academicJournals

Vol.11(37), pp. 3562-3568, 15 September, 2016
DOI: 10.5897/AJAR2016.11063
Article Number: 0C2E62560500
ISSN 1991-637X

http://www.academicjournals.org/AJAR

African Journal of Agricultural Research

Full Length Research Paper

Present status of the black rot disease of tea in Bangladesh

M. S. Islam[1]*, I. Ahmad[2] and M. Ahmed[1]

[1]Plant Pathology Division and Director, Bangladesh Tea Research Institute, Srimangal-3210, Bangladesh.
[2]Department of Food Engineering and Tea Technology, Sahajalal University of Science and Technology, Sylhet, Bangladesh.

Received 30 April, 2016; Accepted 16 May, 2016

A survey was carried out in 2015 at Bangladesh Tea Research Institute (BTRI) to ascertain the impact of varieties, topography, age of plants and shade condition on the incidence and severity of Black rot disease in tea. Data were collected monthly from 300 tea bushes selected randomly for each attribute with three replications. Data were recorded on the incidence and severity of the diseases by observing the typical symptom by using 0-5 scoring scale. Disease incidence and disease index was computed by following a referenced formula. In all the cases of attributes, the maximum level of incidence with Black rot disease was found in September but severity with the same was found in July. The incidence and severity of Black rot disease were significantly higher in hellock (23.52 and 16.64%) areas as compared to flat and tillah areas. Age of tea plants had no variation with severity of the disease but a significant variation was found with the incidence. Highest incidence (22.64%) was found in immature tea bushes. More amount of disease was observed in shaded areas as compared to unshaded areas. Seed tea bush (22.64 and 17.07%) was found to be more predisposed to Black rot disease than clones (20.59 and 16.38%). The findings of this study will help to understand the pattern of distribution of the disease in the commercial tea fields so that the planters can escape the diseases easily.

Key words: Incidence, severity, black rot, tea.

INTRODUCTION

Tea is an important cash crop of Bangladesh. It is one of the largest agro-based industries in the country. There are 169 tea estates having about 59.609 thousand hectares of land under tea plantation producing about 63.86 million kg of made tea with average yield of 1239 kg per hectare during 2014 (PDU, 2015). About 2.67% of this production is exported and Bangladesh earns a substantial amount of foreign exchange of US$ 2,867 thousand during 2013-2014 (PDU, 2015). The geographical location of tea growing area is restricted only to some green specks between 21° 30′ and 26° 15′ north latitude and between 89° 0′ and 92° 41′ east longitude (Ahmed, 2005). Tea ecosystem is a complex agro-ecosystem. It comprises tea, shade trees, green

*Corresponding author. E-mail: btrippsyeful@yahoo.com.

crops, forest, etc. The intensive mono culture of a perennial crop like tea over an extensive and contiguous area in apparently isolated ecological zones in Bangladesh has formed virtually a stable ecosystem which provided unlimited opportunity for perpetuation and spread of endemic and introduced diseases (Alam, 1999). The architecture of tea plantation, variability of plant types and the systemic interaction of various agro-techniques, intercultural operation, etc. imposes a significant impact on development of diseases. In Bangladesh, the average yield of tea per hectare is quite low as compared to other tea growing countries of the world. Many factors are associated with such low yield. The loss of tea in Bangladesh tea due to various pests, diseases and weeds has been estimated to be about 10-15% (Sana, 1989). Tea being a perennial crop is prone to attack by many pests and diseases. The majority of the diseases in tea are of fungal origin. More than 400 pathogens cause various diseases in tea (Chen and Chen, 1990) viz. foliage, stem and root. Among the diseases, Black rot is a most destructive leaf disease of tea caused by *Corticium theae* Bernard (Ali, 1992). Black rot of tea is of primary nature and is responsible for direct reduction of crop yield (Ali, 1992). The disease attacks the maintenance leaves just below the plucking table. Infected leaves do not falloff but remain hanging and attached to the next leaf by means of small pads of mycelium at the point of contact. Dense shade, bad drainage and sanitation, high humidity etc. are usually considered predisposing factors for the prevalence of the disease. Hellock areas and North tillah slopes are also conductive to the disease (Ali, 1992). Tunstall and Sarmath (1947) recorded a loss in the yield up to 50% on a bush attacked by Black rot when left untreated for four seasons consequently. Tea zone of Bangladesh divided into three units, viz. Tillah- a low hill, are normally up to 300 ft high steeply rounded. Flat are categorised as high flat and low flat. These are slightly undulating to undulating (Sana, 1989). Hellock is the place in between two adjacent tillah.

