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EVALUATION OF SOME SUGARCANE GENOTYPES AGAINST SMUT DISEASE CAUSED BY *USTILAGO SCITAMINEA* SYDOW

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Abstract

Smut (*Ustilago scitaminea* Sydow.) is one of the most important sugarcane diseases in Bangladesh that causes serious losses not only in yield but also in sucrose content. Chemical control and agronomic practices are not effective to reduce the infection of smut. Substitution of susceptible varieties by resistant ones is one of the most successful and reliable methods to combat the disease. Resistant genotypes of sugarcane could play an important role in reducing the loss caused by the disease. Therefore, a field trial was conducted for screening of sugarcane genotypes to find out the level of resistance against smut at BSRI farm, Ishurdi during two consecutive years in plant cane. Thirty-nine sugarcane genotypes (including resistant and susceptible standard) were tested through artificial inoculation with the causal fungus *Ustilago scitaminea* following spore suspension method. Among 39 genotypes, 14 were found as resistant, 6 were moderately resistant, 7 were moderately susceptible, 7 were susceptible and rest 5 were found as highly susceptible against smut disease. The genotypes showing susceptible reactions to smut should be avoided for commercial cultivation.

***Key words*:** Screening, genotype, resistance, smut, artificial inoculation.

Introduction

Smut (*Ustilago scitaminea* Sydow.) is one of the most important sugarcane diseases not only in Bangladesh but also in other sugarcane growing countries of the world (Ahmed, 1974). It causes serious losses in yield and in sucrose content (Hoy, 1986; Padmanaban *et al.*, 1988). This is a result of the systemic nature of the disease which leads to a grassy growth habit in susceptible varieties and complete crop loss (Comstock, 2000). The fungus has the potential to infect all types of cane. It was first reported in Natal in South Africa in 1877 and has since been reported in all other countries that lie between 20°N and 20°S of equator (Martin *et al.*, 1961). Smut can be of epidemic proportion especially when a susceptible variety or a diseased sett is planted (Agnihotri, 1990). Smut disease is characterised by a distinctive whip-like structure from the apices of affected stem with a fairly hard woody core surrounded by a powdery mass of soft spores (Antoine, 1961). Symptoms of sugarcane smut include black whip-like structures from terminal meristem or meristems of lateral buds of infected stalks (Ferreira and Comstock, 1989). Primary transmission of the smut fungus occurs through planting diseased seed cane. Secondary spread is through windblown spores. Spores in or on soil are carried to different fields via rain or irrigation water where they can cause new infections to cane (Agnhotri, 1983; Rott, *et al.*, 2000). Usually, in most disease-prone sugarcane varieties, smut whips emerge within 120 days after planting and an average size whip produces about 10^{11} spores/cm^2 (Agnihotri, 1990). The whips reduce the yield and quality of sugarcane and jaggery (James, 1973; Bachchlav *et al.*, 1979; Mukerjee *et al.*, 1979).

Data on quality parameters indicate that in smutted canes, brix and purity of sugar are adversely affected (Martin *et al.*, 1961). The loss may go up to 100% when naturally infected setts are planted and the loss may range from 42.47 to 59.20% when artificially inoculated setts are planted (Bachchhav *et al.*, 1979; Goyal *et al.*, 1982).

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Whittle, (1982) reported maximum potential loss of 12.4% to 25.6% in comparisons of yields of artificially inoculated and healthy varieties. Yield loss was assessed which ranging from 39-56% in plant cane and 52-73% in ratoon cane (Mohan Rao and Prakasam, 1956). Yield losses of up to 50% in plant crops and 73% in the ratoon crops due to smut disease have been reported in India (Durairaj *et al.*, 1972) and significant yield losses of sugarcane in South Africa (Antoine, 1961; Cormstock *et al.*, 1993). Sandhu *et al.,* (1969) reported yield losses of 70.7% to 75.3%. In Bangladesh, Rahman *et al.,* (1998) reported yield loss of 83.92% in the clone of I 291-87 and 59.45% in I 31-88 due to the infection of smut disease. Rahman *et al.,* (1998) also reported commercial cane sugar loss of 64.12% and 39.39% in the disease canes of the clones I 291-87 and I 31-88, respectively compared to their healthy canes. A high incidence of smut was observed in the promising clone I 291-87 at BSRI farm, as a result, it had to be dropped from breeding programme (Anon., 1995). The reduction in yield and quality of sugarcane varies widely in different sugarcane growing areas of the world and is dependent mainly on the races of the pathogen present, the sugarcane varieties and the prevailing environmental conditions (Lee-Lovick, 1978).

