MANAGEMENT OF PURPLE ROOT DISEASE OF *HEVEA BRASILIENSIS* IN IMMATURE PLANTATION

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Incidence of purple root disease was observed in a five-year-old rubber plantation at Hahara, Assam, India. The fungus, *Helicobasidium compactum*, upon infection, forms distinct spongy fruiting bodies encircling the collar region of the rubber plant. The efficacy of fungicides *viz.* 0.5 per cent tridemorph, 0.13 per cent propiconazole and 0.03 per cent hexaconazole was evaluated. Development of fruiting bodies of the pathogen on trees was completely checked, consequent to fungicide application. All the three fungicides were equally effective in containing the disease. Healthy plants recorded significantly higher girth compared to the affected plants. However, no significant variation was observed in girth among the treated plants. Influence of these chemicals on soil microflora was not observed at the end of the study after two years. Survey on host range of pathogen has identified *Pueraria phaseoloides* and*Cleome viscosa* as collateral hosts.

Key words: Fungicides, *Hevea brasiliensis*, Microbial population, Purple root disease

Hevea brasiliensis is the only economically and commercially important tree crop which produces natural rubber(NR). The increasing demand for NR has necessitated the extension of rubber plantation in the states of North East India. A number of diseases attack the rubber tree at different stages of its growth. Many affect growth and latex production and some lead to mortality of plants. Among the diseases of rubber,purple root disease caused by *Helicobasidium compactum* Boedijn,was also reported from forest trees in Europe, Australia, Asia and Africa (Gibson, 1979). The fungus infects the roots of a wide range of plant species like hardwood and conifers (Browne, 1968). Association of the pathogen with root and collar rot of *Pinus* spp.has been reported from Zimbabwe, Nigeria, Kenya, Malawi, Tanzania and South Africa (Bottomley, 1937; Browne, 1968; Gibson, 1975; 1979). Severely affected plants show stunted growth of terminal shoots, yellowing of leaves, wilting and finally mortality of plants (Bottomley, 1937).

The incidence of purple root disease in rubber was first reported by Snowden (1921). Development of fruiting body of the fungus on the tapping panel of rubber was reported by Boedijn and Steinman (1930). Severe attack of the disease on the rubber plant was noticed during late 1930's in Java and Indonesia (DeFluiter, 1939). Several workers have reported that the purple root

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disease was one of the major root diseases affecting rubber plants of all ages (Zhang and Chee, 1989a,b ;Zhang *et al.*, 1990).

In India, the disease was first reported by Rajalakshmy and Joseph (1994) in seedling nursery. The occurrence of this root disease was also reported in nursery seedlings from Tura, Meghalaya, by Mondal and Deka (2004). Experiment conducted in seedling nursery and polybag plants on disease management indicated the efficacy of tridemorph, propiconazole, hexaconazole and thiram (Idicula *etal.*, 2002). The disease was seen infecting five-year-old plants at the experimental farm of Regional Research Station, Guwahati, Assam,where the study was undertaken to evaluate the extent of damage caused by the pathogen and also to develop control measures by evaluating different fungicides. The effect of fungicides on population of soil microflora and the host range within the plantation were also recorded.

A field trial was conducted during 2011-13 on five-year-old rubber plants of clone RRIM 600. The trial was laid out in a disease affected area where up to 12 per cent incidence of purple root disease was recorded. The experiment having five treatments was imposed on 20 affected plants each per treatment. Three rounds of fungicide solution (1 L plant^{-1}) were applied on the collar zone at an interval of one month. The treatments were (i) untreated, infected plants, (ii) 0.5 per cent tridemorph (6.25 mlL^{-1} water) treated infected plants, (iii) 0.13 per cent propiconazole (5mlL^{-1} water) treated infected plants, (iv) 0.03 per cent hexaconazole (6 mlL^{-1} water) treated infected plants and (v) healthy plants. Disease control was expressed as percentage of number of plants recovered by the treatment among the total number of plants infected. Similarly, disease incidence was expressed as percentage of number of disease affected plants among the total number of plants infected by the fungus in a plot.

Girth of the experimental plants were recorded twice, before imposing the treatment, and after two years of the treatment, to assess the impact of the pathogen on the growth of plants. Similarly, soil samples from the rhizosphere of infected plants were also evaluated for microbial populations before and after the treatment. A survey on collateral hosts of the pathogen,*H.compactum* inside the plantation was also carried out.The data were analyzed statistically.

The results of the study are presented in Tables 1-3. The mycelia of the pathogenic fungus infected the root and penetrated the tissues and formed distinct fruiting bodies by encircling the collar region (Fig.1). The fruiting bodies were soft, spongy and purple violet in color which is the distinct characteristic of the pathogen. The average size of fruiting bodies measured was 29.4 cm in length (ranging from (25-35 cm) and 22.3 cm in width (ranging from 15-35 cm).The infestation of the pathogen was observed during November to March and the mortality of the infected plants was not observed in untreated or treated plots. There was 100 per cent reduction of purple root disease infection in

Fig. 1. Fruiting body of purple root disease

all the treated plots in comparison to control plots. In India, Rajalakshmy and Annakutty (1994) first reported the presence of distinct fruiting bodies girdling the collar region, purple colored fungal growth on the root surface and adventitious root formation as the distinguishing disease symptoms. Prasanth and Naik (2010) observed in teak that the fungus first forms extensive mycelium in soil, hyphae of which penetrate the root tissues and form a cushion-like covering. These fruiting bodies are brownish violet when dry and dark purple brown to black when wet, often seen girdling at the base of stem which in turn leads to decline of the foliage, production of sprouts followed by death of plant.

