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PREVALENCE OF DISEASES AND PESTS OF RUBBER (*HEVEA BRASILIENSIS*) IN TRIPURA

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Survey of diseases and pests of rubber (*Hevea brasiliensis*) in Tripura was carried out in 18 locations covering 47 sites of West and South Tripura districts during 2008-10. The survey revealed prevalence of four leaf diseases (*viz.* powdery mildew, C*olletotrichum* and *Corynespora* leaf diseases and *Periconia* leaf blight), pink disease and brown root in varying intensities. However, powdery mildew, C*olletotrichum* leaf disease and brown root disease were found to be more common. Among insect pests, minor incidence of scale insects (in association with sooty mold), mealy bugs, termites, borer beetles and mooply beetles were observed. The plantations were also damaged by other animals like spotted dear and rats. The trend of disease and pest occurrence over three years was more or less consistent.

Keywords: Diseases, *Hevea brasiliensis,* Pests, Survey, Tripura

INTRODUCTION

Diseases are major biotic constraints leading to higher cost of natural rubber production in India. Several fungal diseases are reported to attack leaf, stem, panel and root of rubber plants both in traditional and non-traditional rubber growing areas of the country. Tripura, one of the non-traditional rubber growing regions, is the second largest producer state of natural rubber in India. Now rubber is an economically and socially important crop in this state occupying 50,070 ha area with an annual production of 23 ,280 tonnes (Rubber Board, 2011). However, of late these plantations are also affected with several diseases as in traditional regions.

Information on the prevalence and distribution of diseases and pests is essential to assess their economic importance to prioritize research and to develop strategies for preventing the spread. There is a little information on the disease of rubber status in this state and hence survey was initiated in 2008 to document the prevalence and distribution of various diseases and pests in West and South Tripura districts. Rubber cultivation is mainly concentrated in West Tripura followed by South Tripura and to some extent in North Tripura districts. The incidence and severity of diseases and pest of rubber in Tripura during the period from 2008 to 2010 is presented and discussed.

MATERIALS AND METHODS

The survey was conducted in 18 locations covering 47 sites of West and South

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Tripura districts during 2008-2010, both in young nursery plants and in mature plantations.

Survey on powdery mildew was conducted during the disease season of February-May. In mature plantations, the investigation was carried out in a random sample of 20 trees representing a small block. The scoring of powdery mildew was done on a 0-5 scale, where 0 = No disease, 1 = very light (<10% of leaf area infected), 2 = light (10-25% of leaf area infected), 3 = moderate (26-50% of leaf area infected), 4 = severe (51-75% of leaf area infected) and 5 = very severe (>75% of leaf area infected + leaf fall). A similar scale of 0-5 was used for assessing the *Colletotrichum* leaf disease, *Periconia* leaf blight and *Corynespora* leaf fall disease. The disease status was categorized based on average severity score of 0-5 scale, where N = no disease (0-1), L = low (1.1-2.0), M = moderate (2.1-3.0), S = severe (3.1-4.0) and VS = very severe (4.1-5.0) (Manju *et al*., 1999).

The per cent disease index (PDI) was calculated using the formula,

$$PDI = \frac{\text{Sum of numerical ratings}}{\text{No. of plants observed} \times \text{Maximum disease grade}} \times 100$$

Incidence of pink disease, root disease and pest occurrence was calculated by dividing the number of affected trees by the total number of trees observed and was expressed as per cent affected trees. Weather data during the period was also collected from agrometeorological observatory of RRII, Taranagar and yearly as well as monthly means were calculated. Simple and multiple correlations were worked out between weather parameters and the severity of two major leaf diseases *viz*. powdery mildew and *Colletotrichum* leaf disease.

Table 1. **Trend of rubber diseases and pests in Tripura (2008-2010)**

	Disease status			PDI		
	2008	2009	2010	2008	2009	2010
A. Diseases						
Powdery mildew	Moderate to severe	Moderate	Low	40-55	35-40	15-20
Colletotrichum leaf disease	Moderate to severe	Moderate to severe	Moderate to severe	40-50	30-60	40-60
Corynespora leaf disease	-	Moderate	-	-	40-46	-
Periconia leaf disease	Low	Low	Low	10-15	5-10	5
Pink disease	-	Low	Moderate	-	0.80	12.2
Brown root disease	Low	Low	Low	1-2.0	1.5-2	1.5-2.5
B. Pests						
Scale insects	Low	Low	Low	1-1.2	1.5	1.3
Mealy bugs	-	-	Low	-	-	2
Termite	Low	Low	Low	1.5	2.5	2
Animal attack	-	Severe	-	-	22	-

RESULTS AND DISCUSSION

Occurrence of diseases of rubber in Tripura

The survey revealed prevalence of four leaf diseases *viz.* powdery mildew, C*olletotrichum* and *Corynespora* leaf diseases and *Periconia* leaf blight, pink disease and brown root in varying intensities (Table 1). However, powdery mildew, C*olletotrichum* leaf disease and brown root disease were observed to be more common. Incidence and severity of various diseases in the locations surveyed are presented in Table 2.

