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Screening of Cowpeas for Resistance to the Flower Bud Thrips, *Megalurothrips sjostedti* Trybom (Thysanoptera: Thripidae)

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Abstract: Seventeen cowpea cultivars were screened for resistance to the flower bud thrips, *Megalurothrips sjostedti* Trybom in field trials during 2003 and 2004. In 2003, the results showed that ITH 98-20 and TVu 1509 (resistant control) supported significantly ($p<0.05$) lower thrips populations than Vita 7 (susceptible control) and most of the cultivars except ITH 98-49 and Sanzi. Significantly lower thrips damage ratings were recorded for 11 cultivars including TVu 1509 and Sanzi than Vita 7. Sanzi and ITH 98-47 also had significantly lower yield losses due to thrips compared with Vita 7, the susceptible control. In 2004, no significant differences in thrips populations were detected among the cultivars. However, thrips damage ratings were significantly lower in 5 cultivars including Sanzi and TVu 1509 than Vita 7. Significantly lower yield losses also were recorded for 8 cultivars including Sanzi than Vita 7, the susceptible control. There were positive, but nonsignificant, correlations between thrips populations and damage ratings and also between damage ratings and yield loss in both years. The above results show the potential of finding resistance sources in the cultivars tested.

Key words: Thrips, *Megalurothrips sjostedti*, cowpea cultivars, resistance, damage rating, yield loss

INTRODUCTION

Cowpea, *Vigna unguiculata* (L.) Walpers, is an important food crop and a major source of protein for many families in Ghana and other countries in sub-Saharan West Africa. The tender leaves and soft stems as well as the green pods are eaten as vegetables and the dry seeds are a staple food (Okigbo, 1978; Parh, 1993). The protein content ranges from 23-38% in the grain and 29-43% in the leaves (Bressani, 1985). The foliage and stems are also a good source of fodder for livestock as well as a green manure and a cover crop.

Despite its importance, cowpea yields are greatly depressed by a complex of biotic and abiotic factors of which insect pests are the most important. Without insect control, yields range between 100 and 250 kg ha^{-1} compared to a nearly 10-fold increase when insect control is applied (Jackai and Daoust, 1986; Abate *et al*., 2000). Several insect pests attack the crop in the field and at storage, with the flower bud thrips *Megalurothrips sjostedti* Trybom (Thysanoptera: Thripidae) being one of the most damaging in Africa (Jackai and Daoust, 1986; Jackai *et al*., 1992). Thrips attack terminal leaf buds, racemes (flower buds) and flowers resulting in browning, distortion and abscission of floral parts (Jackai and Daoust, 1986). Insecticides have been the principal recourse for control of insect pests on cowpea. However, insecticides are expensive and often beyond the reach of most peasant farmers who produce the bulk of cowpea in Ghana. In addition, there are health and environmental hazards associated with the use of insecticides. Important natural enemies of insect pests are highly susceptible to many of the commonly used insecticides for control of cowpea pests (Abudulai *et al*., 2001).

Host plant resistance is one strategy that can be deployed to control insect pests and offers the potential to minimize or eliminate the use of insecticides and preserve natural enemies that control pests, while maintaining or increasing crop quality and yield (Wiseman and Davis, 1990). Insect resistant cowpea varieties can thus help sustain productivity of resource-poor farmers. Screening germplasm is one way of identifying the genetic base from which insect-resistant and agronomically desirable cultivars can be developed. The objective of this study was therefore to screen cowpea cultivars for sources of resistance to thrips.

MATERIALS AND METHODS

Seventeen cowpea cultivars were screened during 2003 and 2004 for resistance to the flower bud thrips, *Megalurothrips sjostedti* under natural infestation in the

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field at Nyankpala (latitude 9°42 N, longitude 0°55 W and 184 m altitude) in the Northern Region of Ghana. The cultivar, TVu 1509 was used as the resistant control and Vita 7 as the susceptible control (Jackai and Singh, 1988) in the study. The experimental area for the trials was divided into two quadrats, Q1 and Q2, designated as sprayed and unsprayed, respectively. To avoid insecticide drift to unsprayed plots, a 2-m wide sorghum border was planted between the quadrats. The treatments were replicated three times in each quadrat in a randomized complete block design. Individual plots consisted of two rows, 5 m long and 0.75 m apart. Intra-row spacing was 0.20 m, with two plants per hill. The trials were planted on 25 July in 2003 and 5 August in 2004. Insecticide protection on Q1 plants commenced at raceme formation (30-35 days after planting [DAP]). The insecticide spray was continued at 7-10-day intervals until the crops reached full maturity. A total of three sprays were applied to Q1 plants during the season. Plants in Q2 were sprayed at 50% podding (50-55 DAP) against pod-sucking bugs (PSBs) to eliminate their confounding effects in identifying thrips resistant cultivars. All insecticide protection was accomplished using λ-cyhalothrin (as Karate 2.5 EC) applied at the rate of 2.5 g (a.i.) ha^{-1} using a CP-15 knapsack sprayer.