After two years of experimentation, in the untreated,infectedplot, only one plant was damaged by the disease. The fungicide treatment with tridemorph, propiconazole and hexaconazole completely eradicated fruiting body of *H. compactum* and all the infected plants were free of the disease. Thus, it indicated that all the three fungicides were equally effective in controlling the pathogen. No damage to the infected plants was observed contrary to the infection in seedlings, probably the pathogen could not penetrate deep into the tissues as the plants were older. Idicula *et al.* (2002) also observed that all the above fungicides were on par in their efficacy and recovery was better when chemical treatment was carried out at initial stages of infection in seedling nursery.

Inside the plantation, two plant species *viz. Pueraria phaseoloides* (family: Leguminoceae) and *Cleome viscosa* (family: Cleomeaceae) were identified as collateral host of *H.compactum*,on which typical fruiting body of the pathogen was observed.The presence of collateral hosts inside the plantation might have favored the survival of inoculum of the pathogen throughout the year and affected the rubber plants during favorable conditions.

Girth of the plants before and after treatment indicated that the highest girth was recorded in healthy control plants (57.8 cm) which was significantly superior to the disease affected plants either treated or untreated (Table1). The rhizosphere microbial population of both pre- and post- treated plants was also evaluated to assess the impact of fungicides on the soil microorganisms. It was observed that there existed variations in the microbial populations in the rhizosphere soils. Quantitatively, there was a decrease in the total microbial population in the rhizosphere soils of tridemorph, propiconazole and hexaconazoletreated diseased plants after one month of treatment. The soil

Table 1. **Influence of treatments on control of disease and growth of affected plants**

Treatment	Incidence of purple root disease after treatment		Disease control (%)	Mean girth (cm)	
	No. of affected plants	Disease incidence (%)		Pre-treatment	Post-treatment
Infected, untreated control	1.0	5.0	-	43.0	51.2
Tridemorph 0.5%	0	0	100	42.5	49.9
Propiconazole 0.13%	0	0	100	46.7	50.4
Hexaconazole 0.03%	0	0	100	43.5	47.0
Healthy plant	0	0	-	49.1	57.8
CD (P = 0.05)				3.47	4.42

Table 2.**Effect of treatments on the microbial population of rhizosphere soil**

Treatment	Fungi (10^3)			Bacteria (10^4)			Actinomycetes (10^4)		
	Pre-treatment	One month after treatment	Two years after treatment	Pre-treatment	One month after treatment	Two years after treatment	Pre-treatment	One month after treatment	Two years after treatment
Infected, untreated control	45.4	49.8	43.7	54.8	59.2	61.9	36.5	39.4	32.4
Tridemorph 0.5 %	41.3	38.9	44.7	34.6	34.4	46.4	20.4	19.5	32.9
Propiconazole 0.13%	41.5	40.9	44.5	34.7	32.7	47.4	22.1	19.2	32.2
Hexaconazole0.03%	41.4	42.3	42.5	35.5	32.2	36.2	21.8	22.1	28.2
Healthy plant	46.4	51.6	49.6	55.6	63.3	62.5	34.9	38.0	36.5
SE±	1.0	1.1	0.9	0.9	1.1	0.8	0.6	0.8	0.5
CD(P = 0.05)	3.1	3.2	2.7	2.6	3.2	2.5	1.8	2.4	1.5

microflora population in the untreated and healthy plants showed an increasing trend in one month where as in the chemical treatments, the trend reversed (Table2). This indicated that the fungicides applied to check the purple root disease had influenced the total microflora of the soil. The soil microflora population was highest in the affected untreated plants and healthy plants but in tridemorph, propiconazole and hexaconazole-treated rhizosphere soils, the population was on par. However, after two years, at the end of the experiment, no influence of these chemicals was seen on total microflora. The present study revealed that both bacterial and actinomycetes population increased quantitatively in all the post treated soils (Table 2). Qualitatively similar types of fungal species were dominating in all the treated soils. Among the species, saprophytic fungi, viz. *Trichoderma* sp., *Penicillium* sp., *Aspergillus* sp., *Mucor* sp. and filamentous yeasts were very common (Table 3).

Table 3. **Relative abundance of fungal species distribution (per cent) in the rhizosphere soils of purple root disease infected and healthy plants**

Fungal taxa	July 2011		November 2011		July 2012	
	Infected	Healthy	Infected	Healthy	Infected	Healthy
Trichoderma viride	6.7	6.2	3.8	6.5	4.2	6.1
Pythium sp.	2.2	-	-	1.9	-	-
Penicillium spp.	13.3	17.2	12.8	13.0	16.7	16.7
Aspergillusniger	-	-	-	3.7	-	3.03
Aspergillus sp.	-	11.4	10.3	7.4	8.3	16.7
Mucor sp.	4.4	3.1	-	1.9	4.2	-
Cladosporium sp.	-	3.1	2.6	2.8	2.1	3.0
Cephalosporium sp.	-	—	5.1	3.7	8.3	3.0
Absidia sp.	-	-	2.6	1.9	4.2	-
Filamentous yeasts	73.3	59.4	62.9	57.4	52.1	51.5

The proliferation of disease was checked by treating the infeted plants with tridemorph, propiconazole and hexaconazole and all the three fungicides were quite effective against the pathogen.Only five per cent disease incidence was noted in infected untreated control plot. The highest girth was attained by healthy plants.

Quantitatively, a decrease in the total microbial population was observed after one month of treatment in the rhizosphere soils of treated plants which indicated the influence of fungicides. The microflora of untreated control and healthy plants were higher compared to treated plants. The fungal population was higher in the rhizosphere of healthy plants while in tridemorph, propiconazole and hexaconazole treated plots the population was on par in the post- treated rhizosphere soils. After two years of chemical treatment, no influence of fungicides was seen on the population of soil microflora.

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