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Prophylactic Spraying Against Abnormal Leaf Fall Disease: Essential or Not

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INTRODUCTION

Abnormal leaf fall disease caused by *Phytophthora* spp is the most important and distructive desease of rubber in India. This disease was first noticed in 1905 in Sri-Lanka and in 1910 at Palapilly area of Trichur District in India. The symptoms of the disease are pod rot, leaf fall, shoot rot, die back of twigs and drying of branches. The pathogen also causes bark rot (boak stripe) and patch canker. Leaf fall has been noticed yearly in all high rainfall rubber areas in India and also in some parts of Sri Lanka, Burma and Tropical Central and South America. Only pod rot and mild leaf fall has been recorded in Java, Sumatra, and Tropical Africa. In low rainfall areas like Kanyakumari District of Tamilnadu both pod rot and leaf fall occurred occasionally in 1961, 1982 and 1987. In Malaysia also an outbreak of this disease was noticed in 1966 and 1967 (Chee, 1969) and in some subsequent years (Radziah, (1985). Severe leaf fall, necessitating control measures every year, occurs only in India in rhe states of Kerala and Karnataka.

History of control of the diseases

Mc Rae (1919) was the pioneer to study this disease in detail. He identified the causative organism and also made some studies on its control. According to him, the initial inoculum for the spread of this disease came from died back twigs, fruit stalks and mummified pods, which harbour oospores. Inoculum potential is created by infection in dods and presence of large number of pods increased the inlenslty and spread of the disease. Ramakrishnan and Radhakrishna Pillai (1961) identified a number of perennial, wild and cultivated, host plants harbouring the pathogen and also made detailed investigations on the disease. Petch (1912) was of the view that the disease can be reduced by preventing the formation of fruits.

Studies on the control of this disease in India were initiated by Mc Rae in 1917. Dead branches and fruits were removed from a 40 ha. area and marked difference was noticed with the untreated area. He also tried spraying copper sulphate solution for deblossoming to reduce fruit formation, but found it impracticable due to scarcity of water. Eventhough 30 years elapsed then, since Bordeaux mixture was discovered, Mc Rae did not recommend this versatile fungicide. Ashplant (1928) first recommended spraying Bordeaux mixture 0.75 to 0.8 percent against this disease in India, by using high volume pressure sprayers and power sprayers. 40 m long bamboo lances were used and the maximum height reached was 9.0 to 12 m when the height of trees were 25 to 30 m. Ramakrishnan and Radhakrishna Pillai (1961) tried removal of dried pods and died back twigs and got a leaf retention of 25 to 30 percent compared to 84-90 percent in areas sprayed with 1 percent Bordeaux mixture. Adding 0.2 percent zinc sulphate to Bordeaux mixture increased the efficacy. They also tried deblossoming the trees with chemicals like maleicacid (0.1 percent), E. W. 400 (0.4 percent) and in 2, 4-4-D (15 ppm) solution and found them to be ineffective, as flowering in Hevea is irregular and repeated spraying were required. But, peries (1965) stated that hand picking of pods caused significant reduction in the incidence of the disease in Sri Lanka. In India one round of spraying 1 percent Bordeoux mixture before the onset of monsoon was recommended and is being continued to combat this disease even today. Sherples (1936) stated that spraying with urea or application of sodium nitr-

