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Varietal resistance of *Sorghum bicolor* (L.) Moench to *Sporiosorium sorghi* Link in Nigeria

P. S. Marley & D. A. Aba
Department of Crop Protection, Department of Plant Science,
Institute for Agriculture Research/Faculty of Agriculture,
Ahmadu Bello University, Samaru, Zaria, Nigeria

Abstract

Sorghum genotypes were screened for resistance to *Sporiosorium sorghi* in the screenhouse and in the field. Screenhouse trials showed ICSV 2 and ICSV 1049 to have considerable resistance while ICSV 1002 was completely immune. Field trials in 1994 and 1995 confirmed them to be resistant.

Key words: Additional sorghum, carbon, resistance

Resume

Les genotypes de sorghum étaient croisés pour la résistance au *Sporiosorium sorghi* dans la serre et dans le champ au Nigeria. Les essais en serre et au champ ont montré que ICSV 2, NSU 74 et ICSV 1049 étaient résistants tandis que ICSV 1002 était très résistant. Les essais menés au champ en 1994 et 1995 ont confirmé leur résistance.

Mots clés: Sorgho additionnels, le charbon, la résistance

Introduction

Sorghum, *Sorghum bicolor* (L.) Moench is a very important cereal crop in Nigeria. It occupies 6 million hectares which is about 46% of the total land area devoted to cereal production within the savanna zone of the country.

Diseases constitute an important production constraint under both traditional and improved farming conditions with losses estimated at about 10-12% (Selvaraj, 1980). Smuts are the

most damaging panicle diseases in Nigeria especially on unimproved cultivars, although a few improved cultivars (e.g. JNV 202, etc) are highly susceptible to covered smut (Marley, 1995a).

Covered smut caused by *Sporiosorium sorghi* Link occurs throughout sorghum-growing areas of Nigeria with grain losses of up to 50% (Keay, 1968). However, with the advent of cheap thiram-based fungicides, seed treatment is practiced by progressive small scale farmers in certain sorghum growing areas thus reducing

the incidence of the disease. Nevertheless, there appears to be an increase in the incidence of covered smut in the country. Surveys conducted between 1993 - 1995 revealed an incidence of 37 - 82.2% (Marley, 1994; 1995b; 1996). Whether the increased incidence of covered smut is due to erratic supply of agricultural inputs (Poswal and Akpa, 1991), lack of suitable seed treatment chemicals (Tarr, 1992; Zummo, 1984) or the presence of alternative hosts (Marley, 1995a) is not known. However, these factors make the development of covered smut resistance a necessary component of any disease management package against the disease.

This paper reports on results of a study to identify sources of resistance to the pathogen for use by breeders in Nigeria and elsewhere.

Materials and Methods

Sorghum genotypes and cultivation

The cultivars and lines used in this study are listed in Table 1. Due to seed shortage, some genotypes were not screened in the field either in 1994 or 1995 and were, therefore, replaced as the need arose. Screenhouse trials were conducted in pots containing field soil while field trials were carried out at the Institute of Agricultural Research (IAR) farm Samaru, Nigeria. The site was sprayed with glyphosate (Round-up, Monsanto (Irl.) Ltd, Dublin, Ireland) and 3 weeks later was ploughed to a depth of about 20 cm. The site was harrowed twice and ridged 75 cm apart. Seed was planted 30 cm apart and thinned to two plants per stand four weeks after crop emergence. Split application of fertilizer with 64 kg N/ha of N:P:K: (27:10:10) was carried out. First application

was at two weeks after emergence while the second application was carried out six weeks after crop emergence. Manual weeding was done at 3 weeks after sowing while moulding up was carried out at second fertilizer application.

Inoculation

Inoculum consisted of *S. sorghi* infected panicles that were collected during the previous growing season and kept in the laboratory under room temperature (25 - 30°C).

Table 1. List of *Sorghum bicolor* cultivars and lines screened.

