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ABSTRACT

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A survey was conducted in seven upazilas of greater Sylhet district of Bangladesh during July to October 2017 with a view to assess the status of citrus canker disease. The survey revealed that citrus canker is present in all the upazilas. Disease incidence varied from 28 to 40% and the severity varied from 22 to 25%. The highest disease incidence was observed in Gowainghat and the lowest in Chatok upazila. Among the citrus species surveyed Kagzi showed the highest (40%) incidence and Satkora had the lowest (27%). Kagzi showed the highest severity while Mandarin was found to have the lowest severity. Survey in the nurseries of these upazilas showed less disease incidence and severity than orchards. Similar trend was observed in different citrus species as well.

Key words: citrus, canker, survey, disease incidence

INTRODUCTION

Citrus is one of the most popular fruits in Bangladesh. Among them, mandarin, malta, pomelo, lemon, lime etc, are much common. Citrus is acid rich fruit and has medicinal value. It is a good source of Vitamin C. Edible part of citrus fruit is internal part i.e juice but only different is 'Jaralebu' (*Citrus medica*) in which edible part is outer part i.e rind of the fruit. It belongs to the family rutaceae. It is widely cultivated in the country. Due to market demand its production is increasing every year. In 2009-2010 the total citrus production was around 21 thousand metric ton (BBS 2010) while in 2019-2020 it is around 1,42,790 ton (BBS 2021). Sylhet region is known for quality citrus production because of favorable climatic and soil conditions. Around 15% of the total production 20,636 ton is produced in Sylhet region (BBS 2021). Among the diseases, citrus canker is a major disease found among all the citrus fruits produced in the Bangladesh (DAE 2014). It is a bacterial disease caused by the organism *Xanthomonas axonopodis* pv. *citri*. It infects leaves, twigs and fruits of citrus plants. Leaf and fruit symptoms appear as small blister like lesions that increase with time. As lesions increase they turn gray to brown surrounded by yellow halo. The centre of the lesion becomes raised and corky and visible on both sides. Leaves may die and fall out and sometimes shot hole symptoms appear. In the fruit the lesions appear as scab like or corky often with a yellow halo (Dewdney *et al.* 2018). Severe infection of citrus canker disease results in defoliation, die-back, deformation of fruit and premature fruit drop (Graham *et al*. 2004; Gottwald *et al*. 2002). It causes production loss by reducing quality and quantity and premature fruit drop. In Bangladesh the disease prevalence is high and causes economic loss. Moreover, the disease is major threat to citrus export. In a survey it was found that the disease varies depending on lemon species and season. On an average the disease incidence is around 53 percent in the orchards and 17% in the market. In seedlings of various citrus species it was found that incidence of canker disease is the highest (72.22%) in July in Khagrachari and the lowest (28.33%) in Dhaka division in January (Dey *et al*. 2013; Rashid *et al.* 2014).

Many farmers are dependent on this important fruit crop. In Bangladesh Sylhet region is known as citrus growing area. Various citrus species like malta, sweet orange, lemon, lime, pomelo etc. are grown all over Sylhet. Citron locally known as Jaralebu is an exportable item of this area. This lemon is exported in Europe. It has also demand in gulf countries like Kuwait, Saudi Arabia, UAE and Qatar. Due to attack of canker European Union banned export of citrus from Bangladesh in 2008 and later on it was lifted for taking appropriate measures to control the disease (Kaysar *et al*. 2017). But unfortunately, very little work has been done on the disease. To take management strategy it is essential to know the prevalence of the disease among different citrus species and nature of damage. The present study was carried out with the following objectives: I. To know the prevalence of citrus canker in different upazilas of Sylhet region; II. To estimate disease incidence and severity among various citrus species.

MATERIALS AND METHODS

Sylhet is located at 24.8917°N 91.8833°E, in the north eastern region of Bangladesh. The climate is humid subtropical. From April to October it is hot and humid with very heavy showers and thunderstorms almost every day, whilst the short dry season from November to February is very dry and fairly clear. Nearly 80% of the annual average rainfall of 4,200 millimeters (170 in) occurs between May and September. Mean temperature is the lowest (15^{0}C) in January and the highest (30^{0}C) in May. The soil is acidic.