Microclimate of an area under tea plantation is greatly influenced by the architectures of plantation. In the same area, there are tillah, flat and hellock. Such topographical diversities directly affect penetration of solar radiation, humidity, temperature and air circulation in an area, thus influences plant growth as well as diseases development (Islam and Ali, 2010). There still remain many gaps in the authors' knowledge on the process of different diseases in tea and understanding of the complex relationships between various dimensions. So, this research work was conducted to define the pattern of distribution and severity of Black rot disease in the commercial tea fields towards the appropriate control strategies.

METHODOLOGY

A survey was carried out during February to last November' 2015 at the main farm of Bangladesh Tea Research Institute (BTRI) and its research farm to ascertain the impact of varieties, topography, age of plants and shade condition (Figure 2) on the prevalence and severity of the diseases. Surveyed site was situated under Moulvibazar district (Figure 1). Data were collected monthly from 300 tea bushes selected randomly for each attribute. This survey was replicated thrice for each. Data were recorded on the prevalence and severity of the diseases by observing the typical symptom (Figure 3). These were done by using the following 0-5 scoring scale (Islam and Ali, 2011).

The severity of the disease was expressed in percent disease index (PDI), which was computed following a standard formula as described below (Singh, 2000).

$$\text{Percent disease incidence} = \frac{\text{No.of infected plants}}{\text{Total number of plants counted}} \times 100$$

$$\text{Percent disease index (PDI)} = \frac{\text{Sum of all disease ratings}}{\text{Total number of ratings} \times \text{maximum disease grade}} \times 100$$

Weather parameter during the surveyed period was collected from the weather regional office, BTRI campus, Srimangal, Government of the People Republic of Bangladesh. Data was subjected to analysis of variance by MSTAT computer programe. Mean separation was done by Duncan's multiple range test (DMRT).

RESULTS AND DISCUSSION

The Black rot disease was seen in the field in the month of February with very negligible amount. In all cases of attributes, the maximum incidence was found in September but severity with the same was found in July. From the month of April to May, an increasing trend of disease development was found. During this time, temperature, relative humidity and rainfall were also high (Figure 4). The result in Table 1a and b revealed that seed tea bush was found to be more predisposed (22.64 and 17.07%) to Black rot disease than clones (20.59 and 16.38%). All the year round, a significant protagonist of variety was found for infecting the disease only with the incidence (Table 1a and b). Age of tea plants had no variation with severity of the disease but a significant (p= 0.01) variation was found with the incidence. Highest incidence (22.64%) was found in immature tea bushes and severity (16.88%) in mature tea (Table 2a and b). Table 3a and b represents the result of topographical variation for infection of the Black rot disease. The maximum and statistically dissimilar incidence was found in hellock areas (23.52%) followed by flat areas (22.52%). Hellock areas has also a great impact on disease severity, which is 16.46% followed by flat areas. But the degrees of severities with all topographical areas were statistically (p= 0.01) identical. Another element shade revealed the significantly different impact on disease severity but similar impact on incidence. More amount of disease was observed in shaded areas as compared to unshaded areas. In shaded condition, both incidence and severity were high these were 20.83 and 16.44%, respectively (Table 4).