ate or ammonium sulphate increased leaf retention. This was confirmed later in India with NPK mixture application by Ramakrishnan and Radhakrishna Pillai (1961). They found Bordeaux mixture to be superior to copper fungicides and organic fungicide like Phytolan, Dithane Z 78 etc. Old stocks of copper oxychloride fungicides were phytotoxic. Dusting copper fungicides such as Cuprosan 6, 12, 24%, Copper sandoz 25% etc. using power duster was tested and leaf retention was found to be lower compared to that with Bordeaux spraying. Due to disadvantages of high volume spraying they introduced spraying of oil based copper oxychloride fungicide in diluent spray oil through Micron 420 operated from the ground. They found 4.5 kg of actual copper per hectare to be sufficient to give 70 to 80 percent leaf retention. The particles could reach upto 24 m. During the same period Kershaw (1962) pioneered aerial spraying of rubber with fixed wing aircraft and helicopter. Using oil based copper fungicide and spray oil he could achieve 87 percent leaf retention. Later only helicopters were found suitable. A lighter sprayer. Minimicron 77 was introduced, susbequently, but this could reach a height of only about 16 m. In 1973 Shaw Duster cum sprayer was introduced, which was lighter in weight and could reach 24 m. More efficient and lighter sprayers, like Shaw Microspray power 400 and Aspee Turblow were developed in 1983 and 1985 respectively with technical collaboration of RRII. During 1980-'85 newer application machines like tractor mounted sprayer and fogging machines were tested and the former was found unsuitable. The latter was suitable for low rainfall areas but had fire hazard and frequent break downs. During 1973, 56% oil dispersible copper oxychloride powder and 72 USR indigenous spray oil were introduced. Fifty six percent COC has very good shelf life. It is easy to transport and mix. Use of indigenous spray oil effected considerable saving of foreign exchange. Introduction of oil based copper fungicides and low volume ground and aerial application resulted in considerable reduction in cost of control operations. Sethuraj and Kothandaraman (1973) found adequate evidence for the formation of ethylene in the abscission caused by *Phytophthora*. In laboratory experiments they could present leaf fall by spraying 2, 4-D at 100 and 200 ppm. At the present rates of inputs the cost for Bordeaux, aerial and micron spraying are Rs. 1700, 937 and 807 respectively.

In recent years (1982-83) specific fungicides for *Phytophthora*, like Aliette and Ridomyl, were tested and found ineffective. Crown budding of tolerant clones is proved to be a good technique for preventing the disease, but poor bud success preclude its wide spread use. Tree injection of fungicides and antibiotics are also being experimented Oil based formulations of newer fungicides may be useful, but are not available. Radziah (1985) state that in Malaysia aerial spraying of copper oxychloride in oil and fogging of the same fungicide or Captafol in oil is recommended against this disease.

Eventhough consistent and enormous efforts have been put in right from the year 1910 upto this day by many research workers, planters pesticide, spray oil and sprayer manufactures a report appeared recently in national malayalam daily that protecting rubber trees against this disease is a wasteful cultural practice. The arguments put forth was that the crop loss due to the disease is not adequate to warrant costly ontrol measures and some amount of leaf fall is only beneficial. This has caused considerable confusion among the planters, especially the small holders.

Crop loss

A cursory study on crop loss was made by MC Rae (1919). From the discussions with planters, he found that a loss of 30 to 40 kg of dry rubber per hectare per year due to the disease. He was of the opinion that the loss involved was so large that it is practicable to spend money on preventive measures. Later Ramakrishnan and Radhakrishna Pillai (1961) recorded yield in areas protected and not protected with Bordeaux mixture. An yield loss of 37.68 to 50.46% was recorded in clones BD 5, Tjir land G 11. Planters themselves realised the benefits of spraying and widely adopted the prophylactic control measures. The main constraint for conducting further crop loss study was that well managed estates declined to spare areas for the experiment, fearing irrepairable damage to their trees. For the experiment, a minimum of 4 ha area has to be left unsprayed for at least 5 years, correct record of yield has to be maintained for the treatment and control plot of a minimum of 4 ha each of the same clone and age and as far as possible tappers in the experimental area should not be changed. Steady increase in the cost of

Table 1. DETAILS OF CROP LOSS EXPERIMENT

Sl. No.	Location	Treatment plot area (ha)	Clone	Age (Yr.)	Crop Loss %	85-'86 Dry rubber kg/ha	Crop Loss %	86-87** Dry rubber kg/ha
1	Ranni	0.5	RRIM 600	10	9.27*	—	—	—
2	Kumbazha	4.0	RRIM 600	15	9.57	199.69	14.57	160.63
3	Mundakayam	4.0	PB 86	25	15.75	239.36	17.98	215.25

