 2 kg of FYM

T3 - *Pseudomonas fluorescens* (50 g) + *Trichoderma viride* talc formulation (50 g) + 2 kg of FYM/ tree + Foliar spray with *Pseudomonas fluorescens* (@ 0.5% as pre monsoon spray)

T4 - *Pseudomonas fluorescens* liquid formulations @ 0.5% as soil and foliar spray

T5 - Bordeaux mixture 1% foliar spray as pre monsoon spray (Farmers practice)

T6 - Untreated control

The treatments were imposed thrice in a year with 10 replications in a RBD.

Results and Discussion

The incidence of pod rot disease was observed in the month of August to December. The results of the study are presented in Table 1.

Table 1. Effect of bio-control agents on cocoa pod rots (*Phytophthora palmivor*a)

S.No.	Pod rot disease incidence (%)	Yield (No. of pods/tree)	Dry bean yield (kg/tree)
T1	12.26	70	2.33
T2	14.57	65	2.17
T3	11.92	75	2.50
T4	13.00	78	2.60
T5	12.65	70	2.33
T6	43.92	50	1.67
SEd	0.28	-	0.45
CD@5%	0.54		0.23

Among the six treatments, the treatment T_3 - *Pseudomonas fluorescens (50g) +Trichoderma viride* talc formulation (50g)+ 2 kg of FYM per tree was observed to be effective in reducing the pod rot incidence (11.92 per cent) followed by the treatment T_1 - *Pseudomonas fluorescens* talc formulation 100 g per tree +2 kg of FYM (12.26 per cent) as compared to control (43.92 per cent). All the bio-control agents treatments effects were also on par with the chemical check (T_5). However the highest pod yield (78 fruits/tree) and dry bean yield (2.60 kg/tree) was recorded by the treatment T_4 (*Pseudomonas fluorescens* liquid formulations (5ml/litre-50ml/10litres/tree) as compared to T_6- control (50 fruits/tree and 1.67 kg/tree respectively). This is an initiative trial and these results will be confirmed in the next season. Similar findings were reported by several workers. *Trichoderma* spp. produces several antibiotics and lytic enzymes effective against soil borne pathogens. *T. harzianum* was found to be antagonistic to *P. aphanidermatum* and *P. myriotylum* (Wells and Bell, 1980). Suppression of rhizome rot of turmeric was achieved through soil application of *Trichoderma* spp. @1kg/ha (Ramarethinam and Rajagopal, 1999).

Fluorescent Pseudomonads have revolutionized the field of biological control of soil borne plant pathogens. During the last 25 years, they have emerged as most promising group of plant growth promoting rhizobacteria involved in the biocontrol of plant disease. Treatment with certain strains of fluorescent pseudomonads showed enhanced resistance in sugarbeet to the fungus *P. ultimum* which causes pre and post emergence damping-off (Osburn *et al.,* 1983) and seedling infection in cotton (Gutterson *et al.,* 1986). In cocoa, the epiphytic bacterium *Pseudomonas flourescens* from the surface of healthy pods found to be more effective than copper oxide or chlorothalonil in controlling black pod disease (Gomes *et al.,* 1996) and also reported several factors and treatments leading to integrated management of this disease.

Conclusion

Among the six treatments, the treatment T_3 - *Pseudomonas fluorescens* (50 g) + *Trichoderma viride* talc formulation (50 g) + 2 kg of FYM per tree was observed to be effective in reducing the pod rot incidence (11.92 per cent) followed by the treatment T_1 - *Pseudomonas fluorescens* talc formulation 100 g per tree +2 kg of FYM (12.26 per cent) as compared to control (43.92 per cent). All the bio-control agents treatments effects were also on par with the chemical check (T_5). However the highest pod yield (78 fruits /tree) and dry bean yield (2.60 kg/tree) was recorded by the treatment T_4 (*Pseudomonas fluorescens* liquid formulations (5ml/litre-50ml/10 litres/ tree) as compared to T_6- control (50 fruits/tree and 1.67 kg/tree respectively).

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