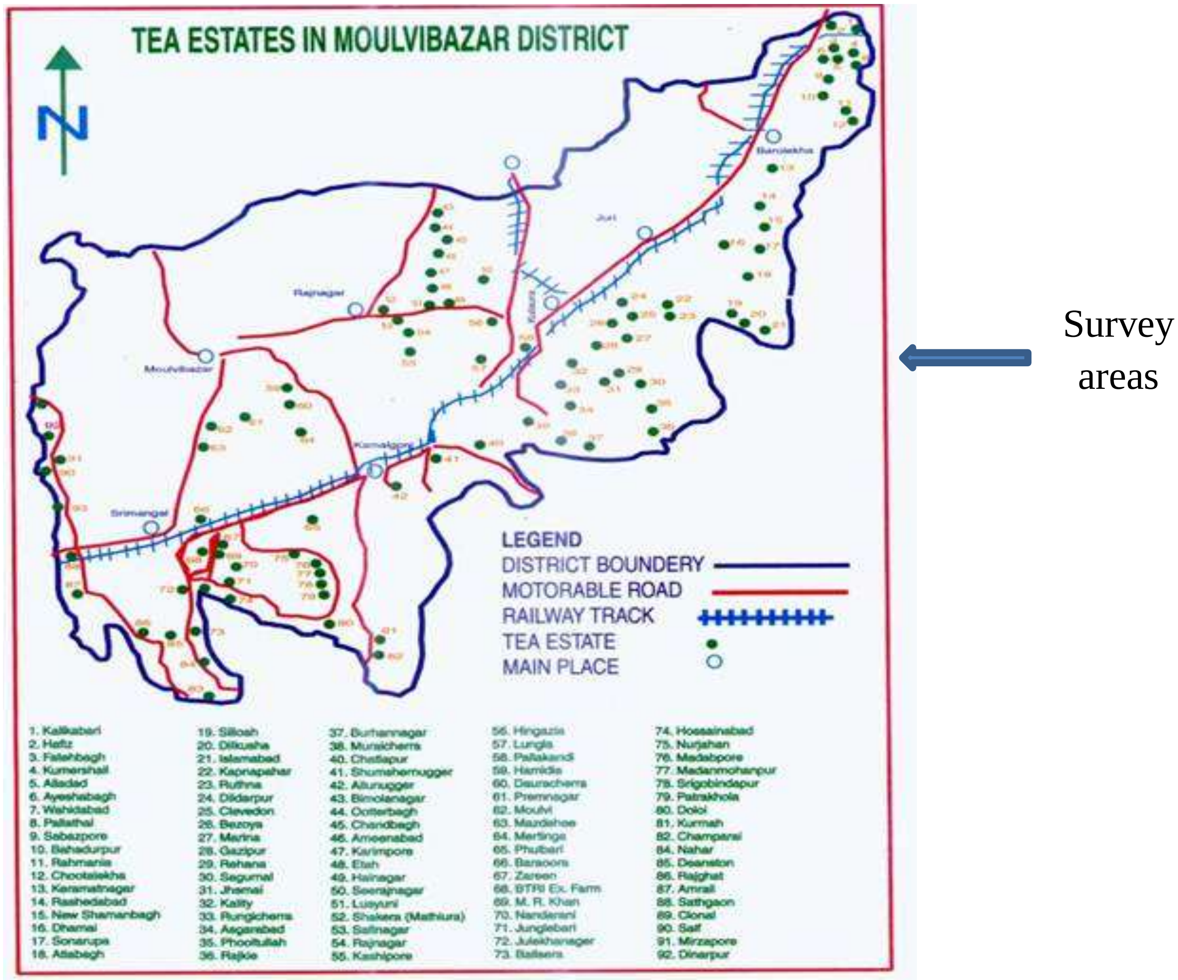

Figure 1. Map of survey areas.

