Instituto Nacional de Investigación y Tecnología Agraria y Alimentaria (INIA)
Available online at www.inia.es/sjar

Spanish Journal of Agricultural Research 2008 6(1), 92-95
ISSN: 1695-971-X

Short communication. Cotton cultivars with moderate resistance to African cotton mosaic virus

M. D. Alegbejo, I. Onu and O. O. Banwo*

Department of Crop Protection. Faculty of Agriculture. Institute for Agricultural Research (IAR). Ahmadu Bello University. PMB 1044. Zaria. Nigeria

Abstract

A 3 year screening of 25 long staple cotton cultivars for resistance to African cotton mosaic virus (ACMoV) conducted in northern Nigeria during the 1999-2001 wet seasons indicated that no cultivar was immune or resistant. Two cultivars, Pima S_1 and Pima S_4 were moderately resistant (16% infection), four cultivars Pima S_2, Pima S_3, Giza 45 and Giza 69 were moderately susceptible (31% infection), while the remaining 19 cultivars were highly susceptible. The moderately resistant cultivars are high yielding, have high quality lint characteristics such as crin percentage, bundle strength, and micronaire fineness. They can be used to reduce the menace caused by ACMoV on cotton in Nigeria.

Additional key words: disease resistance, *Gossypium hirsutum* cultivars, plant virus.

Resumen

Comunicación corta. Cultivares de algodón con resistencia moderada a African cotton mosaic virus

Se llevó a cabo durante tres años, durante las estaciones húmedas de los años 1999-2001, en el norte de Nigeria, una búsqueda de resistencia al African cotton mosaic virus (ACMoV) entre 25 cultivares de algodón de fibra larga. Ningún cultivar fue immune o resistente. Dos cultivares (Pima S_1 y Pima S_4) fueron moderadamente resistentes (16% de infección), cuatro cultivares (Pima S_2, Pima S_3, Giza 45 y Giza 69) fueron moderadamente susceptibles (31% de infección) y los 19 cultivares restantes fueron altamente susceptibles. Los cultivares moderadamente resistentes dieron una producción alta y tienen una hiladura de alta calidad. Estos cultivares pueden ser utilizados para reducir la amenaza producida por ACMoV en algodón en Nigeria.

Palabras clave adicionales: cultivares de *Gossympium hirsutum,* resistencia a enfermedades, virus vegetales.

African cotton mosaic virus (ACMoV), synonym Cotton yellow mosaic virus (Malathie *et al*., 2003), is fast becoming important on cotton (*Gossypium hirsutum* L.) in Nigeria. The virus occurs sporadically in Africa, south of the Sahara, namely: Benin Republic, Cameroon, Central African Republic, Cote d' Ivoire, Ghana, Mali, Nigeria, Tanzania, Chad and Togo (Cauquil and Follin, 1983; Fauquet and Thouvenel, 1987; Brunt *et al*., 1996; Alegbejo, 1999). ACMoV is one of the uncharacterized viruses on cotton, however, Cotton yellow mosaic virus is believed to be bipartite containing ssDNA (Brown, 2001). Infected plants exhibit irregular mottle or yellow mosaic, stunting, reduced canopy and leaf deformation, fewer flowers and boll shedding. Symptom severity depends on the cotton variety, management practice and environmental conditions (Brown and Bird, 1972; Cauquil and Follin, 1983; Fauquet and Thouvenel, 1987; Malathi *et al*., 2003).

ACMoV is transmitted persistently by *Bemisia tabaci* Gen. and by grafting (Cateland, 1971; Lourens *et al.,* 1972; Bink, 1973, 1975; Malathi *et al*., 2003). It is not seed-borne, neither is it sap-transmitted (Cauquil and Follin, 1983). The virus can result in up to 30-50% loss in yield after severe infections. Yield loss arise due to reduced flower production, boll shedding and stunting of susceptible plants (Bink, 1973; Cauquil and Follin, 1983). A four year survey of ACMoV conducted in northern Nigeria between 1996 and 1999 indicated

* Corresponding author: banleks@yahoo.co.uk
Received: 18-07-07; Accepted: 30-01-08.

