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Field screening of promising sugarcane genotypes against whip smut disease and borer pests

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Abstract
Six genotypes of different maturity groups along with checks were screened against whip smut disease and borer pest under artificial and natural field condition during season 2021- 22 to identify sources of disease and pest resistance. Eight entries designated *viz.*, PDN 18005, PDN 18014, PDN 18016, PDN 18022, PDN 18025, CoM 0265, Co 86032 and CoC 671 exhibited resistant reaction whereas, 03 entries *viz.*, PDN 18008, Co 7219 and Co 7527 genotypes exhibited moderately susceptible in their reactions to smut disease under artificially inoculated conditions in the field. Susceptible checks Co 740 had susceptible reaction indicated much disease pressure with susceptible reaction. Based on the incidence all the test genotypes recorded less susceptible reaction to early shoot borer. In case of incidence of internode borer, genotype CoM 0265, observed moderately susceptible and remaining genotypes showed highly susceptible reaction to internode borer. The incidence of top shoot borer was not seen throughout the crop season and eventually showed less susceptible reaction. These resistant germplasm may be further utilized as donor for further breeding programs to evolve new resistant variety against whip smut and borer pests of sugarcane.

Keywords: Whip smut, borer pest, sugarcane, resistant, susceptible, germplasm

Introduction
Sugarcane (*Saccharum spp*., L) is one of the major cash and industrial purpose crops in many tropical and subtropical countries. Sugarcane is a renewable, natural agricultural resource crop because it provides sugar, bio fuel, fibre, fertilizer and myriad of by co-products with ecological sustainability (Singh and Katiyar 2016) [19]. Cane yield is markedly influence by several factors of which diseases and insect pests are known to inflict considerable losses in production as well as sugar recovery. Among these factors red rot, smut, wilt diseases, early shoot borer, internode and top shoot borer pests are the most destructive factors for reducing the return to the crop. The whip smut is a fungal disease caused by *Ustilago scitaminea* Sydow causes yield loss to the tune of 39-56% in planted crop and 52-73% in ratoon crop of sugarcane (Comstock, 2000) [10]. The severity of the disease often depends on the pathogen races, environmental conditions and cultivars grown (Akalach and Touil, 1996) [2]. It becomes more serious under favourable conditions, which can even cause a complete crop failure in extreme cases (Bachchhav, *et al.*, 1979) [6]. About 1300 species of insect pests are known to cause damage to sugarcane crop globally and 220 species of insects have been known to attack sugarcane in India. Sugarcane plant during their different growth stages are attacked by a number of insect which are major constraints in getting low yield (Minnatullah *et al*., 2016 and Paudel *et al.*, 2021) [13]. Due to heavy infestation of the pests, serious decline (86.00% reduction in cane yield and 1.4-1.8% reduction in sugar recovery) has been reported. Different measures are applied for control of sugarcane smut such as hot water treatment, roughing out diseased plants, planting resistant or tolerant cultivars and the application of fungicides. (Rott, *et al.*, 2000 and Rajput, *et al.*, 2019) [15, 14], Whereas, sugarcane borers are hidden pests, therefore the approach of pesticides and limited use of biological agents were found less. Management of plant disease and pest through host resistance is considered as the best option for crop protection. Hence a total of twelve sugarcane genotypes included in the station varietal trials were assessed for their reaction to the smut disease by artificial inoculation and borer pest at natural field condition with a view to find out the sources of resistance for their further exploitation in breeding programme and without harming other biota present in ecosystem for smut and borer pest resistance.

Material and Methods

Six genotypes with six checks were tested against whip smut disease under artificial inoculated conditions in the field during *Suru* seasons of 2021-22 at Central Sugarcane Research Station, Padegaon. Two eye budded sets of each genotype from Station trial (Early & Midlate) were artificially inoculated by soaking them for 30 minutes in fresh viable (90 to 95% viability) smut teliospores suspension (@ 10 g per 50 lit of water) having spore load of 10^6 to 10^8 teliospores ml^{-1} (Shinde *et al*., 1985 and Chirme *et al*., 1998) [18, 9]. Such treated sets were planted in moist soil in the field @ 15 setts per row of 6 m length. The observations on germination were noted at 30 and 45 days after planting and the incidence of smut was recorded at fortnightly interval up to harvest. Smut incidence was calculated as percentage of total clumps infected. Based on the cumulative smut incidence, the genotypes were categorized as per Shah *et al.* (1997) and Anonymous (2021) [17, 4] as follows.

Smut Reaction	Incidence (%)
1. Resistant (R)	0.00
2. Moderately resistant (MR)	0.01 to 10.00
3. Moderately susceptible (MS)	10.01 to 20.00
4. Susceptible (S)	20.01 to 30.0
5. Highly susceptible (HS)	More than 30.00

Whereas, in case of early shoot borer, the observations was recorded on the basis of total number of shoots and numbers of dead hearts due to the early shoot borer were recorded at 30, 60, 90 and 120 days after planting and cumulative per cent infestation was worked out. While, the observation on the per cent incidence of internode and top shoot borer, were recorded at time of harvest on 25 canes. It is calculated by following formula % incidence = total no. of infested cane/total no. of cane observed x 100

The assessment of reaction of shoot, internode and top shoot borer based on cumulative % incidence were worked out and the genotypes were categorized as per Anonymous (2022) [5] as follows.