At the end of the monsoon, the disease causing fungus, *Corticium theae* Bernard produced resting bodies in the soil, creaks and crevices of the infected stems. The active mycelium died during the dormant season which produces new mycelium again during the next monsoon (Ali, 1992). The disease became evident after about four weeks following the onset of rains. Mature leaves and adjacent stems were infected by the disease causing organisms (Sarmah, 1960). Islam and Ali (2010) specified as the highest incidence of Black rot was noticed only on seedling and highest in flat areas. Mooi (1965) and Stewart (1990) reported that very young plants are susceptible to late blight, plants of intermediate age are the most resistant, and old plants become more susceptible again. A study conducted on *Chrysanthemum morifolium* found that leaf age affected the number and size of lesions caused by *Pseudomonas cichorii*, with older leaves being less susceptible to infection than younger, immature leaves (Jones et al., 1985). Conversely, Sanchez et al. (2003) found that in coffee (*Coffea arabica*), infection by *P. cichorii* was more frequent on older leaves. In the case of cocoa, coffee or tea plantations, agroforestery systems could also modify pests and disease incidence when compared with mono specific plantations and the effect of shade trees on diseases could have several explanations (Beer, 1987; Beer et al., 1989; Guyot et al., 2008; Schroth et al., 2000). The shade reduces sunlight and particularly UV-B, which plays an important role in some plant diseases such as blister blight of tea (Gunasekera et al., 1997); shade modifies the micro-environmental conditions (reduced temperature, reduced temperature fluctuations, reduced air movements and increased humidity) and creates a “phylloclimate” able to perturb interactions between pathogens and target organs (Chelle, 2005); and shade can also work as a barrier and can limit the splash dispersal of the pathogen (Ntahimpera et al., 1998). Young fruit and leaf tissues of citrus are more susceptible to *Xanthomonas axonopodis* pv. *citri* (citrus canker) than mature tissues (Verniere et al., 2003). The

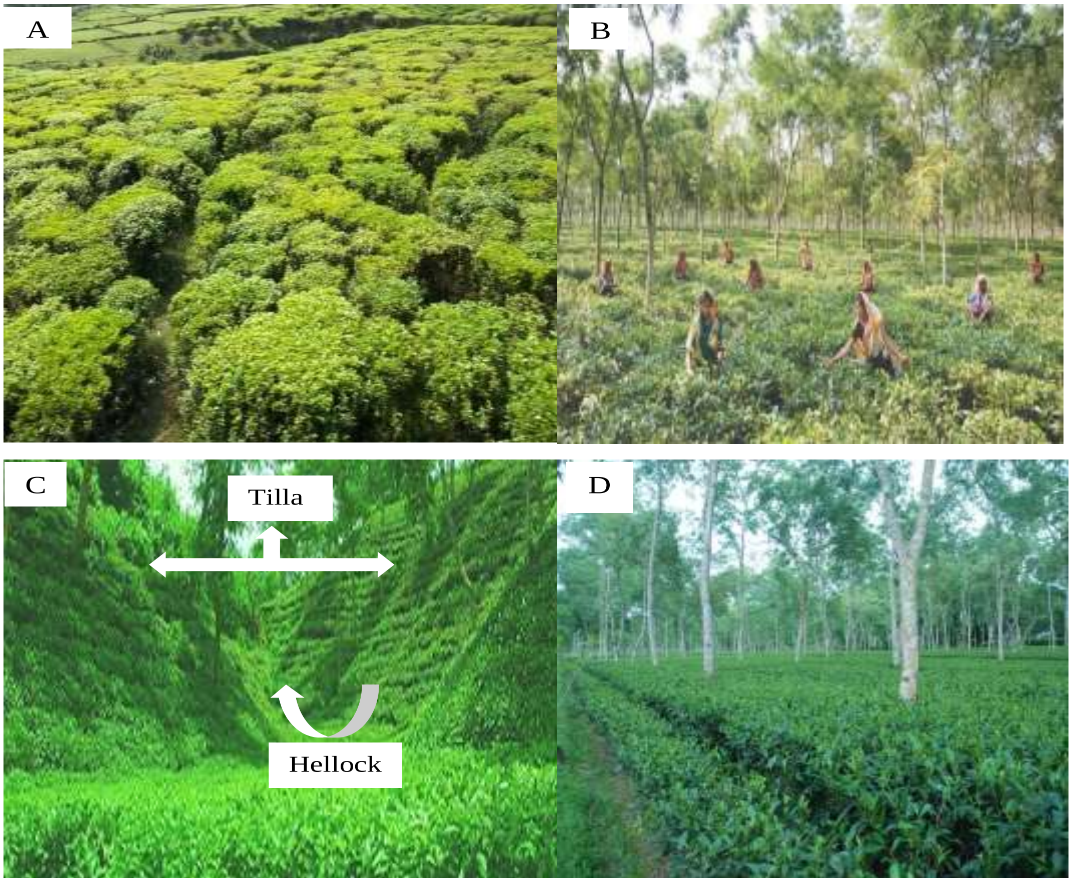

Figure 2. The surveyed fields were mentioned as A = Mature tea plantation with un-shade condition, B = Immature tea plantation in flat areas with sufficient shade, C = Tea plantation in tillah and hellock areas and D = Mature tea plantation in flat areas with sufficient shade.

