Tropical Agricultural Research and Extension 1(2): 162-164, 1998

Short communication

Reaction of selected cowpea (*Vigna unguiculata* L. Walp) breeding lines to *Xanthomonas campestris pv. vignicola*

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Accepted 15 October 1998

ABSTRACT

Disease pressure in a cowpea screening field in Kano, a Sudan Savanna region of Nigeria, was increased by early planting of spreader lines of cowpea varieties susceptible to bacterial blight incited by *Xanthomonas vignicola*. Fourty five cowpea lines, previously found to be resistant to canker and blight (only 0 - 5 % of leaves with leaf spot) in the regular screening fields in 1993 and 1994 were screened in fields with high disease pressure. Nine cowpea breeding lines were confirmed as resistant to bacterial blight. Others were susceptible at varying degrees. Sixteen breeding lines were found to be resistant to canker induction and 12 were resistant to both blight and canker. Field screening under increased disease pressure by planting spreader lines two weeks earlier was more effective than the regular screening in fields with relatively low inoculum level, when spreader lines were planted along with breeding lines under test.

Key words: Bacterial blight, canker, cowpea, field screening, *Vigna unguiculata, Xanthomonas campestris*

Cowpea *Vigna unguiculata* L. (Walp) is an important proteinous staple in Nigeria and in many other parts of tropics and subtropics (Williams 1977). The annual world cowpea production in 1996 was estimated as 3 million tonnes out of which Nigeria produces 1.7 million tonnes (Singh *et al.* 1997). In Africa, bulk of the production of cowpea comes from small scale subsistence agriculture where low grain yields of about 88 kg ha^{-1} are obtained in places like the lowland tropics of West Africa (Summerfield *et al.* 1985). Apart from the problems of poor nutrient and physical status of the soils, cowpea production is severely constrained by a large number of pests and diseases (Emechebe and Shoyinka 1985). Bacterial diseases, though of economic importance, have not been well studied in Nigeria (Williams 1975). As a result of the restricted distribution of bacterial pustule (Patel 1981), bacterial blight caused by *Xanthomonas campestris pv vignicola* has become the most important bacterial disease of cowpea in the Sudan Savanna part of Nigeria. Bacterial blight symptoms are initially tiny water soaked dots on leaves, which develop a tan to orange colouration with a yellow hallo. These spots merge so that a large area of leaf is affected. On stem, the pathogen causes crackings (cankers) and also water soaked spots on pods.

Ekpo (1978) reported a yield reduction in the range of 19.2% - 81.1% in two cowpea varieties grown for two years due to bacterial blight. Complete defoliation of susceptible plants under epiphytotics of bacterial blight has also been reported (Emechebe and Shoyinka 1985). The effective management of disease involves the development of resistant crop varieties. The use of resistant varieties has no negative effects on the ecosystem unlike chemicals. It is effective and affordable for subsistance farmers.

The development of resistant crop varieties also depends on the reliability of the method of screening for resistance. One of the techniques widely used in evaluating field resistance is the field screening method (Dhiman *et al.* 1984). However, most cowpea varieties regarded as having field resistance are often found to be susceptible in farmers fields, where the inoculum density can be higher. Hence the aim of this study was to identify breeding material that will survive increased inoculum pressure for future breeding programmes using the breeder's screening field and a screening field with increased disease pressure, both located at the International Institute of Tropical Agriculture (IITA) station in the Sudan Savanna region in Nigeria.

The field screening was conducted at Kano in the Sudan Savanna on longitude 08'31E, latitude 12'03N and at an altitude of 1500m, a region where bacterial blight is endemic. The soil texture is generally sandy, dominated by a fine sand subfraction and clay content in most of the surface horizons. Carbon, total nitrogen and available

phosphorus are low (IAR 1980).

For many years the experimental sites have been used to screen cowpea germplasm against bacterial blight. The disease pressure was increased in one of the plots by early planting of a highly susceptible variety as spreader lines coupled with the increased frequency of screening in the plot.