Powdery mildew

In mature rubber plantations of Tripura, severity of powdery mildew was observed moderate to severe in 2008, moderate in 2009 and low in 2010. During 2009-10, low incidence (15-20%) of powdery mildew was observed in polybag nurseries and in mature

Table 2. **Incidence of different rubber diseases at various locations of West and South Tripura districts (2008-10)**

District	Location	Status of leaf diseases*					Pink disease (%)	Brown root disease (%)
		No of sites	Powdery mildew	*Periconia* leaf blight	*Colleto-trichum* leaf disease	*Corynespora* leaf fall disease		
West Tripura	Rangamala	4	1.2	-	2.5	-	-	1.5
	Santarampara	3	2.2	1.1	2.2	1.5	-	1.4
	Bhagawanpara	2	1.5	-	2.2	-	-	1.1
	Dhariatol	2	3.5	1.1	3.0	-	-	1.1
	N C Nagar	2	2.5	1.1	2.6	2.5	-	1.7
	Laxmandepha	2	1.2		1.8	-	-	1.3
	Taranagar	4	2.5	1.4	2.2	2.3	-	1.9
	Pathalia	2	1.3	-	2.1	-	-	1.0
	Warenbari	2	1.3	-	2.2	-	-	0.5
South Tripura	Bagma	4	2.0	1.2	2.5	2.5	-	2.4
	Kariamura	2	2.5	1.1	3.5	1.2	-	1.9
	Dariabagma	2	1.2	-	3.2	1.1	-	1.8
	Takmachera	2	1.5	-	2.5	-	-	1.0
	Paticheri	2	1.5	-	1.5	-	-	1.0
	Belonia	3	3.3	-	2.5	-	-	2.4
	Mirza	3	1.4	1.3	3.0	-	-	1.8
	Jolaibari	2	1.2	-	2.2	-	-	2.0
	Sabrum	4	1.2	1.2	2.5	-	4.3	2.7

* Indicate average severity score for 2008-2010 period

plantations. The disease was observed to initiate and aggravate at light green pendulum leaf stage rather than in the young leaves. Flowers were also infected affecting pod development and seed production. It was observed in moderate to severe form in young nursery plants during this period. In majority of the locations the disease was observed light in mature plantations, while it was moderate to severe in young plants. Severe incidence of the disease was observed only in five survey sites of Dhariatol and Belonia locality recording average severity score of 3.5 and 3.3, respectively in 0-5 scale (Table 2). In 89 per cent of sites surveyed, severity of powdery mildew was low to moderate recording average severity score ranging 1.2 to 2.5. Powdery mildew disease caused by *Oidium heveae* is the major leaf disease in