Visual ratings for thrips damage on Q2 plants were recorded on 5 consecutive plants within each row at 35-40 DAP on a scale of 1-5, where 1 = slight to no visible damage and 5 = heavily damaged. Populations of thrips were estimated by randomly picking 20 racemes or flowers per plot, depending on the stage of growth. The samples were taken between 0800 and 1000 am local time. The racemes/flowers were placed in glass vials containing 40% ethanol and subsequently were dissected to count thrips. The infestations were assessed weekly for four weeks from 30 DAP.

At maturity, pods from all two rows of each plot were harvested, hand-threshed and grain weight taken. Percent yield loss (YL %) was computed by subtracting Q2 yields from those of corresponding replicates in Q1 in a relation YL % = 100 (Q1- Q2)/Q1.

Statistical Analyses: All data were subjected to analysis of variance and means were separated by using Least Significance Difference (LSD) where F-values were significant at $p<0.05$ (SAS Institute, 1998). There were significant ($p<0.05$) year by treatment interactions for the parameters examined so data for each year were analyzed separately. The data for thrips damage ratings, thrips populations and yield loss were subjected to correlation analyses (SAS Institute, 1998) to determine the association between the different parameters used to assess cultivar resistance to the pest.

RESULTS

In 2003, thrips populations in racemes were low and no significant ($p>0.05$) differences were detected among the cultivars. However, populations increased rapidly during flowering with the cultivars supporting significantly ($p<0.05$) different numbers of thrips in flowers (Table 1). ITH 98-20 and TVu 1509 (resistant control) supported significantly ($p<0.05$) lower thrips populations than Vita 7 (the susceptible control) and most of the other cultivars except Sanzi and ITH 98-49. The lowest thrips damage rating of 2.5 was recorded for ITH 98-47, ITH 98-53 and ITH 98-7, but this was not significantly ($p>0.05$) lower than those for Ife Brown, TVu 1509 and ITH 98-45 (Table 1). ITH 98-48, Sanzi, ITH 98-13, ITH 98-51 and ITH 98-49 had damage ratings that were not significantly different from that of TVu 1509. All the aforementioned cultivars had significantly lower damage ratings than Vita 7, the susceptible control. There were significant differences ($p<0.05$) in percent yield loss among the cultivars. The lowest yield loss was recorded for ITH 98-47. This was significantly lower than Vita 7, but was not significantly ($p>0.05$) different from Sanzi, ITH 98-46 and TVu 1509. There were nonsignificant ($p>0.05$) positive correlations between thrips populations in racemes and in flowers ($r = 0.13$), thrips populations in racemes and damage rating ($r = 0.12$) and damage rating and percentage yield loss ($r = 0.09$).

In 2004, thrips populations also were low in racemes. Populations built up later in flowers but no significant differences were detected among the cultivars (Table 2). The lowest damage rating was recorded for TVu 1509 and Sanzi. This rating, however, was not significantly lower than those for ITH 98-46, ITH 98-24 and ITH 98-45. The damage ratings for all these cultivars were significantly lower than those recorded for vita 7, the susceptible control and the other cultivars except ITH 98-53 whose rating was not significantly lower than that for ITH 98-45 (Table 2). As in 2003, percent yield loss in 2004 was significantly ($p<0.05$) different among the cultivars (Table 2). Significantly lower yield loss was recorded for ITH 98-45, ITH 98-49, ITH 98-47, Sanzi, ITH 98-18, ITH 98-46, ITH 98-48 and ITH 98-51 than Vita 7, the susceptible control. There were nonsignificant ($p>0.05$) positive correlations between thrips populations in racemes and damage rating ($r = 0.06$) and between damage rating and yield loss ($r = 0.07$) in 2004.