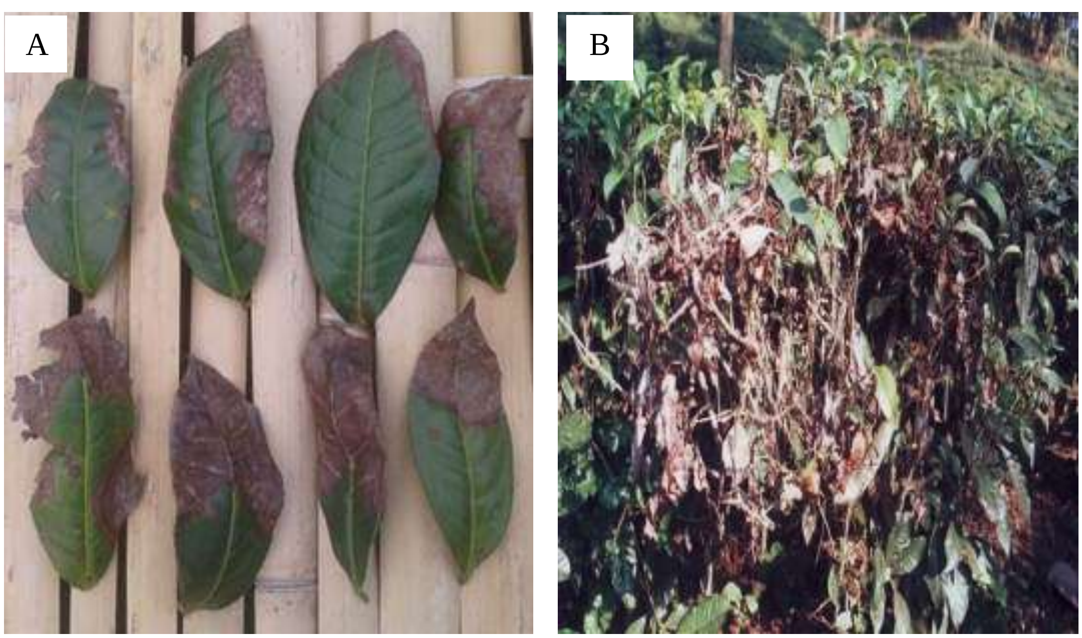

Figure 3. A= Black rot infected lea leaves and B= Black rot infected tea bush.

