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MANAGEMENT OF BLACK STRIPE DISEASE OF *HEVEA*

C. Kuruvilla Jacob, Thomson T. Edathil and Sabu P. Idicula

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Field experiments were conducted to evolve a schedule for application of non-mercurial fungicides for protection of tapping panels of *Hevea* trees from black stripe disease caused by *Phytophthora* spp. Mancozeb 0.375 per cent and phosphorous acid 0.08 per cent gave effective and economic protection when applied at weekly intervals.

Key words : *Hevea brasiliensis*, Black stripe, *Phytophthora*, Chemical control.

C. Kuruvilla Jacob (for correspondence), Thomson T. Edathil and Sabu P. Idicula, Rubber Research Institute of India, Kottayam - 686 009, Kerala, India.

INTRODUCTION

Black stripe disease caused by *Phytophthora* spp. which was considered to be less important in India, has recently gained more importance with the popularity of rainy season exploitation of rainguarded rubber (*Hevea brasiliensis*) trees. Panel disinfection using organomercurial fungicides has been recommended for the control of this disease (Pillay and George, 1980). Organomercurial fungicides are known to cause human toxicity (Huising, 1974) which has prompted the Central Insecticide Board of the Government of India to issue directives to restrict the use of these fungicides for seed dressing purpose only. Attempts made earlier to identify alternative fungicides for the control of black stripe indicated the usefulness of mancozeb 0.75 per cent, captafol 0.8 per cent and thiram 0.75 per cent, mancozeb being significantly superior to the other two (Edathil *et al.*, 1988) . The present study was aimed at identifying the optimum interval between consecutive rounds of fungicide application, effective economic dosage and to explore new fungicides for the control of the disease.

MATERIALS AND METHODS

Experiments were designed and conducted on two important aspects of disease management, *viz.*, interval between fungicide applications and alternative fungicides.

Interval between fungicide applications

Field experiments were laid out at Lahai Estate (Pathanamthitta District, Kerala) in clone PB 28/59 in a randomized block design with seven treatments and four replications, with a plot size of one ha each. The fungicides included were mancozeb (0.75%), captafol (0.8%) and thiram (0.75%) applied either weekly or fortnightly. Weekly application of methoxyethyl mercury chloride (MEMC 0.015%), the fungicide recommended earlier, formed the control. The fungicides were dispersed in water and approximately 4 l was used per hectare per round. The treatments were initiated with the onset of SW monsoon and continued upto the end of the rainy season. The fungicides were applied using coconut husk brush on the tapping cut, covering 5 cm above it (Edathil *et al.*, 1988).

Observations were recorded from 100 trees selected randomly covering the entire area of each plot. Disease intensity of the panels was graded as 0 = no infection, 1 = mild infection, 2 = medium infection and 3 = severe infection. Based on these grades, percentage disease index was worked out (Edathil *et al.*, 1988) and analysed statistically.

Alternative fungicides

Two field experiments were laid out, one each in clones RRIM 600 and PB 28/59. In the former, the treatments imposed were mancozeb (0.75 and 0.375%), two formulations of phosphorous acid, viz., Akomin (0.08%) and Phosjet (0.08 and 0.16%), metalaxyl (0 . 105 %) and MEMC (0 . 015 %). Each treatment was replicated three times in a randomized block design consisting of plots of one ha each. The fungicides were applied at weekly intervals and observations recorded in the same way as described earlier. The experiment was repeated for a second disease season with the same treatments except for metalaxyl which was applied at a concentration of 0.035 per cent active ingridient.

In the clone PB 28/59, a block trial was laid out with phosphorous acid at the rates of 0 . 08 and 0 .1 per cent along with MEMC at the rate of 0.015 per cent as treatments. The experiment was continued for two consecutive seasons and the observations were recorded annually at the end of each disease season as given earlier.

RESULTS AND DISCUSSION

Interval between fungicide applications

The disease index recorded in the two seasons is presented in Table 1. In the first season, the lowest disease incidence was recorded in weekly application of captafol (19.84%) followed by weekly application of mancozeb (20.04%). Thiram also was effective when applied weekly. But there was no significant difference between treatments. During the second season, weekly application of mancozeb (20.02%) was on par with weekly application of captafol (27.15%) in disease index but was superior to all other treatments. In an earlier trial similar results were obtained indicating that closer intervals of application provide better protection than longer intervals irrespective of the fungicides used (Edathil *et al.*, 1992).

