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Effects of Fungicides and their Combinations with Nitrogen Manuring and Artificial Defoliation on Control of Corynespora Leaf Fall of Hevea *Rubber*

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The effectiveness of several fungicides and fungicide combinations with artificial defoliation or increased nitrogen manuring on control of Corynespora leaf fall on mature rubber was evaluated for several years. Benomyl performed better than chlorothalonil, mancozeb, propineb or prochloraz for the control of the disease as infection was lower and canopy density was higher in plots treated with benomyl as compared to other treatments. Six rounds of fungicide applications produced better results than four rounds. Alternate applications of benomyl and chlorothalonil produced higher canopy density than individual fungicide treatment in certain years. The effectiveness of combining benomyl with artificial defoliation or increased nitrogen manuring was also evaluated. At the beginning of the season, benomyl, benomyl + artificial defoliation and benomyl + nitrogen manuring produced lower infection and percentage defoliation, and higher canopy density than the untreated control plots. The increase in canopy density was significant at the early season of the year. The canopy density dropped significantly and by the end of the year there was little difference between treated and untreated plots. The results indicate that fungicide and the other treatments are effective in improving the canopy density of trees affected by Corynespora leaf fall, however the economic benefit has to be looked into.

Since *Corynespora cassiicola* (Berk. & Curt.) Wei was detected in rubber nurseries in 1960[1], it gained prominence and by 1975 it caused severe defoliation of immature plants in the field[2]. Surveys conducted in 1990s indicated that Corynespora leaf fall (CLF) was widespread and severe in several localities on mature trees[3–6]. Currently, CLF is an important disease of mature rubber in Malaysia[3–6], Indonesia[7,8] and also in Sri Lanka[9].

Various actions have been taken to control the disease. When serious infection of CLF was detected in Malaysia, several young fields of clone RRIM 725, a susceptible clone, was removed[10]. Another susceptible clone, IAN 873 was deleted from the Planting Recommendation[11]. Similar action was taken on another susceptible clone RRIC 103 in Sri Lanka[9]. Surveys in Malaysia also indicated that clone RRIM 600 was severely infected and the

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clone was not recommended for further planting in areas with severe CLF infection[3]. However, strategies are necessary to reduce disease severity and rehabilitate mature areas already severely infected by CLF.

C cassicola also infects other crops, and on these other crops, the disease is managed with fungicides such as chlorothalonil, mancozeb or benomyl[12]. These fungicides were also effective on *C cassicola* of rubber[9,10,13-15]. Continuous weekly spraying of fungicides *e g* propineb, benomyl or mancozeb[9,15] controlled the disease on rubber. However, the disease reappeared once spraying was terminated as *C cassicola* also infects mature rubber leaves. Young leaves especially at the limp green stage are more susceptible to *C cassicola*[8]. It may be possible to reduce the severity of CLF if fungicide spraying is concentrated during this period. This paper reports the effects of applying several fungicides onto young rubber leaves to control CLF. The effects of fungicides were compared with the effects of supplying extra nitrogen fertiliser and artificially defoliating mature rubber leaves. Artificial defoliation was recommended to avoid *Colletotrichum gloeosporioides* and *Oidium heveae*[16] while increased nitrogen manuring reduced the severity of *O heveae*[17].

MATERIALS AND METHODS

Pattern of Leaf Fall of Infected Leaves

The number of mature leaves infected by *C cassicola* abscised throughout the year was recorded at the Rubber Research Instiute Experimental Station, Sungai Buloh on *Hevea* clone RRIM 725 and at a commercial estate (*Estate A*) at Segamat, Johor state on clone RRIM 600. The fallen infected leaves collected within leaf cages [an area of 2 m × 2 m cleared within the inter-row of the rubber trees, borders were demarcated with plastic sheets (30 cm height) and the ground within the cages was covered with plastic sheets] were counted weekly. The trial was carried out for three years (1991–1993).

Effectiveness of Fungicides

The trials were conducted at two commercial estates (*Estates A* and *B*) at Segamat. The clone RRIM 600 in the two estates suffered severe CLF in 1990[3]. The rubber plants were planted in 1982 and 1975 at *Estate A* and *Estate B*, respectively.

The fungicides were sprayed using a Jacto 400 AJ mistblower mounted on a tractor that moved along alternate inter-rows of rubber plants. In most instances, aqueous suspensions of solutions of the chemicals were applied at the rate of 200 l/ha. The concentrations of the chemicals were as specified in the text and tables. The fungicides were first applied at the beginning of the refoliation period when most of the leaves were at the stage of copper-brown and limp-green. The number of applications was as specified in the text. The fungicides evaluated in the trials were benomyl (Benlate 50WP®) at 500 g/ha, mancozeb (Dithane M 45®) at 1 kg/ha, propineb (Antracol®) at 1 kg/ha, chlorothalonil (Daconil Flowable 500®) at 1 kg/ha and prochloraz (Sportak® or Octave®) at 200 g/ha.

Effectiveness of Benomyl, Artificial Defoliation and Nitrogen Manuring

In this experiment, the effectiveness of benomyl, artificial defoliation, nitrogen manuring and their combinations were

compared at the two estates at Segamat. Benomyl at 500 kg/ha was applied for five rounds as specified above. The defoliant Ansar 550® (MSMA) at 10% concentration was sprayed once in early January *i.e.* before the onset of normal annual wintering. The nitrogen fertiliser (sulphate of ammonia) was applied at 100 g/tree, one month after the estate's normal fertiliser application at the beginning of the year.

