Developments in Plantation Crops Research, 1998, pp. 251-254.

CONTROL OF SHOOT ROT DISEASE IN *HEVEA*

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Field experiments were conducted during 1993-95 disease seasons at two high disease prone areas *viz.*, Mundakayam and Palapilly, for the control of shoot rot disease caused by *Phytophthora* spp. in young rubber plants. Systemic fungicides such as metalaxyl MZ, fosetyl Al and phosphorus acid were compared with Bordeaux mixture for their efficacy in checking the disease. Two herbal based fungicides *viz.*, Kaarmar and Protect, were later included in the trial. The effect of phosphorus acid, which contained phosphorus, on plant growth was studied. The results indicated that phosphorus acid at 0.16 per cent and metalaxyl MZ at 0.20 per cent were the effective treatments. Spraying of phosphorus acid had significantly increased the girth of plants. Though the cost of spraying of phosphorus acid is high, it has some advantages over copper fungicides.

INTRODUCTION

Shoot rot disease caused by *Phytophthora* spp. occurs widespread in rubber plantations during south-west monsoon period. It results in rotting of terminal green portion of rubber plants of all age group. The damages are more prominent in nursery and immature plants and under severe disease incidence the growth of young plants is affected upto six months (Pillay *et al.*, 1980). Bordeaux mixture was found effective for the control of this disease (Ramakrishnan, 1957). Later experiments had also indicated the supremacy of copper fungicides (Idicula *et al.*, 1992). The preparation of Bordeaux mixture is cumbersome and therefore, many rubber growers prefer other ready to use fungicide formulations. Moreover, faulty preparation of Bordeaux mixture leads to poor protection and sometimes even to phytotoxicity.

The extensive use of copper fungicides and the possibility of consequent accumulation of copper in soil prompted a search for new fungicides against rubber diseases. Considering these facts, the present study was undertaken to identify effective ready to use non-copper fungicides for shoot rot disease control and also to assess their effect on plant growth.

MATERIALS AND METHODS

Field experiments were carried out for three years (1993-95) on one year old rubber plants at two hot spots of the disease *viz.*, Mundakayam and Palapilly to evaluate the efficacy of selected fungicides.

Effect of fungicides on disease

Experiments were laid out at Manikal Estate (Mundakayam) and Pudukkad Estate (Palapilly) in randomized block design with nine treatments, having three replications each, during 1993 and 1994 disease seasons. The plot size was 0.1 ha. The clones included in the experiments were PB 235 (1993) and PB 311 (1994) at Mundakayam and PB 311 (1993) and PB 260 (1994) at Palapilly. The fungicides selected were metalaxyl MZ (0.2%), fosetyl Al

(0.16%), two formulations of phosphorus acid *viz.*, Akomin 20 and Phosjet 40 (each at 0.04, 0.08 and 0.16%) and Bordeaux mixture (1%), the recommended fungicide served as the control. During 1995 disease season, the experiment was conducted only at Mundakayam in clone RRIM 600, where efficacy of two herbal proprietary fungicides *viz.*, Kaarmar (0.2 and 0.4%) and Protect (0.2%) was compared with phosphorus acid (Phosjet 0.16%) and Bordeaux mixture.

The spraying was done at fortnightly interval using knap sack sprayers. The disease intensity in the experimental plots was assessed periodically by grading the plants, based on symptoms, on a 0-4 scale where:

0 - no infection

1 - mild - few black lesions on shoot or leaves

2 - moderate - lesions upto 3 cm length with rotting of only shoot tip

3 - severe - shoot rotten from tip upto 5 cm length

4 - very severe - shoot rotten from tip exceeding 5 cm length

The percentage disease index (PDI) was calculated using the formula,

$$PDI = \frac{\text{No. of numerical ratings} \times 100}{\text{No. of plants observed} \times \text{max. disease grade}}$$

and mean PDI was analyzed statistically.

Effect of fungicides on plant growth

As phosphorus is an essential plant nutrient, the spraying of phosphorus acid is likely to influence plant growth. To study the effect of spraying of this fungicide on plant growth, phosphorus acid (0.16%) and Bordeaux mixture (1%) were sprayed in one ha area each at Mundakayam (clone PB 311) and Palapilly (clone PB 235) and fifty plants from each plot were selected for assessing the growth. The diameter of the plants was measured before imposing treatments and again after four months on completion of the spraying schedule. The increment in diameter was calculated and analyzed statistically.

