IMPACT OF POWDERY MILDEW DISEASE ON THE YIELD OF RUBBER IN TRIPURA

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Powdery mildew is the major fungal leaf disease of rubber in Tripura. A field trial was conducted to assess the economic impact of sulphur dusting against powdery mildew in 23 year old rubber plantations of clones RRII 105 and RRIM 600. Higher incidence and severity of powdery mildew disease was observed in RRII 105. The average severity of powdery mildew disease in sulphur dusted blocks of the two clones was 28.6 per cent as compared to 55.8 per cent in the undusted blocks. The growth of the trees was adversely affected in the undusted blocks of both the clones. The mean annual crop loss was estimated to be 19.5 and 14.2 per cent in the undusted blocks of RRII 105 and RRIM 600, respectively. The economic advantage of sulphur dusting as control measure against powdery mildew disease was evident as cost of dusting compensated by 1.22 per cent increment in the yield based on the then prevailing costs and price of rubber.

Key words: Crop loss, Disease control, *Hevea brasiliensis*, Powdery mildew, Sulphur dusting, Tripura

INTRODUCTION

Powdery mildew disease of rubber caused by the fungus *Oidium heveae* Steinm. is prevalent in all the rubber growing parts of North East India (Mondal *et al*., 1994). Leaf fall due to powdery mildew adversely affect the growth and yield of rubber. It can result in serious retardation in the rate of growth and bark renewal (Liyanage and Jacob, 1992). The disease adversely affect photosynthesis and respiration in infected leaves compared to healthy ones (Annamalainathan and Jacob, 2002). However, information on crop loss due to *Oidium* attack in popular clones of rubber in Tripura region is not available. Therefore, an investigation was carried out to assess the economic impact of powdery mildew disease on the yield of two popular clones cultivated in Tripura.

MATERIALS AND METHODS

The experiment was conducted in research farm of Rubber Research Institute of India, at Taranagar in Tripura in a 23 year old plantation of two popular clones *viz*. RRIM 600 and RRII 105 for six consecutive years during 2008-2013. Paired plot design was adopted where one block was dusted with sulphur and the other one was kept as control. The plant stand of RRIM 600 and RRII 105 was 336 and 236 per hectare and the experimental trees were 150 and 220, respectively. Trees were tapped under alternate daily tapping (S/2 d2 6d/7) in the

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BI-1 panel for both the clones and a tapping rest of two months was given during February to March.

During 2008, all the blocks in both the clones were dusted. The pre-treatment yield of each block was recorded for one year and the treatments were imposed in the next year. Three rounds of dusting of sulphur (70%) @ 12 kg ha^{-1} $round^{-1}$ was given at 10 days interval in the treatment block, while the other block in each clone was kept as undusted control.

The incidence and severity of powdery mildew disease was assessed by visual scoring using 0-5 scale, where 0 = perfectly healthy, 1 = very light (<10% of leaf area infected), 2 = light (10-25% of leaf area infected), 3 = moderate (25-50% of leaf area infected), 4 = severe (50-75% of leaf area infected) and 5 = very severe (>75% of leaf area infected + leaf fall).

The Percent Disease Index (PDI) or Disease Severity (DS) Index was calculated using the following formula,

$$\text{PDI or DS} = \frac{\textit{Sum of numerical ratings}}{\textit{No of plants observed X Maximum disease grade}} \text{ X } 100$$

Tree girth at a height of 150 cm from bud union was recorded annually and the mean girth increment was calculated. The block wise latex yield and number of tapping days were recorded for calculating the dry rubber yield. Monthly latex samples were collected for determining the average dry rubber content in each block. The dry rubber content (DRC) was recorded by gravimetric method. The rubber yield was calculated using the following formula,

$$\text{Rubber yield} = \frac{\textit{Latex (kg) X DRC X No of tapping days per year}}{100}$$

The potential yield of the undusted blocks was estimated annually on the basis of the pretreatment yield with yield in the dusted block during the year as reference using the following formula (Jacob *et al*., 1992).

$$\text{Potential yield in undusted block} = \frac{\textit{Yield in dusted block X Pretreatment yield in undusted block}}{\textit{Pretreatment yield in dusted block}}$$