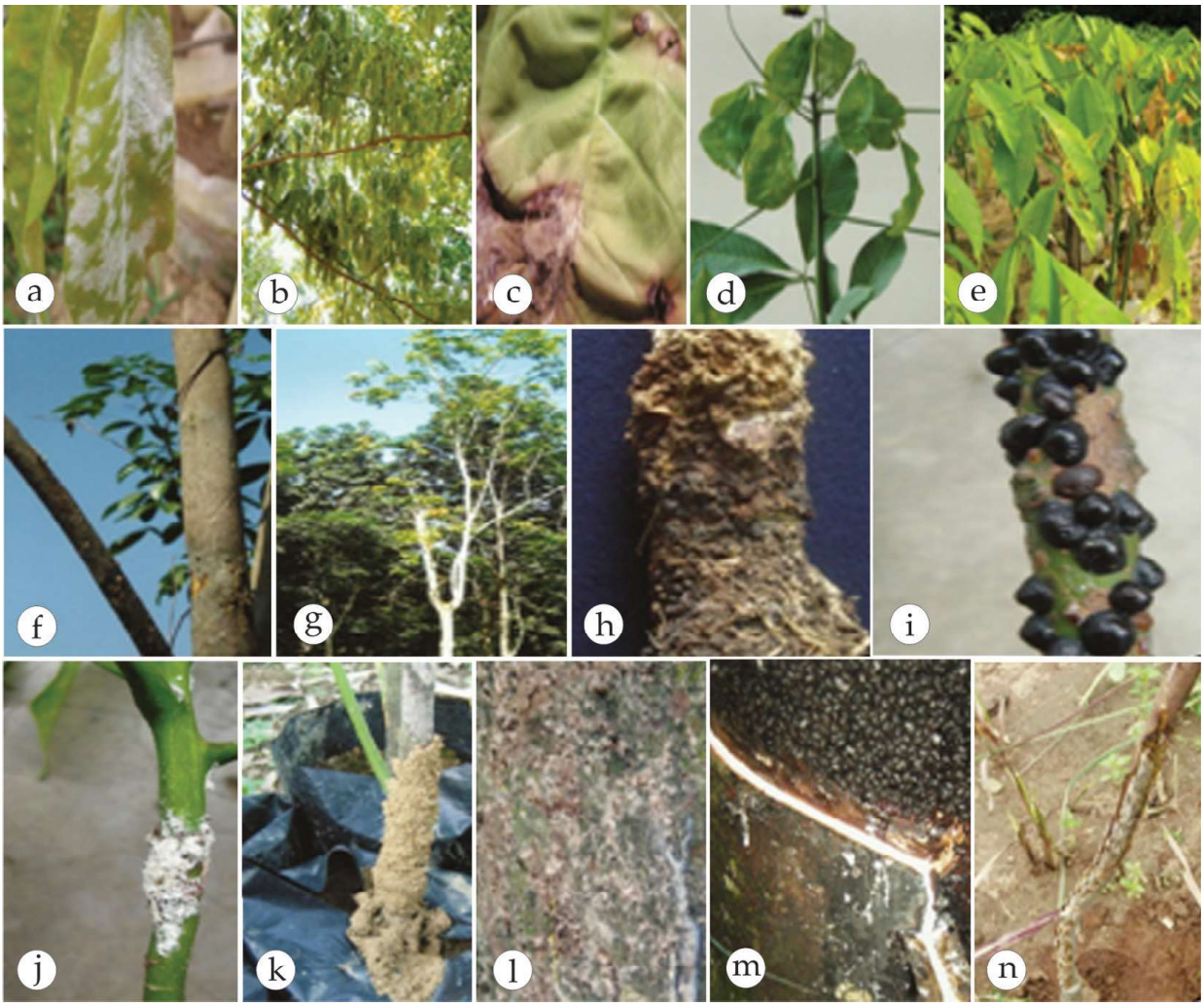

Fig. 1. (a-n): Diseases and pests of rubber in Tripura (a - Powdery mildew in young plant, b - Powdery mildew in mature plant, c - *Periconia* leaf blight, d - *Colletotrichum* leaf spot, e - *Corynespora* leaf disease, f - Pink disease, g - Brown root disease (Mature), h - Brown root disease (Immature), i - Scale insects, j - Mealy bugs, k - Termites attack, l - Borer beetle, m - Mooply beetle, n - Deer attack)

rubber plantations of north-eastern region (Fig. 1a and Fig. 1b) and caused 28 per cent yield loss (Mondal and Jacob, 2002).

Periconia leaf blight

Low incidence of *Periconia* leaf blight caused by *Periconia heveae* was observed in seedling and in polybags during January-February every year (Fig.1c). The disease was observed low in eight surveyed locations recording average severity score of 1.2 (Table 2). This disease was observed only in north east region where the climatic factors were congenial for growth of the pathogen (Mehrotra, 1988; Mondal *et al.*, 1998). Temperature ranging 15-20 °C, cool night, dew and relative humidity around 90 per cent favoured development of the disease (Mondal *et al.*, 1998).