Assessment

Leaf fall of infected leaves, percentage leaf defoliation, percentage infection and canopy density were determined. Leaf fall was determined by counting weekly the number of fallen infected leaflets inside leaf cages (three cages per replicate). Percentage infection was determined by counting the number of infected leaves and total number of leaves in a randomly selected whorl. Percentage defoliation was determined by counting the number of missing leaflets in a whorl assuming the normal three leaflets/leaf. For the determination of percentage infection, 15 trees were selected randomly per replicate and a whorl randomly taken from each tree. Canopy density was visually estimated or recorded using the Haines mirror[18] or a LAI 2000 canopy analyser.

Experimental Design

The experimental design was a randomised complete block with three one-hectare replicates per treatment. The data were analysed using the Microquasp programme.

RESULTS

Leaf-fall Pattern

Leaf fall of infected leaves recorded at the Experimental Station, Sungai Buloh on clone RRIM 725 and at *Estate A* on clone RRIM 600 occurred throughout the year. The general pattern at *Estate A* was that leaf fall was high between June to August, decreased thereafter and again increased between September and October and later declined. This pattern mildly correlated with rainfall. At the RRIM Station, similar pattern of leaf fall occurred in 1991 and 1992 but less distinct. Except for 1991 where leaf fall was high at the beginning of the year (May–June), the general pattern was that leaf fall progressively increased until the end of the year, then it declined (*Figure 1*).

Effectiveness of Fungicides

The effectiveness of benomyl, propineb, prochloraz and mancozeb was compared in trials carried out in 1991 and 1992 at the two trial sites. Trial at *Estate A* in 1991 indicated that four rounds of spraying of fungicides failed to reduce infection and defoliation, and the improvement in the canopy density was not significant when compared to the untreated control. There was a slight reduction in leaf fall until July. On the other hand, following six rounds of spraying, benomyl was better than propineb or prochloraz as infection in the benomyl treated plots was significantly lower than in the untreated control. There was no significant differences in the mean percentage defoliation, however percentage defoliation was lower in benomyl treated plots at the early and middle seasons. The three fungicides applied improved canopy density, and benomyl produced higher canopy density than the other fungicides. The improvement was obtained with four or six rounds of spraying, however the increase in canopy as compared to control were not significant after four rounds and significant following six rounds of benomyl (*Table 1*). Similar results were obtained at *Estate A* in 1992 whereby infection and defoliation were