The crop loss in undusted block was estimated using the formula,

$$\text{Percentage crop loss} = \frac{\textit{Potential yield - Realized yield}}{\textit{Potential yield}} \text{ X } 100$$

RESULTS AND DISCUSSION

Year-wise data on incidence and severity of powdery mildew is given in Table 1. Moderate to severe incidence of powdery mildew disease was observed in undusted blocks of both the clones during March to May of 2008-2013. Incidence and severity of the disease was observed more in RRII 105 while RRIM 600 was observed to be moderately tolerant. During 2008 (pre-treatment year), average severity was 46.6 and 41.2 per cent in RRII 105 and RRIM 600, respectively despite sulphur dusting. During 2009-2013, on an average basis, sulphur dusting was observed to reduce the severity of powdery mildew disease by 48.5 percent in both the clones over undusted control. The year-wise data on annual mean girth of both the clones under sulphur dusted and undusted condition is presented in Figure 1. Annual mean girth increment (MGI) was observed comparatively higher in dusted blocks in both the clones. RRIM 600 recorded MGI of 1.79 cm, while RRII 105 recorded MGI of 0.98 cm in dusted blocks (Table 2).

Table 1. **Effect of sulphur dusting on the incidence and severity of powdery mildew disease**

Year	RRII 105				RRIM 600			
	Undusted		Dusted		Undusted		Dusted	
	DI (%)	DS (%)	DI (%)	DS (%)	DI (%)	DS (%)	DI (%)	DS (%)
2008	100.0	59.6	80.0	33.5	80.0	54.4	70.0	28.0
2009	90.0	63.2	60.0	30.2	90.0	50.5	70.0	30.2
2010	100.0	54.4	60.0	25.4	100.0	52.7	50.0	27.3
2011	80.0	64.0	50.0	32.5	80.0	48.4	40.0	25.6
2012	100.0	62.2	50.0	30.0	90.0	50.0	50.0	25.0
2013	100.0	60.0	50.0	30.0	100.0	50.0	40.0	25.0
Mean	95.0	60.5	58.3	30.3	90.0	51.0	53.3	26.9

