

NEW RACE OF SUGARCANE SMUT ON MAUI

S. Schenck

Summary

Smut disease of sugarcane is caused by a fungus, *Ustilago scitaminea*. It is transmitted by airborne spores that are produced from a whiplike structure. The spores germinate in wet conditions on the plant surface and infect the plant through the buds (eyes). The fungus grows systemically in the plant without obvious symptoms and is spread in infected stalk seed pieces. In Hawaii, the disease is kept under control by giving seed a short hot water treatment, monitoring seed fields, and discarding varieties from the breeding program that have susceptibility ratings of 6 or over.

The commercial varieties range from completely resistant to moderately susceptible. One variety considered to be completely resistant was H78-7750. This had never been seen to become infected with smut. However, in 2001 several seed fields on Maui were observed to have smut whips. It was confirmed that this variety was infected with a new race of the smut fungus, but was still resistant to the old smut race. All current commercial varieties were screened for their resistance to the new smut race. Some varieties had the same rating, some were more susceptible, and some less susceptible to the new race.

Introduction

Sugarcane smut caused by *Ustilago scitaminea* Sydow was first reported in Hawaii in 1971 (Byther et al., 1971), although it had been a serious disease in other parts of the world for many years. In susceptible varieties it can spread rapidly, cause significant yield losses and reduce cane stands to unmillable grassy stalks. In Hawaii, the disease is controlled by continued monitoring of seed fields, hot water treatment of seed and breeding for resistance; all of which add to the cost of production.

Sugarcane resistance to *U. scitaminea* appears to be the result of several characteristics and is probably determined by a number of genes (Hector et al., 1995; Lloyd & Naidoo, 1983). In addition, commercial sugarcane varieties are polyploid hybrids of several *Saccharum* species. Genetic resistance in this case does not follow the strict gene-for-gene pattern as seen in some fungal pathogen-host interactions, although differences in variety susceptibility to different smut isolates have been reported (Comstock & Heinz, 1977; Gillaspie et al., 1983; Grisham, 2001). The appearance of smut in Hawaii in 1971 caused plantations to replace susceptible varieties with more resistant ones in order to maintain productivity, but in 1976 one of the most resistant varieties, H50-7209, suddenly became widely infected (Comstock & Heinz., 1977). Based on differences in the susceptibility ratings of a series of varieties, it was determined that a second race of the fungus had appeared. Several years later another trial was carried out and differences in variety susceptibility between Hawaiian smut isolates could no longer be detected (Grisham, 2001). *Ustilago scitaminea* as well as other *Ustilago* species readily hybridize between races and even between species (Bakkeren & Kronstad, 1996). Determination of the identity of sugarcane smut races and maintenance of resistant commercial varieties has thus proven to be difficult.

In 2001, some seed fields of the completely resistant variety H78-7750 became infected. Up to 20% of stools were observed to have smut whips. It was subsequently determined that H78-7750 was susceptible to infection by smut from Maui but not by smut isolated on Oahu. This led to installation of trials to determine the susceptibility of the major Hawaiian commercial varieties to the new Maui smut isolate.

Materials and Methods

In order to confirm the existence of a new smut race based on host range, clean vegetative seed of H78-7750 was obtained from the HARC breeding station. One set was inoculated by dipping in a spore suspension of smut from H78-7750 on Maui, and another set with the "old race" of smut from Oahu. These were planted in field plots and observed for the presence of smut during the plant crop and first ratoon.

Field trials were installed on Maui and Oahu to establish the susceptibility of all current Hawaiian commercial sugarcane varieties to the new smut race. Uninfected vegetative seed from each variety was inoculated with smut spores (about 1×10^6 spores/ml) from H78-7750 and planted in field plots. The plots were observed for smut through the plant and first ratoon crops and susceptibility was rated following the standard procedure (Ladd *et al.* 1973). In the breeding program, any new sugarcane variety that has a smut rating higher than 5 is discarded, but several of the high-yielding varieties have ratings from 3 to 5. In these, the disease is controlled by careful monitoring of seed fields and hot water treatment of all seed.

Results

The results of the field trial comparing the Maui smut isolate and the "old" Oahu isolate clearly showed that H78-7750 was susceptible only to the Maui smut. Smut whips appeared in the plot inoculated with the Maui smut within six months of planting and increased in number during first ratoon. The plot inoculated with Oahu smut remained free of whips.

The susceptibility of commercial varieties observed in the Maui field trial are shown in Table 1. Varieties H65-7052, H87-4319, H87-5794, and H90-7492 were resistant to the old smut race and remained resistant to the new one also. H78-3567, that was moderately susceptible to the old smut race, has so far not become infected with the new race at all. H78-7750, H83-7061, and H88-2953 were resistant to the old smut race, but are moderately susceptible to the new race. Preliminary results in the field trial on Oahu also show H78-7750 and H83-7061 to be susceptible. The grades in Table 1 are based on HSPA Pathology Report 34 (Ladd *et al.* 1973), where S1 is completely resistant, S4-S5 are moderately susceptible, and S9 is very highly susceptible.

Table 1. Susceptibility of Hawaiian Sugarcane Varieties to the New Smut Race.

<u>Variety</u>	<u>% Infected Stools Per Plot</u>		<u>Smut Grade</u>	
	<u>Plant Crop</u>	<u>First Ratoon</u>	<u>Old Race</u>	<u>New Race</u>
H65-7052	15.9	7.7	S2	S3
H77-4643	7.7	7.7	S5	S2
H78-3567	0	0	S5	S1
H78-4153	7.1	7.1	S5	S2
H78-7750	9.0	27.3	S1	S5
H83-7061	33.3	16.7	S1	S5
H87-4319	0	0	S1	S1
H87-5794	0	0	S1	S1
H88-2953	27.3	27.3	S2	S5
H90-7492	0	0	S1	S1

Discussion

The existence of a new smut race with differences in variety susceptibility will mean that the new susceptibility ratings will have to be considered in the disease control program. The new smut race will have to be included in breeding program susceptibility screening. Varieties H78-7750 and H83-7061, which were previously resistant, now have ratings of 4 - 5 to the new smut race. This should not be a problem as long as they are monitored and the seed for planting is given short hot water treatment. We have been treating H77-4643, H78-3567, and H78-4153 in that way all along with good results. It should be kept in mind that smut resistant varieties should also be treated and monitored even though the appearance of new smut races is quite rare.

References

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