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SCREENING OF PHIL 2016 SERIES FOR RESISTANCE TO SUGARCANE SMUT (*SPORISORIUM SCITAMINEUM*)

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ABSTRACT

Genetic resistance offers the most effective and cheapest technique to control the spread of sugarcane smut and to prevent economic losses. Thus, thirty clones from Phil 2016 Series were subjected to resistance screening trials. Canepoints were dip inoculated with smut spores and were planted in randomized complete block design (RCBD) with three replications. Smut incidence were monitored for seven months. Level of resistance was determined using percent incidence and its corresponding rating in a standard rating scale. Nine clones were consistent highly resistant to very highly resistant from plant cane until the first ratoon. Phil 16-114-1085, 85-0647, 82-0619, 78-0539, 79-0583, 79-0579, 76-0515, 93-0695, and 52-0373 were selected. However, seven more clones were resistant until ratoon canes. Phil 16-115-1121, 104-0955, 104-0965, 99-0773, 145-1277, 78-0573, and 98-0755 may also be recommended for selection. The result of the trial would be consolidated to the data of other variety tests to select smut-resistant and high yielding clones for commercialization.

INTRODUCTION

Sugarcane smut, caused by the fungus *Sporisorium scitamineum*, is considered as one of the major diseases of sugarcane in the Philippines. Disease development begins with the pathogen's penetration through the buds, followed by its systemic growth and the conversion of the cane's terminal axes into a dark, whip-like structure which contains its spores (Wada, 2003). Aside from this apparent symptom, stunting and death are also some of smut's symptoms. Hence, it can reduce cane yield by 20-50%, with a corresponding sugar loss of 75% (Singh et al., 2019)

Existing control measures for sugarcane smut includes subjecting the canepoints to hot water treatment (52°C for 30 min) with chemical fungicide, 0.1% triademiphon (Dela Cueva et al., 2020). However, small planters usually lack the required facilities for this kind of treatment. Other cultural practices, such as roguing of infected standing canes, deep plowing, and irrigating, are usually costly and laborious. Thus, planting resistant varieties proves to be the most effective method to control the infection of sugarcane smut (Bhuiyan et al., 2021).

Continuous screening of resistance among new varieties is essential to address problems in the evolution of smut strains and avoid the rapid breakdown of resistance (Ramesh Sundar, 2012). Hence, Smut Resistance Screening Test is a standard procedure annually conducted by Sugar Regulatory Administration's (SRA) researchers to continuously monitor the responses of new clones to smut. Resistant clones will be further studied for their potential to become new commercialized varieties.

OBJECTIVE

General Objective:

The screening was conducted to evaluate the resistance of 2016 series of sugarcane clones to smut and consolidate the result with the corresponding data on other ecological and yield tests.

Specific Objectives:

1) To provide data on reactions of clones to sugarcane smut;
2) To determine clones that are resistant against smut pathogen

METHODOLOGY

Preparation of Inoculum

Whips were collected from smut-infected canes and were pulverized. Then, they were placed in buckets of water to prepare the spore solution.

Thirty clones from Phil 2016 Series were prepared for inoculation (Table 1). Three-eyed canepoints were all dipped in the spore suspension for 15 min. Then, the canepoints were incubated inside sacks for 24h.

Planting

The study was laid-out in randomized complete block design (RCBD), with three replications, in the experimental area of Luzon Agricultural Research and Extension Center (LAREC). Canepoints were planted in six-meter row to represent one clone. One hundred canepoints were planted per clone.

Data Collection

Collection of incidence data was done monthly until the 7^{th} month after planting (MAP). Incidence data were determined based on the presence of whip per stool. Percent incidence was computed as

$$\% \text{ incidence} = \frac{no.of\ infected\ stools}{no.of\ germinated\ canes}\ x\ 100$$

Resistant clones were selected based on the standard rating scale (Hutchinson, 1970) (Table 2). The screening process was repeated until the first ratoon cane.

Table 1. List of Phil 2016 clones to be screened for smut resistance and their corresponding parentage.