Abbreviations used: ACMoV (African cotton mosaic virus), HS (highly susceptible), IAR (Institute for Agricultural Research), MR (moderately resistant), MS (moderately susceptible), NAR (National Agricultural Research), SED (standard error of difference).

that the incidence of the virus ranged from 4.1 to 12.0% (Alegbejo, 1999).

The most effective, sustainable and environmentally friendly control measure against plant viruses is the use of resistant cultivars. Consequently, we conducted trials to identify cotton cultivars that exhibit resistance to ACMoV.

A 3-year trial was conducted in northern Nigeria during the 1999-2001 wet seasons. The 25 long staple cotton cultivars obtained from the Fibre Research Programme, Institute for Agricultural Research (IAR) Samaru, Nigeria were used. The trial was laid out as a randomized complete block design and replicated three times. Each cultivar was allocated to a plot made up of two ridges, 4.5×1.2 m. Four seeds were sown per hole, 30 cm apart. The plots were separated from each other by a border row of 60 cm. Seedlings were thinned to two per stand, two weeks after germination. About 60 plants were grown per year for each of the 25 varieties. Ten ACMoV-infected cotton plants with a high population of *B. tabaci* were transplanted between adjacent cultivars to serve as source of inoculum.

The crop was fertilized at two and six weeks after germination with N.P.K. (20:10:10) at the rate of 20 kg ha^{-1} on each occasion. Disease incidence based on symptoms induced by ACMoV was recorded each year from one week after germination till the end of the growing season in December in order to obtain the percentage of infection. Disease severity was rated in individual plants using a visual scale of 1-7 where 1 = no visible symptoms; 3 = mild mosaic and slight leaf distortation; 5 = severe mosaic and leaf distortion; 7 = very severe mosaic, and severe leaf distortion. Resistance level was determined as outlined in Table 1. Cotton seed and lint harvested from each plot were weighed and recorded.

Each year data from percentage of infection and yield were analysed using the analysis of variance (SAS, 1988). Given that there were no differences among years, a joint analysis was done after which the standard error of difference (SED) between means was used to separate means of the different varieties that differed at 5% level of probability.

None of the 25 cultivars was immune or resistant. However two cultivars (Pima S_1 and Pima S_4) were moderately resistant. Four cultivars were moderately susceptible while 19 were highly susceptible (Table 2). There were significant differences ($P \leq 0.05$) between the different disease severity classes (highly susceptible, moderately susceptible, and moderately resistant) for disease incidence and yield. Infected plants were mottled, stunted and reduced in size compared with healthy plants, which were uniformly green and showed no visible symptoms or malformations. Symptoms began about four weeks after germination.

There were similar results in all the three trials (Table 2). Pima S1 and Pima S4 were moderately resistant

Table 1. Determination of resistance level

Rating	Percentage infection	Disease severity
Immune	0.00	1.00
Resistant	1.00-15.00	1.10-2.90
Moderately resistant	16.00-25.90	3.00-4.90
Moderaterly susceptible	26.00-36.90	5.00-6.90
Highly susceptible	≥37	7.00

Table 2. Performance of long staple cotton cultivars screened for resistance to African cotton mosaic virus (ACMoV) at Samaru in the 1999-2001 wet seasons

