Egypt. J. Agric. Res., 72 (2), 1994.

METHODS FOR SUGARCANE SMUT CONTROL IN EGYPT

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(Manuscript received 23 November 1992)

Abstract

Tests compared the reliability of different methods used to artificially inoculated clones for their reaction to sugarcane smut. Reactions to smut were also noted for sugarcane varieties. Hot-water treatment and fungicides were also carried out.

Both the dip and wound past method gave results in testing smut resistance; however, the dip method (dipping one budded cane setts for 30 minutes in a spore suspension of 5x10 teliospores / ml water) is preferred as this method is less severe and less laborious than the wound past method.

Of the main and promising sugarcane varieties tested, G. 68/88, F153 and G. 47/84 were found to be highly resistant to smut; G. 37/85 and G. 68/84 were resistant; G. 74/96, G.T. 54/9 (C9) and G. 368/75 were moderately resistant while NCO310, E. 68/18 and F151 were highly susceptible.

Hot water treatment at 52C for 20 minutes and 50C for 2 hours were found to be more effective than other comparable treatments.

Preliminary results showed that smut is successfully by Bayleton and Benlate. The fungicides Dithane z-78 and Daconil were next in efficiency.

Treating seedcane for 2 hours in hot water 50C containing Bayleton was more effective than each treatment applied separately.

No single method is controlling smut. Therefore, an integrated approach is used for minimizing losses caused by this disease.

INTRODUCTION

Culmicolous smut of sugarcane caused by *Ustilago scitaminea* Sydow, is world wide distributed and at some times has proved to have a significant effect in the 120 sugarcane producing countries of the world. The disease was observed in Natal, South Africa 1877, by McMartin (1945). Since then the disease has been reported in all countries that lie between 20 N and 20 S of the equator, Martin *et al.* (1961). The situation for sugarcane smut was reviewed by Lee-Lovick (1978).

In Egypt, the total cultivated area of sugarcane is approximately 250.000 feddan, (from 1983 until now) and only one variety, G.T. 54/9 (C9), is in production. Culmicolous smut was firstly recorded in Egypt in 1930 and again in 1935. The appearance of smut was observed at El-Sabaaeiia in 1974 and 1975. During 1981/83 it appeared on the NCO 310 variety in Minya, Kena and Aswan Governorate. This variety was replaced by the G.T. 54/9 (C9) according to ministerial decree 1983 as a result of attacking NCO 310 severity by smut.

Planting resistant variety is the most practical and economical way to control the disease, thus screening for smut resistance is a pre requisite in breeding programmes. These finding were supported by Flores (1981), Waraitch (1982), Perez and Mauri (1983) and Abdel Fatteh (1989).

Varietal reactions to smut can be evaluated by several inoculation techniques. The most widely-used technique is the dip inoculation method (Byther and Steiner, 1974). Another inoculation technique is the wound-past technique (Leu *et al.* 1976) and the brushing chniqutee (Luthra *et al.* 1938).

Since release of a variety combining resistance to smut with better yield and other beneficial agronomic characteristics requires a number of years.

The first attempt to cure smut disease of sugarcane by hot water treatment was in 1889. Continuous use of the hot water treatment has not apparently changed the heat resistance of the disease causing organism or altered the characteristics of cane varieties. Hot-water treatment (HWT: 2 hr./50C) is well known for eliminating smut from infected seedcane (Benda, 1980; Bailey, 1983 and Farias, 1985).

Chemical control by using, Aggalol at 0.5% and Dithane z-78 at 0.3% concentration has been found effective against surface contamination, Muthusamy (1973).

Recently, Bailey (1979) suggested triadimefon (Bayleton) with hot water treatment for controlling both smus and ratoon stunting disease.

The present study was conducted to investigate the optimal way to control the sugarcane smut disease.

Trials were carried out at Giza Research Station, Pathology Section, Sugar Crops Research Institute, ARC, Giza, Egypt.