DI-Disease Incidence DS-Disease Severity

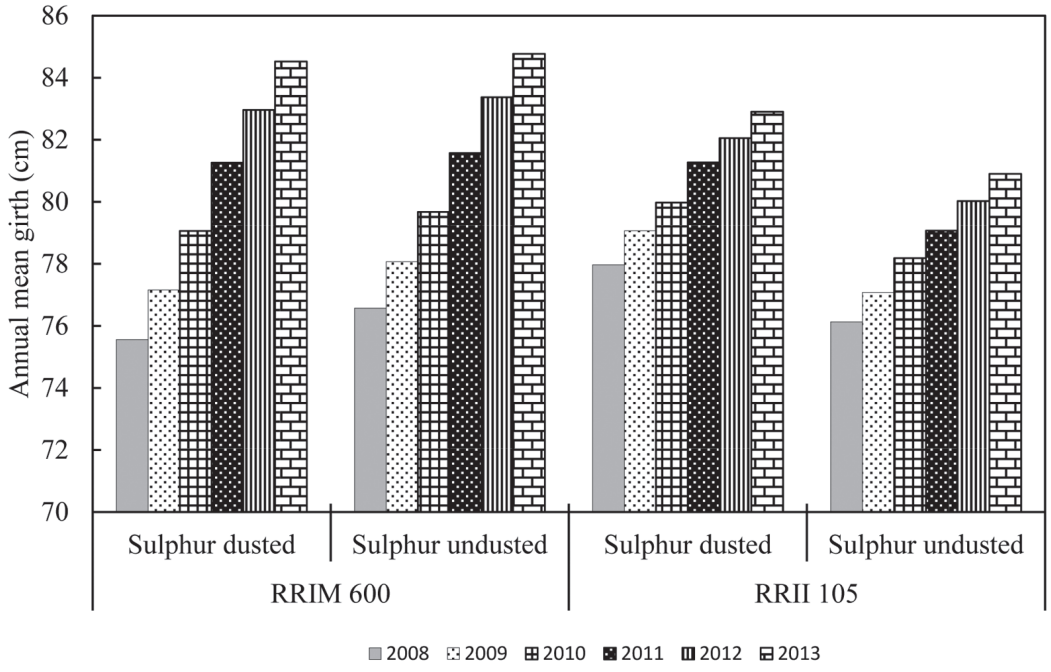

Fig. 1. Annual mean girth of trees under sulphur dusted and undusted conditions

Annual mean yield (g t^{-1} t^{-1}) of RRIM 600 and RRII 105 was 42.7 and 45.2, respectively in dusted blocks. The crop loss in undusted blocks of RRII 105 and RRIM 600 was estimated using the pretreatment yield recorded during 2008 using the formula of Jacob *et al.* (1992). The average pretreatment yield was 1397 kg ha^{-1} and 1323 kg ha^{-1} for RRII 105 and RRIM 600, respectively. During the observed period (2008-13) in

Table 2. **Annual girth increment in dusted and undusted blocks of RRIM 600 and RRII 105**

Year	Annual mean girth increment (cm)			
	RRIM 600		RRII 105	
	Dusted	Undusted	Dusted	Undusted
2008-09	1.60	1.50	1.10	0.95
2009-10	1.90	1.60	0.90	1.10
2010-11	2.20	1.90	1.30	0.89
2011-12	1.70	1.80	0.78	0.95
2012-13	1.56	1.40	0.85	0.88
Total	8.96	8.20	4.93	4.77
Mean	1.79	1.64	0.98	0.95

dusted blocks, RRIM 600 recorded average yield of 1449 kg ha^{-1} and RRII 105 recorded average yield of 1246 kg ha^{-1}. The mean annual yield loss in undusted blocks of RRIM 600 and RRII 105 was estimated to be 14.2 and 19.5 per cent, respectively. Year-wise yield data is represented in Table 3. In a field trial conducted at RRII Regional Experimental Station, Nagrakata, West Bengal an annual crop loss of 28.5 per cent was reported in clone RRII 105 by Mondal and Jacob (2002). Jacob *et al*. (1992) reported eight to 12 per cent more disease in clone PB 86 in unprotected plots compared to protected plots, resulting 21 to 32 per cent crop loss in Kanyakumari region, Tamil Nadu. It was also reported that eight to 18 per cent more disease in unprotected plot of RRIM 600 led to 14 to 29 per cent crop loss in another study in that region. Wastie and Mainstone (1968) have reported a crop loss of 8.1 per cent in the clone PB 5/51 over a period of nine months in Malaysia. Increased bark renewal and girth increment were also observed in trees protected against powdery mildew compared to unprotected trees. Tan and John (1985) reported 6.3 to 10.3 per cent yield increase by controlling powdery mildew disease in Malaysia.

At the cost of sulphur dust (Rs. 60 kg^{-1}) and labour (Rs. 15 hour^{-1}) that prevailed in 2013, one round of dusting required Rs. 920 per hectare. Cost of three rounds of dusting (Rs. 2760) could be realized by an increase in annual yield of 14 kg dry rubber (at the rate of Rs. 200 kg^{-1} of dry rubber during 2013). As the rubber yield in Tripura was well above 1150 kg per hectare, a crop gain of 1.2 per cent could compensate the cost of the control measures adopted.

CONCLUSION

It can be concluded from the present study that powdery mildew results in an

Table 3. **Effect of powdery mildew disease on yield of RRIM 600 and RRII 105**

Year	RRII 105			RRIM 600		
	Undusted (kg ha^{-1})	Dusted (kg ha^{-1})	Yield loss (%)	Undusted (kg ha^{-1})	Dusted (kg ha^{-1})	Yield loss (%)
2008	1425	1368	-	1346	1300	-
2009	1200	1366	15.7	1350	1426	8.6
2010	1100	1168	9.6	1250	1410	14.4
2011	866	1125	26.1	1673	1838	12.1
2012	857	983	16.3	1133	1364	19.8
2013	1070	1467	30.0	1180	1353	15.8
Mean	1086	1246	19.5	1322	1449	14.2

average crop loss of 16.9 per cent (dry rubber) in rubber plantations in Tripura. The additional cost of sulphur dusting could easily be compensated with a small gain (1.22%) in dry rubber production.

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