Table 1: Show the Cumulative incidence ESB, IB and TSB

S. N.	Grade	Cumulative% incidence of ESB	Cumulative % incidence of IB	Cumulative % incidence of TSB
1	Less Susceptible (LS)	0-15	0 – 20	0 – 10
2	Moderate Susceptible (MS)	15.1-30	20.1 – 40	10.1 – 20
3	Highly Susceptible (HS)	above 30	Above 40	Above 20

Results and Discussion

Six entries along with six checks of different maturity groups were screened against whip smut disease under artificial and borer pest at natural field condition. The data presented in Table 2 indicated that out of 12 genotypes tested, eight entries designated *viz*., PDN 18005, PDN 18014, PDN 18016, PDN 18022, PDN 18025, CoM 0265 and Co 86032 exhibited resistant reaction to sugarcane smut caused by *Ustilago scitaminea* Sydow, whereas, 03 entries *viz*., PDN 18008, Co 7219 and Co 7527 genotypes exhibited moderately susceptible in their reactions to smut disease under artificially inoculated conditions in the field. Susceptible checks Co 740 had susceptible reaction indicated much disease pressure with susceptible reaction. The reaction to smut disease is one of the selection criteria at the early phase of any hybridization programme. The usual method of identifying resistant clones through inoculation test is still the reliable method. (Flores, *et al.*, 2009). The percentage smut infection increased up to sixth months and showed a decreasing trend towards cane maturity (Mendoza 1971) [12]. The method of artificial inoculation by immersion of cutting in suspension of smut spores of sugarcane was found to be effective to evaluate the resistance against smut in experimental material of sugarcane (Briceno *et al*., 2005) [8]. It is confirmed from the present study that the sources of resistance against whip smut are available in sugarcane which can be utilized in breeding programme for evolution of new high yielding sugarcane varieties coupled with resistance to whip smut (Afghan *et al*., 1995; Begum *et al*., 2007; Sabalpara and Vaishnav, 2002 and Ali Khan *et al*., 2009) [1, 7, 16, 3]. The resistant germplasm against whip smut of sugarcane plays a key role for evolution of resistant varieties through breeding programme (Begum *et al*., 2007) [7].

The data pertaining to incidence of borer in sugarcane was recorded and presented in table 2. It is seen from the data that least incidence of early shoot borer was recorded on PDN 18008 (9.92%). All the test genotypes (PDN 18005, PDN 18008, PDN 18014, PDN 18016, PDN 18022 and PDN 18025) along with checks recorded less susceptible reaction to ESB. While in case of incidence of internode borer, genotype CoM 0265, observed moderately susceptible and remaining genotypes showed highly susceptible reaction to internode borer. The incidence to top shoot borer was not seen throughout the crop season and eventually showed less susceptible reaction.

Similar observation were recorded by Sing and Madan (2002) reported that 12 genotype were graded as tolerant, 39 as moderately tolerant, 34 as susceptible and 8 as highly susceptible with top borer based on graded per cent incidence. In case of shoot borer incidence which was varied from 5.51 to 12.64% and on the basis of rating of shoot borer, all genotypes showed less susceptible reaction. Chand *et al.*, (2010) [22] reported that the incidence of shoot borer ranged from 6.66 to 15.10%. Abdullah (2008) also reported that low infestation of shoot borer. Kumbhar *et al*, (2018) [23] found that, the minimum (12.35%) and maximum (19.55%) infestation of dead hearts of early shoot borer in crop plant varieties CoSe 95422 and CoSe 09451, respectively while minimum (2.25% and 14.85%) and maximum (6.45% and 20.64%) infestation of root borer and top borer were recorded in different varieties, CoP 08436 and CoSe 09451 respectively.

Table 1: Response of sugarcane genotypes to against whip smut and borer pest

S. N.	Genotypes	Smut %	Reaction	Early Shoot Borer		Internode Borer		Top Shoot Borer	
				% Cumulative Infestation	Reaction	% Incidence	Reaction	% Incidence	Reaction
1	PDN 18005	0.00	R	11.17 (19.47)	LS	46.67 (43.08)	HS	00.00 (00.00)	LS
2	PDN 18008	16.67	MS	9.92 (18.15)	LS	46.67 (42.99)	HS	00.00 (00.00)	LS
3	PDN 18014	0.00	R	9.99 (18.35)	LS	76.67 (65.85)	HS	00.00 (00.00)	LS
4	PDN 18016	0.00	R	9.84 (18.07)	LS	40.00 (38.85)	HS	00.00 (00.00)	LS
5	PDN 18022	0.00	R	10.08 (18.15)	LS	43.33 (41.07)	HS	00.00 (00.00)	LS
6	PDN 18025	0.00	R	10.50 (18.74)	LS	43.33 (41.07)	HS	00.00 (00.00)	LS
7	CoM 0265	0.00	R	12.11 (20.32)	LS	30.00 (33.21)	MS	00.00 (00.00)	LS
8	Co 86032	0.00	R	11.07 (19.19)	LS	46.67 (42.99)	HS	00.00 (00.00)	LS
12	Co C 671	0.00	R	11.52 (20.79)	LS	50.00 (45.08)	HS	00.00 (00.00)	LS
9	Co 740	20.52	S	11.23 (19.52)	LS	70.00 (62.01)	HS	00.00 (00.00)	LS
10	Co 7219	10.25	MS	12.56 (20.65)	LS	53.33 (47.71)	HS	00.00 (00.00)	LS
11	Co 7527	12.50	MS	12.11(20.32)	LS	63.33 (53.15)	HS	00.00 (00.00)	LS

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