Survey area and period

The survey was conducted throughout the monsoon (July to October) which is ideal for spreading the disease during 2017-18 in major citrus growing areas of greater Sylhet. Survey was conducted to know the incidence and severity of citrus disease at farmer`s field. Seven upazilas of greater Sylhet region were surveyed in the study. The survey was conducted following random sampling technique. The upazilas were Gowainghat, Jaintapur and Beanibazar of Sylhet district, Srimangal and Juri of Moulvibazar district, Chatak and Bahubal of Sunamganj and Habiganj district respectively. Ten farmer's orchards were selected randomly from each upazila. Two orchads in Chatok, four orchards in Bahubal upazila were selected and each tree was observed thoroughly. Disease was identified by observing typical symptoms. Sometimes hand lens was used for critical observation of the disease. The symptom of the disease was recorded following the description of Gottwald *et al.* (2002). Data on incidence and severity of citrus disease were recorded. Leaves, fruits and twigs were observed to found the disease.

Disease incidence and severity was calculated according to Johnston and Booth (1983).

$$\text{Disease Incidence (\%)} = \frac{\text{No. of plants infected}}{\text{No. of plants ovserved}} \times 100$$

$$\text{Disease Severity (\%)} = \frac{\text{Area of infected plant tissue (leaves)}}{\text{Total leaf area}} \times 100$$

Disease was also surveyed in different nurseries in different upazilas of greater Sylhet region. Data were analyzed by R software.

RESULTS AND DISCUSSION

Survey of Citrus Canker disease in some selected areas of greater Sylhet

A comprehensive survey was conducted to assess the disease incidence and severity of Citrus canker disease at 7 citrus growing upazilas of greater Sylhet during 2017-18. The results are presented in Table 1. Disease incidence and disease severity varied significantly in different locations. The disease incidence ranged from 28.73 to 39.80%. The significantly highest disease incidence was found at Gowainghat upazila (39.80%) and Jaintapur (39.73%) followed by Sreemangal (36.98%). The significantly lowest incidence was found at Chatok (28.73%) followed by Bahubal (31.15%).

Table 1. Incidence and severity of canker disease of citrus at 7 citrus growing upazilas ofgreater Sylhet district in 2017-18

Sl. No.	Name of Upazilas	Disease incidence (%)	Disease severity (%)
1	Gowainghat	39.80a	25.65ab
2	Jaintapur	39.73a	29.00a
3	Sreemangal	36.98ab	25.26ab
4	Juri	34.11bc	21.79b
5	Beanibazar	33.58bc	23.80b
6	Bahubal	31.16cd	21.79b
7	Chatok	28.73d	22.60b
	CV	15.34	23.30
	Lsd	4.56	4.82

Disease severity did not vary widely. The significantly highest severity was found at Janitapur (29.00%) upazila followed by Gowainghat (25.65%) and Sreemangal (25.26%). The lowest disease severity was found in Bahubal (21.79%) which was significantly lower than Gowainghat and Janitapur. Disease incidence is greatly influenced by surrounding environment. The environment in greater Sylhet has little variation. In the present study disease incidence was found to be between 28 to 40% which is relatively low and the severity was almost similar. There might be some variations in micro environment like crop canopy, density and type of species and the management practices which might play an important role in disease variation. Temperature between 20-30^{0}C is optimum for citrus canker disease development but in cool and dry environment it takes longer time (Dewdney *et al.* 2018). Canker disease is also influenced by leaf miner infestation in the orchards and leaf wetness (Belasque *et al.* 2005). In a survey in Himachal Pradesh, India incidence of citrus canker was found to be between 28 to 39% (Kumar *et al.* 2020). In the present study similar results were found. Dey *et al.* (2013) in their survey found around 53% citrus canker incidence which is a little bit higher than the present study.

Survey of Citrus canker disease on different germplasm of citrus

Survey of citrus canker disease on different germplasm showed a great variation among different germplasm (Table 2). The highest disease incidence was found in kagzi (40.07%) followed by Elachi (37.55%) Jara (37.36%), Sorboti lebu (36.15%), Adajamir (35.45%), Malta (35.25%), and which were significantly different from Mandarin (34.08%), Seedless lebu (34.13%), China lebu (33.14%), and Pomelo (33.27%). The lowest disease incidence was found in Satkora (27.07%).