* Based on yield by cup–coagulation method

** Unprotected plots of 1985-86 were also sprayed.

control of the disease necessitated a re evaluation of the benefits of spraying Radhakrishna Pillai *et al.* (1974) artificially defoliated mature GI 1 trees by clipping off 25, 50, 75 and 100% leaves and reported a crop loss of 0, 22.79, 30.60 and 24.14% respectively. There was total refoliation in 100% defoliated trees in two months. Since the experimental trees were well protected by aerial spraying serious consequences of the disease such as shoot rot, die back and drying of branches were not noticed. Again concerted effort was made in 1984 to obtain area for this experiment, with the offer to compensate the losses. M/s Harrisons Malayalam kindly offered areas for the experiment at Kumbazha and Mundakayam. Simultaneously the area raised for this experiment at the Central Experiment Station of RRII near Ranni came into tapping. The experiment was started in all these three areas and in 1985 the treatment plots were left unsprayed. Eventhough the experiments were planned to continue for 5 years, the experiments at Kumbazha and Mundakayam were abandoned due to the request of the management , as the vitality of the trees left unsprayed was considerably affected. At Ranni, 31 trees in the unsprayed and 13 trees in sprayed plots were uprooted due to wind between April and July 1985 and the unsprayed plot was oversprayed while aerial spraying in 1986 and 1987. Hence, the data obtained from the experiment at Ranni was rendered useless.

The results of the experiments are furnished in Table 1 and these indicate considerable loss in the year after leaving the areas unsprayed and also in the next year, when the unsprayed areas were protected. In the first year after leaving the area unprotected the percentage of loss was more in older area. But in the subsequent year with protection the percentage of loss increased in younger area compared to older area. At the present cost of aerial spraying and price of rubber, even a loss of 50 kg. of dry rubber per hectare can justify protection against the disease. The recommended dosage of 4.5 kg. of actual copper per hectare in low volume spraynig provides only optimum leaf retention of 70-80% in normal mossoon.

Factors affecting yield loss

It is known to all the planters that the yield drop during refoliation after wintering in the month of February is high, when compared to average yield and peak yield in October-November. This is due to the absence of leaves, very low soil moisture and natural physiological factors. But *Phytophthora* leaf fall occurs when the soil moisture is very high. Hence sudden yield depression in previously protected areas is not noticed. Moreover, the real effect of the disease does not occur in unsprayed experimental plot due to drift of fungicide from adjacent sprayed area. Only when the experiment is continued at least for five years, the full effect on yield could be obtained.

Climatic regimes of the disease

The optimum climatic regimes for triggering the leaf fall were identified by various workers with improvements in parameters and narrowing down the limits. These are furnished in Table-II. For sustained spread of infection the rains must continue.

Table II

COMPARISON OF FORECASTING FORMULAE OF PHYTOPHTHORA

Weather parameter		Peries, 1969	Pillai *et. al.* 1980	Jayarathnam *et. al* 1987
a	Rainfall			
	per day (mm)	2.5	—	1.0
	total (mm)	—	250-300	112 or more
	duration (day)	4.0	7–10	5.0
b	Temperature (°C)			
	max	—	26-30	29-31
	min.	—	22-25	22-23
	mean	29	—	29-27
c	R. Humidity (%)			
	mean	80	—	80
	max	—	98	93
d	Sunshine (Hr/d)		without intermittent hot sunshine	
	mean	3.0		2-4
	min.	—	—	0.1
e	Forecast	within 14 days	mark the commencement	9–15 days from the overcast day

The suitable climatic regimes for initiating the disease occur in the month of May, June and July and the number of their occurrences is furnished in Table-III

Table III. NUMBER OF OCCURRENCE OF SUITABLE CLIMATIC REGIME

Year	Months			Onset of the monsoon
	May	June	July	
1983	—	—	8	Late and weak
1984	—	3	—	Normal and active
1985	6	2	—	Early and active
1986	—	6	—	Late and weak
1987	—	2	—	Normal and weak

CONCLUSION

These observations indicate that the disease can appear even in years when monsoon fall, but intensity may not be severe. Considering the damage done to the trees such as leaf fall, die back of twigs and drying of branches which result in the loss of vitality of the tree and also the crop loss; protecting the trees against the ravages of this disease is essential for a tree crop like rubber, having an economic life span of 30 years. Unprotected trees will be more prone to bark rot. (black stripe) and patch canker. Sparse canopy permits more light and encourage weed growth, resulting in increased weeding cost. Moderately tolerant clones like RRII 105, GI 1, PB 217 and GT 1 are likely to get protection with lower dosages of fungicide according to rainfall pattern of the region concerned, but experimental evidences are required on this aspect.

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