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EFFICIENT MANAGEMENT OF POWDERY MILDEW DISEASE OF *HEVEA* RUBBER PLANTS WITH INTEGRATED USE OF SYSTEMIC AND NON-SYSTEMIC FUNGICIDES

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Experiments were conducted to evolve suitable techniques of fungicidal application for the integrated use of systemic and non-systemic fungicides and to identify effective non-systemic fungicides in the management of powdery mildew disease of rubber plants (*Hevea brasiliensis* Muell. Arg.). In the mature trees, it was found that two rounds of dusting of 1.5 per cent tridemorph dust with one round of dusting of 70 per cent sulphur dust in the middle proved to be the most effective and significantly superior to three rounds of either tridemorph or sulphur dusting. The mixed use of systemic and non-systemic fungicides (tridemorph + sulphur) was on par with this treatment. The cost of application of these two treatments was also comparable. In spraying experiments, mixed use of systemic and non-systemic fungicides (carbendazim + wettable sulphur) and microsul a new non-systemic fungicide were found to be much promising and economic.

INTRODUCTION

Sulphur fungicides, either in the form of dust or wettable powder, were being used for the control of powdery mildew disease of rubber caused by *Oidium heveae* Steinm. from the very beginning of rubber plantations in India. Bright sunlight is required for the proper action of these fungicides as they act by vaporization. Krishnankutty and Edathil (1987) have observed that intermittent showers and cloudy days during refoliation period made sulphur dusting ineffective. Attempts of fogging systemic fungicide like oil-based tridemorph gained much attention for controlling this disease in Malaysia and Brazil (Lim, 1982) and subsequently in India (Edathil *et al.*, 1984). However, frequent breakdowns and fire hazard of fogging machines prevented their widespread use. Later, dusting and spraying of systemic fungicides were proved to be effective in controlling this disease (Edathil *et al.*, 1988a, b; Jacob *et al.*, 1996). As the repeated use of any systemic fungicide may enhance the chances of development of resistance in the pathogen (Dekker, 1973; Iida, 1975; Delp, 1980) alternate or mixed use of systemic and non-systemic fungicides was practiced (Eckert, 1977; Edathil *et al.*, 1992).

The present study was aimed at evolving suitable application techniques to the integrated use of systemic and non-systemic fungicides and to identify effective non-systemic fungicides for the efficient management of powdery mildew disease of *Hevea brasiliensis*.

MATERIALS AND METHODS

Experiment on mature trees

Eleven year old rubber trees of the clone RRII 105 were selected for this experiment during 1994 disease season in a high elevation plant-

ing at Waynad district of Kerala. Six treatments were given in plots of one hectare each. Ten sampling trees were marked in each treatment plot before the starting of the experiment. The treatments were:

1. Three rounds of tridemorph 1.5 per cent dust
2. First and third rounds with tridemorph 1.5 per cent dust and sulphur dust 70 per cent as second round
3. Three rounds of sulphur dust 70 per cent
4. First and third rounds with sulphur dust 70 per cent and tridemorph 1.5 per cent dust as second round
5. Three rounds of premixed tridemorph and sulphur dusts
6. Untreated control

The quantities of fungicides used were, tridemorph 7 kg/ha/round, sulphur dust 12 kg/ha/round and for mixed treatment tride-morph 3.5 kg + sulphur dust 6 kg/ha/round. The interval between rounds was 10-15 days. The power duster was carried along every fourth row in the early morning hours while dusting. The quantity of the fungicides used was sufficient enough to cover one hectare area of mature rubber (Edathil *et al.*, 1992).