MATERIALS AND METHODS

Resistance testing methods:

Trial 1

The dip, wound-past and brushing methods were compared using pots 50 cm diameter with 10 replications. There were five buded setts per pot and the sugarcane variety was NCO 310. For the dip inoculation method (Ferreira *et al.* 1980), the cane setts were dipped in a spore suspension of 5x10 teliospores / ml of water for 30 minutes with 1 drop of tween 20/100 ml as recommended. In the wound-past method (Leu *et al.* 1976), the buds were pricked 6 times at the periphery with a fine needle and then a spore suspension of 5.0 g. teliospores/L. of water was brushed on the wound of the cane. The brushing technique (Luthra *et al.* 1938) was accomplished by atomizing a spore suspension (spray) using the same rate of teliospores.

Variety resistance testing: Two years (1990-1991).

Trial 2

Varietial resistance testing was done according to a randomized blockdesign with 10 replicates. Eleven promising and main varieties were tested, viz, G. 68/88, NCO 310, G. 74/96, E 68/18, G. 368/75, F 153, F 157, G. 37/85, G. 47/84 and G. 86/84. The dip method was used for testing.

Seed treatment:

Trial 3

Hot-water treatment (HWT) is well known for eliminating smut for infected seed cane. The sugarcane setts were treated as shown in Table 1.

The inoculated single-bud cutting (Trial 1) variety NCO 310 was planted and arranged in 10 replicated pots (5 bud/pot). Untreated checks were simultaneously planted to observe the incidence of the disease.

Table 1. Hot water treatments.

50°C·1 hour	52°C 10 minutes	54°C 5 minutes
50°C 2 hours	52°C 20 minutes	54°C 10 minutes
50°C 4 hours	52°C 30 minutes	54°C 15 minutes

Trial 4

The trial was carried out as a randomized block design with 10 replicates using the variety NCO 310. Three treatments were compared: (1) control, (2) dip method (see Trial 1), (30 immersion of the cane setts for two hours in a systemic fungicides solution, v.z., Benlate 50% 1g/L, Bavistin 50% 2.5 g/L, Bayleton 5% 2.5 g/L, protective fungicides i.e., Dithane M45% 2.5 g/L., Dithane z 78% 2.5 g/L and preventative fungicide Daconil 2.5 g/L of water prior to inoculation by dip method. The surface wetting agent was Tween 20 used at 1 drop / 100 ml.

Trial 5

Combined hot water and fungicide treatments as described in trial 3 and 4. All trials contained the following conditions:

1. Smut spores of 95 percent viability were collected from smut- infected cane.
2. The seedcane used in all experiments obtained from special nurseries at Giza and El-Mataana (Kena governorate).
3. The treated cane setts were kept overnight by incubation for 24 hours and planted the next day.
4. All the experiments were conducted in the greenhouse and planted in the spring

and summer months.

5. Infection was expressed as % infected stool. Stools showing whip symptoms were destroyed.
6. Cumulative disease incidence is calculated after 3-5 months of planting using numerical rating of 0-9, as mentioned in the following table according to the degree rating system proposed by Hutchinson (1969).

Percentage of infection stools		
Degree		Reaction
0	Highly Resistant (HR)	
1.0 - 2.0		0
2.1 - 3.0		1
3.1 - 5.0	Resistant	2
5.1 - 8.0		3
8.1 - 11.0	Moderately Resistant (MR)	4
11.0 - 15.0		5
15.0 - 22.0		6
22.0 - 30.0	Susceptible (S)	7
More than 30	Highly Susceptible (HS)	8

RESULTS AND DISCUSSION

Different factors should be done in mind while designing a programme for controlling smut disease or for drawing the rating system for evaluating smut resistance ability of the tested varieties. The treatments applied and percentage of infection are presented in Table 2.

The wound-past method gave significantly higher infection percentage com-

Table 2. Results of techniques applied for testing the pathogenecity of *U. scitaminea*.

Treatments	% Infected stools
Control	0
Dip method	34
Wound-past method	72
Atomizing spore suspension spray method	12
L.S.D. at 0.01	18.53

Table 3. Reaction of different sugarcane varieties to artificial inoculation with *U. scitaminea*.