NO.	CLONES		PARENTAGE		
1	Phil 2016	105-1039	Phil 80-5619	x	Phil 97-512-3161
2	Phil 2016	120-1147	Phil 97-0687	x	Phil 06-2289
3	Phil 2016	145-1281	Q 96	x	Phil 99-1793
4	Phil 2016	123-1173	Q 102	x	Phil 97-512-3161
5	Phil 2016	83-0627	Phil 79-161-1497	x	Phil 97-0687
6	Phil 2016	115-1121	Phil 8715	x	Phil 97-0687
7	Phil 2016	104-0955	Phil 80-5613	x	Phil 04-1011
8	Phil 2016	104-0965	Phil 80-5613	x	Phil 04-1011
9	Phil 2016	102-0891	Phil 97-0687	x	Phil 97-512-3161
10	Phil 2016	154-1335	Phil 93-236-3301	x	Phil 8723
11	Phil 2016	99-0773	Phil 91-143-1091	x	Phil 04-1011
12	Phil 2016	145-1277	Q 96	x	Phil 99-1793
13	Phil 2016	186-1373	Phil 80-0635	x	Phil 06-223-1899
14	Phil 2016	124-1213	Phil 6607	x	Phil 93-190-2349
15	Phil 2016	114-1085	Phil 80-5613	x	Phil 97-512-3161
16	Phil 2016	85-0647	Phil 85-23-4345	x	Phil 04-1011
17	Phil 2016	82-0619	Phil 7115	x	Phil 04-1011
18	Phil 2016	78-0539	Phil 97-0687	x	Phil 91-142-1091
19	Phil 2016	78-0573	Phil 97-0687	x	Phil 91-142-1091
20	Phil 2016	79-0583	Phil 97-0687	x	Phil 92-44-0751
21	Phil 2016	79-0579	Phil 97-0687	x	Phil 92-44-0751
22	Phil 2016	76-0515	Phil 8717	x	Phil 97-0693
23	Phil 2016	93-0695	Phil 86-130-1157	x	Phil 97-2041
24	Phil 2016	98-0755	Phil 91-120-0909	x	Phil 97-512-3161
25	Phil 2016	75-0469	Phil 86-130-1157	x	Phil 97-0687
26	Phil 2016	90-0673	Phil 04-1011	x	Phil 97-0693
27	Phil 2016	90-0669	Phil 04-1011	x	Phil 97-0693
28	Phil 2016	99-0781	Phil 91-143-1091	x	Phil 04-1011
29	Phil 2016	100-0811	Phil 93-118-1207	x	Phil 97-512-3161
30	Phil 2016	52-0373	Phil 09-07-0097	x	Phil 97-0693

Table 2. Smut Resistance Rating Scale.

Incidence (%)	Description of Reaction
1.0 - 2.5	Very Highly Resistant
2.6 - 5.5	Highly Resistant
5.6 - 7.5	Resistant
7.6 - 12.5	Intermediate Resistant
12.6 - 15.5	Intermediate Average
15.6 - 17.9	Intermediate Susceptible
18.0 - 22.5	Susceptible
22.6 - 25.6	Highly Susceptible
25.7 and above	Very Highly Susceptible

RESULTS AND DISCUSSION

Responses of the tested clones showed inconsistencies on both plant and ratoon cane (Table 3). Majority of clones showed declining resistance during ratoon cane. This observation was expected due to the systemic nature of disease and the accumulation of pathogen population (Keane & Kerr, 2005; Ramesh Sundar, 2012). Thus, the diseased plant canes were anticipated to remain infected as ratoon canes while previously healthy ones were still being infected by the disease. Improving resistance during ratoon canes may be attributed to variations between the germination and stool counts.

For stricter selection, only clones that were able to remain highly resistant until the first ratoon were selected: Phil 16-114-1085, 85-0647, 82-0619, 78-0539, 79-0583, 79-0579, 76-0515, 93-0695, and 52-0373 (Table 3). However, seven more clones which were resistant as plant/ratoon canes may be considered: Phil 16-115-1121, 104-0955, 104-0965, 99-0773, 145-1277, 78-0573, and 98-0755. Hence, sixteen (16) clones may be recommended for further trials. Four clones obtained Very Highly Resistant ratings which they maintained until first ratoon: Phil 16-114-1085, 85-0647, 82-0619, and 93-0695.

The concept behind resistance trials is the presence of genetic resistance where certain genes may produce preformed defenses or the more complicated, induced defenses. One example of preformed defense against sugarcane smut is bud resistance (Ramesh Sundar, 2012). Buds with tightly enclosed scales prevent the pathogen infection more effectively. When infection starts, certain chemical signaling also occur as part of induced defenses, which express hormones, enzymes, defense-related proteins, and other chemicals to suppress pathogen infection (Tabassum & Blilou, 2022).

