

Resistance of some Cowpea lines to the Brown Blotch Disease

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Abstract

Sixty four lines of cowpea (*Vigna unguiculata* L. Walp sub sp. *unguiculata*) were screened for resistance to brown blotch disease both in the greenhouse and in the field. Field screening was conducted during 4 growing seasons. Results of both greenhouse and field corroborated each other as no line identified as resistant in the greenhouse was susceptible in the field or vice versa. Through out the study, Crimson, Hope, TVx3236, TVu 1896 AG and H 144-1 were consistently resistant while Ife Brown, Ife BPC, A44/2 were susceptible.

Introduction

Brown blotch disease of cowpea incited by *Colletotrichum truncatum* (Singh and Allen, 1979), is a relatively new disease of cowpea in Nigeria. The causal organism of the disease had earlier been reported on other crops including soybean in North Carolina (Wolf and Lehman, 1920). The disease was first reported in Jamaica in 1945, thereafter in India (Rao, 1965) and its distribution in the tropics and sub-tropics has been documented (Emechebe, 1980).

The disease was first observed at the University of Ife in 1980 on the Internship cowpea plot. The Ife Brown seeds on which the disease was first observed came from Institute of Agricultural Research and Training (I.A.R.&T). The brown blotch is a term used to describe the characteristic symptoms in the form of purplish brown discolouration which may be seen on all aerial parts of the plant i.e. leaf veins, petioles, stems, peduncles and especially pods.

Cowpea plants can be infected between seedling and reproductive stages. A humid environment is conducive to epiphytotic development of the disease. Seedling infection results generally in stunted plants or in a dieback of affected seedlings if the infection reaches the stem tip at an early stage of seedling development. Distortion and malformation of pods occur as a result of early pod infection. Such early infection generally results in colossal losses arising from shriveling, twisting and blighting of pods which consequently fail to produce seeds. Pods attacked at a more mature stage contain varying levels of infected seeds. Infected seeds generally give rise to infected seedlings since the incitant is seed transmitted (Emechebe, 1981). Kelani (1984) demonstrated that the disease organism was seed-coat borne. He showed that seed yield from pods which got heavily attacked at an early stage was very low. His study confirmed an earlier observation that brown blotch disease reduced seed yield in cowpea by about 65.6% (Onesirosan unpublished). A total crop failure may be inevitable when epiphytotic development of the disease occurs at the time of initiation of pod development. Preliminary investigations on chemical control (unpublished) showed that chemical application was rarely effective during

regular and continuous rainfall or when the disease had successfully been established.

This paper reports the results of screening experiments in both greenhouse and field to identify potential sources of resistance to the brown blotch disease.

Materials and Methods

Greenhouse Studies

Thirty lines of cowpea were used. Nine-600cc plastic cups of each line were planted at the rate of seven seeds per cup of sterilized soil. Seedlings were inoculated with a spore suspension (Ca 4×10^4 spores/ml) of the incitant at 5, 10 and 14 days after planting (DAP). This was an attempt to identify the most suitable stage for inoculation and disease symptom expression. For each stage, all 7 seedlings in two cups per line were treated with twenty ml of the spore suspension poured on wet soil surface around the stem bases while the 7 seedlings in one other cup were treated around the stem bases to serve as the control. The seedlings were then covered up with moistened polythene bags to provide humid environment for optimum infection and put under the greenhouse bench for 48 hours after which the polythene bags were removed and the cups placed on the greenhouse bench.

Disease severity on the seedlings were recorded nine days after inoculation, using the following disease severity index of 0-4 as shown below:

Index	Length of lesion at the stem base	Disease reaction
0	0 cm (no lesion)	Immune
1	0-1.0	Resistant
2	$>1.0 \leq 2.0$	Moderately Resistant
3	$>2.0 \leq 3.0$	Moderately Susceptible
4	> 3.0	Susceptible

The disease rating for each line was obtained by averaging the sum of the indices recorded for the seedlings. Inoculation at 5 DAP gave the best result and it was subsequently picked and used following the preliminary investigation.