Varieties	Reaction %	Rank	Reaction	Grade
G. 68/8	0	D	HR	0
NC.O 310	44	B	HS	9
G. 74/96	12	C	MR	5
GT. 54/9 "C9"	11	CD	MR	5
E. 68/18	72	A	HS	9
G. 368/75	11	CD	MR	5
F. 151	43	B	HS	9
F. 153	0	D	HR	0
G. 37/85	10	CD	R	4
G. 47/84	0	D	HR	0
G. 68/84	8	CD	R	4
L.S.D. at 0.01 level	10.55			

pared either the control. The dip method proved to be significant, while the atomizing spore suspension spray method was the least.

The dio method is preferable for testing the reaction of cane varieties to smut disease, however, as it appears that the woynd past method is very severe and more laborious than the other methods. Dipping is a widely and practically technique by different authors, By the and Steiner (1974) and Ferreira *et al.* (1980).

In Trial, II, the resistance of 11 commercial and promising varieties, viz, G. 68/88, NCO 310.

Gt. 54/9 "CO", E 68/18, G. 368/75, F 153, F 151, G. 37/85, G. 47/84 were tested according to the dip method as described in Trial 1.

As the disease cannot be completely controlled by fungicides and cultural practices, the use of resistant varieties is the only alternative method. Regular screening of varieties is the only alternative method. Regular screening of varieties G. 68/88, NCO 310, G. 74/96, GT. 54/9 "C9", E 68/18, G. 368/75, F 153, F 151 and primising lines G. 37/85, G. 47/84 and 68/84 is being done in the greenhouse. Differential behaviour of smut has been observed. The results are recorded in Table 3. It is evident that three colones, namely G. 68/88, F 153 and G. 47/84 were highly resistant to smut. Of the remaining clones two varieties were rated as resistant, three as moderately resistant, and three as highly susceptible, Table 3.

Such variation indicates the presence of a genetical source of resistance among the tested cane varieties which can be utilized in a breeding programme for successful control.

Hot water treatment against smutted setts had been tried. Several treatments were compared, (Table 1) to determine their efficiency in controlling smut disease. It is clear from the data in Table 4, that hot water treatment at 52 C for 20 minutes or 50 C for 2 hours was more effective than other treatments. Benda (1981) found an intermediate length of time (52 C for 30 to 45 min.) to control smut disease.

Moreover, there was appreciable reduction in the germination percentage of the other treated setts.

Survival of cuttings used for treatments remains the critical limiting factors when considering the numerous experimental alternatives.

Table 4. Effect of hot-water treatment on sugarcane setts.

	Dipping Time	% Infection stools
50°C	1 hours	12
	2 hours	6
	3 hours	0
52°C	10 minutes	8
	20 minutes	6
	30 minutes	2
54°C	5 minutes	0
	10 minutes	0
	15 minutes	0
Control (Dipping method)		30
L.S.D. at 0.01		N.S.*

Table 5. Effect of fungicides on infected stools of sugarcane.

Treatment	% Infection stool
Bavistin + Dip.	16
Bayleton + Dip.	6
Benlate + Dip.	8
Daconil + Dip.	10
Dithane M45	12
Dithane Z78	10
Dipping method	30
L.S.D. at 0.01	N.S.

Table 6. Effect of combined hot water treatment + fungicide on percentage of infected stools of sugarcane.

Treatment	% of infected stools
ɔ0C 2 hours + Bayleton	0
52C 20 min. + Bayleton	2
Dip method (conrol)	30
L.S.D. at 0.01	N.S.

