Bayero Journal of Pure and Applied Sciences, 3(2): 110 - 114
Received: July, 2010
Accepted: September, 2010
ISSN 2006 - 6996

INFLUENCE OF COWPEA GENOTYPE AND MILLET-CROPPING SYSTEM ON COWPEA DAMAGE BY THRIP AND APHID PESTS IN THE SUDAN SAVANNAH OF NIGERIA

Muhammed, I. B.,[1*] A.U. Yusuf[2] and B. S. Wudil[2]
[1]Department of Agronomy, Bayero University, Kano, Nigeria.
[2]Department of Crop Protection, Bayero University, Kano, Nigeria.
*Correspondence author: ibabamohd@yahoo.co.uk

ABSTRACT
A study was carried out to investigate the effect of cowpea genotype and row arrangement on aphids and thrips infestation on cowpea intercropped with millet during the 1999 and 2000 cropping seasons at Minjibir in the Sudan savanna zone of Nigeria (lat. 12^0 $08^{'}$ N long. 8^0 32' E, 500m above sea level). Treatments consisted of six genotypes made up of one local Danila and five improved (IT90K-277-2, IT95K-1090-3, IT96D-740, IT96D-757 and IT96D-772) and four row arrangements (1M:1C, 2M:2C, 1M:2C, and 2M:4C, reflecting millet to cowpea rows). These were laid down in a split plot design with three replications. Cowpea genotype had significant effect on number of days to 50% flowering. In 1999, IT90K-277-2 and IT95K-1091-3 had significantly shorter days to 50% flowering than the other genotypes. Number of days to maturity, aphids and thrips damage on cowpea was significantly affected by cowpea genotype, where IT90K-277-2 and IT95K-1091-3 attain maturity significantly earlier than the other genotypes in both seasons. In 2000, IT90K-277-2 had the least thrips damage compared to the other cowpea genotypes while Danila recorded the highest damage. On row arrangement, plants at 1M:1C row arrangement took significantly longer days to attain 50% flowering compared to 2M: 2C, 1M: 2C and 2M: 4C row arrangements. The results indicated that IT90K-277-2 recorded the highest yield and had some tolerance for aphids and thrips, and could be recommended to farmers in the Sudan Savanna of Nigeria.
Key words: Cowpea, genotype, millet, thrip, aphid, pest.

INTRODUCTION

Cowpea (Vigna unguiculata (L.) Walp.) constitutes the cheapest source of dietary protein for low income sector of the population in West and Central Africa (Rachie, 1995). The grain serves as the most practicable source of storable and transportable protein, especially in developing countries of the tropics where animal protein is limited and equally expensive (Kwasi, 1992). Bressani (1985) reported that cowpea grain contains 23-30% protein, 60-66% carbohydrates, 5-6% fibre, 3.4-3.7% ash and 1.1-3.0% oil. Moreover, cowpea provides the cheapest source of fodder for livestock and also has the unique ability to fix atmospheric nitrogen, even in very poor soils thus contributing to the improvement of its fertility (Emechebe and Singh, 1997). All these attributes, coupled with its ability to tolerate draught, shade and fast growth habit in warm climates made cowpea to be a very important crop and an essential component of various farming systems in the marginal lands and drier regions of the tropics (Carsky *et al.,* 2002).

The major constraints to cowpea production include low density of cowpea and shading by cereals in intercropping systems, diseases, insect pests and parasitic weeds (Singh and Tarawali, 1997). Bean flower thrips, *Megalurthrips sjostedti* (Trybom) and cowpea aphids, *Aphis craccivora* Koch are among insect pests attacking cowpea in the field. Both adult thrips and their nymphs feed at the base of petals and stigma. Severe injury is characterized by flower malformation, distortion and discolouration. Yield loss has been estimated at about 14.5 kg/ha per individual thrips per plant (Allen *et al.*, 1996). *A. craccivora* is an important pest of cowpea during the seedling stage. Both adult and juvenile aphids suck sap from young leaf and stem tissues. Aphids also infest the reproductive structures but the damage is more devastating during the seedling phase when they also transmit the cowpea aphid-borne mosaic virus (Roberts *et al.*, 1993).

At present great emphasis is being placed on the application of synthetic insecticide to control major field pests of cowpea and this has resulted in their indiscriminate usage, leading to development of genetic resistance of pest species and the accumulation of chemical residues in treated food materials (Champ and Dyte, 1976). Furthermore, the increased costs of mostly imported synthetic insecticides have caused a serious drain on the fragile economy of third world countries where the exchange rate is in favour of the developed countries where these pesticides are produced.

The use of resistant varieties is a cheap, effective and ecologically safe method of protecting crops against pests since there is no special technology which has to be adopted by the farmer (Helbig, 1997). Intercropping, apart from spreading the labour peak of the farmer, has also been shown to reduce the incidence of pests through the creation of a less favourable environment than that of the monocrop (Steiner, 1982).

This study was undertaken to asses the susceptibility of six cowpea genotypes to thrip and aphid damage in millet-based cropping systems.