Experiment on nursery seedlings

The experiments were laid out in randomized block design on six month old seedlings in the nursery beds during 1994 at Central Experiment Station, Chethackal and during 1995 disease season at Cheruvally Estate, Erumely, Kerala. There were five treatments during 1994 and eight treatments during 1995 season with four replications each in both years. The plot size was 20 x 2 feet bed, containing 80 seedlings each. The details of treatments are presented in Tables 1 and 2. Four rounds of spraying were given during 1994 and only two rounds were given during 1995 season as the disease severity was less during that year. Spraying was given with a high volume knapsack sprayer at an interval of 7-10 days during the disease season of February-March in both years.

Disease assessment

In the dusting experiment, disease intensity was assessed after each round of dusting as severe leaf fall was observed from the beginning. But in spray trials only two assessments were made in the middle and at the end of the experiment. The mean value of the assessments was taken in both the dusting and spraying experiments. In both the cases 10 trees or plants were selected at random and leaf sampling was done from these trees or plants. In the dusting experiment, leaf samples were collected from the terminal flushes of two of the lower branches selected at random from each tree and in the spraying experiment, samples were collected from the terminal flushes of the seedlings. These leaves were graded at 0-4 disease scale and percentage disease index was calculated as per the formula of Horsfall and Heuberger (1942).

Table 1. Treatments, fungicides and dosage tried in the nursery during 1994

Treatment	Name of fungicides		Type	Dosage tried (% ai)
	Trade name	Common name		
1.	Topas 10% EC	Penconazole	Systemic	0.05
2.	Bavistin 50% WP	Carbendazim	Systemic	0.05
3.	Bavistin 50% WP + Sulfex 80% WP	Carbendazim + Wettable sulphur	Systemic + Non-systemic	0.025 + 0.1
4.	Sulfex 80% WP	Wettable sulphur	Non-systemic	0.20
5.	Unsprayed control	—	—	—

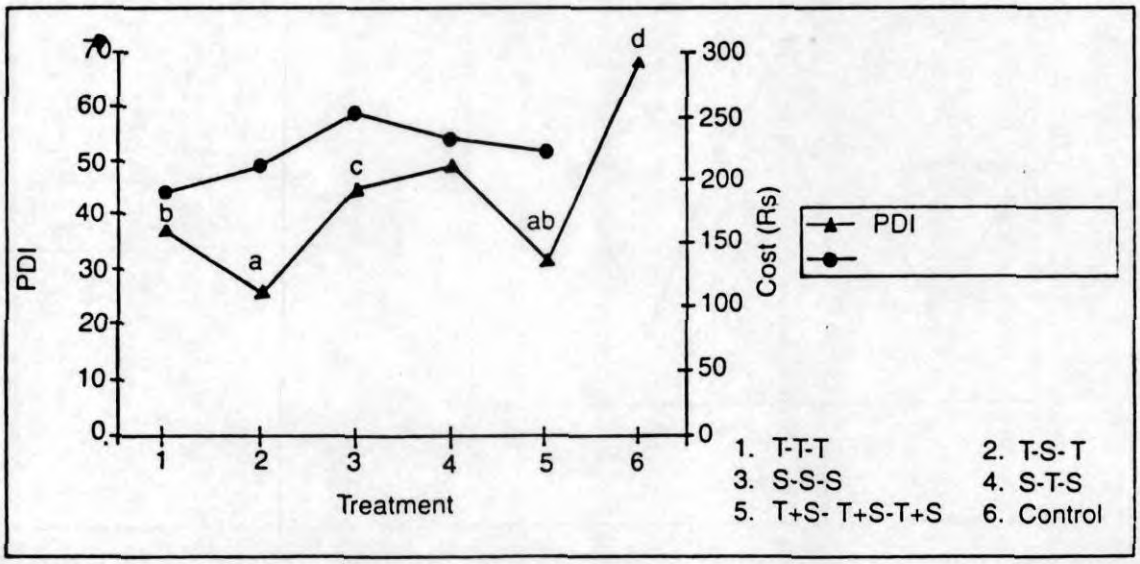
Table 2. Treatments, fungicides and dosages tried in the nursery during 1995