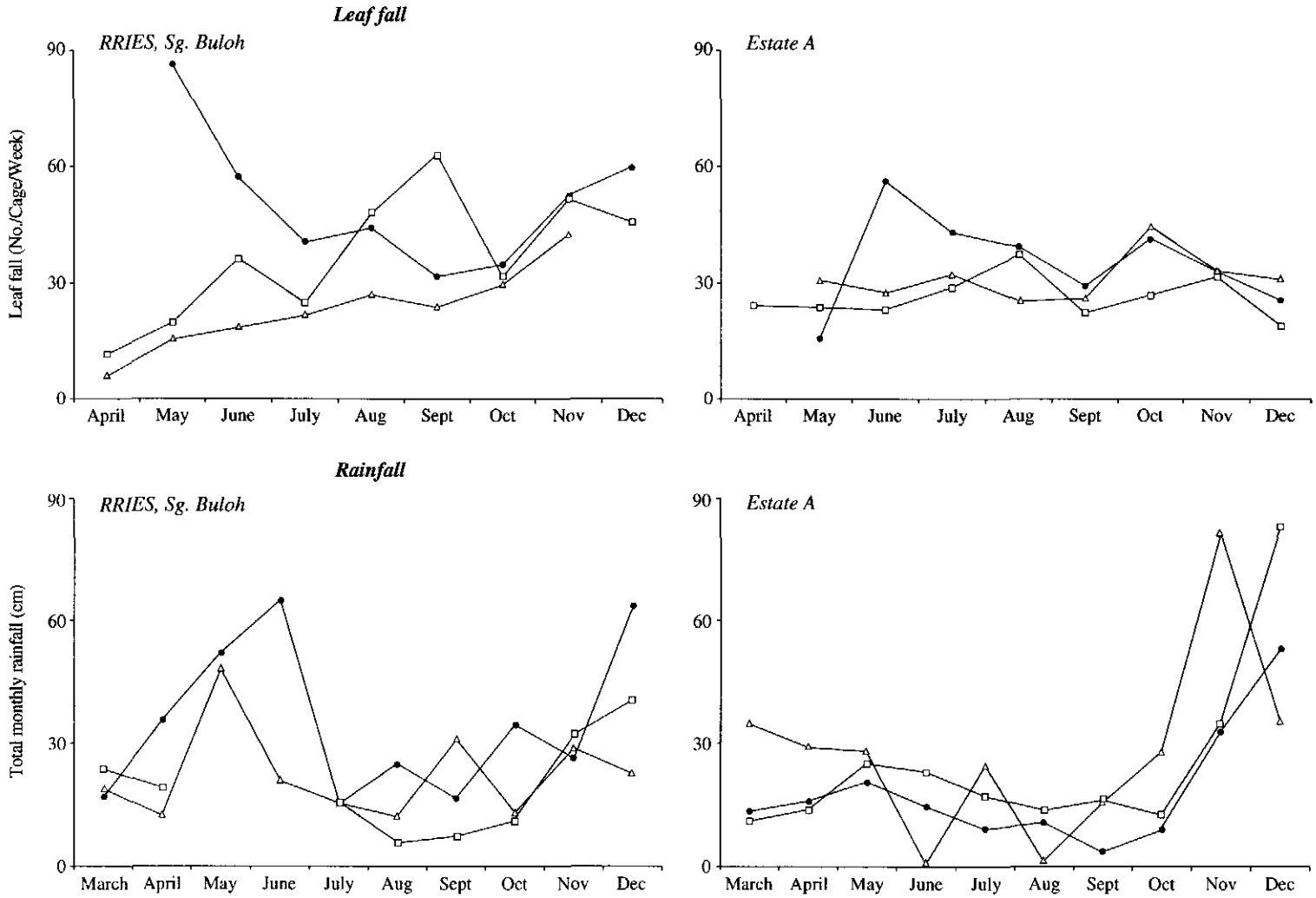


Figure 1. Pattern of leaf fall of Hevea *leaves infected by Corynespora leaf fall in relation to rainfall at RRIES, Sungai Buloh and Estate A in 1991 (-□-), 1992 (-△-), and 1993 (-●-).*

TABLE 1. EFFECT OF THE NUMBER OF ROUNDS OF FUNGICIDE SPRAYS ON CONTROL OF *CORYNESPORA* LEAF FALL OF *HEVEA* RUBBER

Treatments	Four rounds of spray					Six rounds of spray				
	T1[a]	T2[a]	T3[a]	Mean	$LSD_{0.05}$	T1[a]	T2[a]	T3[a]	Mean	$LSD_{0.05}$
A	*Percentage infection at times T1, T2 and T3*									
Benomyl	17.08	17.97	8.70	14.58		12.12	11.73	10.65	11.50	
Propineb	26.60	17.87	16.84	20.44		33.27	16.79	27.17	25.74	
Prochloraz	30.01	31.52	32.63	31.39		21.36	16.57	10.80	16.24	
Control	18.09	23.03	12.84	17.99	7.22	28.22	37.08	21.56	28.95	8.17
Mean	22.94	22.60	17.75			23.74	20.54	17.58		
$LSD_{0.05}$			6.25					7.08		
B	*Percentage defoliation at times T1, T2 and T3*									
Benomyl	31.47	25.12	34.56	30.38		23.36	29.43	39.15	30.64	
Propineb	34.91	25.72	34.86	31.83		39.95	28.43	38.53	35.63	
Prochloraz	32.36	30.36	43.42	35.38		30.38	32.46	26.32	26.72	
Control	23.89	26.52	31.32	27.24	11.91	26.88	34.05	27.01	29.31	10.17
Mean	30.69	26.93	36.04			30.14	31.09	32.76		
$LSD_{0.05}$			10.31					8.81		
C	*Canopy density (%) at times T1, T2 and T3*									
Benomyl	63.33	64.67	40.22	56.07		66.89	69.56	50.44	62.30	
Propineb	57.16	67.33	42.43	55.64		65.78	64.45	41.11	57.11	
Prochloraz	61.33	62.89	35.33	53.18		62.67	64.22	43.55	56.81	
Control	61.33	59.11	36.45	52.30	6.20	61.33	65.78	43.11	56.74	3.84
Mean	60.79	63.50	38.51			64.17	66.00	44.56		
$LSD_{0.05}$			5.37					3.32		
D	*Monthly leaf fall count from May to December*									
Benomyl	14.03	38.32	28.81	27.05		19.65	43.66	33.07	32.13	
Propineb	25.18	38.49	28.77	30.81		29.03	43.12	30.32	34.16	
Prochloraz	26.82	40.57	28.24	31.88		29.51	45.76	27.34	34.20	
Control	29.94	41.21	33.15	34.77	7.04	35.93	49.90	33.09	39.64	7.83
Mean	23.99	39.65	29.74			28.53	45.61	30.96		
$LSD_{0.05}$			6.10					6.78		

[a]T1 = July 1991; [a]T2 = September 1991; [a]T3 = January 1992

For leaf fal: T1 = May/June; T2 = July, August, September; T3 = October, November and December

lower in benomyl plots as compared to plots treated with chlorothalonil, mancozeb or propineb. Even though there was no difference in leaf fall, canopy density was higher in benomyl treated plots than in the other fungicide treated plots (*Figure 2*). In fact, there was little difference between leaf infection and defoliation in plots treated with chlorothalonil, mancozeb or propineb as compared to the untreated control.

At *Estate B* in 1992, benomyl and chlorothalonil when applied singly had little positive effect on infection and defoliation. However, when these two fungicides were combined, infection and defoliation were reduced as compared to control. Nevertheless, plots treated with benomyl, chlorothalonil or their combinations had higher canopy density than in the control (*Table 2*). Trials conducted in 1993 at the same site indicated that there was no benefit of combining benomyl with chlorothalonil (*Table 2*).

Effectiveness of Benomyl, Artificial Defoliation and Nitrogen Manuring at *Estate A*

The effectiveness of benomyl and its combinations with artificial defoliation or nitrogen manuring was evaluated at site A from 1992 to 1994. The comparative effectiveness of benomyl, its combinations with artificial defoliation and nitrogen manuring for 1992, 1993 and 1994 trials are shown in *Figure 3*. The effects of these treatments on infection, percentage defoliation, canopy density and leaf fall at three seasons of the year *i.e.* early season (May, June), middle season (August, September) and late season (December, January) were analysed.