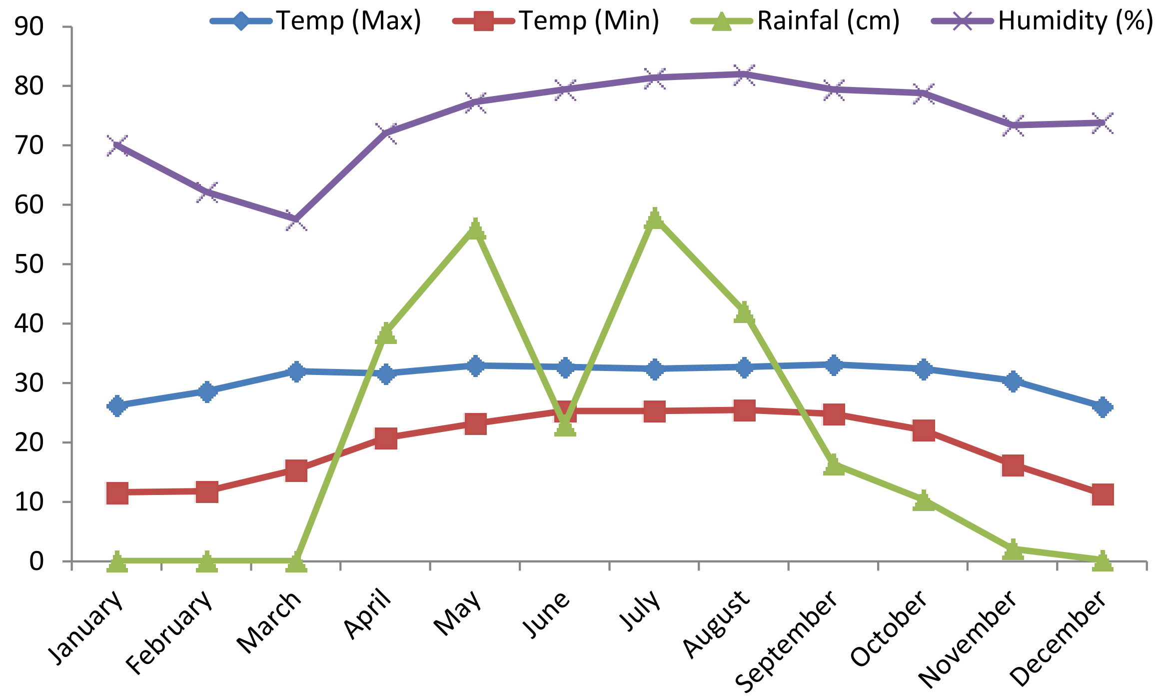

Figure 4. Temperature (°C), rainfall (cm) and humidity (%) during 2015.

Table 1a. Varietal impact on month wise pattern of disease incidence and severity of Black rot disease of tea.

Month	Variety			
	Clone		Seedlings	
	Disease incidence (%)	Disease severity (PDI)	Disease incidence (%)	Disease severity (PDI)
March	8.61[h]	2.72[h]	9.47[h]	3.16[g]
April	11.01[g]	4.10[g]	12.11[g]	5.62[f]
May	14.39[f]	28.50[c]	15.83[f]	26.65[c]
June	21.09[e]	29.99[b]	23.19[e]	31.10[b]
July	24.66[c]	33.29[a]	27.12[c]	36.00[a]
August	26.97[b]	23.18[d]	29.67[b]	26.23[c]
September	27.86[a]	14.84[e]	30.64[a]	12.54[d]
October	26.90[b]	6.64[f]	29.59[b]	8.91[e]
November	23.82[d]	4.13[g]	26.20[d]	3.43[g]

*Numbers followed by the same letters within a column are statistically similar according to a least significant difference test ($P < 0.05$).

Table 1b. Showing different grades against different infection level

Infection (%)	Grade/scale
Nil	0
1- 20	1
21- 40	2
41- 60	3
61- 80	4
>80	5

intimate mixing of varieties is a proven method in certain cropping systems of introducing diversity to reduce plant disease (Wolfe, 1985, Akem et al., 2000 and Zhu et al., 2000). Variety mixtures may reduce disease in three basic ways (Finckh and Wolfe, 1998; Mundt, 2002): (a) resistance induction, by avirulent spores preventing or delaying infection by adjacent virulent spores; (b) barrier effects, with resistant plants acting as barriers to pathogen spread and (c) dilution of susceptible, where there is an increased distance between plants of the most susceptible component for any particular pathogen

Table 2a. Impact of age on the pattern of disease incidence and severity of Black rot of tea.

Month	Age of tea plant			
	Mature		Immature	
	Disease incidence (%)	Disease severity (PDI)	Disease incidence (%)	Disease severity (PDI)
March	9.47[h]	2.99[g]	8.51[g]	2.93[g]
April	12.11[g]	5.44[f]	11.19[f]	4.98[g]
May	15.83[f]	26.52[c]	14.55[e]	28.42[c]
June	23.19[e]	30.47[b]	20.91[d]	31.26[b]
July	27.12[c]	35.97[a]	24.84[c]	33.91[a]
August	29.67[b]	26.18[c]	26.88[b]	24.13[d]
September	30.64[a]	12.66[d]	27.93[a]	14.25[e]
October	29.59[b]	8.64[e]	27.02[b]	7.39[f]
November	26.20[d]	3.16[g]	24.05[c]	3.84[g]

*Numbers followed by the same letters within a column are statistically similar according to a least significant difference test (P < 0.05).

