Advances in Crop Science and Technology
ISSN: 2329-8863

Lemma et al., Adv Crop Sci Tech 2015, 3:4
http://dx.doi.org/10.4172/2329-8863.1000181

Research Article Open Access

Study on the Reaction of Sugarcane Genotypes (CIRAD-2011) to Sugarcane Smut (*Sporisorium scitamineum*) in the Ethiopian Sugarcane Plantations

Abiyot Lemma[1]*, Hadush Hagos[1], Yohannes Zekarias[2] and Amrote Tekle[1]

[1]*Ethiopian Sugar Corporation Research and Training P.o.box 15, Wonji, Ethiopia*
[2]*Bayer Trade Representative Office P.o.box 1/1065, Addis Ababa, Ethiopia*

Abstract

Sugarcane smut disease caused by the fungus *Sporisorium scitamineum* significantly reduces the yield and quality of sugarcane. Study on the reaction of thirty one newly imported genotypes from CIRAD was conducted to evaluate their reaction to sugarcane smut at Metahara sugarcane plantation. The findings of this study were based on collection of sugarcane smut spores, testing the viability of the spore and inoculating the tested material by immersing in the spore suspension (5 x 10^6 spores ml^{-1}) for 30 minutes. During the course of the experiment, data on smut stool count begins six weeks after planting and continues at 10-day intervals till ten months after planting. Evaluation of genotypes for resistance to smut was made based on percentage of infected stools by using a 0-9 disease rating scale. Among the tested materials, no genotypes were shown an immune reaction to the Ethiopian sugarcane smut isolates. While about 81.3% of genotypes have shown from moderately resistant to very highly resistant reaction in which 21.9%, 9.4%, 21.9% and 28.1% were Very Highly Resistant (VHR), Highly Resistant (HR), Resistant (R) and Moderately Resistant (MR) reactions to sugarcane smut respectively. 18.7% of genotypes were shown Intermediate (I) (3.1%), Susceptible (S) (6.25%) and Very highly susceptible (VHS) (9.4%) reactions, so that these genotypes PSR 97 051 (I), FG 02 551 (S), FG 03 396 (S) FG 06 729 (VHS), FG 03 173 (VHS), and FG 03 526 (VHS), won't be considered as promising genotypes which can competently resist to sugarcane smut in the country.

Keywords: Reaction; Sugarcane genotypes; CIRAD-2011; Sugarcane smut; *Sporisorium scitamineum*

Introduction

Sugarcane smut is caused by *Sporisorium scitamineum*, a basidiomycetous fungus that exists in several physiologic races [1,2]. It is believed to be originated in Asia and spread slowly to other continents through Africa in the late nineteenth and early twentieth [3]. *S. scitamineum* is one of the most prevalent diseases and it has been responsible for the demise of several leading varieties [4-6]. This disease was first reported in Ethiopia with the commencement of commercial sugarcane plantation at Wonji Shoa in the early 1950's [7]. Since then, it spreads to other newer sugarcane commercial farms and is threatening the sugar industry due to its effect on cane yields.

Symptoms of sugarcane smut include black whip-like structures from terminal meristem or meristems of lateral buds of infected stalks [8]. On maturity, the whip raptures and frees millions of tiny black spores which are then disseminated by wind. Other symptoms include smutted side shoots, stem galls, grassy stools, bud proliferation, general reduction in plant size, and increased tillering [1,9,10]. Perpetuation of the smut pathogen occurs through planting diseased seed cane. In plant cane, smut infection usually remains latent in the buds of underground stubble. When such buds are harvested, the shoots that come up bear smutted whips [1]. 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 by rain or irrigation water where they can cause new infections to cane [1].

Smut reduces the yield and quality of sugarcane. Reduction in yield and quality varies widely in different sugarcane growing areas of the world and is mainly dependent on the races of the pathogen present, the sugarcane genotypes and the prevailing environmental conditions [11]. Estimates of economic losses have ranged from negligible to levels serious enough to threaten the agricultural economy of an area [11]. Sandhu et al. [4] was reported, sugar cane smut can cause 12%–75% yield losses. Lee Lovick [11], was also mentioned, a total crop failure may possible if susceptible genotypes are used and conditions are favorable for infection. In Ethiopia sugarcane smut causes 19.3 to 43% in sugar yield and 30 to 43% in cane yield [12], the total monetary loss due to this disease in the older sugar estates of Ethiopia was estimated to about ten million birr per year [13]. According to Firehun et al. [13] Smut in Ethiopia led to the discontinued cultivation of varieties like Co 419 and NCo 310.