Colletotrichum leaf disease

In Tripura, *Colletotrichum* leaf disease was observed to be most common in nursery plants as well as to some extent in 3-4 year old immature rubber trees (Fig.1d). The disease was observed to be prevalent throughout the year. All the three distinct symptoms *viz*. papery lesions, raised spots and anthracnose were observed in the disease affected plants. Both *C. gloeosporioides* (Penz.) Sacc. and *C. acutatum* were isolated from the infected leaves. Shoot die-back due to severe disease incidence was also observed in seedling nurseries of Bagma, Kariamura region. In Taranagar, the disease was observed to attack young pods during rainy seasons, causing pod rot. This disease had been reported earlier in nurseries and young plantations from North East India (Deka *et al.*, 1996; Singh *et al.*, 1998). During this survey period, moderate to severe incidence of *Colletotrichum* leaf disease were observed in young plants recording 30-60 PDI. In 79 per cent of locations surveyed, the disease was observed in moderate level recording average severity score ranging 2.1 to 3.0 (Table 2). Similar symptoms were also observed in young rubber plantations in traditional rubber growing regions (Ramakrishnan and Pillay, 1962; Rajalakshmy and Joseph, 1988).

Corynespora leaf fall disease

Moderate incidence of *Corynespora* leaf fall disease (CLF) caused by *Coryrespora cassicola* was observed in polybag and seedling plants of NC Nagar, Bagma and Taranagar area (Fig.1e). In NC Nagar area, the disease recorded 40-46 PDI during April 2009. In Tripura, CLF was not observed in immature plantations. The disease was observed only in five locations in polybag plants (Table 2). Widespread incidence of CLF in mature rubber plantations of Nettana, South Karnataka was reported by Manju *et al.* (2001).

Pink disease

Pink disease by *Corticium Salmonicolor* was observed only at four sites of South Tripura districts *viz*. Sabrum and Kolachora (Fig.1f). The disease was observed during November 2009 in low intensity (0.8%) in a 3 year old young plantation of RRIM 600 clone at Sabrum (Table 1). During May 2010, the disease was observed in 3-4 year old immature plantations of Kolachara region, Sabrum recording 12 per cent disease incidence (Table 1). The average incidence of the disease at South Tripura was 4 per cent during the period (Table 2). The disease was also observed in 5-6 year old plants of PB 28/59 clone in Meghalaya (Deka *et al.*, 1998).

Brown root disease

Brown root caused by *Phellinus noxius* was observed to be the most common problem in Tripura. This was the only major root disease reported from India (Ramakrishnan and Pillay, 1962). On an average, 1.5 per cent incidence of this disease was observed in sporadic locations of West and South Tripura districts (Table 2). The disease was observed comparatively more in immature plants (4-5 year old) than in mature plants (Fig.1g and Fig.1h). Low incidence (<5 per cent) of brown root disease was earlier reported in Assam and Tripura by Mondal *et al.* (1994).

Occurrence of pests in Tripura

Incidence of pests and their intensity of damage in rubber were comparatively lower than in many other crops. However, occurrence of a few pests *viz.* scale insects, mealy bugs, termite, borer beetles and mooply beetles were observed at different places. Damage of rubber plants by bamboo rats (*Rhizomus pruniosus*) and spotted dear during early immature period was also reported in different locations.

Scale insects

Minor incidence of scale insects in young twigs of nursery plants (Fig.1i) was observed in few places and was always associated with sooty mold in mature leaves. The population of this insect was observed to be quite high recording around 5 numbers per cm of twig.