Smut is controlled by planting resistant or tolerant varieties, hot water treatment of seed cane for 20 minutes at 52-54^{o}C or 30 minutes at 50^{o}C, removal of smutted clumps in the field, reducing the number of ratoons in susceptible varieties and by treating seed cane with protectant fungicide (Fauconnier, 1993; Rott *et al.*, 2000; Gupta, 1979). Chemical control and agronomic practices are not effective to reduce the infection of smut. Substitution of susceptible varieties by resistant ones is one of the most successful and reliable methods to combat the disease. Resistant genotypes of sugarcane could play an important role in reducing the loss caused by the disease. Therefore, screening of sugarcane genotypes against smut disease is a pre-requisite in the varietal development programme before releasing varieties for commercial cultivation. Aiming to this, field trial was conducted to find out the level of resistance of sugarcane genotypes against smut pathogen (*Ustilago scitaminea*).

Materials and Methods

The experiment was conducted at BSRI farm, Ishurdi during the cropping season 2015-16 in plant and 2016-17 in ratoon cane with 39 sugarcane genotypes comprising clones under Zonal Yield Trial (ZYT) III, II, & I and Advanced Yield Trial (AYT) where the variety Isd 39 and the clone variety Isd 37 were used as resistant and susceptible standard, respectively. The widely used spore suspension method was followed for creating artificial epiphytotic of the disease (Durairaj *et al.*, 1972; Satyavir and Beniwal, 1978; Ferreira *et al.*, 1980). In this technique, chlamydospores of *Ustilago scitaminea* were collected from different varieties and locations. The collected spores were kept in proofed plastic bags and preserved in refrigerator. The spores showing germination above 90% were used for making thick homogeneous suspension of 10^6 spores/ml. Tween 20 was added to the suspension @ 0.5 ml/liter for homogeneous mixture of spore. Two budded setts of each sugarcane genotype were inoculated by dipping setts in smut spore suspension for 30 minutes before planting. The inoculated setts were planted in 16 m long rows in the field with three replications. Each line/row contained 50 setts. Data on disease incidence were recorded starting from 90 days after planting (i.e. after the first appearance of whips) and continued up to 12 months at an interval of one month. Cumulative smut infection percentage from the whole season for each genotype was determined. On the basis of percentage of smut incidence, the genotypes were evaluated as follows (Begum *et al.*, 2007):

Smut infection (%)	Reaction
0.00 – 3.00	Resistant (R)
3.10 – 5.00	Moderately Resistant (MR)
5.10 – 10.00	Moderately Susceptible (MS)
10.10 – 25.00	Susceptible (S)
Above 25.00	Highly Susceptible (HS)

Results and Discussion

The data collected on cumulative percentage of infection during the years 2016 and 2017 were summarized in table 1. The genotypes tested varied to their reaction against the smut disease. Out of 39 genotypes evaluated, 14 genotypes viz. Isd 39, I 99-10, I 103-10, I 168-11, 118-10, I 09-12, I 59-12, I 73-12, I 102-12, I 124-12, I 149-12, I 155-12, I 182-12 and I 62-11 were found resistant; 6 genotypes viz. I 249-11, I 65-12, I 102-12, I 143-12, I 146-12 and GT-11 were found moderately resistant; 7 genotypes viz. I 30-09, I 07-11, I 212-11, I 230-11, I 106-10, GT-17 and I 299-11 were found moderately susceptible; 7 genotypes viz. I 101-10, I 131-10, I 111-11, I 198-11, I 141-12, I 183-12 and I 193-12 were found susceptible; and 5 genotypes viz. Isd 37, I 64-10, I 180-12, I 85-10 and I 36-12, showed highly susceptible reaction.