The most efficient and economic method for disease control, including sugarcane smut, is the use of resistant varieties [14-16]. The efforts made by the Research and Training of Ethiopian Sugar Corporation to attain high-yielding, disease-resistant *Saccharum* spp. which can be introduced for commercial production and to introduce *Saccharum* spp. hybrid clones with particular attributes for breeding program results with continuous use of introduced germplasm mainly from CIRAD and other organizations and institutes abroad. About 165 genotypes in four batches have been imported from CIRAD during 2011 – 2015. After the quarantine precautions are being exercised in closed quarantine at Worer center of EIAR [Ethiopian Institute of Agricultural Research], 31 genotypes from the first batch [CIRAD

***Corresponding author:** Abiyot Lemma, Ethiopian Sugar Corporation Research and Training P.o.box 15, Wonji, Ethiopia, Tel: +251925279507; E-mail: alemma2009@gmail.com

Received April 23, 2015; **Accepted** August 06, 2015; **Published** August 12, 2015

Citation: Lemma A, Hagos H, Zekarias Y, Tekle A (2015) Study on the Reaction of Sugarcane Genotypes (CIRAD-2011) to Sugarcane Smut (*Sporisorium scitamineum*) in the Ethiopian Sugarcane Plantations. Adv Crop Sci Tech 3: 181. doi:10.4172/2329-8863.1000181

2011] have evaluated for their reaction to smut at Metehara Sugarcane Plantation Farm.

Objective

To evaluate the reaction of sugarcane genotypes [CIRAD-2011] to sugarcane smut

Materials and Methods

Study on reaction of the newly imported genotypes to sugarcane smut was conducted in Metahara sugarcane plantation during 2014/15 cropping seasons. From the test genotypes, stalks were cut from 10 month-old seed cane nursery. The leaves were detached from the stalks to expose buds and then cut into single-budded setts. To swell up the buds and ensure their susceptibility, the tested materials were incubated for an overnight in a polythene bag filled with a liter of water following the procedures of Bock [17].

Sugarcane smut spore were collected from infected fields of Metehara sugarcane plantation commercial farm, and its viability were tested before it was used for inoculation. The incubated setts were immersed in the spore suspension [5 x 10^6 spores ml^{-1}] for 30 minutes (Lee-Lovick, 1978). To create favorable condition for infection, the inoculated setts were again incubated in a polythene bag filled with a liter of water just after inoculation [17].

A day after inoculation, the planting material were planted in Randomized Complete Block Design [RCBD] with three replications in the field number "OR 19C of Metehara Sugarcane Plantation". Plot size was six furrows of 6 m length each, i.e. 52.2 m^2. In the course of the experiment, all cultural practices remain the same as recommended for commercial sugarcane production.

During the course of the experiment, data on smuted stool count/observation begins six weeks after planting and continues at 10-day intervals till ten months after planting. Total number of stool count was taken at four months after planting. After recording smut-affected stools, they were uprooted and buried at the edge of the field. Then, evaluation of genotypes for resistance to smut was made based on percentage of infected stools by adopting the scale used by Latiza et al [18] (Table 1).

Infected stools (%)	Disease rating	Reaction group
0	0	Immune
0.1 – 2.5	1	Very highly resistant (VHR)
2.6 – 5.5	2	Highly resistant (HR)
5.6 – 7.5	3	Resistant (R)
7.6 – 12.5	4	Moderately resistant (MR)
12.6 – 15.5	5	Intermediate (I)
15.6 – 18.0	6	Moderately susceptible (MS)
18.1 – 22.5	7	Susceptible (S)
22.6 – 25.5	8	Highly susceptible (HS)
25.6 – 100	9	Very highly susceptible (VHS)

Table 1: Disease rating scale [18].