Table 2b. Variation of incidence and severity of Black rot disease due to variety

Variety	Disease incidence (%)	Disease severity (PDI)
Clone	20.59	16.38
Seedlings	22.64	17.07
LSD (P=0.01)	0.014	1.60
CV (%)	0.02	2.72

Table 3a. Topographical variation on pattern of disease incidence and severity of Black rot.

Month	Topography					
	Tillah		Flat		Hellok	
	Disease incidence (%)	Disease severity (PDI)	Disease incidence (%)	Disease severity (PDI)	Disease incidence (%)	Disease severity (PDI)
March	8.61h	2.06h	9.12f	1.74f	9.19g	3.03f
April	11.01g	4.09g	11.63e	4.22ef	11.74f	5.30ef
May	14.39f	28.49c	15.64d	23.00c	15.68e	25.70c
June	21.09e	29.98b	23.55c	27.82b	23.14d	29.82b
July	24.66c	33.27a	26.82b	32.64a	26.97c	34.79a
August	26.97b	23.20d	30.00a	22.74c	29.41b	24.59c
September	27.86a	14.85e	30.18a	13.36d	30.39a	13.37d
October	26.90b	6.65f	29.67a	7.01e	29.70ab	7.91e
November	23.82d	4.13g	26.13b	3.90f	26.42c	3.63f

*Numbers followed by the same letters within a column are statistically similar according to a least significant difference test (P < 0.05).

Table 3b. Statistical analysis of impact of age on disease incidence and severity

Age of plant	Disease incidence (%)	Disease severity (PDI)
Mature	20.65	16.88
Immature	22.64	16.79
LSD (P=0.01)	0.255	3.81
CV (%)	0.34	6.45

genotype. Variety diversification may also help to reduce pesticide input in conventional systems (Andrivon et al., 2003). The research findings were reviewed with the above findings of other plantations and fruits crops. All these reviewed findings matched the present findings.

Survival and dissemination of the pathogen, nature of infection, mode of penetration of the pathogen etc. are greatly influenced by the various environmental factors. Temperature, humidity, light penetration, ventilation, etc. are the important factors for aggressiveness of the pathogen as well as disease development. These factors varies from one tea section to another section with varies of tea plant architecture, shade condition, topography, age and varieties. The findings of this study will be helpful to understand the pattern of distribution of the disease in the commercial tea fields so that the planters can escape the disease easily. These findings met the objectives of the present study and are also helpful for further study regarding the control of the disease.

Conflict of Interests

The authors have not declared any conflict of interests.

REFERENCES

Ahmed M (2005). Tea Pest Management. Evergreen Printing, 9/1 Segun Bagicha, Dhaka. pp. 1-3.

Akem C, Ceccarelli S, Erskine W, Lenne J (2000). Using genetic diversity for disease resistance in agricultural production. Outlook Agric. 29:25-30.

Alam AFMB (1999). Profile of Tea Industry in Bangladesh. In Global Advances in Tea Science. Araval Books Int. (P) Ltd. P 9.

Ali MA (1992). Black rot disease of tea. Pamphlet no. 14. Bangladesh Tea Res. Inst. Srimangal. pp. 5-10.

Andrivon D, Lucas, JM, Ellisseche D (2003). Development of natural late blight epidemics in pure and mixed plots of potato cultivars with different levels of partial resistance. Plant Pathol. 52:586-596.

Beer J (1987). Advantages, disadvantages and desirable characteristics of shade trees for coffee, cacao and tea. Agrofor. Syst. 5:3-13.

Beer J, Muschler R, Kass D, Somarriba E (1989). Shade management in coffee and cacao plantations. Agrofor. Syst. 38:139-164.

Chelle M (2005). Phylloclimate or the climate perceived by individual plant organs: What it is? How to model it? What for? New Phytopathol. 166:781-790.