Table 3. Reactions of the clones against sugarcane smut.

No.	Clones			PLANT CANE		RATOON CANE	
				Incidence (%)	Description	Incidence (%)	Description
1	Phil 16	105-1039		8.2	Intermediate Resistant	2.2	Very Highly Resistant
2	Phil 16	120-1147		25.7	Very Highly Susceptible	8.1	Intermediate Resistant
3	Phil 16	145-1281		10.5	Intermediate Resistant	10.5	Intermediate Resistant
4	Phil 16	123-1173		12.5	Intermediate Resistant	0.0	Very Highly Resistant
5	Phil 16	83-0627		9.1	Intermediate Resistant	9.1	Intermediate Resistant
6	Phil 16	115-1121	*	5.4	Highly Resistant	5.9	Resistant
7	Phil 16	104-0955	*	6.1	Resistant	3.0	Highly Resistant
8	Phil 16	104-0965	*	6.7	Resistant	3.0	Highly Resistant
9	Phil 16	102-0891		7.7	Intermediate Resistant	34.6	Very Highly Susceptible
10	Phil 16	154-1335		2.4	Very Highly Resistant	7.9	Intermediate Resistant
11	Phil 16	99-0773	*	2.3	Very Highly Resistant	7.0	Resistant
12	Phil 16	145-1277	*	5.4	Highly Resistant	6.5	Resistant
13	Phil 16	186-1373		10.5	Intermediate Resistant	6.5	Resistant
14	Phil 16	124-1213		10.4	Intermediate Resistant	13.3	Intermediate Average
15	Phil 16	114-1085	**	2.0	Very Highly Resistant	0.0	Very Highly Resistant
16	Phil 16	85-0647	**	2.3	Very Highly Resistant	0.0	Very Highly Resistant
17	Phil 16	82-0619	**	2.6	Very Highly Resistant	0.0	Very Highly Resistant
18	Phil 16	78-0539	**	0.0	Very Highly Resistant	4.2	Highly Resistant
19	Phil 16	78-0573	*	5.9	Resistant	0.0	Very Highly Resistant
20	Phil 16	79-0583	**	2.3	Very Highly Resistant	4.2	Highly Resistant
21	Phil 16	79-0579	**	4.8	Highly Resistant	4.7	Highly Resistant
22	Phil 16	76-0515	**	2.7	Highly Resistant	5.3	Highly Resistant
23	Phil 16	93-0695	**	0.0	Very Highly Resistant	0.0	Very Highly Resistant
24	Phil 16	98-0755	*	5.7	Resistant	2.9	Highly Resistant
25	Phil 16	75-0469		7.7	Intermediate Resistant	6.0	Resistant
26	Phil 16	90-0673		16.1	Intermediate Susceptible	22.6	Highly Susceptible
27	Phil 16	90-0669		11.1	Intermediate Resistant	12.1	Intermediate Resistant
28	Phil 16	99-0781		12.1	Intermediate Resistant	10.3	Intermediate Resistant
29	Phil 16	100-0811		29.6	Very Highly Susceptible	16.0	Intermediate Susceptible
30	Phil 16	52-0373	**	5.0	Highly Resistant	2.6	Highly Resistant

**Consistent highly resistant until first ratoon
*Resistant until first ratoon

CONCLUSION

After undergoing, Smut Resistance Screening Trials, nine out of 30 clones from the Phil 2016 Series were labelled as resistant: Phil 16-114-1085, 85-0647, 82-0619, 78-0539, 79-0583, 79-0579, 76-0515, 93-0695, and 52-0373; whereas, seven more clones can be considered as they were intermediate resistant until first ratoon: Phil 16-114-1085, 85-0647, 82-0619, and 93-0695. This data shall be consolidated with other trials to determine the clones' potential to be commercialized as high yielding varieties (HYVs).

The recurrent development of new smut variants requires researchers to continue studies on breeding and screening trials. This evolution of the pathogens may result to increased pathogenicity that will make previously resistant varieties susceptible. However, it is important to consider the existing environmental conditions in the experimental area as it is a major factor in the disease triangle.

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