Cotton cultivar	ACMoV infected plants (%)	Resistance category	Seed cotton yield (Mg ha^{-1})
Bar XL7(79)6	38.49 ± 0.09	HS	792.60 ± 2.52
Bar XL7(79)8	40.01 ± 1.0	HS	764.40 ± 55.76
Acala 15/7C	40.09 ± 0.14	HS	747.0 ± 3.59
Bar XL7(79)25	43.50 ± 0.61	HS	787.52 ± 2.99
Bar XL7(79)33	45.87 ± 0.55	HS	702.89 ± 1.51
Bar XL7(79)34	45.90 ± 0.59	HS	745.35 ± 5.03
Bar XL7(79)35	45.03 ± 0.51	HS	709.07 ± 6.45
Bar XL7(79)36	42.08 ± 1.07	HS	783.11 ± 2.50
Bar 14/25(81)1	40.49 ± 0.62	HS	592.73 ± 1.56
Bar 14/25(81)14	46.48 ± 0.58	HS	790.69 ± 1.17
Bar 14/25(81)16	47.21± 0.26	HS	793.59 ± 5.38
Bar 14/25(81)18	42.92 ± 0.28	HS	756.88 ± 5.96
Bar 14/25(81)23	40.95 ± 0.13	HS	790.72 ± 0.61
Bar 14/25(81)24	46.70 ± 0.59	HS	800.92 ± 1.23
Bar 14/25(81)39	44.64 ± 0.56	HS	596.88 ± 3.39
Bar 14/25(81)43	43.44 ± 0.39	HS	756.83 ± 5.24
Pima S1	17.20 ± 0.61	MR	900.87 ± 5.17
Pima S4	18.77 ± 0.57	MR	893.48 ± 2.56
Bar 14/25A	41.02 ± 1.03	HS	792.91 ± 3.05
Pima S2	26.77 ± 0.41	MS	883.26 ± 2.75
Pima S3	28.71 ± 0.53	MS	853.56 ± 3.07
Giza 45	30.62 ± 0.48	MS	797.40 ± 6.43
Giza 68	39.29 ± 0.71	HS	732.88 ± 3.05
Giza 69	30.56 ± 0.54	MS	896.41 ± 11.99
Bar XL 7	38.70 ± 0.53	HS	764.13 ± 0.99
SED	5.65	1.49	40.22

HS: highly susceptible. MS: moderately susceptible. MR: moderately resistant. SED: standard error of difference.

while Pima S2, Pima S3, Giza 45 and Giza 69 were moderately susceptible. The moderately resistant and moderately susceptible cultivars were also high yielding.

This study reveals that there are two moderately resistant and four moderately susceptible cotton cultivars to ACMoV in northern Nigeria. Some cotton cultivars earlier identified as tolerant to ACMoV in some other African countries include EH9, Y1422 and HG9 (Cateland, 1971; Fournier and Cateland, 1971; Cateland and Bink, 1974; Cauquil and Follin, 1983; Malathi *et al*., 2003). As a result of the 1968-1971 epidemic of the disease in Chad (Malathi *et al*., 2003) the resistant variety HG9 replaced the susceptible BJA592, and the disease has been controlled since that time (Cauquil and Follin, 1983). Attempts made to obtain these cultivars for inclusion in this study was not successful. Hence the moderately resistant cultivars found in this study can be used to combat the menace caused by the disease on cotton in Nigeria. According to Cateland (1973), susceptibility to ACMoV originated from Triump, while resistance may be found in the N'Kourale lineage. Cultivars originating from the National Agricultural Research (NAR) triple hybrids (*G. hirsutum* × *G. arboreum* × *G. raymondii* are intermediate in susceptibility (Cauquil and Follin, 1983). The N'Kourale lineage could then be bred with the moderately resistant cultivars found in this study in order to obtain highly resistant cultivars.

The results obtained in this study were consistent during the 3-year probably because infector row infested with an efficient ACMoV vector, *B. tabaci*, were used between adjacent cultivars. This ensured that all plants had an equal chance of being infected. Also the trial was located in an environment with high population of ACMoV vector, thereby nullifying the chances of a plant escaping the disease. All the cultivars were colonized by whiteflies within 4 wk after germination.

The two moderately resistant cultivars were probably more resistant than others because they had an in-built resistant factor to the virus or because they were probably not preferred as hosts by the whitefly vector of ACMoV. The moderately resistant and moderately susceptible cultivars are long staple cotton with high quality lint characteristics such as crin percentage, bundle strength, and micronaire fineness (Alabi, 1999). All these characteristics are highly valued by the textile industries. Although the other 19 cultivars are highly susceptible, they are also high yielding, have good lint qualities and are long staple. The moderately resistant and moderately susceptible cultivars reported in this study could be used in combination with other control measures to combat the deleterious effect caused by this disease in Nigeria. The resultant effect will increase cotton yield and ultimately the farmers income.

