

Red Rot Incidence of Sugarcane in Bangladesh

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ABSTRACT

A systematic survey on red rot disease incidence was conducted in 7 sugar mill and 3 non mill districts representing all sugarcane growing zones of Bangladesh for two consecutive cropping seasons. The disease was noticed in varying percentages in different cane varieties under mill and non mill zones. In the mill zones, the varieties Isd 2/54, Isd 16, Isd 17 and L. Jaba C were surveyed at Panchagar, Thakurgaon, Gaibandha, Chuadanga, Jessore, Jamalpur and Kishorganj and the average red rot incidence was 2.95, 3.13, 7.86, 0.36, 0.11, 1.77 and 6.81% respectively. In the non mill zones of Sirajganj, Chapai-Nawabganj, Gazipur and Shibganj; seven local indigenous varieties viz. , Co 419, Co 527, Q.69, Misimala, Indonesia, Dholbazari, Pyasi and Co 1158 were surveyed and the mean disease incidence of plant and ratoon crop of the varieties were found 5.23, 1.56, 1.60, 13.65, 13.65, 21.02, 1.6 and 0.89 percent, respectively. Red rot incidence in plant crops under water logged condition raised from apparently healthy seedcane of 70 sugarcane clones showed no disease in 17 clones and the rest showed 1-100% infection. The crop raised in high land from healthy seedcane of 425 sugarcane clones of germplasm collection plot showed no red rot infection in 416 clones under field condition and the rest 9 clones showed 7.6 to 50% red rot incidence. Prevalence of the disease was higher under water-logged condition and also in ratoon crop than plant crop in both mill and non-mill zones. The survey revealed differential varietal behaviour as well as different agro-ecological effect on red rot incidence.

INTRODUCTION

Sugarcane (*Saccharum officinarum* Linn.), is one of the most important industrial cash crops in Bangladesh. It is the principal sugar crop in the country. The crop is grown in 0.191 million hectares of land under wide agro-ecological conditions (Anon., 1993). Annually 0.2 million tonnes of sugar and 0.3 million tons of 'gur' are produced from it (Ali *et al.* 1989). In Bangladesh, there are two well defined zones of sugarcane cultivation, one is mill zones and the other is non mill zones. During 1994-95 crop season, average yield of sugarcane was 46.72 and 39.53 tonnes in the mill and non mill zones respectively, while in the same year the national average yield was 43.38 tonnes per hectare (Anon., 1996). The average of cane yield and sugar percent are quite low compared to the advanced sugarcane growing countries of the world.

Among many causes, sugarcane diseases play an important role to decrease the yield of sugarcane as well as sugar. So far 38 sugarcane diseases have been recorded in

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Bangladesh of which red rot is considered as major one (Rahman *et al.* 1983). It is the earliest known sugarcane disease and is widely distributed in many sugarcane growing countries in the world. The disease is mainly responsible for the deterioration of many promising commercial varieties and continues to be a problem in mainland U.S.A., Taiwan, Bangladesh, India, Australia, etc. (Agnhotri, 1983). Kirtikar and Verma (1962) reported 44.10% loss in cane yield in the variety CoS 430. Sandhu *et al.* (1969) recorded 12 to 41.5% losses in the varieties Co 312, Co 313, Co 453 and CoL 29. Ahmed *et al.* (1986) reported 28.52% losses at initial infection and 82.73% when red rot infection was over 50% in the cultivars L 116 and B 4360. In Bangladesh, it is reported from preliminary survey that red rot alone is perhaps responsible for 10-15% yield reduction. Hundred per cent cane loss in some particular plots due to the disease is not uncommon (Anon., 1979). In case of red rot infection in epidemic form it destroys 80-90% of mature crop during harvesting season from mid. November to March. The millable cane stalks completely dries out and can only be used as fuel (Ali, 1986). The variety Co 1158 which occupied 60% of the total cane areas of mill zones, had to be rejected due to red rot. Some high yielding popular varieties like Isd 5/55, Isd 9/57, Co 419, Co 527, Co 11158, BO 17, Bo 34, BO 67, BO 70, Q. 69, BS. 96 (Isd 15) and Isd 17 were withdrawn from commercial cultivation due to their susceptibility to red rot (Malek, 1985; Rahman, 1988). In fact some scattered information is available with the above noted run out varieties but no information is available with the existing varieties under cultivation in the field. As such, a systematic survey on the incidence of the disease in the existing cultivated varieties in the mill and non mill zones including some clones under water-logged condition and germplasm collection plot were undertaken and the results are presented.