Field Screening and disease observation

Planned field screening was conducted during the early and late seasons of 1983 and early seasons of 1984 and 1985. Forty-one genotypes were screened during the early and late season of 1983. However in 1984 and 1985, twenty three additional lines were screened. All experiments were conducted at the Teaching and Research Farm of the Obafemi Awolowo University. A randomized complete block design with 4 replicates was used during each screening except in the early season of 1983 when only 3 replicates was used. Ife Brown, an adapted but heavily susceptible variety was planted between any two genotypes in each replicate during all trials to serve as a spreader to neighbouring rows. Inter and intra row spacings were 60cm and 30cm respectively on 3-m long rows. Each genotype was planted to a row and was observed and scored for its reaction to brown blotch at the seedling (14 DAP) and podding stages. Scores

were pooled across seasons and replicates for each genotype. Scoring at 14 DAP was not successful for all seasons because of unfavourable weather conditions for disease development at 14DAP. Throughout the study, ideal humid environment for disease development became steady at podding stage-the stage when the plants have also formed a complete ground cover. Consequently scores at the podding stage are reported. The disease rating used at podding stage is indicated below:

A disease index rated on a subjective scale of 0-4 was used where

- | | | | |
|-----|--|---|------------------------|
| 0 = | no symptoms on any part of the plant |) | |
| 1 = | Occasional tiny flecks on stems, petioles or peduncles (plate 1) |) | Resistant |
| 2 = | mild purplish brown discolouration on stems and petioles or pods |) | Moderately Resistant |
| 3 = | purplish brown discolouration of petioles peduncles. No malformation of pods, although such pods carry visible lesion. () |) | Moderately Susceptible |
| 4 = | severe purplish brown discolouration and cracking of stems, large pod lesions, distortion and maldevelopment of pods (plate 2) |) | Heavily Susceptible |

Results and Discussion

Results obtained from greenhouse screening is presented in Table 1. The lines Crimson and Hope showed no lesions following greenhouse inoculation and were therefore classified resistant. The greenhouse screening also showed that 14 lines were moderately resistant to the disease while 7 lines were susceptible.

Field observations revealed that the incidence of the disease is aggravated by humid weather. Symptom development on susceptible cultivars began as orange-water soaked patches around the base of seedlings which became darker with age and spread to girdle the plant. Plants growing in low topography which were attacked early were generally killed if rains were frequent. Plants which outgrew the seedling attack were easily identified by the presence of dark lesions at the base of the stem.

Six lines of cowpea — crimson, Hope TVx 3236 IT82D-889 H144-1, TVu 1896AG had no lesions on any part except a few tiny specks. This reflects hypersensitive reaction similar to disease resistance in studies by Van der Plank (1968). All the six lines were consistent in their resistant reactions throughout the field screenings.

The moderately resistant class showed minor symptoms of infections in form of numerous tiny flecks which gave the stem and petioles a mild purplish brown discolouration but the pods were unaffected. Lines H64-3, BPL-3-1,

Table 1: DISEASE RATING OF 30 LINES OF COWPEA INOCULATED IN THE GREENHOUSE WITH *COLLETOTRICHUM TRUNCATUM*

Line	Average Disease Rating at			Disease Reaction
	5 DAP	10 DAP	14 DAP	
II-V-5-6	4.0	3.5	2.5	Susceptible
Vita - 5	3.9	2.5	2.3	"
Ife Brown	3.7	2.9	2.6	"
H-113-1	3.5	2.0	2.0	"
Vita-5 L -S	3.3	3.0	2.2	"
Vita 3	3.2	2.6	1.6	"
12AK	3.1	2.4	1.0	"
Sese	3.0	1.6	1.5	Moderately Susceptible
Victor	2.8	2.5	2.0	"
TVu 2772	2.4	1.3	1.8	"
2AK	2.3	2.2	2.0	"
Togo 4	2.3	1.6	1.0	"
TVx 309-16	2.3	1.0	1.0	"
TVu 66-2-E	2.2	1.4	1.0	"
TVu 1534	2.0	1.8	1.4	Moderately Resistant
Mongolian Black Eye	2.0	1.8	0.5	"
TVu 200	1.8	1.8	0.6	"
Arlington	1.7	1.6	1.3	"
EW-1	1.7	1.6	0.8	"
H-64-3	1.6	1.5	1.0	"
ER-7	1.6	1.4	1.2	"
TVu 946	1.5	1.0	1.0	"
BPL 3-1	1.5	0.9	0.9	"
H13-	1.4	1.0	0.8	"
TVu 946-1-E	1.3	0.0	0.0	"
H5 1-K	1.2	0.5	0.3	Moderately Resistant
TVu 946-2-E	1.0	1.0	0.8	"
Black Eye	0.5	0.4	0.3	"
Crimson	0.0	0.0	0.0	Immune
Hope	0.0	0.0	0.0	Immune