Acknowledgement

We are grateful to the Leader Fibre Research Programme, IAR Samaru for supplying seeds of the 25 cotton cultivars used and for funding the project. The technical assistance rendered by Mr. I.F. Wayo and Mr. A. Zubairu is highly appreciated.

References

ALABI S.O., 1999. Breeding for long staple cotton. 1999/2000 Review and Planning Meeting Report on Fibre Research Programme, Institute for Agricultural Research (IAR), Ahmadu Bello University (ABU) Zaria, Nigeria. pp. 18-24.

ALEGBEJO M.D., 1999. Screening of cotton cultivars for resistance to cotton mosaic virus. 1999/2000 Review and Planning Meeting Report on Fibre Research Programme, Institute for Agricultural Research (IAR), Ahmadu Bello University (ABU) Zaria, Nigeria. pp. 48-50.

BINK F.A, 1973. A new contribution to the study of cotton mosaic in Chad. I. Symptoms, transmission by *Bemisia tabaci* Genn. II. Observations on *B. tabaci* III. Other various diseases on cotton and related plants. Coton Fibres Trop 28, 365-378.

BINK F.A., 1975. Leaf curl and mosaic diseases of cotton in Central Africa. Emp Cott Rev 25, 133-141.

BROWN J.K., 2001. Viral and phytoplasma diseases of cotton. In: Compedium of cotton diseases (Kirkpatrick T.L., Rothrock C.S., eds), 2nd ed. APS Press. pp. 48-57.

BROWN J.K., BIRD J., 1972. Whitefly-transmitted geminivirus and associated disorders in the Americans and Caribean Basin. FAO Plant Prot Bull 28, 6-23.

BRUNT A., CRABTREE K., DALLWITZ M.J., GIBBS A.J., WATSON L., 1996. Viruses of tropical plants: descriptions and lists from the VIDE Database. CAB Intnl, Wallingford, UK. 148 pp.

CATELAND B., 1971. Transmission par greffage d'une nouvelle maladie epidemique des cotonniers au Tchad. Coton Fibres Trop 26, 263-265. [In French].

CATELAND B., 1973. Étude de la resistance varietale des cotonniers a la mosaique du Tchad. I. Choix d'un crible de selection. Coton Fibres Trop 28, 301-305. [In French].

CATELAND B., BINK F.A., 1974. Étude de la resistance varietale des cotonniers a la mosaique du Tchad. Coton Fibres Trop 29, 207-213. [In French].

CAUQUIL J.C., FOLLIN J.C., 1983. Presumed virus and mycoplasma-like organism diseases in subsaharan Africa and in the rest of the world. Coton Fibres Trop 38, 293-317.

FAUQUET C., THOUVENEL J.C., 1987. Plant viral diseases in the Ivory Coast. ORSTORM, Paris. Documentation techniques No. 46, 243.

FOURNIER J., CATELAND B., 1971. Étude du comportement de deux varieties de cotonniers cultivés au Tchad en presence d'une mosaique peut-etre nouvelle. Coton Fibres Trop 26, 229-233. [In French].

LOURENS J.H., VAN DER LAAN P.A., BRADER L., 1972. Contribution a l'étude d'une communs: assais de transmission de cotonnier à cotonnier par les Aleurodidae. Coton Fibres Trop 27, 225-230. [In French].

MALATHI V.G., RADHAKRISHNAN G., VARMA A., 2003. Cotton. In: Virus and virus-like diseases of major crops in developing countries (Loeberstein G., Thattappilly G., eds). Kluwer Academic Publishers, London, UK. 800 pp.

SAS, 1988. SAS users' guide: Statistics, 5th edition, Statistical Analysis System Institute Inc. North Carolina, USA.