Infection. At the early season of the three years, benomyl + nitrogen, and benomyl + defoliation had lower infection than control while artificial defoliation had similar percentage infection as control. For benomyl and benomyl + defoliation, the trend continued through the middle until the late seasons. However, infection in benomyl + nitrogen was similar to control in the late seasons of the years.

Percentage defoliation. Percentage defoliation in artificial defoliation plots was similar to control plots. However, percentage defoliation was lower in plots treated with benomyl or its combinations with artificial defoliation and nitrogen manuring at the early season and by the middle and late seasons, there was no difference with the control. Percentage defoliation in middle and late seasons was significantly higher than in the early season.

Leaf fall. The trend in the number of leaves defoliated by CLF caught in the leaf cages fluctuated simultaneoulsy with only slight differences between treatments. In all treatments, maximum leaf fall occurred at the early season and decreased towards the end of the year. At the early season, leaf fall in artificially defoliated plots was slightly lower than the control and this trend was maintained to the middle season. Leaf fall in the other treatments was similar to the control at all the three seasons.

Canopy density. The canopy density in benomyl, benomyl combined with defoliation or nitrogen, and artificial defoliation plots was higher than in control in the early and middle seasons. However, the canopy density declined towards the end of the year as indicated by lower canopy density in middle season and late season as compared to early season and middle season, respectively. In fact, there was a

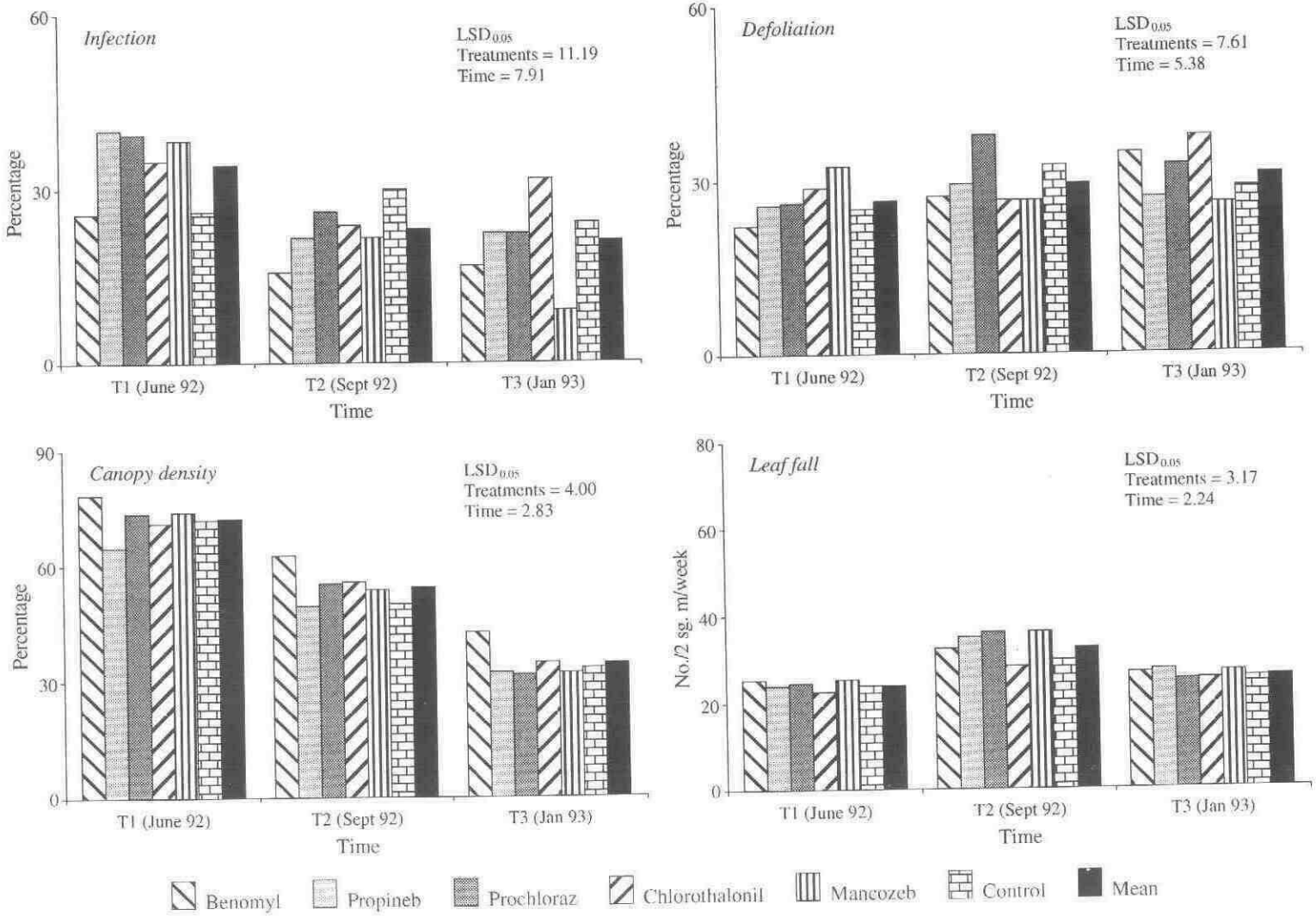
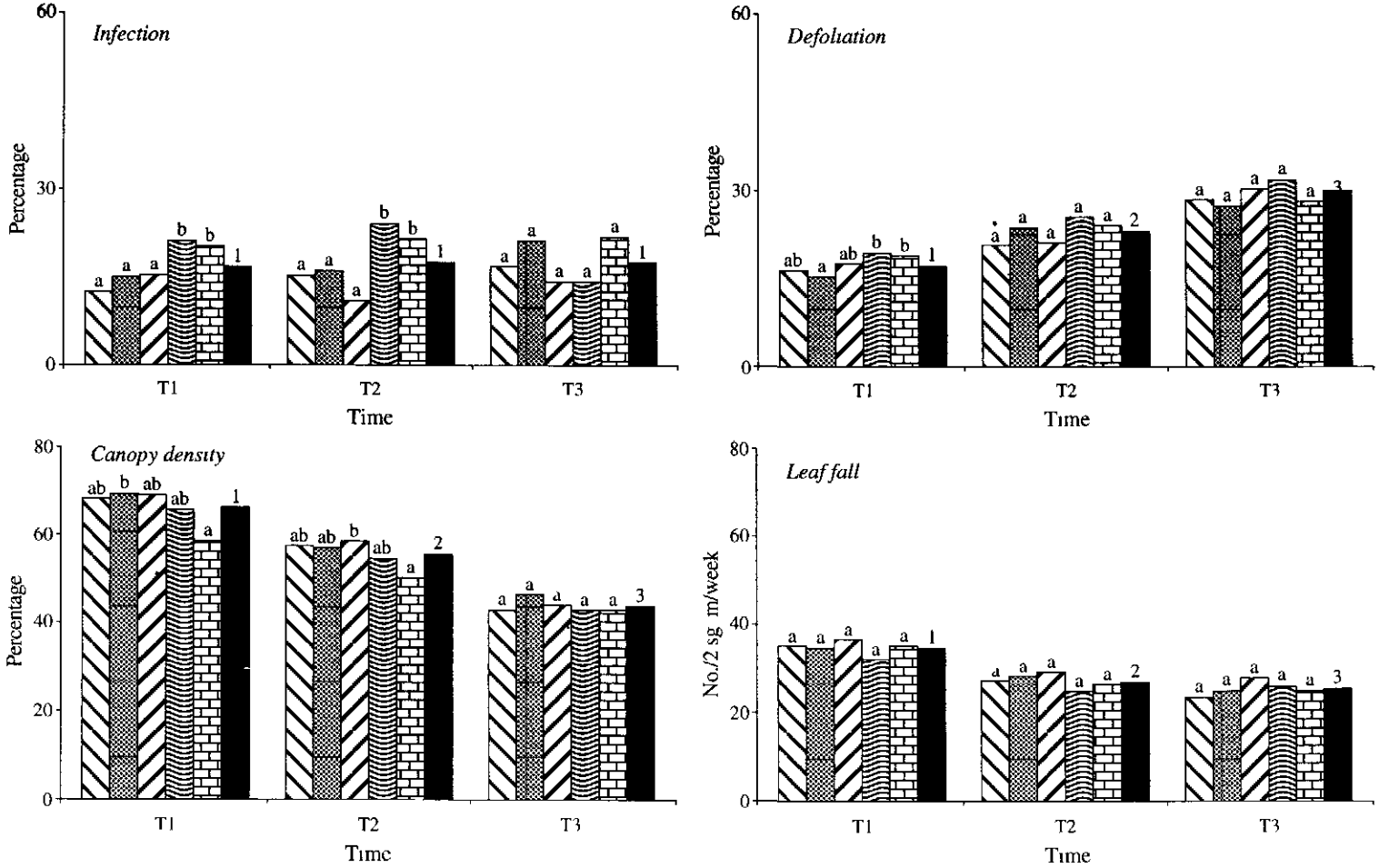