Smut can cause total crop loss in susceptible varieties, especially if infected seed cane (sett) is used as planting material to establish a crop (Croft *et al.*, 2008b). The variety Isd 39 and the variety Isd 37 used for resistant and susceptible standards, respectively also showed same

Table 1: Reaction of sugarcane genotypes against *Ustilago scitaminea* at BSRI farm, Ishurdi during 2015-16 in plant cane and 2016-17 in ratoon cane.

Sugarcane genotypes	2015-2016 (Plant Cane)		2016-2017 (Ratoon Cane)		Remarks
	Smut infection (%)	Reaction	Smut infection (%)	Reaction	
Isd 39 (RS*)	0.00	R	2.22	R	R
Isd 37 (SS**)	29.85	HS	46.26	HS	HS
I30-09	3.12	MR	7.40	MS	MS
I64-10	48.57	HS	31.81	HS	HS
I85-10	15.62	S	78.26	HS	HS
I99-10	0.00	R	0.00	R	R
I101-10	21.21	S	6.25	MS	S
I103-10	0.00	R	0.00	R	R
I131-10	4.65	MR	25.00	S	S
I106-10	0.00	R	5.71	MS	MS
I118-10	0.00	R	0.00	R	R
I07-11	0.00	R	5.50	MS	MS
I111-11	14.28	S	6.81	MS	S
I168-11	0.00	R	0.00	R	R
I198-11	5.40	MS	14..28	S	S
I212-11	0.00	R	7.89	MS	MS
I230-11	0.00	R	7.14	MS	MS
I249-11	0.00	R	3.70	MR	MR
I62-11	0.00	R	0.00	R	R
I299-11	0.00	R	6.52	MS	MS
I9-12	0.00	R	0.00	R	R
I36-12	17.39	S	31.81	HS	HS
I59-12	0.00	R	0.00	R	R
I65-12	0.00	R	3.70	MR	MR
I73-12	0.0	R	0.00	R	R
I102-12	0.00	R	4.34	MR	MR
I124-12	0.00	R	0.00	R	R
I137-12	0.00	R	0.00	R	R
I141-12	0.00	R	10.25	S	S
I143-12	0.00	R	3.17	MR	MR
I146-12	0.00	R	5.88	MR	MR
I149-12	0.00	R	0.00	R	R
I155-12	0.00	R	0.00	R	R
I180-12	5.88	MS	30.00	R	HS
I182-12	0.00	R	0.0	R	R
I183-12	0.00	R	19.44	S	S
I193-12	0.00	R	10.20	S	S
GT-11	0.00	R	4.54	MR	MR
GT-17	0.00	R	5.88	MS	MS

*RS = Resistant Standard, **SS = Susceptible Standard

reaction during cropping season 2015-16 and 2016-17. A successful disease infection depends upon available inoculum, susceptible host and environmental conditions favourable for infection (Agrios, 2004). Many genotypes showed different reactions in two consecutive years. This may be due to environmental variations and change of races/strains/pathotypes in two years. Chona, (1943) found the same variety showed 12-50% smut infection in one locality and 35-40% infection in another locality. The genotypes like I 141-12, I 183-12 and I 183-12 were showed resistant reaction in plant cane but susceptible in ratoon cane. Ratooning can induce symptom development in latently infected plants (Croft and Braithwaite, 2006). The sudden breakdown of the resistance of those genotypes to smut disease is a pointer to the possibility of the existence of more virulent races of *U. scitaminea*

than what was obtained before. The increase in smut incidence between the plant and ratoon crop has been widely reported overseas (Comstock, 2000; Lee-Lovick, 1978). The increase of disease incidence in ratoon cane compared to plant cane might be due to build up of inoculums over a long period of time.

Conclusion

From this study, it may be concluded that preference should be given in selecting those genotypes which are resistant to moderately resistant to smut disease, having resistant against other major diseases. The screening of sugarcane genotypes should be continuous process so that the genotypes showing susceptible to highly susceptible reactions can be discarded before release.

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