Table 2. Incidence and severity of Citrus canker in different Citrus germplasm during in 2017-18

Sl no.	Germplasm	Disease Incidence (%)	Disease Severity (%)
1	Kagzi (*Citrus aurantiifolia*)	40.07a	35.0a
2	Elachi lebu (*Citrus limon*)	37.55ab	18.57bcd
3	Jara (*Citrus medica*)	37.36ab	21.63de
4	Sorboti lebu (*Citrus limettoides*)	36.15ab	20.64de
5	Ada jamir (*Citrus assamensis*)	35.45ab	23.00cd
6	Malta (*Citrus sinensis*)	35.25ab	27.88bc
7	Mandarin (*Citrus reticulata*)	34.08b	15.69e
8	Seedless Lemon (*Citrus limon*)	34.14b	24.14bcd
9	China lebu (*Citrus limon*)	33.15b	24.20bcd
10	Pomelo (*Citrus maxima*)	33.28b	29.74ab
11	Satkora (*Citrus macroptera*)	27.07c	19.85de
	CV	15.34	23.30
	Lsd	5.72	6.05

Different citrus species are known to vary in susceptibility to citrus canker disease (Gottwald *et al.* 1993; Koizumi 1981 and Stover *et al.* 2014). Dey *et al.* (2013) also reported variation in canker in different citrus species. This phenomenon was also observed in the present study.

Survey of Citrus canker in different nurseries

Survey was also conducted in nurseries of different upazilas. The lowest disease incidence was observed at Chatok (23.18%) which was statistically similar with Sreemangal (23.74%), Bahubal (24.57%), Gowainghat (26.44%), Beanibazar (25.91%) (Table 3). The highest incidence was found at Sylhet sadar (29.91%) followed by Jaintapur (27.36%).

Disease severity showed little variation among different upazilas. The lowest disease severity (21.17%) was observed at Bahubal followed by Gowainghat (22.40%), Sylhet sadar (23.10%), Jaintapur (23.44%), Chatok (23.57%) and the highest severity was found at Sreemangal (24.18%) and Beanibazar (24.42%).

Table 3. Incidence and severity of Citrus canker disease in nursery during 2017-18

Sl. No.	Name of Upazila	Disease incidence (%)	Disease Severity (%)
1	Sylhet sadar	29.91a	23.10ab
2	Beanibazar	25.91bc	24.42a
3	Gowainghat	26.44bc	22.40ab
4	Jaintapur	27.36ab	23.44ab
5	Bahubal	24.57bc	21.17b
6	Sreemangal	23.74c	24.18a
7	Chatok	23.18c	23.57ab
	CV	11.07	23.18
	Lsd	3.38	2.94

Disease incidence and severity did not show much variation in the nurseries. Rashid *et al.* (2014) reported that canker incidence and severity in the nurseries vary widely in relation to location and time. They reported that in January disease incidence and severity varies from 28 to 32% and 5 to 8% respectively whereas in July it varies from 55 to 72% and 21-27% respectively. The present study was done in July to October. In the present study both disease incidence and severity were lower than the previous study. This might be due to variation in species, management practices and location.

Citrus canker on different germplasm at nursery

Prevalence of citrus canker among different germplasm in the nursery did not show wide variation (Table 4). The highest disease incidence was found in kagzi (32.71%), followed by malta (27.83%), Pomelo (27.43%) and Seedless lemon (25.50%) and the lowest incidence was found in Mandarin (20.01%) and Jaralebu (21.75%).

The highest severity was found in Kagzi (29.18%), followed by Malta (27.24%), Pomelo (25.10%) and Jara (20.95%) and Seedless (19.84%) and the lowest severity was found in Mandarin (16.79%).

Table 4. Prevalence of Citrus canker in different germplasm in the nursery during 2017-18

Sl. No.	Name of the species	Disease Incidence (%)	Disease Severity (%)
1	Kagzi	32.71a	29.18a
2	Malta	27.83b	27.24ab
3	Pomelo	27.43b	25.10b
4	Seedless	25.50b	19.84c
5	Jara	21.75c	20.95c
6	Mandarin	20.01c	16.79d
	CV	11.07	10.74
	Lsd	3.13	2.72

CONCLUSION

Survey on citrus canker disease in Sylhet region revealed the disease is very much present in all the upazilas and nurseries which varies depending on location and species. The highest disease is observed in Gowainghat upazila and the most susceptible was found to be Kagzi. Although there is much variation in disease incidence but severity does not vary that much.

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