Forty five cowpea lines found to be resistant to bacterial blight in 1993 and 1994 were selected from the regular screening field while other cowpea cultivars, known to be highly susceptible to bacterial canker, obtained from the cowpea pathology trials at IITA Ibadan, Nigeria were used as checks. The selected germplasm included TVU lines (IITA germplasm collections) and the nationally developed materials (IT, IAR & IAR&T) and also local land races.

Land preparation involved disc harrowing and ridging. The seeds of the test cowpea varieties were sown in 4.2m long rows at a distance 20cm, and 75cm between rows. Each plot consisted of 8 rows arranged in a randomized complete block design with four replicates. Two weeks prior to planting, a mixture of 2 highly susceptible varieties IT82D-889 and IT87D-224 were planted across the test plots at a rate of 2 seeds per hole with 20cm spacing between plants and 50cm spacing from test tows.

Basal application of fertilizer N.P.K. 15:15:15 at 200kg ha^{-1} was used and insecticide Azodrin 60 (containing 600 gl^{-1} WSC) at 600 ml ha^{-1} and 400 ml ha^{-1} of Cymbush 10EC (containing 100 gl^{-1} cypermethrin) in 500^{-1} of water was applied when insect pests were noticed. The field pre-emergence herbicides Gramaxone (Paraquat 200 g l^{-1}) at the rate of 3-5l ha^{-1} and Galex (Metolachlor 330 g l^{-1} and Metobromuron 150g l^{-1}) at the rate of 1l ha^{-1} were applied immediately after planting the spreader varieties. Subsequent weed control was carried out manually at 8 weeks after planting. Disease severity was assessed by estimating the proportion of leaves infected by bacterial blight in a plot to the total number of leaves in the plot. This percentage estimate was then converted to a 0-75 scale, where

0 = no leaves show symptoms
5 = 1-5% of the leaves show symptoms
25 = 6-25% of the leaves show symptoms
50 = 26-50% of the leaves show symptoms
75 = 51-100% of leaves show symptoms.

Scores <5% were considered resistant, 5% - 25% moderately resistant and >25% susceptible. Bacterial canker incidence ratings were also done using the proportion of infected plants to the total number of plants in a plot. This percentage estimate was also converted to a 0-75 scale, where

0 = no symptoms of infection as the stems
5 = 1-5% of the plants $plot^{-1}$ show symptoms of infection
25 = 6-25% of the plants $plot^{-1}$ show symptoms of infection
50 = 26-50% of the plants $plot^{-1}$ show symptoms of infection
75 = 51-100% of the plants $plot^{-1}$ show symptoms of infection

Scores < 5% were considered resistant, 5% - 25% moderately resistant and >25% susceptible. The data collected was subjected to analysis of variance and Duncan's multiple range test was used to compare the means.

The results of this study revealed a highly significant difference ($P < 0.001$) between the reaction of the cowpea lines in the field with increased disease pressure and that of the normal field disease pressure (Table 1). This probably resulted from the high inoculum potential in the test plot with high disease pressure. Various factors however may have contributed to the low disease score recorded in the regular screening fields. These may include the bacterial inoculum level in the soil and debris; plants may have escaped infection at the susceptible stages of development or there may have been an uneven distribution of the inoculum in the field.

Based on the average disease severity scores, cowpea cultivars differ significantly in their reactions to bacterial blight and canker induction by the pathogen. Of the 49 breeding lines screened, 24 lines were susceptible, 13 lines were moderately susceptible and 9 lines were resistant. In terms of canker development, 15 cowpea lines were susceptible and 17 lines were found to be resistant (Table 1). Results showed that both the bacterial canker and the blight expression are varietal. Varietal resistance to bacterial blight in cowpea has been reported by Kishum *et al.* (1980). The reaction of Ife Brown in the present study conform with that reported by Allen *et al.* (1981) and Ekpo (1979).