Cultivar/line name	Source/country of origin
ICSV 424	ICRISAT, India
ICSV 111	"
ICSV 2	"
ICSV 1002	"
ICSV 1049	"
ICSV 554	"
ICSV 655	"
84-W-830	Burkina-Faso
84-W-848	"
84-5-130	"
16-5 BF	"
84-4 BF	"
1034 BF	"
1023 BF	"
21658 Y	"
3443	"
18455	"
BOPEN-5	"
Frikaan	Niger
Kampti GLM	"
Singe 1	"
Singe 2	"
IS 9928	ICRISAT, India
Mori Local	Nigeria
NSV 74	"

Teliospores were harvested by shaking the smutted heads in polyethylene bags to dislodge them. Debris was separated from teliospores by shaking the mixture on a 200-mesh (75 µm) sieve.

Teliospores collected were used to inoculate seeds of test sorghum cultivars and lines. This was done by coating seed of each genotype with teliospores (0.5 g/kg seed) as described by Selvaraj (1980). Inoculated seeds were planted within four hours after coating.

Screenhouse trial

Twenty of the sorghum genotypes listed in Table 1 were screened in 1993. The seeds were inoculated as described above and 10 seeds of each genotype were sown in 30 cm-diameter earthenware pots containing field soil. Each sorghum genotype was replicated three times and arranged in a randomised complete block design on the screenhouse floor. The pots were watered every other day and temperatures ranged between 25 - 30°C. Equal numbers of uninoculated seeds of each genotype served as control. Disease incidence and severity were assessed 120 days after planting when all heads had matured. Disease severity was rated on a 1 - 9 scale modified from Thakur and King (1988) where 1 = clean panicle with no infection, 2 = < 1% seeds infected/head, 3 = 1 - 5% seeds infected/head, 4 = 6 - 10% seeds infected/head, 5 = 11 - 20% seeds infected/head, 6 = 21 - 35% seeds infected/head, 7 = 36 - 50% seeds infected/head, 8 = 51 - 75% seeds infected/head, and 9 = > 75% seeds infected/head.

Field trials

Trials were established at Samaru, Zaria (11° 11'N, 70° 38' E) in the 1994 and 1995 wet seasons. Site preparation and inoculation in

both years were carried out as described above. For each genotype, the seeds were treated with teliospores as described above. Trials were planted on 17 July, 1993 and 24 July, 1994. The experiments were arranged in a randomised complete block design with two treatments viz: treated with teliospores and control (no spores). Each treatment was replicated three times with each plot made up of six ridges, 6m long and 0.75 m apart. Sixteen weeks after planting, when the plants had matured, the experiment was terminated and harvested. Disease incidence and severity were assessed as described earlier while yield was determined from the four inner rows of each plot.

Results and Discussion

In the screenhouse trial, three entries ICSV 2, ICSV 1002 and ICSV 1049 showed resistance to the covered smut pathogen (Table 2). Many of the entries such as local Mori, Kampti, Singe 1, Singe 2 and IS 9928 were highly susceptible with all the inoculated plants showing infection. Control plants did not show any symptoms.

The reaction of the various genotypes in the field are shown in Table 3. Out of the 20 genotypes screened in 1994, ICSV 2, ICSV 1002 and ICSV 1049 maintained their resistance and an additional line, NSV 74 was resistant. These genotypes maintained their resistance in 1995 (Table 4). Some of the genotypes (ICSV 2, and ICSV 1002) that showed resistance also had good yield (data not shown). The grain yield ranged between 1.7 - 2.6 tons/ha.

The identification of possible sources of resistance in the screenhouse necessitated further field screening which confirmed the resistance in some of the lines. Although Selvaraj (1980) reported the non-availability of sources of resistance in all lines screened, King (1972, 1973) identified a few lines such

Table 3. Reaction of various sorghum genotypes to *Sporisorium sorghi* under artificial inoculation, Samaru, 1994

