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EVALUATION OF NEW OIL-DISPERSIBLE FUNGICIDE FORMULATIONS FOR THE CONTROL OF ABNORMAL LEAF FALL OF RUBBER (*HEVEA BRASILIENSIS*) CAUSED BY *PHYTOPHTHORA* SPP.

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New oil-dispersible fungicide formulations, mancozeb and its combination with copper oxychloride (COC) and metalaxyl in combination with COC were field - tested in different locations for the control of abnormal leaf fall disease of rubber (*Hevea brasiliensis*) caused by *Phytophthora* spp. by aerial and ground spraying. A powder formulation of mancozeb and a combination product of COC and metalaxyl (5 kg/ha) were found to be as effective as COC (8 kg/ha). The new fungicides are useful alternatives for COC which has been continuously in use for about four decades.

Key words: Abnormal leaf fall, Disease control, *Hevea*, *Phytophthora*, Spraying.

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INTRODUCTION

Oil-dispersible copper oxychloride (COC) formulations have been in use for the control of abnormal leaf fall disease caused by *Phytophthora* spp. on rubber trees (*Hevea brasiliensis*) in India (Edathil *et al.*, 2000). The oil - dispersible formulations are preferred due to the lower specific gravity of spray fluid which favour a higher delivery when applied from ground and due to the longer persistence and slower release of the active ingredient. This is particularly significant for rubber trees which often attain more than 25 m height and are sprayed only once in a season prior to the monsoons (Ramakrishnan and Pillai, 1961). Repeated use of COC has resulted in the accumulation of copper in rubber growing soils (Rajendran *et al.*, 1999). Hence attempts were made to evaluate new oil-based fungicides which may reduce or replace the use of copper fungicides for rubber spraying.

MATERIALS AND METHODS

Five field experiments were conducted to evaluate new oil - dispersible fungicide formulations. A combination of metalaxyl and copper oxychloride (Ridomil plus) and mancozeb (Indofil M45) alone or in combination with COC either as liquid or as powder were evaluated (Tables 1 to 5). The experiments were conducted on mature rubber trees of clone RRIM 600, GT 1, RRII 105 and PB 235. Only one round of pre-monsoon spraying was carried out either from the ground using micron sprayers or aerially by using helicopters as per recommended practice (Rubber Board, 2000). Ground spraying was conducted in 0.4 ha and aerial spraying in 4 ha blocks. In the case of the micron spraying trial on clone PB 235 the plot size was 0.25 ha and the experiment was laid out in randomized block design with three replications per treatment. The other experiments were

Table 1. **Effect of different dosages of COC-metalaxyl combination on leaf retention**

Treatment	Dosage (kg/ha)	Leaf retention (%) RRIM 600 Season I	RRIM 600 Season II	RRII 105 Season II
COC 50% + metalaxyl 5%	3.0	-	40.53	63.46
COC 50% + metalaxyl 5%	5.0	50.0	78.56	62.2
COC 50% + metalaxyl 5%	7.5	60.0	-	-
COC 56%	8.0	29.0	50.17	73.29
Unsprayed	-	17.0	20.09	48.52

conducted as block trials without replications at each location. In the trial on clone GT 1, the sample trees were considered as replicates for analysis of the data. The test fungicides were dispersed in spray oil and sprayed at different dosages (as indicated in the tables). Copper oxychloride (56% oil - dispersible powder) dispersed in oil and sprayed at the recommended dosage formed the control. Unsprayed controls were not maintained in the aerial spraying trials and in the replicated trial in the clone GT 1 as the estates did not permit leaving areas unsprayed in these experiments. A spray volume of 36 to 40 L/ha was used depending on the canopy size. Leaf retention was assessed using the leaf counting method (Idicula *et al.*, 1989).

RESULTS AND DISCUSSION

The effect of spraying different dosages of COC-metalaxyl combination on leaf retention in the clones RRIM 600 and RRII 105 at the Central Experiment Station of Rubber Research Institute of India (RRII) at Chethackal, Ranni is presented in Table 1. The combination fungicide when sprayed at a dosage of 5 kg/ha gave satisfactory leaf retention comparable to COC-sprayed controls. Although higher dosage was more effective in the clone RRIM 600 during the first season it was not considered subsequently as there is no appreciable reduction in the dosage of COC used when compared to the currently recommended dosage of oil dispersible COC (8 kg/ha). The apparent poor leaf retention in COC-sprayed plots during the first season could be due to the heavy rains that followed the spraying on subsequent days. The systemic activity of metalaxyl might have helped in higher leaf retention under such adverse conditions.

The combination fungicide was subsequently used for aerial application in two clones *viz.* GT 1 and RRIM 600 at two locations each and the results are presented in Table 2. In the two locations where the clone GT 1 was aerially sprayed using COC-metalaxyl combination at the dosage of 5 kg/ha, the leaf retention was comparable to that in the control plot sprayed with COC at the rate of 8 kg/ha. But in the clone RRIM 600, COC gave better leaf retention at one of the two locations while in the other, the combination fungicide was far superior. Considering all the locations, it can be concluded that the combination fungicide at the lower dosage is comparable to COC at the recommended dose.