Although information abounds of the positive correlations between resistance expressed in green house screening and in field screening (Allen *et al.* 1981; Patel and Jindal 1970), recent observations also reveal that most of the cowpea cultivars reported to have field resistance to bacterial blight were probably only screened in fields with low inoculum potential. Hence, such cowpea cultivars may become susceptible under high inoculum pressure. Therefore, screening of varieties of cowpea in fields with high inoculum potential will be important to identify resistant lines.

The identified varieties resistant to bacterial

Table 1. Reactions of 49 cowpea breeding lines to bacterial blight under increased disease pressure compared with regular screening of field

Cowpea breeding lines	Regular screening field (Average disease score 1993 and 1994)	Screening field with increased disease pressure (Average disease score 1994 and 1995)	Average disease score (Canker)
IT87D-2246-4*	75 S†	73a S	49a S
IT86F-209-5	5 R	73a S	29de S
IT87D-941-1	0 R	69a S	37bc S
TVU12487	5 R	63ab S	33cd S
TVU1330	5 R	63ab S	50a S
IT70-611-3	5 R	58ab S	36bc S
IFE BROWN	0	56ab S	41ab S
IT90K-77	75	50abc S	43ab S
IT84D-666	0	50a-c S	27de S
IT90K-76°	75	51a-c S	45a S
IT89KD-260	5	44a-f S	16fa MS
TVU4642	5	44a-f S	36bc S
IT89KD-355	5	41a-f S	20ef MS
IT89KD-245	5	42a-f S	34cd S
IAR48°	50	50a-c S	40ab S
IT891KD-391	5	38b-h S	15fa MS
IT92KD258-12	5 R	38b-h S	13fg MS
IT90K-76-4	0 R	38b-h S	10gh MS
IT87D-879-1	5 R	34c-i S	33cd S
IT82E-60	0 R	38b-h S	15fg MS
TW110	5 R	27c-k S	10gh MS
IT85DM.363	5 R	28c-k S	19ef MS
IT92KD258-9	5 R	28c-k S	4h R
IT90-277-2	0 R	23e-k MS	11gh MS
ALOKA-LOCAL	5 R	21r-k MS	11gh MS
IT92KD-404-1	5 R	20f-k MS	6ef MS
IT88D-8667-11	5 R	20f-k MS	11gh MS
IT29OK284-2	5 R	20f-k MS	0h R
IT92KD312-3	5 R	19f-k MS	4h R
TVU1179	5 R	15f-k MS	4h R
IT9KD-474	5 R	18f-k MS	15fg MS
ART91-1	5 R	13f-k MS	14fg MS
SUVITA 2	5 R	13f-k MS	19ef MS
IT92KD-257-10	5 R	10g-k MS	18ef MS
IAR4(48)15-1	5 R	10g-k MS	28de S
TVU11702	5 R	9h-k MS	6gh MS
TVU11424	5 R	5ijk MS	3h R
TVU8333	5 R	5ijk MS	3h R
IT91K-118820	5 R	5ijk MS	1h R
TVU11063	5 R	4jk R	0h R
IT83S-911	0 R	4jk R	4h R
IT92KD-371-1	5 R	4jk R	5h R
IT92KD-262-2	5 R	4jk R	4h R
TVU13505	5 R	4jk R	0h R
TVU236	5 R	4jk R	3h R
IT81D-1228-14	5 R	4jk R	4h R
TVU4630	5 R	3jk R	0h R
TVU1235	5 R	3jk R	0h R

Means with the same letters in a column are not significantly different from each other
according to Duncan's Multiple Range Test (0.05)

* = Susceptible, check
† S = Susceptible, MS = moderately susceptible and R = resistant

blight in this study are being screened for resistance to fungal and viral diseases and also for nematodes and insect pests. Increased disease pressure created by planting susceptible cultivars two weeks before establishment of screening nurseries has helped to discriminate between susceptible and resistant cultivars. Besides the immediate and direct economic significance of resistant lines for release as varieties to farmers, breeders will also find these lines (TVU11063, IT83-911, IT92KD-371-1, IT92KD-262-2, TVU13505, TVU236, IT81D-1228-14, TVU4630 and TVU1235) useful as donors of resistant genes for future breeding programmes.

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