Table 2: INDEX RATING ACROSS SEASONS AND REPLICATES FOR REPRESENTATIVE GENOTYPES WITHIN EACH REACTION GROUP

Reaction Group	Geneotypes	1983E	1983L	1984E	1985E	Mean
		Reps	Reps	Reps	Reps	
Resistant	Hope	1 2 3	1 2 3 4	1 2 3 4	1 2 3 4	0.13
	Crimson	0 0 0	0 0 0 0	0 0 0 0	0 0 0 0	0.13
Susceptible	Ife Brown	0 1 0	0 0 0 0	0 1 0 0	1 0 0 1	0.27
	Ife BPC	4 4 3	4 4 4 4	4 4 4 3	4 4 4 4	3.87
Moderately Resistant	H64-3	4 4 4	4 4 4 4	4 4 4 4	4 4 4 4	4.00
	Black Eye	2 2 2	2 1 3 1	1 2 1 1	2 2 2 1	1.67
Moderately Susceptible	IT 82E-60	2 2 2	2 2 1 2	2 1 1 2	1 0 2 1	1.53
	II-v-5-6	3 3 3	3 3 3 3	3 4 3 3	3 3 3 3	3.07
		3 3 3	3 3 3 3	3 3 4 3	3 3 3 3	3.07

E = early season
L = Late season.

Table 3: REACTION PATTERN OF SOME COWPEA LINES TO BROWN BLOTCH DISEASE OF COWPEA.

Reaction Category	Brown Blotch Index	Cowpea lines in each category
Immune	0	
Resistant	1	Hope, Crimson, TVx 3236, IT82D-889, H114-1, TVu 1896-AG.
Moderately Resistant	2	2AK, TVu 2000, H113-1, 9AK, TVu 662E, Sese, Togo 4, TVx 309 AG, EW/1, Black Eye, Vita 5, TVu 946-2E, H51-1, Arlington, TVu 946-1E, Victor, TVu 2772, Vita 3, TVu 1785, TVu 200, TVu 1785, IFH107, IT81D- 1137, POPSE1, IAR-339-1, IAR48, IT82D-952, IAR-180-4, IT82D-709, IT82D-669, IBH-101, L-25, IAR-72, IT82D-952, IT81D-975, IAR-176-B, IAR-81-40, TVx 4262-09D, TVu 401, ITS835-818, BPL-3-1
Moderately Susceptible	3	ER7, 12AK, II-V-5-6, TVu 1534, H13-1 H113-4, IT82E-60, IT84E-124, IT81D-994, K-59, L43, K-28, IT81D-897.
Heavily Susceptible	4	Ife Brown, Ife BPC, A44/2 IT82D-174.

Black Eye and others indicated in Table 3 belong to this category. Isolated dark lesions were occasionally found at the bases of some genotypes.

All genotypes in the moderately susceptible class had visible lesions on stems, petioles and pods but the lesions seldom coalesced. Pod blighting and malformation were also less intense than in heavily susceptible category. Some of the genotypes which were classified as susceptible like 12AK, II-v-5-6 in the greenhouse screening fell into this same group during the field screenings.

In the highly susceptible group, symptoms were observed at an early stage from below the soil. These extended upwards gradually and eventually girdled the stems in Ife Brown used as the spreader variety. Lesions spread along the midvein and then to other veins of the primary leaves. It was noted that the stage of infection and the amount of rainfall during disease development influenced the disease severity. The disease spread to the other highly susceptible lines e.g. IT82D-174, A44/2 and Ife BPC from the spreader variety at an early stage and were badly discoloured and produced blighted, distorted, underdeveloped and shrivelled pods. Few seeds obtained from this category carry brown blotch lesions on their Testae (Plate 2).

Except for the additional lines tested in the field, the greenhouse and field reactions were strongly correlated in this study since no line that shows a susceptible reaction in the greenhouse showed a resistant reaction in the field or vice-versa. Crimson and Hope were consistently resistant both in the greenhouse and on the field. Similarly, Ife Brown was susceptible both in the greenhouse and on the field.

It is interesting to observe that all the susceptible lines in this study have desirable seed characteristics (e.g. rough seed coat and large/medium seed size) which gave them a high consumer appeal. On the other hand the majority of the resistant lines had little consumer appeal except TVx 3236, which however, has small seeds.

While the control of this disease can be attempted on a temporary basis by timely application of fungicides like benomyl or by seed treatment before planting, a more permanent approach is to use identified sources of resistance to transfer resistance into agronomically acceptable lines.

Multilines can also be developed to stabilize such improved lines against possible future races of the pathogen. A technique had been successfully employed to deploy disease resistance genes and circumvent undesirable genotype-environmental effects in wheat (Borlaug, 1958) and oats (Jensen, 1965; Browning and Frey, 1969). This should also be possible in cowpea.



Resistant plants have clean pods but may have tiny floccs (lesions) on their peduncles.



Pods from heavily susceptible plants showing large pod lesions and severely distorted pods.

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