Figure 2. Effectiveness of several fungicides on control of Corynespora leaf fall of Hevea *Rubber (Estate A, 1992).*

TABLE 2. EFFECT OF ALTERNATE APPLICATIONS OF BENOMYL WITH CHLOROTHALONIL ON CONTROL OF CORYNESPORA LEAF FALL OF *HEVEA* (*ESTATE B*, 1992, 1993)

Treatments	1992					1993				
	T1[a]	T2[a]	T3[a]	Mean	$LSD_{0.05}$	T1[a]	T2[a]	T3[a]	Mean	$LSD_{0.05}$
A	Percentage infection at times T1, T2 and T3									
Benomyl	13.12	15.25	17.34	15.23		5.37	11.31	14.19	10.29	
Chlorothalonil	13.68	11.47	18.01	14.38		–	–	–	–	
Benomyl + Chlorothalonil	9.14	16.91	12.57	12.87		5.48	13.77	9.53	9.59	
Control	10.61	19.91	18.41	16.31	5.98	6.81	10.24	14.69	10.58	5.37
Mean	11.63	15.88	16.58			5.88	11.77	12.80		
$LSD_{0.05}$		5.18					5.37			
B	Percentage defoliation at times T1, T2 and T3									
Benomyl	19.37	23.06	32.45	24.96		14.77	19.71	26.46	20.31	
Chlorothalonil	27.55	18.40	29.59	25.18		–	–	–	–	
Benomyl + Chlorothalonil	13.33	20.81	28.65	20.93		18.71	19.92	24.65	21.09	
Control	20.24	22.39	28.96	23.86	7.71	14.54	19.25	22.55	18.78	3.68
Mean	20.12	21.16	29.91			16.00	19.62	24.55		
$LSD_{0.05}$		6.67					3.68			
C	Canopy density (%) T1, T2 and T3									
Benomyl	66.89	62.00	38.22	55.70		53.11	55.11	37.78	48.66	
Chlorothalonil	65.77	52.44	32.67	50.37		–	–	–	–	
Benomyl + Chlorothalonil	62.66	56.67	39.78	54.37		48.45	46.67	35.34	43.48	
Control	61.33	48.67	30.89	48.59	5.98	46.00	40.67	35.33	40.66	6.85
Mean	64.16	54.94	35.39			49.18	47.48	36.15		
$LSD_{0.05}$		5.18					6.85			