S/N	Genotypes	Infected Stool Incidence (%)	Disease rating	Reaction
1	FG 06 729	36.1	9	VHS
2	FG 03 204	1.8	1	VHR
3	FG 04 187	10.7	4	MR
4	FG 06-700	3.1	2	HR
5	CP 00 1252	6.9	3	R
6	FG 03 103	7.9	4	MR
7	DB 700 47	11.6	4	MR
8	TCP 93 4245	1.8	1	VHR
9	FG 03 318	11.5	4	MR
10	PSR 97 051	12.6	5	I
11	HO 95 988	11.0	4	MR
12	FG 03 173	40.4	9	VHS
13	FG 03 447	6.0	3	R
14	FG 02 551	18.6	7	S
15	CP 99 1534	5.8	4	MR
16	B52/298	8.2	4	MR
17	FG 02 553	8.9	4	MR
18	FG 03 418	2.8	2	HR
19	CP 99 1894	0.2	1	VHR
20	FG 03 396	19.2	7	S
21	PSR 97 087	4.7	3	R
22	FG 03 425	6.6	3	R
23	FG 03 214	1.3	1	VHR
24	PSR 97092	7.4	3	R
25	FG 03 372	5.4	3	R
26	FG 04 708	0.5	1	VHR
27	VMC 95 212	0.8	1	VHR
28	VMC 95 173	11.3	4	MR
29	FG 04 705	2.8	2	HR
30	FG 04 829	6.9	3	R
31	FG 03 526	31.4	9	VHS
32	FG 04 754	2.2	1	VHR

Table 2: Reaction of CIRAD 2011 genotypes to Smut.

Result and Discussion

A total of 32, thirty one genotypes of CIRAD 2011 and one widely grown commercial check cultivar, which were planted during 2014, had shown variable reaction to sugarcane smut isolates at Metehara Commercial sugarcane plantation farm. Among these, no any material was shown an immune reaction to the Ethiopian sugarcane smut isolates. While about 81.3% of the tested materials have shown from moderately resistant to very highly resistant reaction in which 21.9%, 9.4%, 21.9% and 28.1% were Very Highly Resistant (VHR), Highly Resistant (HR), Resistant (R) and Moderately Resistant (MR) reactions to sugarcane smut respectively. Genotypes like FG 06 729, FG 03 526 and FG 03 173 which have imported to the country with import certificate information of resistant reaction to sugarcane smut have found to be very highly susceptible to the Ethiopian sugarcane smut isolates (Table 2). Likewise genotypes PSR 97 051 (intermediate), FG 02 551 (susceptible) and FG 03 396 (susceptible) had brought to the country with moderately resistant, intermediate and resistant reactions information respectively. Different sugarcane cultivars in the world may react differently to sugarcane smut isolates. For example cultivar H50-7209 is susceptible to smut in South Africa, but resistant in Taiwan [19]. NCo376 which has been considered as resistant cultivar in China [20], is out of production due to its high susceptibility to sugarcane smut in the Ethiopian Sugarcane plantation [13]. Unlike the varietal reaction information in the import certificate, this study has shown that about 16.1% of the test genotypes have not competently resist to the Ethiopian sugarcane smut isolates. In general, 18.7% of the tested materials in this study were shown intermediate (3.1%), susceptible (6.25%) and very highly susceptible (9.4%) reaction (Table 2) so that these genotypes will not be considered as promising genotypes which can competently resist to sugarcane smut in the country.

Conclusion and Recommendation

Thirty one genotypes of CIRAD 2011 and one widely grown commercial check cultivar, a total of 32 genotypes, which were planted during 2014, had shown variable reaction to sugarcane smut. Among these, no any material was shown an immune reaction to the Ethiopian sugarcane smut isolates. While about 81.3% of the tested materials have shown from moderately resistant to very highly resistant reaction in which 21.9%, 9.4%, 21.9% and 28.1% were very highly resistant (VHR), highly resistant (HR), resistant (R) and moderately resistant (MR) reactions to sugarcane smut respectively. 18.7% of genotypes were shown intermediate (PSR 97 051), susceptible (FG 02 551, FG 03 396) and very highly susceptible (FG 06 729, FG 03 173, FG 03 526) reaction, so that these genotypes won't be considered as promising genotypes which can competently resist to sugarcane smut in the country.