Chen ZM, Chen XF (1990). The diagnosis of tea diseases and their control in Chinese. Shanghai Sci. Tech. publishers, Shanghai, China. pp. 73-88.

Finckh MR, Wolfe MS (1998). The Epidemiology of Plant Diseases: Diversification Strategies. Ed. G.D. Jones. Dordrecht, the Netherlands: Kluwer pp. 231-259.

Gunasekera TS, Paul ND, Ayres PG (1997). The effects of ultraviolet-B (UV-B: 290-320 nm) radiation on blister blight disease of tea (Camellia sinensis). Plant Pathol. 46:179-185.

Guyot J, Cilas C, Sache I (2008). Influence of host resistance and phenology on South American leaf blight of the rubber tree with special consideration of temporal dynamics. Eur. J. Plant Pathol. 120:111-124.

Islam MS, Ali M (2010). Incidence of Major Tea Diseases in Bangladesh. Bangl. J. Agric. Res. 35(4):605-610.

Islam MS, Ali M (2011). Efficacy of Sedomil 72 WP and Recozeb 80 WP in controlling red rust of tea. Bangladesh J. Agril. Res. 36(2):279-284.

Jones JB, Chase AR, Harbaugh BK, Raju BC (1985). Effect of leaf wetness, fertilizer rate, leaf age, and light intensity before inoculation on bacterial leaf-spot of Chrysanthemum. Plant Dis. 69:782-784.

Mooi JC (1965). Experiments on testing field resistance to Phytophthora infestans by inoculating cut leaves of potato varieties. Eur. Potato J. 8:182-183.

Mundt CC (2002). Use of multiline cultivars and cultivar mixtures for disease management. Ann. Rev. Phytopathol. 40:381-410.

Ntahimpera N, Ellis, MA, Wilson LL, Madden LV (1998). Effects of a cover crop on splash dispersal of Colletotrichum acutatum conidia. Phytopathology 88:536-543.

PDU (Project Development Unit) (2015). Statistics on Bangladesh Tea Industry-2015. Bangladesh Tea Board, Srimangal, Moulvibazar. pp. 26-66.

Sana DL (1989). Tea Diseases: Control guide. Tea Science. Ashrafia Boi Ghar, Dhaka. pp. 34-35:201-230.

Sanchez L, Zapata M, Rodriguez RDP, Beaver JS (2003). Distribution and pathogenicity of Pseudomonas cichorii (Swingle) Stapp in coffee in Puerto Rico. J. Agric. Univ. Puerto Rico 87:123-135.

Sarmah KC (1960). Red rust- Cephaleuros parasitiaus Karst. Disease of tea and associated crops in North-East India. Memo. no. 26. Ind. Tea Assoc. pp. 44-46.

Schroth G, Krauss U, Gasparotto L, Duarte JA, Vohland K (2000). Pests and diseases in agroforestry systems of the humid tropics. Agrofor. Syst. 50:199-241.

Singh RS (2000). Assessment of disease incidence and loss. Introduction to Principles of Pathol. 3rd edition. Offord & IBH Publishing co. pvt. ltd. P 328.

Stewart HE (1990). Effect of plant age and inoculum concentration on expression of major gene resistance to Phytophthora infestans in detached potato leaflets. Mycol. Res. 94:823-826.

Tunstall AC, Sarmah KC (1947). Black rot of tea in North East India. Memo. no. 19. Ind. Tea Assoc. pp. 1-26.

Verniere CJ, Gottwald TR, Pruvost O (2003). Disease development and symptom expression of Xanthomonas axonopodis pv. citri in various citrus plant tissues. Phytopathology 93:832-843.

Wolfe MS (1985). The current status and prospects of multiline cultivars and variety mixtures for disease resistance. Ann. Rev. Phytopathol. 23:251-273.

Zhu Y, Chen H, Fan J, Wang Y, Li Y, Chen J, Yang S, Hu L, Leung H, Mew TW, Teng PS, Wang Z, Mundt CC (2000). Genetic diversity and disease control in rice. Nature 406:718-722.