[a]T1 = June; T2 = September; T3 = December/January



Within a time, values with same letter are not significantly different at p = 0.05 Means with same number are not significantly different at p = 0.05

Benomyl | Benomyl + Nitrogen | Benomyl + defoliation | Artificial def | Control | Mean

Figure 3 Effect of benomyl and its combinations with artificial defoliation or nitrogen fertiliser on control of Corynespora leaf fall of Hevea *(Estate A, 1992).*

difference of about 10%–15% in canopy density between seasons.

Effects of Benomyl, Artificial Defoliation and their Combination at *Estate B*

The effects of benomyl, defoliation and their combination on infection and percentage defoliation are shown in *Figure 4*. Generally, benomyl, artificial defoliation and their combination had positive effects on infection at the early season. The effect on defoliations was not significant. On the other hand, the canopy density in benomyl, artificial defoliation and their combinations was higher than in the control throughout the three seasons.

Between seasons, there were increases in infection and percentage defoliation between early and middle seasons but no differences were recorded between middle and late seasons. The canopy density in later seasons was lower than preceding seasons.

DISCUSSION

The previous surveys conducted in 1990[3], 1991[4], 1993[5] and 1996[6] indicated that CLF is an important leaf disease of rubber in Malaysia. Its occurrence is widespread throughout Peninsular Malaysia with severe areas in the south and east of the Peninsular. When CLF was detected to cause severe leaf defoliation on an immature field planting in 1975[3], the management strategy to contain the disease was to remove the susceptible clone RRIM 725 from immature fields[10]. Then, infection on other clones in the field was mild. However, in 1990 the disease was already severe on the widely planted clone RRIM 600 in the south of the country[3]. Subsequently, RRIM 600 was recommended not to be planted in the severe disease areas[3]. In addition, chemical control was investigated to rehabilitate areas suffering from severe CLF.

As *C. cassiicola* also infects many other crops, many fungicides were found effective and are being used to control the fungus. Following the outbreak of CLF in 1975, Benlate T® (benomyl + thiram) was found most effective in a nursery trial[19] and benomyl was found to be effective amongst 24 fungicides screened in the laboratory[20]. However trials in an immature field of RRIC 103 indicated that Benlate T® produced only 50% control due to poor spray coverage[2]. Four fungicides *i.e.* benomyl, mancozeb, orthocide and propineb were found effective in controlling the disease in Sri Lanka[9]. It was reported that when spraying was done at five-day-intervals commencing from refoliation, for a period of six months, complete control of the disease was achieved[9]. Infection occurred once spraying was terminated.

The above information indicated that chemical control is feasible, however continuous application is necessary to completely inhibit infection as the fungus is capable of infecting both young and mature leaves. However, young leaves are more susceptible and the disease developed on young leaves is more severe than on older leaves. In addition, young leaves when infected fall faster than mature leaves[8]. This paper reports that fungicides applied at the time of refoliation influenced disease severity. Amongst the fungicides tested, benomyl was more effective than chlorothalonil, mancozeb, propineb and prochloraz in reducing infection, percentage defoliation and increasing canopy density. However, benomyl only slightly reduced