RESULTS AND DISCUSSION

Effect of fungicides on disease

The shoot rot disease intensity recorded in the first two disease seasons is presented in

Table 1. Effect of fungicides on shoot rot disease

Treatment	Concentration	Percentage disease index			
		1993		1994	
		Palapilly	Mundakayam	Palapilly	Mundakayam
Phosphorus acid					
(Akomin 20)	0.04	27.5	19.3	15.0	18.6
	0.08	26.7	18.7	22.0	12.7
	0.16	18.4	10.8	18.0	8.7
Phosphorus acid					
(Phosjet 40)	0.04	29.6	22.2	19.0	16.0
	0.08	27.2	23.0	12.0	18.6
	0.16	19.4	17.1	17.0	12.7
Fosetyl Al	0.16	24.7	23.0	20.0	19.3
Metalaxyl MZ	0.20	18.6	17.8	20.0	10.3
Bordeaux mixture	1.00	17.4	14.6	15.0	8.7
CD		2.97	2.77	NS	5.9

Table 1. In the first year (1993), Bordeaux mixture (1%), phosphorus acid formulations (Akomin and Phosjet) at 0.16 per cent and metalaxyl MZ (0.2%) were effective in containing the disease and recorded less than 20 per cent disease. The phosphorus acid (0.16%) was as effective as Bordeaux mixture. Fosetyl Al was inferior to phosphorus acid at 0.16 per cent, though the latter is a hydrolysis product of the former. In 1994, there was no significant difference between treatments at Palapilly whereas at Mundakayam the effect was significant. The phosphorus acid (Akomin - 0.16%) and Bordeaux mixture registered less than 10 per cent disease and were on par with metalaxyl MZ (10.3% PDI). In 1995, phosphorus acid (Phosjet 0.16%) and Bordeaux mixture recorded maximum disease control (4.0 and 6.0% PDI respectively) and were significantly superior to both the herbal fungicides (Table 2).

Table 2. Effect of herbal fungicides on shoot rot disease (1995)

Treatment	Concentration % ai	Percentage disease index
Kaarmar	0.2	12.0
Kaarmar	0.4	10.5
Protect	0.2	13.5
Phosphorus acid	0.16	4.0
Bordeaux mixture	1.0	6.0
CD		4.6

The efficacy of phosphorus acid and metalaxyl in controlling *Phytophthora* diseases was reported by many workers. Metalaxyl and phosphorus acid were effective in controlling *Phytophthora* diseases in avocado and pineapple (Rohrbach, 1985; Pegg *et al.*, 1987). In *Hevea*, phosphorus acid (0.08%) has been reported to control bark rot disease in India (Jacob *et al.*, 1995) and metalaxyl (0.2%) in Malaysia (Tan, 1983).

Effect of fungicides on plant growth

The data on diameter increment are presented in Table 3. The plants sprayed with phosphorus acid recorded more diameter and the difference was significant at both locations. The diameter increment was 6.89 mm in phosphorus acid as compared to 6.18 mm in Bordeaux mixture sprayed plants. The difference was more pronounced in clone PB 235 and the values were 6.26 mm and 4.96 mm for phosphorus acid and Bordeaux mixture respectively. The better growth of plants with phosphorus acid could be attributed to phosphorus, the mineral plant nutrient in the fungicide.

The comparative cost of effective fungicides *viz.*, metalaxyl MZ, phosphorus acid and Bordeaux mixture is presented in Table 4. Out of the three, Bordeaux costs Rs.13.00 per ha per round followed by phosphorus acid (Rs.22.00) and metalaxyl MZ (Rs.67.00). Phosphorus acid is the cheapest non-copper fungicide found effective against shoot rot disease. This can be an alternative to Bordeaux mixture for those growers who find the preparation of Bordeaux mixture cumbersome. Many growers resort to the use of wettable copper oxychloride instead of Bordeaux mixture as it is easy for application. For them, phosphorus acid is cheaper and

Table 3. Effect of phosphorus acid on plant growth

Location	Mundakayam (PB 311)		Palapilly (PB 235)	
Fungicides	Phosphorus acid	Bordeaux	Phosphorus acid	Bordeaux
Diameter increment (mm)	6.89	6.18	6.26	4.96
SE	0.20	0.16	0.33	0.34
't' value	2.63*		2.60*	

*Significant at 5% level

equally effective. Moreover, the use of phosphorus acid would help in reducing the copper accumulation in soil and also provide better growth of plants.

Table 4. Cost of treatments

Fungicide	Cost*/ha/round (Rs)
Metalaxyl MZ	67.00
Phosphorus acid	22.00
Bordeaux mixture	13.00

* Cost of fungicide only

ACKNOWLEDGEMENTS

The authors thank Dr. K. Jayarathnam, Joint Director, Rubber Research Institute of India for the guidance throughout the study. They also thank the management of Manikal and Pudukkad Estates for providing all assistance in conducting the field experiments.

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