Regarding the fungicidal treatments, cumulative percentages of smut incidence are presented in (Table 5). Diptreatment of setts with fungicides, i.e. Bayleton or Benlate was highly effective in reducing smut infection in the highly susceptible sugarcane variety NCO 310 (Table 5). Bayleton recorded the least incidence of 6.0 percent, followed by 8.0 percent in Beblate. Dithane z 78 or Daconil, were also effective in minimizing the disease incidence. Handojo and Legow (1984) found that immersing two budded setts of POJ 3016 in Bayleton 250 EC 0.5 a.i./L water for 2 h. prior to dipping in spore suspension of 5x10 teliospores / ml. water during 10 min. protected the treated setts against smut infection. Also, Natarajan and Muthusamy (1981) stated that sugarcane smut can be best controlled by pre-treating the setts in Bayleton at 1 ml/L or Daconil at 2.5 g/L for 5 minutes.

Although it is possible to reduce the incidence of smut with a combination of hot water and fungicidal treatment. It gave the best response for controlling or reducing the smut incidence (Table 6).

Bailey (1979) suggested a triadimefon plus hot water treatment for controlling both smut and ratoon stunting disease. Benda (1981) developed a short hot water treatment (52 C for 20 min.) combined with fungicide which can be used as preventive treatment. Bailey (AL 1983) found that treating sugarcane for two hours in hot water 50 C containing 250 ug/ml triadimefon was more effective than a similar treatment in cold water when smut was severe. No single method alone will give promising results. Hot water treatment combined with Bayleton as an eradicative and prophylatic treatment give the best results for controlling sugarcane smut.

ACKNOWLEDGEMENT

Appreciation is extended to Dr. Saleh H. Farrag and Dr. Willis L. McCuistion for their helpful comments during the preparation of this manuscript.

Recognition is given to the National Agricultural Research Project (NAPR) for financial support to complete this research.

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طرق مكافحة مرض تفحم قصب السكر فى مصر

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قسم بحوث الافات (الامراض والحشرات) معهد بحوث المحاصيل السكرية – مركز البحوث الزراعية – الجيزة – مصر

مرض تفحم قصب السكر والمتسبب عن فطر *Ustilago scitaminea* Sydow من اهم المشاكل المرضية فى زراعة قصب السكر. فقد اجرى هذا البحث لدراسة افضل الطرق لاحداث العدوى الصناعية. كذلك تقيم الاصناف والاصناف المبشرة لقابليتها للاصابة بالتفحم ثم كيفية طرق المكافحة المختلفة باستخدام المعاملة بالماء الساخن او المبيدات وكلا المعاملتين معا.

اعطت كلا طريقتى الغمر والحقن مع حدوث جرح افضل النتائج لاختبار العدوى الصناعية وقد تميزت طريقة (غمر عقل قصب السكر والمحتوية على برعم واحد فى معلق جراثيم الفطر بتركيز ١٠٠ x ٥ لمدة ٣٠ دقيقة) افضل الطرق تقيما لاحداث الاصابة والتى استخدمت فى التجارب التالية.

اختبرت مجموعة من الاصناف الرئيسية والمبشرة ضد مرض التفحم واوضحت النتائج ان الاصناف جيزة ٨٨/٦٨ وف ١٥٣ وجيزة ٧٤/٩٦ وجيزة ٨٤/٤٧ عالية المقاومة والاصناف جيزة ٨٥/٣٧ وجيزة ٨٤/٦٨ مقاومة واصناف ج.ت. ٩/٥٤ س٩ وجيزة ٧٥/٣٦٨ متوسطة المقاومة بينما اصناف ناتال كوامباتور ٣١٠، ٦٨/١٨ و اف ١٥١ عالية الاصابة.

وجد ان المعاملة بالماء الساخن ٥٢ م لمدة ٢٠ دقيقة و ٥٠ م لمدة ٢ ساعة فعالة فى الاقلال من حدوث مرض التفحم وكذلك اظهر المبيد بيليتون وبنليت فعالية فى الاقلال من الاصابة بينما حققت المعاملة المرتبطة باستخدام الماء الساخن ٥٠ م لمدة ٢ ساعة مع مبيد بيليتون اكثر فعالية فى الاقلال من حدوث المرض.

عموما لا توجد طريقة واحدة فعالة فى الحد من مرض التفحم ولكن لا بد من استخدام المكافحة المتكاملة فى الاقلال من الضرر الناجم عن مرض التفحم فى قصب السكر.