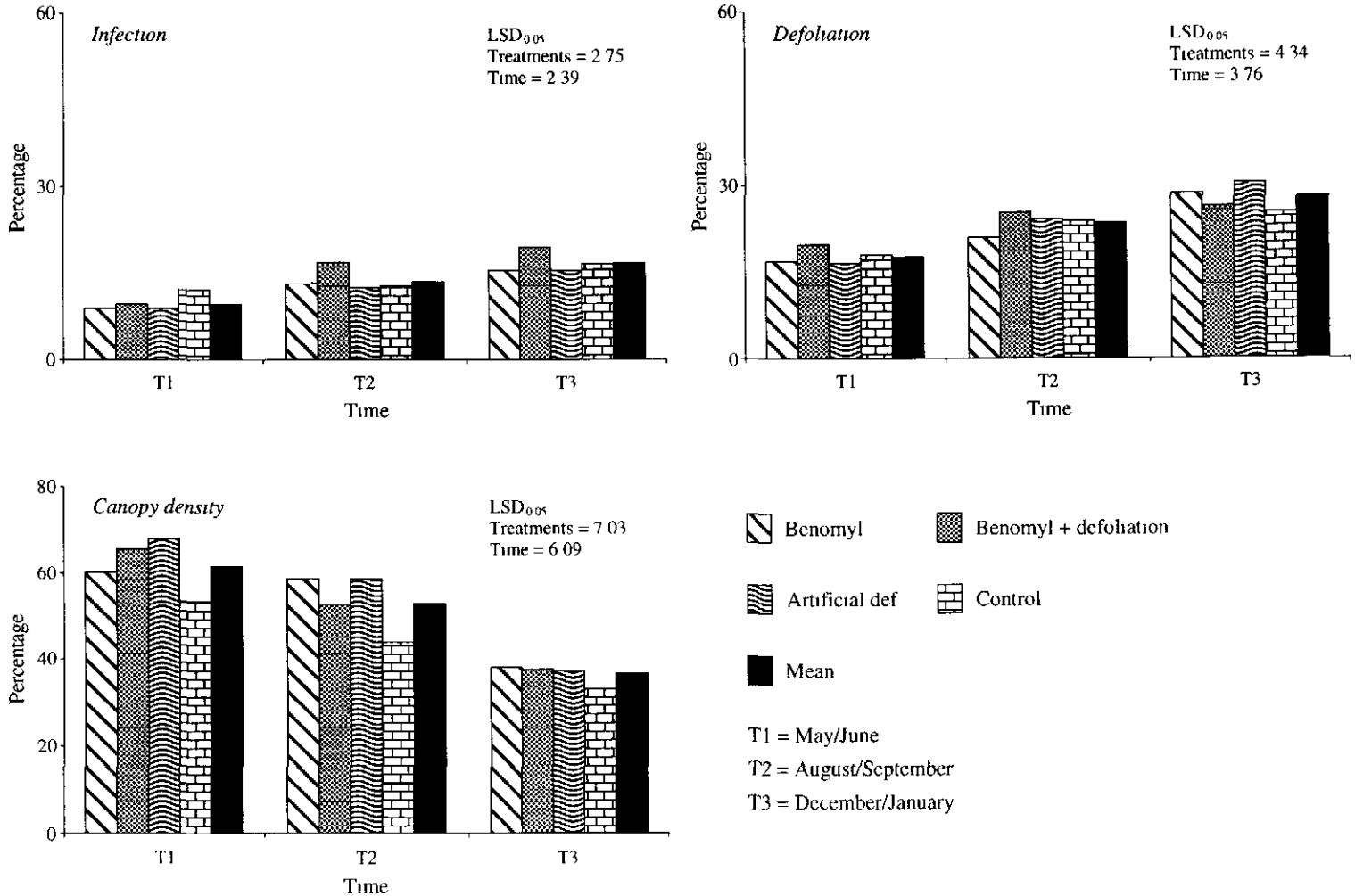


Figure 4 Effects of benomyl, artificial defoliation, and their combinations on control of Corynespora leaf fall of Hevea *(Estate B, 1992-94)*

infection and percentage defoliation as compared to the untreated control. Chee[13] indicated that for chemical control of CLF to be effective, uniform and adequate spray coverage is necessary as one disease lesion is sufficient to cause leaf defoliation. Therefore, a systemic fungicide such as benomyl would be more appropriate than contact fungicides for the control of CLF as indicated by the better effectiveness of benomyl than chlorothalonil or mancozeb in reducing infection and percentage defoliation. Chee[21] indicated that benomyl is systemic in rubber leaves. Benomyl was also more effective at *Estate A* than at *Estate B* presumably due to better fungicide coverage at the former site, as the trees were younger and shorter than the latter site. In addition, tree trunks lying along the interrows of rubber trees sometimes hampered spraying at *Estate B*. The effects of benomyl were about similar to the effects of alternate applications of benomyl and chlorothalonil. This initial results indicated that benomyl applications can be combined with other fungicides such as chlorothalonil which is effective on *Colletotrichum gloeosporioides*. In certain years, *C. gloeosporioides* was severe at the time of refoliation.

Artificial defoliation has been effectively used to control secondary leaf fall (SLF) caused by *C. gloeosporioides* or *O. heveae*[16] and increased nitrogen manuring was effective in increasing canopy density following Oidium SLF[17]. There was little difference in infection and percentage defoliation between benomyl and its combinations with nitrogen manuring or artificial defoliation. Artificial defoliation produced erratic effects on infection and defoliation as it had negative effects in 1992 and positive effects in 1993 and 1994 at *Estate A*. The prevailing weather conditions following artificial defoliation *i.e.* at the time when the trees were refoliating could have influenced infection by *C. cassiicola*. Artificial defoliation plus benomyl was more effective in reducing infection in 1994 as compared to 1992 because in 1992 benomyl was applied onto maturing leaves *i.e.* at the same time when the other treatments were performed while in 1994 benomyl was applied at the time when the artificially defoliated plots were refoliating. The results thus suggest that benomyl treatment should more appropriately be applied onto young leaves at the time of refoliation for better control of CLF. Artificial defoliation was less successful in controlling CLF as compared to its good effects on SLF which may be due to the longer susceptible period of rubber leaves to CLF as compared to the short susceptible period to SLF as mature leaves are immune to SLF. Nevertheless, the canopy density following treatments with artificial defoliation or combinations of benomyl with artificial defoliation or nitrogen manuring was higher than in the control despite minimum positive effects of these treatments on infection or percentage defoliation. The increase in canopy density could be contributed by the positive effects of these treatments on SLF. This implies that in situation where CLF occurs together with SLF, artificial defoliation alone was equally effective in improving canopy density and therefore is more economically attractive as only one spray application is needed as compared to multiple applications for the fungicides.

The positive effects of fungicides and the other treatments were more obvious in the early season and to a lesser extent in the middle and late seasons. The canopy densities in the middle and late seasons were lower than in the preceding seasons indicating that following the chemical treatments infection occurred on the

maturing leaves. The similar level of percentage infection in the middle and late seasons indicates the occurrence of later infections. At least a great proportion of the leaves infected at the time of refoliation would have defoliated by July/August. Percentage defoliation in the middle and late seasons was higher as compared to the early seasons.