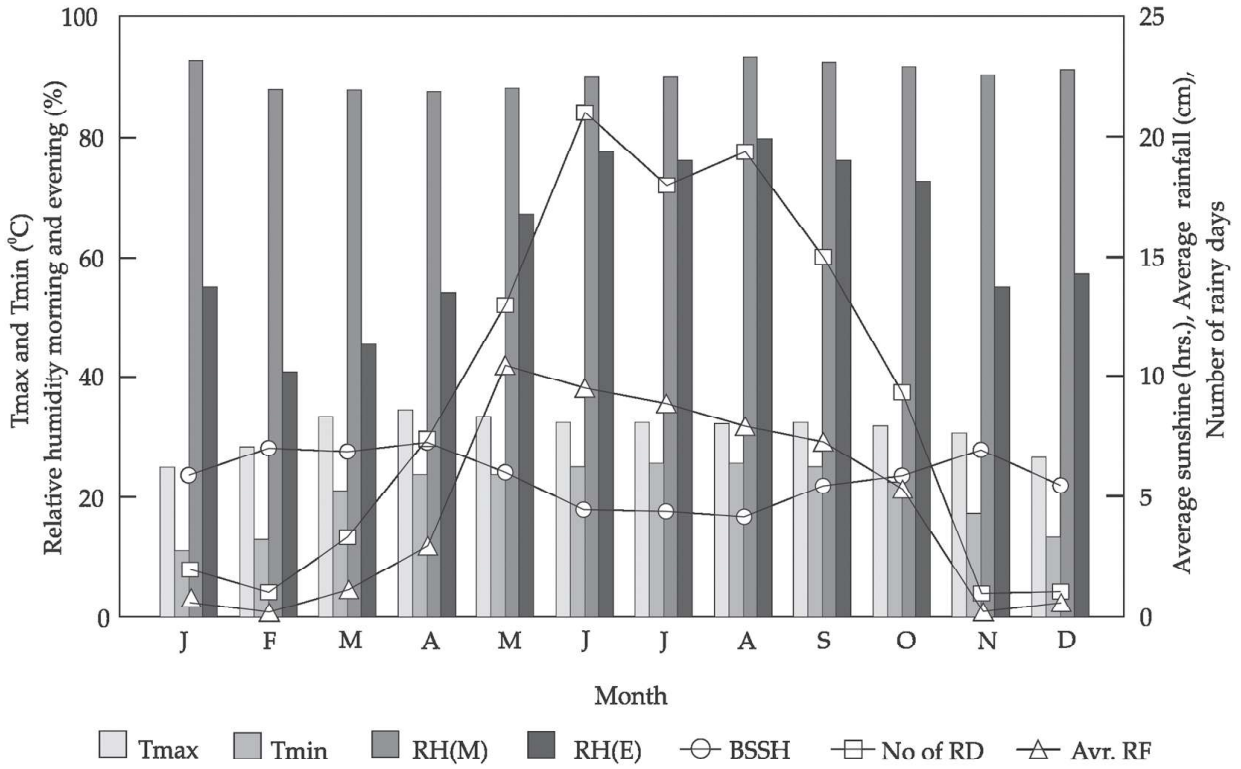

Fig. 2. Monthly mean weather parameters at Taranagar farm (during 2008-2010)

Mealy bugs

Mild infestation of mealy bug was observed in polybag nursery plants of RRIM 600 clone during March, 2010 (Fig.1j). The pest was observed only during 2010 when the mean maximum temperature during March, 2010 was 34.6°C. The mean maximum temperature of March during 2008-10 was recorded 33.1 °C (Fig.2). Mealy bug is a thermophilic insect and hence high temperature could have helped its population build up. The pest was not observed during the same period of 2008-09. Increasing trend of mealy bug attack with increase in maximum temperature was also observed by Mathew *et al*. (2010).

Termites

Low incidence of termite attack was observed in seed germination beds as well as in poly bag plants (Fig.1k) at a few places. The incidence was observed commonly in seed germination beds. Though termites made galleries in the tapping panel of mature rubber plants during winter, it did not affect the tapping.

Borer beetle

Low incidence of borer beetle was observed in tapping panel dryness affected trees at Amtoli region (Fig.1l). Development of pin head tunnels in bark and production of powdery material were observed in the affected plants.

Mooply beetle

Dormant phase of mooply beetle, the nuisance litter pest of rubber, was observed in two to three plants at Taranagar research farm (Fig.1m). The congregation of this pest was observed just below the rain guard during November 2010.

Bamboo rat

This pest was found in Tripura, Assam, Mizoram and Nagaland. It feeds on leaf, young soft grass, roots of rubber plants and has burrowing habit. Rat damage in rubber was reported from various location of Tripura.

Spotted dear

During September, 2009, bark feeding on a two-year-old rubber plantation (RRIM 600 clone) was observed at Pathalia, Bishramganj by spotted deer (*Axis axis*), as evident from the hoof mark on the spot (Fig.1n). The upper soft barks of young plants were eaten by the animal up to 2-3 feet. Badly damaged plants snapped at the collar region after a month or two and the damage was very severe (22%). The recovery percentage of the affected plants was only 4 per cent. This problem was not very common in rubber plantations of Tripura.