References

1. Agnihotri VP (1983) Diseases of Sugarcane. Oxford and IBH Publishing Company. 65-86.
2. Anon (1984) National Sugar Research Centre (NSRC) Annual Report. 41-42.
3. Elston DA, Simmonds W (1988) Models of sugarcane smut disease and their implications for testing variety resistance. Journal of Applied Ecology 25: 319-329.
4. Sandhu SA, Bhatti DS, Rattan BK (1969) Extent of losses caused by red (Physalosporatucumane NSis Speg.) and smut (Sporisorium scitamineum Syd) Journal of Research 6: 341-344.
5. Whittle AM (1982) Yield loss in sugar-cane due to culmicolous smut infection, Tropical Agriculture 3: 239-242.
6. Hoy JW, Hollier CA, Fontenot DB, Grelen LB (1986) Incidence of sugarcane smut in Louisiana and its effects on yield. Plant Disease 70: 59-60.
7. Anonymous (1986) A report on Agricultural Research and Services Project. Ethiopian Sugar Corporation Vol I, Agrima Project Engineering & Consultancy Services. Bombay, India.
8. Ferreira SA, Comstock JC (1989) In: Diseases of sugarcane. Major Diseases.
9. Ricaud CBT, Grishan MP (2001) an international project on genetic variability within sugarcane smut Proc. Int Soc Sugar Technol 24: 459-461.
10. Rott P, Bailey A, Comstock JC, Croft BJ, Sauntally AS (2000) A guide to sugarcane diseases. Published by CIRAD and ISSCT. 339.
11. Lee-Lovick G (1978) Smut of sugarcane-Sporisorium scitamineum. Review of Plant Pathology 147: 181-188.
12. Abera T, Mengistu H (1992) Effect of smut on yield of sugarcane in Ethiopia. Proceedings of the joint conference Ethiopia Phytopathological Comitee and Comitee of Ethiopian Entomologists.
13. Firehun, Abera YT, Yohannes Z, Leul M (2009) Hand book for Sugarcane Pest Management in Ethiopia, Ethiopian Sugar Development Agency Research Directorate.
14. Villalon B (1982) Sugarcane smut in lower Rico Grande Valley of south Texas. Plant Dis 66: 605-606.
15. Pruett CJH, Waller JM (1989) A report on sugarcane diseases in the Santa Cruz area of Bolivia. Sugar Azucar 84: 35-37.
16. Phelps RH, Donelan AF (1991) Disease and other problems affecting sugarcane cultivar change in Tridinad and Tobago 1975 to 1989. In: Proceedings of the 24th West Indies sugar Technologist' Conference, Kington, Bridgetown, Barbacaos, April 8-12 (Sugar Association of the Caribbean (1989) Caroni Research Station, carapichaina, Tridinad) 88-95.
17. Bock KR (1964) Studies on sugar-cane smut (Sporisorium scitamineum) in Kenya. Trans Br Mycol Soc 47: 403-417.
18. Latiza AS, Ampusta DC, Rivera JR (1980) Reaction of sugarcane clones to strain B of Sporisorium scitamineum syd. Int Soc Sugarcane Technology 2: 1456-1462.
19. Nzioki HS, Jamoza JE, Olweny CO, Rono JK (2010) Characterization of physiologic races of sugarcane smut (Sporisorium scitamineum) in Kenya. African Journal of Microbiology Research 4: 1694-1697.
20. You-Xiong Q, Jian-Wei L, Xian-Xian S, Xu Li-Ping, Ru-Kai C (2011) Differential Gene Expression in Sugarcane in Response to Challenge by Fungal Pathogen Sporisorium scitamineum Revealed by cDNA-AFLP. Journal of Biomedicine and Biotechnology 2011: 10.

Citation: Lemma A, Hagos H, Zekarias Y, Tekle A (2015) Study on the Reaction of Sugarcane Genotypes (CIRAD-2011) to Sugarcane Smut (*Sporisorium scitamineum*) in the Ethiopian Sugarcane Plantations. Adv Crop Sci Tech 3: 181. doi:10.4172/2329-8863.1000181