MATERIALS AND METHODS

A systematic survey on red rot incidence was conducted in sugar mill and non-mill zones for two consecutive cropping season of 1991 and 1992. The sugar mills zones included 7 districts viz., Panchagar, Thakurgaon, Gaibandha, Chuadanga, Jhenidah, Jamalpur and Kishorganj representing Panchagar Sugar Mills (PSM), Thakurgaon Sugar Mills (TSM), Rangpur Sugar Mills (RSM), Carew & Co. Mobarakganj Sugar Mills (MKSM), Zeal Bangla Sugar Mills (ZBSM) and Kaliachapra Sugar Mills (KCSM) zones, respectively and 3 non-mill districts included Chapai Nawabganj, Gazipur and Serajganj representing three greater non-mill zones. A survey on red rot incidence under water-logged condition was also done at Sugarcane Research Institute (BSRI) farm, Ishurdi, Pabna. Besides a survey on red rot incidence was done in the germplasm maintenance and trial plot of flowering varieties maintained by Breeding Division, SRTI. The survey was done on the major available cultivated varieties in the respective mill and non-mill zones. In the mill zones, the widely cultivated varieties Isd 2/54, Latarijaba-C, Isd 16 and Isd 17 were included. At Shilganj area of Chapai-Nawabganj district, survey was done in 4 commercial varieties viz. Co 419, Co 527, Co 1158 and Q 69. At Sreepur areas of Gazipur district, survey was done in 3 indigenous varieties locally named as Misrimala, Indonesia and Dholbazari. At Serajganj area, the survey was done on two varieties locally named as Pyasy and Co 1158.

The areas selected for survey were divided into 4 sectors such as north, south, east and west as followed by Rahman *et al.* (1980). From each sector, 5 plots of each variety and category (Plant and ratoon) were randomly selected and surveyed. However, it was flexible if the varieties and categories were not equally represented within a single sector, an attempt was made to sample an equal number of plot of each category within the location as a whole. From each area, 20 plots of plant crop and 20 plots of ratoon were surveyed for each variety and proportionately low and high land planting were also considered. The disease incidence was assessed as the percentage of inspected stool. Five hundred stools were considered to be representative sample size. To provide a representative sample of the whole plot, the rows inspected were such that they were more or less evenly distributed across the plot (Rahman *et al.* 1980).

Healthy seed materials of 72 promising clones including commercially cultivated, indigenous, exotic and different promising lines under zonal yield trial I, II and III were obtained from Breeding Division of BSRI and planted in a low land to observe the disease incidence under water-logged condition in 5m x 6m plots having 6 rows at 1m apart. Three replications were maintained for each lines and randomized. Observation for red rot incidence was made at regular interval from planting to harvest of the crop. Healthy seed materials of 425 sugarcane clones planted in 3m rows at 90 cm apart in the germplasm maintenance plot at BSRI farm under normal field condition was also observed for red rot incidence and data were recorded for two consecutive seasons.

RESULTS AND DISCUSSION

The disease was manifested in the standing canes of the surveyed areas as dried and withered leaves, shrivelled and dried stems and death of entire crop in the field. It was noticed in varying percentages in different varieties cultivated under mill and non-mill zones in Bangladesh. From survey areas (Table 1), it was noticed that disease incidence in plant and ratoon crop of four commercially cultivated varieties ranged respectively from 0-22% and 0-50% in Isd 2/54, 0-52% and 0-60% in Latarijaba C; 0-60% and 0-8% in Isd 16, 0-65% and 0-65% and 0-100% in Isd 17. The disease was observed in seven sugar mills zones, namely Panchagar (PSM), Thakurgaon (TSM), Gaibandha (RSM), Chuadanga (KSM), Jessore (MKSM), Jamalpur (ZBSM) and Kishorganj (KCSM). The highest incidence of the disease (100%) and crop damage was recorded in the ratoon crop of Isd in the mill zone of Panchagar, Thakurgaon and Gaibandha districts. In mill zones, variety Latarijaba-C showed the lowest mean disease incidence of 0.54% and 1.3% in plant and ratoon crop followed by Isd 2/54 of 0.79% and 1.58%; Isd 16, 1.51% and 4.78% and of Isd 17, 4.92% and 4.85% in plant and ratoon crop respectively. Red rot incidence was always higher in ratoon crop than in plant crop.