The effect of spraying different formulations of mancozeb on the control of abnormal leaf fall was also studied in

Table 2. **Effect of aerial spraying of COC-metalaxyl combination on leaf retention**

Treatment	Dosage (kg/ha)	Leaf retention (%) GT 1 Malankara Thodupuzha	GT 1 SFCK Punalur	RRIM 600 RPL Kulathupuzha	RRIM 600 Cheruvally Erumeli
COC 50% + Metalaxyl 5%	5.0	69.37	87.54	62.54	43.43
COC 56%	8.0	62.22	81.54	72.80	11.18

Table 3. **Effect of spraying different formulations of mancozeb on leaf retention**

Treatment	Dosage kg/ha	Leaf retentions (%) Season I RRIM 600	Season II GT 1	Season III GT 1
Mancozeb 70%	5.0	45.39	29.57	62.58
Mancozeb 70% + COC 15%	5.0	43.55	22.76	59.28
Mancozeb 50% + COC 15%	10.0	-	36.56	-
COC 56%	8.0	62.57	60.90	75.21
Unsprayed	-	11.26	55.69	35.29

different clones over several seasons. The effect of micron spraying on clones RRIM 600 and GT 1 during three different seasons is presented in Table 3. In block trials the leaf retention was not comparable to COC even when the dosage was increased up to 10 kg/ha. Replicated trials were undertaken in two clones *viz.* PB 235 and GT 1 at Malankara Estate, Thodupuzha, a high rainfall area. The trials were carried out in two different years. The result of the trials in PB 235 is presented in Table 4. It was evident that only mancozeb 70 per cent powder formulation at the dosage of 5 kg/ha was comparable to the recommended dose of COC (8 kg/ha). Similar results were observed in trials on GTI also (Table 5).

Earlier attempts to use water - dispersible formulations of metalaxyl as well as mancozeb for the control of abnormal leaf fall disease resulted in poor leaf retention. In the present study, better disease control was observed with both COC-metalaxyl combination and mancozeb oil-dispersible powder formulation when sprayed after dispersion in agricultural spray oil. Low efficacy of water - dispersible COC in comparison to oil - dispersible COC due to their lower persistence has prevented the former from being recommended for rubber spraying (Idicula and Jose, 2000). Such prolonged persistence might have resulted in the good performance of the fungicides now tested.

Table 4. **Effect of spraying different formulations of mancozeb in clone PB 235 on control of abnormal leaf fall disease**

Treatment	Formulation	Dosage (kg/ha)	Leaf retention (%)
Mancozeb 70%	Powder	3.20	36.03(36.76) *
		5.0	57.87(50.03)
Mancozeb 50% + COC 15%	Powder	3.45	44.29(41.72)
		5.16	38.96(38.56)
Mancozeb 26% + COC 10%	Liquid	9.33	42.04(40.30)
		12.92	47.72(43.66)
COC 56%	Powder	4.0	38.82(38.52)
		6.0	46.10(42.75)
		8.0	55.59(48.20)
Unsprayed	-	-	20.72(26.89)
CD (P=0.05)			7.77

*Figures in parentheses indicate are sine transformed values

Table 5. **Effect of spraying different formulations of mancozeb in clone GT 1 on control of abnormal leaf fall disease**

Treatment	Formulation	Dosage (kg/ha)	Leaf retention (%)
Mancozeb 75%	Powder	3.0	53.25
		5.0	64.90
Mancozeb 50% + COC 15%	Powder	3.0	26.46
		5.0	37.92
Mancozeb 30%	Liquid	4.0	24.01
		6.0	46.66
COC 56%	Powder	8.0	66.41
CD (P=0.05)			24.68

Water-dispersible formulation of metalaxyl has been reported to be effective for the control of black stripe disease of rubber caused by *Phytophthora* spp. (Tan, 1989). Water-based mancozeb has also been found effective for the control of this disease (Edathil *et al.*, 1988; Jacob et al., 1995). Preliminary observations on the control of abnormal leaf fall disease using oil-dispersible mancozeb have been reported (Jacob *et al.*, 1994). Oil-dispersible mancozeb was also found to be effective for the control of *Corynespora* leaf disease of rubber (Manju *et al.*, 2001).

The present study indicates that the use of COC in rubber plantations can be significantly reduced by using the combination fungicide containing metalaxyl.

The reduction in the use of copper (active ingredient) will be from 4.5 kg to 2.5 kg per ha. Alternatively, the use of copper fungicide can be avoided by using oil- dispersible mancozeb at the rate of 5 kg/ha (3.36 kg a.i./ ha) in areas planted with moderately susceptible clones like GT 1.

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