Table 1. Effect of interval of fungicide application

Treatment	Frequency	Disease index (%) First season (1988)	Disease index (%) Second *season (1989)
Thiram	Weekly	21.83	32.14(28.95)
	Fortnightly	24.59	37.68 (37.54)
Captafol	Weekly	19.84	27.15 (21.80)
	Fortnightly	25.79	30.69(26.21)
Mancozeb	Weekly	20.04	20.02 (12.92)
	Fortnightly	25.04	29.66 (25.00)
MEMC	Weekly	31.38	43.26 (47.04)
CD (P = 0.05)		NS	8.13

* Values in parantheses represent arc sine transformation

Alternative fungicides

The results of the experiment laid aut in clone RRIM 600 (Table 2) showed that all the treatments included were as effective as the conventional treatment with MEMC (0.015%). Among the treat ments, mancozeb recorded the lowest disease incidence. However, between the two doses of mancozeb tried, the difference was only marginal and hence the lower dose of 0.375 per cent is preferable . The phosphorous acid formulations (akomin and phosjet) were effective at

Table 2. **Alternative fungicides for black stripe disease control**

Treatments	Trade name	Dose (% a.i.)	Formulation required	Disease index (%) 1992	1993
Mancozeb	Indofil M 45 75 WP	0.750	10 g	32.97	9.89
Mancozeb	Indofil M 45 75 WP	0.375	5 g	33.55	10.67
Phosphorous acid	Akomin 20	0.080	4 ml	40.44	14.56
Metalaxyl	Apron 35 WS	0.105/ 0.035	3 g 1 g	36.22	18.78
Phosphorous acid	Phosjet 40	0.160	4 ml	36.89	13.78
Phosphorous acid	Phosjet 40	0.080	2 ml	40.00	15.89
MEMC	Emisan 6 WP	0.015	2.5 g	40.33	19.89
CD (P= 0.05)				NS	NS

0 . 08 per cent . Although better control was obtained at 0.16 per cent, it was not significantly different from the lower dose. Metalaxyl at 0.015 per cent was as effective as phosphorous acid (0.16%) but it was not so effective at 0.035 per cent.

The effectiveness of mancozeb has been reported from India (Edathil *et al.*, 1988) and Sri Lanka (Jayasinghe, 1991). But the dosage recommended in Sri Lanka was much higher. Phosphorous acid and metalaxyl are reported to be effective in the control of stem lesions caused by *Phytophthora cambivora* in almonds and cherry (Wicks and Hall, 1988) . Fosetyl Al is known for its rapid downward translocation. Similar effect is expected in phosphorous acid as it is the hydrolysis product of fosetyl Al (Rohrbach and Schenck, 1985), thus protecting the bark cut in succeeding tappings. Metalaxyl (0.2%) has been used effectively for the control of black stripe of *Hevea* in Malaysia (Tan, 1983).

The results of the block trials in clone PB 28/59 over two seasons (Table 3) confirm the effectiveness of phosphorous acid. Both the dosages tried (0.08 and 0.16%) were as effective as MEMC (0.15%) in both the seasons.

Among these fungicides, mancozeb and phosphorous acid formulations are available in the local market. The cost of mancozeb (0.375%) required per hectare per round is Rs.3.00 and that of phosphorous acid (0.08%) is Rs.2.00. Metalaxyl is not available in the local market. At the dosage tried, it costs Rs.35.50 per ha per round. Considering the efficacy and economy, both mancozeb (0.375%) and phosphorous acid (0.08%), can be recommended, to be applied at weekly intervals, for use against black stripe disease.

Table 3. **Effect of phosphorous acid on the control of black stripe disease**

Treatments	Dose (% a.i.)	Formulation required/ha	Disease index 1992	1993
Phosphorous acid	0.080	16 ml	22.0	35.43
Phosphorous acid	0.100	24 ml	21.0	32.77
MEMC	0.015	10 g	23.0	39.22

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