In order of high to low red rot incidence, the cane varieties can be listed as Isd 17, Isd 16, Isd 2/54 and Latarijaba C. The average disease incidence of all the four varieties in the mill zones was 2.95, 3.13, 7.86, 0.36, 0.11, 1.77 and 6.81% at Panchagar, Thakurgaon, Gaibandha, Chuadanga, Jessore, Jamalpur and Kishorganj district, respectively. On the basis of disease incidence, different sugarcane growing areas can be

arranged in a manner, high to low disease prone areas as Gaibandha (RSM Ltd)), Kishorganj (KCSM Ltd), Thakurgaon (TSM Ltd), Panchagar (PSM Ltd), Jamalpur (ZBSM Ltd), Chuadanga (Carew Co. Ltd) and Jessore (MKSM Ltd) (Table 1).

Table 1. Incidence of red rot disease in four commercially cultivated varieties of sugarcane in different districts of sugar mill zones.

Varieties Location	Disease incidence (%)								Disease incidence range and mean
	Isd 2/54		Latarijaba -C		Isd 16		Isd 17		
	Plant crop	Ratoon crop	Plant crop	Ratoon crop	Plant crop	Ratoon crop	Plant crop	Ratoon crop	
Panchagar (PSM Ltd)	0-0.5 (0.03) ⁺	0-10.0 (0.2)	0-0.3 (0.01)	0-0.5 (0.04)	0-0.5 (0.05)	0-1.0 (0.06)	0-60.0 (7.5)	5.0-100.0 (15.7)	0-100.0 (2.95)
Thakurgaon (TSM Ltd)	0-1.0 (0.1)	0-3.0 (0.42)	0-0.5 (0.05)	0-1 (0.2)	0-10.0 (0-0.4)	0-15 (1.47)	0-25.0 (8.2)	2.0-100.0 (14.3)	0-100.0 (3.13)
Gaibandha (TSM Ltd)	0-20.0 (1.66)	0-50.0 (4.16)	0-10.0 (0.83)	0-35 (2.91)	0-40.0 (6.63)	0-65 (9.42)	3-50 (12.5)	8.0-100.0 (24.8)	0-100.0 (7.86)
Chuadanga (Carew & Co.)	0-1.0 (0.2)	0-2.0 (0.33)	0-1.2 (0.17)	0-4.0 (0.39)	0-1.4 (0.12)	0-2.4 (0.81)	0-5.0 (0.25)	0-15.0 (0.6)	0-15.0 (0.36)
Jhenidah (MKSM Ltd)	0-0.4 (0.02)	0-0.8 (0.04)	0-0.2 (0.01)	0-0.5 (0.03)	0-0.5 (0.02)	0-0.7 (0.04)	0-3.0 (0.15)	0-8.0 (0.04)	0-8.0 (0.11)
Jamulpur (ZBSM Ltd)	0-2.0 (0.09)	0-3.0 (0.27)	0-3.0 (0.15)	0-4.0 (0.73)	0-2.0 (0.16)	0-3.0 (0.3)	0.5-26.0 (3.5)	5-55.0 (9.20)	0-55.0 (1.77)
Kishorganj (KCSM Ltd)	0-22.0 (2.75)	0-40.0 (5.71)	0-52.0 (2.6)	0-60.0 (5.3)	0-60.0 (3.2)	0-80.0 (21.4)	0-65.0 (5.5)	0-90.0 (18.0)	0-90.0 (6.81)
Disease incidence range and mean of 7 mill zones	0-22 (0.69)	0-50.0 (1.58)	0-52.0 (0.54)	0-60.0 (1.37)	0-60.0 (1.51)	0-80.0 (4.78)	0-65.0 (4.92)	0-100.0 (11.85)	

⁺ Figures in the parentheses are means and without parentheses are ranges.

