Changing climate and changing patterns of occurrence of pests and diseases in Natural Rubber in India

Jacob Mathew, C. Bindu Roy, Shammi Raj, Thomson Abraham, V. T. Jose, G.C. Mondal, and T. Sailajadevi

Rubber Research Institute of India, Rubber Board, Kottayam, Kerala, India

Weather parameters have an important role in triggering and spreading pests and diseases in natural rubber. Almost all the pests and diseases known to affect natural rubber have been existing since long back. However, of late, some of them that were minor in nature have become major and some prevailing only in nurseries are occurring in mature trees also. Changes in severity and pattern of occurrence have also been noted. An attempt has been made to analyse the pests/disease incidence in natural rubber in India for the past 30 years and the critical climatic factors favouring them are compared.

Abnormal leaf fall disease (ALF) caused by the fungus *Phytophthora* spp. occurring during monsoon season is highly influenced by rainfall pattern. Incidence of this disease in a large estate was compared with the total monthly rainfall in that estate during May to August of every year from 1980. An influence of the rainfall pattern on the ALF disease incidence could be clearly observed during this period. The rainfall pattern of Kanyakumari region of Tamil Nadu, where the incidence was very less up to 1980's and later became severe was also analyzed. An increase in disease incidence corresponding to an increase in rainfall could be noted here also.

ALF has not been observed in rubber plantations of North East (NE) India, where a *Phytophthora*-susceptible clone RRIM 600 is widely cultivated. However, pod rot and ALF disease on rubber trees caused by *P. botryosa* was observed to be high in 1988 and 1989 in three regions of Tripura in NE India (Mondal *et al.*, 1994). But the disease was not observed during the subsequent years. So, a possible threat of *Phytophthora* exists in the form of a sudden and serious outbreak of ALF disease in North East India, where a monoculture with a susceptible clone RRIM 600 exists. It was observed that rainfall is the most important climatic factor governing the onset and severity of ALF disease in traditional region. A continuous spell of 250 to 350 mm rain for 7 to 10 days without intermittent hot sunshine, with minimum and maximum temperatures within the range of 22-25^{0}C and 26-30^{0}C, respectively and relative humidity (RH) above 90% are reported to be conditions congenial for the outbreak of the disease. Therefore, a

few important weather parameters like maximum and minimum temperature, RH, number of rainy days and rain spells at Agartala, Tripura were examined during May to August 1988 to 2009 and compared with that of Kottayam, Kerala in Southern India. During rainy season (May to August 1988 to 2009), the mean maximum and minimum temperatures at Agartala was 31.2^{0}C and 24.9^{0}C respectively, which was higher than that observed in Kottayam during the same period (30.4^{0}C and 23.2^{0}C, respectively). Thus, Agartala weather was hotter than Kottayam during the rainy season (tmax: >30^{0}C), which may be one of the factors inimical to the development of *Phytophthora*. During the same period, RH was found to be higher in Kottayam (85%) than in Agartala (82.6%), yet another factor possibly associated with inoculum establishment in Kerala. Rainfall plays a very important role in the survival of zoospores. Comparison of continuous spells of rainfall for 7 or more days between the two regions indicated that Kottayam received more continuous spells of rainfall (total 334 days in 20 years) coupled with high RH and temperatures within the limits (26-30^{0}C maximum temperature and 22-25^{0}C minimum temperature) for *Phytophthora* survival, whereas in Agartala the number of such days was markedly less (57 days). Optimum RH and favourable temperatures coupled with consecutive rainfall for 3, 4, 6 and 9 days were observed for 17, 9, 3 and 2 times, respectively in Kottayam, whereas Agartala experienced the same conditions for 3 and 4 days for 4 and 3 times, respectively. Therefore, hotter weather with lower RH coupled with less number of rain spells may be some of the important factors preventing inoculum build up for initiating *Phytophthora* infection in rubber plantations of Tripura. Although *Phytophthora* causing pod rot and ALF on rubber trees was observed in 1988 and 1989 in Tripura, the disease was not detected during the subsequent years. It may be noted that there was number and longer spells of rainy days during 1988 (6 days). From 1989 to 2003, only three days of continuous rain along with high RH and optimum temperatures were observed in Agartala. After 2004, this condition has been increasi from 4 to 6 days, suggesting a possible shift in the rainfall pattern which is not a desirable trend as far as likely incidence of ALF is concerned in this part of NE India.