The question of whether fungicide or any other treatment applied at the beginning of the refoliation season is economically beneficial has to be seriously looked into due to the temporary effect on improvement of canopy density. Various fungicides have been reported to be effective on CLF in the laboratory, however these fungicides had limited temporary success in the field. It seems that planting of resistant clones is a long-term most appropriate strategy to manage CLF economically. Nevertheless, fungicide such as benomyl can be used as a corrective measure to rehabilitate areas severely infected by CLF.

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REFERENCES

1. NEWSAM, A. (1961) Pathology Division. *Rep. of the Rubb Res Inst. Malaysia, 1960*, 63.

2. RUBBER RESEARCH INSTITUTE OF MALAYSIA (1975) Corynespora Leaf Spot. *Plrs Bull Rubb Res Inst Malaysia*, **139**, 84–86.

3. TAN, A.M. (1990) Survey on Corynespora Leaf Fall Disease. *Plrs. Bull. Rubb. Res. Inst. Malaysia*, **204**, 80–85.

4. TAN, A.M., LOO, T.P., GANGADARA, V., MOHD. ROSLI BACHIK AND YOON, K.F. (1992) Survey of Major Leaf Diseases of Rubber in Malaysia. *Plrs. Bull. Rubb. Res. Inst. Malaysia*, **211**, 51–62.

5. SHAMSUL KAMAR, A.S. (1994) Distribution and Disease Severity of Rubber Diseases in Malaysia. *IRRDB Symposium on Rubber Diseases of* Hevea, *Cochin, India, 1994.*

6. SHAMSUL KAMAR, A.S. AND SHAMSURI, M.H. (1996) Current Status of Corynespora Leaf Fall in Malaysia. *Workshop on Corynespora Leaf Fall Disease of* Hevea *Rubber, Medan, Indonesia, 1996.*

7. SINULINGGA, W. (1986) Penyakit Gugur Daun Corynespora pada Tanaman Karet. *Warta Perkaretan*, **5**, 10–13.

8. PURWANTARA, A. AND SOEKIRMAN, P. (1991) Perkembangan Gejala dan Sebaran Spora Patogen Penyakit Gugur Daun Corynespora pada Klon Karet PPN 2058. *Menara Perkebunan*, **59**, 33–37.

9. LIYANAGE, A. de S., JAYASINGHE, C.K. AND LIYANAGE, N.I.S. (1991) Losses due to Corynespora Leaf Fall Disease and its Eradication. *Proc. Rubb Growers Conf, 1989*, 401–410.

10. CHEE, K.H. (1988) Corynespora Leaf Spot. *Plrs Bull Rubb. Res Inst Malaysia*, **194**, 3–7.

11. RUBBER RESEARCH INSTITUTE OF MALAYSIA (1989) RRIM Planting Recommendation 1989-1991. *Plrs Bull. Rubb. Res. Inst Malaysia*, **198**, 3–23.

12. KINGSLAD, G.C. AND SITTERLY, W.R. (1986) Studies on Fungicides for Control of *Corynespora cassiicola*. Leaf Spot of Tomatoes in the Republic Seychelles. *Tropical Pest Management*, **32**, 31–34.

13. CHEE, K.H. (1988) Studies on Sporulation, Pathogenicity and Epidemiology of *Corynespora cassiicola* on *Hevea* Rubber. *J. Nat. Rubb. Res.*, **3(1)**, 21–29.

14. GASPAROTTO, L., FERREIRA, F.A. AND JUNQUEIRA, N.T.V. (1988) Mancha de Corynespora em folhas de Seringueira (*Hevea brasiliensis*) no Brazil. *Fitopatol. bras.*, **13**, 278–280.

15. LIYANAGE A. de S., JAYASINGHE, C.K., LIYANAGE, N.I.S. AND JAYARATNE, A.H.R. (1986) Corynespora Leaf Spot Disease of Rubber (*Hevea brasiliensis*): A New Record. *J. Rubb. Res. Inst. Sri Lanka*, **65**, 47–50.

16. AZALDIN, M.Y. AND RAO, B.S. (1994) Practicability and Economics of Large-scale Artificial Defoliation for Avoiding Secondary Leaf Fall. *Proc. Rubb. Res. Inst. Malaysia. Plrs. Conf., Kuala Lumpur, 1974*, 161–170.

17. LIM, T.M. (1974) Enhancing Post-wintering Tree Vigour for Avoiding Oidium Secondary Leaf Fall. *Proc. Rubb. Res. Inst. Malaysia Plrs Conf., 1974*, 178–187.

18. HAINES, W.B. (1942) A Method for Foliage Comparisons in Field Experiments with *Hevea*. *Exptl. Agriculture*, **10**, 117–125.

19. RUBBER RESEARCH INSTITUTE OF MALAYSIA (1975) Crop Protection. *Ann. Rep. Rubb. Res. Inst. Malaysia, 1975*, 133–139.

20. RUBBER RESEARCH INSTITUTE OF MALAYSIA (1976) Crop Protection. *Ann. Rep. Rubb. Res. Inst. Malaysia, 1976*, 169–173.

21. CHEE, K.H. (1979) Movement of Benomyl, Thiophanate Methyl and Mancozeb on Leaves of *Hevea brasiliensis* and their Fungicidal Action on *Microcyclus ulei*. *Proc. Rubb. Res. Inst. Malaysia Plrs. Conf. Kuala Lumpur*, 1979, 410–418.