Treatment	Name of fungicides		Type	Dosage tried (% *ai*)
	Trade name	Common name		
1.	Contaf 5% EC	Hexaconazole	Systemic	0.02
2.	Contaf 5% EC	Hexaconazole	Systemic	0.01
3.	Topas 10% EC	Penconazole	Systemic	0.05
4.	Bavistin 50 WP	Carbendazim	Systemic	0.05
5.	Bavistin 50 WP + Sulfex 80 WP	Carbendazim + Wettable sulphur	Systemic + Non-systemic	0.025 + 0.1
6.	Sulfex 80 WP	Wettable sulphur	Non-systemic	0.20
7.	Microsul 52% EC	Sulphur Emulsion	Non-systemic	0.20
8.	Unsprayed control	—	—	—

RESULTS AND DISCUSSION

In the dusting experiment on mature trees, the treatment of two rounds of dusting with tridemorph and one round of sulphur dusting in between was found to be the most effective and significantly superior to three rounds of tridemorph or sulphur dusting. However, the treatment using half the dozes of tridemorph and sulphur pre-mixed was on par with this treatment (Fig. 1). When considering the cost of fungicides, the treatment with three rounds of the systemic fungicide, tridemorph was the cheapest. But in disease control this treatment is not as effective as the alternate use of systemic and non-systemic fungicides or mixed use of systemic and non-systemic fungicides. In cost factor also these treatments were comparable (Fig. 1). The high risk of development of resistance by the pathogen due to continuous use of systemic fungicides is a matter to be considered seriously (Iida, 1975). Hence, the alternate or premixed use of systemic and non-systemic fungicides in the control of powdery mildew disease on rubber trees is advisable.

In the spraying experiment during 1994, treatments with systemic fungicides *viz.*,



Values with same alphabet are not significantly different according to Duncan's new multiple range test at P* 0.05

Fig. 1. Effectiveness and cost of fungicides in the dusting experiment 1994

penconazole, carbendazim and half the doses of carbendazim and wettable sulphur mixed together were significantly superior to the wettable sulphur. These fungicides were equally effective in controlling powdery mildew disease on nursery plants (Fig. 2). On cost considerations, the mixed use of systemic and non-systemic fungicides is the cheapest. During 1995 season due