In the non mill district viz. Chapai Nawabganj, Gazipur and Serajganj, seven local indigenous varieties are mostly cultivated and the disease incidence is presented in Table 2. At Shibganj area of Chapai Nawabganj, the red rot incidence ranged from 0.1-75%, 0-6.4% and 0.3- 10% in the variety Co 419, Co 527 and Q 69, respectively. At Sreepur of Gazipur, the disease incidence ranged from 0-88%, 0-80% and 0.6-100% in the widely cultivated local indigenous varieties Misrimala, Indonesia and Dholbazari respectively. In Serajganj areas, the disease incidence ranged from 0.2-10% and 0-15% in the local variety Pyasi and run out variety Co. 1158 respectively. The highest incidence of red rot was recorded at Sreepur of Gazipur followed by Shibganj, Chapai Nawabganj and was recorded at Sreepur of Gazipur followed by Shibganj, Chapai Nawabganj and Serajganj. The mean disease incidence of Co 419, Co 527 and Q 69 cultivated at

Shibganj as plant and ratoon crop was recorded 1.45 and 4.14% respectively. The mean red rot incidence of Misrimala, Indonesia and Dholbazari cultivated at Sreepur as plant and ratoon crop was recorded 12.38 and 19.56%, respectively. Similarly the mean disease incidence of Pysai and Co 1158 cultivated at Serajganj as plant and ratoon crop showed 0.34 and 2.15%, respectively. Red rot incidence in the non-mill zones was always higher in the ratoon crop than the plant crop irrespective of varieties. Maximum disease incidence was noticed in Dholbazari followed by Misrimala, Indonesia, Co 419, Co 527, Pysai and Co 1158. on the basis of disease incidence from high to low, the non-mill area can be ranked as Sreepur, Gazipur, Shibganj, Chapai Nawabganj and Serajganj, respectively.

Red rot incidence in plant crops under water-logged condition raised from apparently healthy seedcane of 70 sugarcane clones showed that it varied from 0-100%. Seventeen clones did not show any red rot infection, 18 clones showed infection from 1—50%, 9 clones 5.1-10%, 7 clones 10.1-25%, 8 clones 25.1-50% and the rest 4 clones showed 50.1-100% infection. The crop raised from healthy seedcane of 425 sugarcane clones of germplasm collection plot showed no red rot infection in 416 clones under normal field condition and the rest 9 clones showed 7.6 to 50% red rot incidence. The clones Co 281, Co 285, CP 44-154, CP 50-72, CP 61-49, MY 54-29, POJ 2878, I 119-47 and I 507-85 showed 25.0, 12.5, 7.6, 11.11, 50.0, 13.33, 16.66, 16.66 and 13.0% of red rot incidence, respectively.

A large number of predominant varieties like Isd 2/54, Isd 16, Isd 17, Latarijaba C, Co 419, Co 527, Co 1158, Misrimala, Indonesia, Dholbazari and Pysai etc. which are presently occupying about 85% of total cane cultivated area of Bangladesh have been noticed to suffer severe losses due to red rot. Survey conducted in different sugar mills zones and non mill zones of the country revealed differential varietal behaviour as well as different agro-ecological effect on red rot incidence in plant and ratoon crops. None of the surveyed varieties were found to remain free from red rot in different cane growing zones. In some districts of mill zones like Panchagar, Thakurgaon, Gaibandha, Chuadanga, Jhenidah, Jamalpur and Kishorganj, the varieties Isd 2/54, Latarijaba C, Isd 16 and Isd 17 showed much higher disease incidence (Table 1). The disease was reported widespread in different varieties in various sugarcane growing areas causing severe losses in yield (Ahmed *et al.* Malek *et al.* 1986; Rahman, 1988; Anon., 1979). This confirms that red rot has been a major factor for declining sugarcane yield in the country. In general, ratoon crop showed higher incidence of red rot than plant crop. This higher incidence of red rot in ratoon crop could be attributed to secondary infection or due to multiplication of the red rot pathogen for a longer period in ratoon crop compared to plant crop. The increase of disease incidence in ratoon crop is supported by Sharma and Jha (1957). They reported that the red rot pathogen survives in the soil from 2 months to 1 year along with sugarcane debris and stubbles.

The mean disease incidence varied from variety to variety both in plant and ratoon cane. This is mainly due to the varietal susceptibility to the disease. The varieties Latarijaba C, Isd 2/54, Isd 16 and Isd 17 showed respectively from lower to higher disease incidence and they were reported as resistant, moderately resistant, intermediate and moderately susceptible in disease reaction respectively to red rot among some commercial varieties (Anon., 1989). The disease incidence range also varied from one location to another. The possible reasons for such variation are (i) variation in red rot pathogen within the location or different location in different cane varieties (Sarma and Achutarama Rao, 1977; Satanarayana and Achutarama Rao, 1984; Satyavir *et al.* 1984; Ramapandu and Sarma, 1991) (ii) variation in environmental factors in different locations as the environmental factors play an important role on the development of disease of the host plant after infection (Walker, 1965; Beniwal, 1985).