Corynespora leaf fall disease (CLD) caused by the fungus *Corynespora cassiicola* has been found in nursery plants in Central Kerala from 1958 onwards (Ramakrishnan and Pillay, 1961). But in 1996 it became severe in mature rubber plantations of southern Karnataka and neighboring places in Kerala. Thereafter the disease appears every year in this region in a manageable form. Relative humidity (RH) and early morning temperature in the plantations are reported to be the critical parameters that determine the disease initiation (Sailajadevi *et al.*,

2005). Both these parameters prevailing in plantations of South Karnataka during the months from January to March were compared with the disease incidence from 1996 onwards. A significant positive correlation with the disease incidence and RH was established. RH during this period and also the disease showed a declining trend during this period. However, definite correlation could not be observed with minimum temperature. The Humidity Thermal Index (HTI) which is known to influence plant diseases has been calculated as the ratio of relative humidity to temperature. The HTI of morning relative humidity to minimum temperature was highly related to daily leaf fall due to CLD. The HTI was also compared with that of the Percent Disease Intensity (PDI), which was recorded periodically in different plots. It was found that during 2009 and 2010, HTI could be related with the triggering of CLD after three to four days of HTI remaining ≥ 4.0. Leaf fall started after seven to eight consecutive days of HTI remaining ≥ 5.5. The study indicated that HTI ≥ 4.0 for a consecutive three to four days triggered the disease and a minimum duration of seven days with HTI ≥ 5.5 can favour the development and severity of the disease resulting in leaf fall. It also revealed that incidence and intensity of the disease is greatly influenced by the microclimate over a particular location especially with the HTI.

Powdery mildew disease caused by *Oidium heveae* is the major leaf disease in the North Eastern states of India during the winter period from January to March (Mondal and Jacob, 2002; Mondal *et al.*, 2007). Disease incidence was compared with the average minimum temperature during these months. A reduction in the disease incidence corresponding to an increase in the minimum temperature was evident in the North East region of India. It may be noted that winter temperatures have been on the rise in North East India in recent years (Sailajadevi, 2010).

Though pest incidence in natural rubber is comparatively less, the same is also found to be on the rise as a result of warming temperature in recent years. Both bark feeding caterpillar (*Aetherastis circulata)* and mealy bug (*Ferrisiana virgata)* are thermophilic insects attacking rubber. Incidences of these two pests showed an increasing trend as the maximum temperature during the pest attack season (December to April) also increased over the years. It is interesting to note that mealy bug which was only infesting nursery plants earlier is now infesting mature plants as observed during the summer of 2010.

Attack of cockchafer grub (*Holotrichia serrata)* and slug *(Mariaella dussumieri)* on young rubber plants is generally seen during the rainy season from June to October. Incidences of these two pests were compared with the rainfall pattern from 1957 and both showed a

decreasing trend (although there was increased Cockchafer grub attack in the recent two years). In general, a change in the disease and pest incidence in natural rubber in India corresponding to the changes in climatic parameters could be observed. Therefore, in the current scenario of climate change, shift in the pattern of these pests/disease attacks in natural rubber should be anticipated and their evolution should be closely watched.

REFERENCES

1. Mondal, G.C. and Kuruvilla Jacob, C. (2002). Effect of powdery mildew disease on yield of rubber in northern part of West Bengal. *Proceedings of the 15th Plantation Crops Symposium (PLACROSYM XV)*, Mysore, pp: 531-534.

2. Mondal, G.C., Deka, H. and Chaudhuri, D. (2007). Reaction of *Hevea brasiliensis* clones against powdery mildew disease in North Eastern region of India. *Natural Rubber Research*, 20 (1&2): 90-93

3. Ramakrishnan, T.S. and Pillay, P.N.R. (1961). Leaf spot of rubber caused by *Corynespora cassiicola* (Berk. & Curt.) Wei. *Rubber Board Bulletin*, **5**: 52-53.

4. Sailajadevi, T., Manju, M.J., Nazir, R.B. and Jacob, C.K. (2005). Influence of weather on the incidence of Corynespora Leaf Fall disease of *Hevea* in Nettana, Dakshina Kannada: A preliminary report. In: *Preprints: International Natural Rubber Conference, India 2005*, 6-8 November 2005, Rubber Research Institute of India, Kottayam, India, pp 505-509.

5. Mondal, G.C., Sethuraj, M.R., Sinha, R.R. and Poti, S.N. (1994). Pest and disease of rubber in north east India. *Indian Journal of Hill Farming* **7**: 41-50.

6. Sailajadevi, T. (2010). Has the climate changed in NE India? In: *Abstracts- International workshop on climate change and rubber cultivation: R&D priorities.* Rubber Research institute of India, Kottayam 686009, Kerala, India, 28-30 July, 2010. pp 6-8.