Table 3. **Mean weather parameters recorded at Taranagar farm during 2008-10**

Parameter	2008	2009	2010	Mean
Temperature (°C, Max.)	30.4	31.5	31.4	31.1
Temperature (°C, Min.)	20.4	20.5	20.9	20.1
RH (%, Morning)	90.0	89.9	90.5	90.1
RH (%, Evening)	64.4	61.1	63.4	63.0
BSSH (Hour)	6.0	5.8	5.7	5.8
Mean daily rainfall (mm)	3.7	4.7	5.4	4.6
Mean monthly rainy days	9.0	9.0	10.0	9.0
Total annual rainfall	1369	1699	1966	1678

Role of weather parameters on disease development

Weather plays an important role in the incidence, severity and spread of diseases and pests in any crop. A few important weather parameters like temperature, relative humidity, sunshine hours, number of rainy days, average rainfall and total annual rainfall of Taranagar, Agartala were examined during 2008-10 (Table 3). Slight fluctuation of all the weather parameters was observed during this period. The monthly mean of all the weather parameters were also observed (Fig. 2). Number of rainy days observed to increase from March to June and accordingly more incidence of leaf diseases were observed in nursery plants. Information of weather parameters are therefore very much important for predicting and forewarning of rubber diseases.

Simple and multiple correlations were worked out to establish the relative contribution of weather parameters on the severity of two major leaf diseases *viz.* powdery mildew and *Colletotrichum* leaf disease (Table 4 & 5). Significant negative correlation was observed between severity of powdery mildew and relative humidity, while the correlation with other weather parameters was observed non-significant. Significant negative correlation with relative humidity and positive correlation with temperature was also observed by Bhattacharya and Shukla (2002) in field pea powdery mildew under rainfed condition. In Tripura, prevalence of light drizzle, cloudy weather with mild morning wind, favourable day temperature in the range of 25-28 °C and average relative humidity of 85 per cent were observed favourable for the inoculum build up of powdery mildew

Table 4. **Simple linear correlation coefficients between disease severity of powdery mildew and *Colletotrichum* leaf spot disease and weather parameters**

Weather parameter	Simple linear correlation coefficients	
	Powdery mildew	*Colletotrichum* leaf spot
Temperature (^{0}C, Max.)	0.338^{NS}	0.744**
Temperature (^{0}C, Min.)	-0.012^{NS}	0.893**
RH (%, Morning)	-0.849**	-0.016^{NS}
RH (%, Evening)	-0.588*	0.698*
BSSH (Hour)	0.569^{NS}	-0.528^{NS}
No of rainy days	-0.256^{NS}	0.896**

*indicates significant at 5% probability level, **indicates significant at 1% probability level, NS indicates non significant

Table 5. **Multiple correlation and regression equation between disease severity of powdery mildew and *Colletotrichum* leaf disease with weather parameters**

Disease	Multiple linear regression equation	Multiple correlation R	Coefficient of determination R^2
Powdery mildew	Y_1 =19.72-0.14X_1 + 0.16X_2 -0.14X_3 -0.07X_4 -0.06X_5 +0.03X_6	0.909	0.826
Colletotrichum leaf spot	Y_2 =10.57-0.33X_1 + 0.25X_2 -0.04X_3 -0.04X_4 +0.25X_5 +0.07X_6	0.958	0.918

Y_1 =Expected disease intensity of powdery mildew, Y_2 =Expected disease intensity of *Colletotrichum* leaf spot, X_1 = Temp.(^{o}C, Max.), X_2 = Temp.(^{o}C, Min.), X_3 = RH (%, Morning), X_4 = RH (%, Evening), X_5 = BSSH (Hour), X_6 =No of rainy days

disease. Prevalence of mist, dew and cloudy days with 75 to 80 per cent relative humidity was reported for powdery mildew development in Kerala (Edathil *et al*., 2000). In case of *Colletotrichum* leaf disease, significant positive correlation was observed between disease severity and temperature, evening relative humidity and number of rainy days. High temperature and relative humidity were reported to favour this disease in North East India (Deka *et al*., 1996).

The multiple correlation coefficients (R^2) for powdery mildew and *Colletotrichum* leaf disease were found 0.826 and 0.918, respectively (Table 5). This indicates that 83 per cent change in disease severity of powdery mildew and 92 per cent change in disease severity of *Colletotrichum* leaf disease could be explained by the function of weather parameters. Hence, the R^2 values indicated a strong association between the weather parameters and disease severity for both the diseases. However, correlation and regression studies for a longer period will help in understanding the role of individual weather parameters on severity of rubber diseases in a better way.

CONCLUSION

The present survey showed that rubber plantation of Tripura state also experienced biotic constraints. Four foliar diseases, one stem disease, one root disease and a few vertebrate pests were recorded in rubber and a slight variation in prevalence over three-year period. Powdery mildew, *Colletotrichum* leaf disease and brown root disease were observed to be more common. Minor diseases like pink disease, *Periconia* leaf blight and *Corynespora* leaf fall disease have to be monitored for their spatial and temporal spread and severity.

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