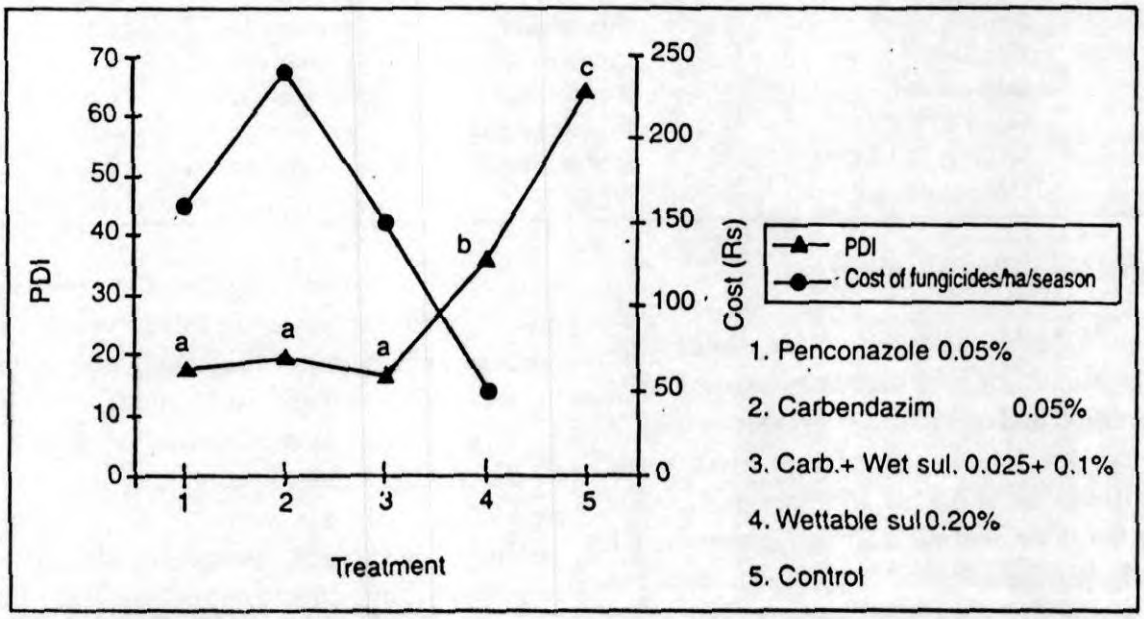


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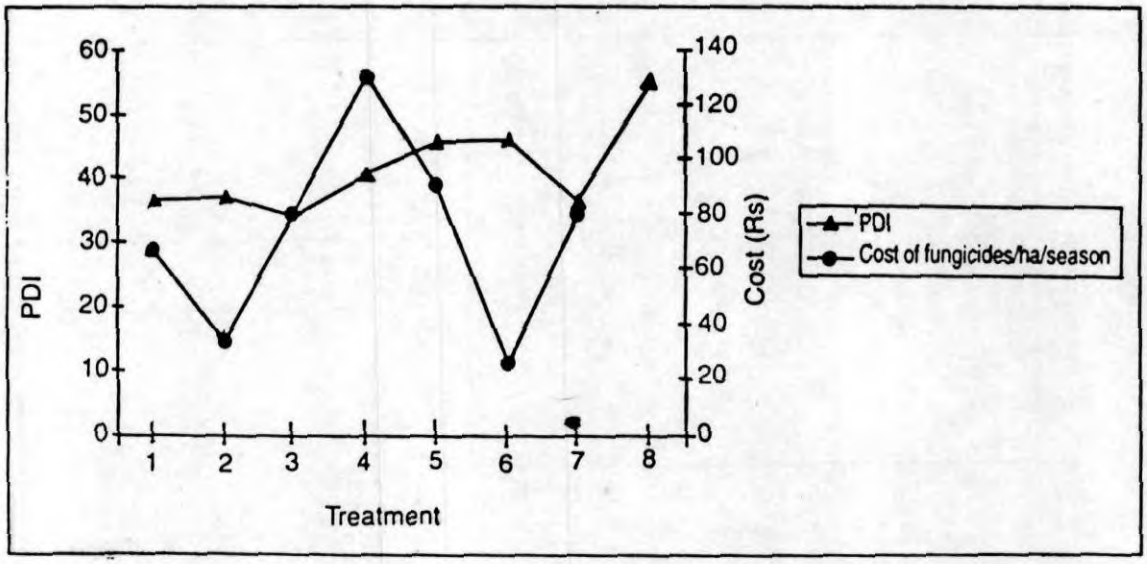
Fig. 2. Effectiveness and cost of fungicides in the spraying experiment 1994



1. Hexaconazole 0.02% 2. Hexaconazole 0.01% 3. Ponconazole 0.05% 4. Carnendazim 0.05%
5. Carb. + wet. sul. 0.025 + 0.1% 6. Wettable sul. 0.20% 7. Microsul 0.20% 8. Control

Values with same alphabet are not significantly different according to Duncan's new multiple range test at P8 0.05

Fig. 3. Effectiveness and cost of fungicides in the spraying experiment 1995

to low disease intensity there was not much variation between treatments. However, 0.01 per cent of the hexaconazole is equally effective as its higher dose (0.02 %). This treatment is on par with treatments of pencona-zole and microsul (Fig. 3). As microsul is a non-systemic fungicide with equal effectiveness as the systemic fungicides, this fungicide can be used for controlling powdery mildew disease on young rubber plants. The cost of penconazole and microsul were lower and comparable.

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