Cultivar/line	Disease		Reaction
	% incidence	Severity	
84-W-848	76.7	8.0	HS
ICSV 554	53.9	7.1	HS
Singe 1	73.0	7.0	HS
85-4 BF	32.4	7.0	HS
Mori local	74.7	7.0	HS
ICSV 424		7.0	HS
84-W-830	51.8	7.0	HS
Kampti GLM	45.2	7.0	HS
BOPEN-5	51.1	6.8	S
ICSV 655	49.1	6.8	S
Frikaan	50.2	6.8	S
21658 Y	49.5	6.7	S
18495	36.6	6.5	S
ICSV 111	35.8	6.5	S
1034 BF	33.5	5.8	S
84-5-130	29.7	5.8	S
18-5 BF	46.2	5.7	S
IS 9928	44.7	4.9	S
3443	31.1	4.5	S
1023 BF	19.7	3.0	R
ICSV 1049	14.7	2.9	R
NSV 74	8.4	1.6	R
ICSV 2	0	1.0	HR
ICSV 1002	0	1.0	HR

HS = highly susceptible; S = susceptible; R = resistant; and HR = highly resistant.

Table 4. Reaction of various sorghum genotypes to *Sporisorium sorghi* under artificial inoculation, Samuru, 1995.

Cultivar/line	Disease		Reaction
	% incidence	Severity	
Singe 1	71.3	7.3	HS
3443	80.7	7.2	HS
Mori local	71.3	7.1	HS
ICSV 554	84.3	7.1	HS
16-5 BF	77.6	7.1	HS
ICSV 130	59.4	6.8	S
21658 Y	60.7	6.8	S
Frikaan	58.9	6.4	S
84-W-830	57.1	6.3	S
84-W-848	72.6	6.1	S
Kampti GLM	72.6	5.6	S
1023 BF	60.4	5.6	S
18495	62.0	5.5	S
ICSV 111	46.8	5.2	S
ICSV 424	35.3	3.7	S
ICSV 1049	18.5	2.3	R
NSV 74	0	1.0	HR
ICSV 2	0	1.0	HR
ICSV 1002	0	1.0	HR

as further attempts will now be made to obtain smut-resistant inbred lines for use in intercrosses to achieve stability and durability of resistance.

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Table 2. Genetic variability of various sorghum cultivars/lines to covered smut pathogen (*Sporisorium sorghi*) in the screenhouse.

Cultivar/line	Percentage of plants infected	Disease severity
ICSV 2	21	2.1
21658-Y	100	8.5
Frikaan	100	8.6
3443	100	6.9
16-5 BF	100	6.7
18495	100	8.7
ICSV 1002	0	0
Mori local	100	9.0
Singe 2	100	9.0
Kampti GLM	100	9.0
ICSV 655	100	9.0
ICSV 554	100	5.0
84-W-830	100	8.9
84-5-130	100	7.1
Singe 1	100	9.0
1023 BF	7	1.2
ICSV 1049	20	2.2
ICSV 111	100	8.9
85-4 BF	100	8.6
IS 9928	100	9.0

Data are means of three replicates

as IS 9290, CK x 299 b 6, FFBL 3-1-6, line 453, SKMDW - 2347, Durra selection, Spur Feterita and Kafir x Feterita to show resistance. Our current effort to develop improved sorghum cultivars with resistance to *S. sorghi* has shown that some materials have either complete immunity or possess considerable resistance. Similarly, recent work in USA has shown the availability of some sources of resistance in lines B35-6, SC414 and Sureno (Claffin and Leslie, 1993). In Burkina Faso, similar efforts have shown sorghum lines ICSV 2, ICSV 111, Gnofing, E35-1, Tougan, Fiyimaiga and

Sariasso 03, 04, 05, 07, 08, 09 and 10 to be immune to covered smut (Dr. L. Quedraogo, Personal communication). Earlier reports by Mathur *et al.* (1964, 1970), Adlakha and Munjal (1966), Singh and Yadav (1966), and Ranganathiah and Govindu (1970) had indicated the availability of sources of resistance to *S. sorghi* in India, while Gortor (1963) reported the presence of two sorghum lines with immunity to the pathogen in South Africa.

The identification of these disease-resistant materials will enhance their utilisation in our covered smut resistance breeding programme