Table 1: Reaction of cowpea cultivars to flower thrips, 2003

Cultivars	No. thrips/ raceme	No. thrips/ flower	Thrips damage rating	Yield loss (%)
ITH 98-48	0.4	5.9	3.0	78.9
ITH 98-20	0.5	4.5	3.3	60.9
ITH 98-49	0.3	5.3	3.0	65.4
ITH 98-24	0.4	5.9	3.5	55.5
ITH 98-46	0.4	7.9	3.5	47.3
TVx 3236	0.4	6.8	3.5	70.7
Vita 7	0.3	6.1	3.5	68.8
ITH 98-45	0.4	6.9	2.8	58.0
ITH 98-13	0.3	6.9	3.0	73.7
ITH 98-51	0.2	7.1	3.0	73.5
Ife Brown	0.4	6.9	2.7	69.5
TVu 1509	0.2	4.7	2.8	54.7
ITH 98-53	0.4	7.3	2.5	69.3
Sanzi	0.4	5.2	3.0	38.3
ITH 98-47	0.3	8.2	2.5	28.1
ITH 98-7	0.3	6.6	2.5	66.0
ITH 98-18	0.4	7.0	3.8	58.0
LSD (5%)	NS	1.2	0.5	26.6
CV (%)	38.6	10.9	9.5	26.2

Values are means of three replicates. NS = F-test nonsignificant at $p<0.05$

Table 2: Reaction of cowpea cultivars to flower thrips, 2004

Cultivars	No. thrips/ raceme	No. thrips/ flower	Thrips damage rating	Yield loss (%)
ITH 98-48	0.7	6.0	3.8	60.1
ITH 98-20	0.6	5.9	3.2	75.6
ITH 98-49	0.8	6.2	4.0	53.7
ITH 98-24	0.8	6.5	2.2	75.5
ITH 98-46	0.8	7.7	2.2	57.4
TVx 3236	0.9	7.0	3.3	86.2
Vita 7	0.7	7.8	3.2	88.2
ITH 98-45	0.7	7.5	2.5	34.7
ITH 98-13	0.7	6.7	3.8	67.5
ITH 98-51	0.8	6.9	3.7	60.3
Ife Brown	0.9	6.4	3.3	91.1
TVu 1509	0.7	7.1	2.0	65.2
ITH 98-53	1.0	6.2	3.0	83.9
Sanzi	0.7	6.7	2.0	57.1
ITH 98-47	0.7	6.2	3.3	54.2
ITH 98-7	0.9	6.7	4.0	80.6
ITH 98-18	0.6	7.4	3.5	57.4
LSD (5%)	NS	NS	0.6	27.7
CV (%)	32.8	17.2	12.2	24.6

Values are means of three replicates. NS = F-test nonsignificant at $p<0.05$

DISCUSSION

The results of the study showed the possibility of obtaining sources of thrips resistance in the screened cultivars. While pest populations were not always significantly different among the cultivars, damage ratings always showed significant differences. Sanzi, which is a local cultivar consistently supported fewer thrips populations and lesser damage comparable to the resistant control, TVu 1509, than Vita 7 (the susceptible control). In a related study, Alabi *et al.* (2003) reported that Sanzi sabinli was resistant to thrips in Nigeria, which corroborated with the results from this study. On the contrary, however, TVx 3236, which was also reported to be resistant to thrips in Nigeria (Alabi *et al.*, 2003) was not found resistant in the present study in Ghana. Thrips resistance was also observed in Sanzi at Fumesua in the Ashanti Region of Ghana (Afun J.V.K. Personal Communication) which also agrees with the findings from the present study. Sanzi has smaller racemes and flowers and probably does not provide enough shelter for thrips compared to varieties with leafy racemes and flowers. In 2003, ITH 98-47, while supporting significantly greater thrips populations than the susceptible control (Vita 7) and most cultivars, sustained thrips damage rating that was not significantly different from the resistant control (TVu 1509). Percent yield loss for ITH 98-47 also was not significantly different from that of the resistant control. This result perhaps suggests tolerance in ITH 98-47. Damage ratings for ITH 98-24, ITH 98-45 and ITH 98-46 also were not significantly different from the resistant control in 2004. Additionally, a lower yield loss was recorded for ITH 98-45 than the resistant control. Although no significant correlations were detected, the trend of the relationships among the parameters used to measure thrips resistance in the cultivars was established. High thrips populations had the tendency for causing more damage to floral organs. Also, high thrips damage had the tendency for resulting in greater yield loss.

In conclusion, the results of the study have demonstrated that sources of resistance have been identified in Sanzi, ITH 98-45 and ITH 98-47. Genes from these cultivars can be incorporated into other cultivated elite varieties most of whom are highly susceptible to thrips to reduce losses from this pest. Also, resistant cultivars when incorporated in integrated pest management programs can lessen the use of insecticides and increase environmental safety for sustainable cowpea production.

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