Table 2. Incidence of red rot disease in different indigenous varieties of sugarcane in the non mill districts.

Locations Varieties	Red rot incidence (%)						Incidence range and mean of different varieties.
	Chapai Nawabganj		Gazipur		Serajganj		
	Plant crop	Ratoon crop	Plant crop	Ratoon crop	Plant crop	Ratoon crop	
Co. 419	0.1-5.0 (2.12)*	0.7-75.0 (8.34)	-	-	-	-	0.1-75.0 (5.23)
Co. 527	0.0-2.5 (1.2)	0.5-6.4 (1.92)	-	-	-	-	0-6.4 (1.56)
Q 69	0.3-5.0 (1.05)	0.5-10.0 (2.16)	-	-	-	-	0.3-10.0 (1.60)
Misirimala	-	-	0.0-50.0 (9.7)	0.5-88 (17.5)	-	-	0-88.0 (13.65)
Indonesia	-	-	0.0-42.0 (9.8)	5.0-80.0 (16.7)	-	-	0-80.0 (13.65)
Dholbazari	-	-	0.6-64.0 (17.64)	22.0-100.0 (24.4)	-	-	0.6-100.0 (21.02)
Pyasi	-	-	-	-	0.2-4 (0.5)	1.5-10 (2.7)	0.2-10.0 (1.6)
Co 1158	-	-	-	-	0-5.0 (0.18)	0.3-15 (1.6)	0-15.0 (0.89)
Disease incidence range and mean of 3 locations	0-5.0 (1.45)	0.5-75.0 (4.14)	0-64.0 (12.38)	0.5-100 (19.56)	0-5.0 (0.34)	0.3-15.0 (2.15)	

* Figures in the parentheses are means and without parentheses are ranges.

In the non mill zones, similar to mill zones, several degenerated and indigenous varieties like Co 419, Co 527, Q 69, Misrimala, Indonesia, Dholbazari, Payasi and Co 1158 showed higher red rot incidence in ratoon crop than plant crop (Table 2). This was perhaps due to the survival of red rot fungus along with the plant debris and stubbles as described in cane varieties in the mill zones. The variation in disease incidence in plant and ratoon crop, from variety to variety and location in location also exists like the mill zones and their causes may be similar. However, the disease incidence in some degenerated and indigenous varieties like Co 419, Co 527, Q 69, Misrimala, Indonesia and Dholbazari was higher as they are run out and rejected due to red rot susceptibility from the mill zones (Malek, 1985; Rahman, 1988; Anon., 1990).

Red rot incidence in plant crops under water-logged condition raised from apparently healthy seedcane of 70 sugarcane clones showed that it varied from 0-100%. Seventeen clones did not show any red rot infection, 18 clones showed infection from 1-50%, 9 clones 5.1-10%, 7 clones 10.1-25%, 8 clones 25.1-50% and the rest 4 clones showed 50.1-100% infection. The disease incidence was much higher when observed under water-logged condition. A large number of varieties showed above 25 to 100% red rot incidence (Table 1). This is in agreement with the previous findings where 30 varieties showed above 25 to 100% infection out of one hundred test varieties (Anon., 1979). High incidence of the disease under water-logged condition is in agreement with the findings that sugarcane genotypes, even the resistant ones, succumb easily to red rot under water-logged condition (Abbott and Hughes, 1961; Srinivasan, 1965). The breakdown of varieties has been essentially attributed to the predisposition of the host to red rot infection in the unfavourable situation (Chona and Padwick, 1942). Various hypothesis have been put forward to explain the varietal break down under water-logged condition. Predisposition of the host to infection under water-logged condition is the main reason (Singh and Lal, 1987). The crop raised from healthy seedcane of 425 clones of germplasm collection plot showed no red rot infection in 416 clones under normal field condition and the rest 9 clones showed 7.6 to 50% red rot incidence. The clones Co 281, Co 285, CP 44-154, CP 50-72, CP 61-49, MY 54-29, POJ 2878, I 119-47 and I 507-85 showed 25.0, 12.5, 7.6, 11.11, 50.0, 13.33, 16.66, 16.66, and 13.0% red rot incidence, respectively. Under normal field condition in the germplasm collection plot, the overall red rot incidence was low and out of 425, only 7 clones showed below 25% red rot and only 2 clones showed 25% and above red rot incidence. The low incidence of the disease was probably due to the use of healthy seedcane as well as better management practices of crop in the germplasm collection plot.

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