MATERIALS AND METHODS

Field trials were conducted at the IITA Agricultural Research farm Minjibir, Kano (lat. 12^0 08' N long. 8^0 32' E, 500m above sea level) in the 1999 and 2000 cropping seasons. The soil of the experimental site was sandy loam. Treatments consisted of a combination of six cowpea genotypes made up of one local Danila and five improved (IT90K-277-2, IT95K-1090-3, IT96D-740, IT96D-757 and IT96D-772) and four row arrangements (1M:1C, 2M:2C, 1M:2C, and 2M:4C, reflecting millet to cowpea rows). The treatments were laid down in a split plot design with row arrangement and cowpea genotype as main and sub-treatments, respectively. The gross plots varied from 14 ridges 75cm apart and 6m long to 6 ridges, 6m long and the net plot from 6 ridges 4m long to 2 ridges 4m long, depending on the row arrangement. The plots received a basal application of 30kg N, 30kg P_20_5 and 30kg k_20/ha in form of urea, single superphosphate and muriate of potash before planting. Millet was top-dressed with 30kg N/ha at 5 weeks after planting. The seeds (cowpea and millet) dressed with Farnasan D were sown at 20cm on 75cm apart ridges for cowpea and 1m on 75cm ridges for millet. The crops were sown as per the row arrangement, after the rains had established. Weeds were controlled using double spray of Delfos at the rate of 1 litre/ha at 40 days after sowing (flowering stage) and 55 days after sowing (DAS) (podding stage). Data on number of days to 50% flowering and 75% pod maturity were recorded. Similarly, aphids and thrips infestation/damage ratings on cowpea were recorded using the following visual ratings as described by Jackai and Singh, (1988): for aphids, level of infestation was assessed by estimating number of aphid colonies on plants/plot at flowering stage using 0-9 scale thus, 0 (no infestation), 1 (a few individual aphids), 3 (a few isolated colonies), 5 (several small colonies), 7 (large isolated colonies), and 9 (large continues colonies), while for thrips, infestation was estimated at post flowering stage (52-58 DAS) using a scale of 1-9 as follows, 1 (browning/drying (i.e, scaling) of stipules, leaf or flower, buds; no bud abscission), 3 (initiation of browning of stipules, leaf or flower; no bud abscission), 5 (distinct browning/drying of stipule and leaf or flower buds; some bud abscission), 7 (serious bud abscission accompanied by browning/drying stipules and bud; non elongation of peduncles), and 9 (very severe bud abscission, heavy browning/drying of stipules and buds; distinct non elongation of (most or all) peduncles). Total dry matter (TDM) of cowpea was recorded at 12 weeks after sowing (WAS) after determining the oven dry weight of 5 plants. Similarly, grain yield of cowpea in each plot was extrapolated to Kg/ha after harvesting the crop. The data were analyzed statistically as described by Snedecor and Cochran (1967). Multiple comparisons of the means were done using Duncan's multiple range test (Duncan, 1955).

RESULTS

Number of days to 50% flowering was significantly affected by cowpea genotype with IT90K-277-2 and IT95K-1091-3 having statistically shorter days to 50% flowering compared with other treatments in 1999, while in 2000, IT95K-1091-3 recorded the shortest days to 50% flowering compared with the other genotypes (Table 1). Danila recorded the longest days to 50% flowering compared to the other cowpea genotypes in both seasons. Significantly longer days to maturity was recorded by Danila in both 1999 and 2000 compared to other genotypes. IT90K-277-2 recorded the shortest days to 75% maturity, although it was at par with IT95K-1091-3 and a similar pattern of response was recorded in 2000. Row arrangement had significant effect on days to 50% flowering in 1999 only. The 1M:1C row arrangement in 1999 recorded significantly longer days to 50% flowering compared with the other row arrangements, which were statistically at par. There were no significant differences among treatments in both 1999 and 2000 on number of days to maturity. Similarly, the interaction effects of cowpea genotype and row arrangement on both parameters were statistically non significant in both seasons (Table 1).

The influence of cowpea genotype and row arrangement on aphid and thrips infestation on cowpea in mixture with millet is presented in Table 2. The result shows that aphid infestation on cowpea was significantly affected by cowpea genotype in 2000 only and Danila recorded the highest infestation, except that it was at par with IT96D-740. There was no significant difference between the rest of the treatments, except IT90K-277-2, which recorded the lowest aphid infestation, although it was at par with IT95K-1091-3. Similarly, in 1999, thrips infestation on cowpea was significantly affected by cowpea genotype with Danila recording the highest thrips infestation that was significantly different from the other genotypes. In 2000, Danila recorded significantly higher thrips infestation compared with the other genotypes and appeared worst while IT90K-277-2 was least affected. There was no significant difference between row arrangement on aphids infestation in both 1999 and 2000. However, significant difference was recorded between row arrangement on thrips infestation in 1999, wherein 2M:4C row arrangement recorded the highest thrips infestation compared with the other row arrangements, which were at par. The interaction effects of cowpea genotype and row arrangement were non significant in both 1999 and 2000 (Table 2).

Total dry matter (TDM) of cowpea at 12 WAS was significantly affected by genotype with Danila having higher values in both seasons (Table 3). The other genotypes had similar TDM except IT93K-1091-3 and IT96D-666 in 1999 and 2000, respectively. In both years, row arrangement had significant effect on TDM, wherein plants at 2:4 row arrangements produced higher values compared with the other arrangements while 1M:1C row arrangement recorded the least value.

In 1999 IT90K-277-2 produced the highest grain yield though statistically comparable to values recorded by IT95K-1091-3 and IT96D-666 (Table 3). However, in 2000 IT90K-277-2 out-yielded all the other genotypes while IT96D-666 recorded the least value. Cowpea plants sown at 2M:4C out-yielded the other arrangements with the values recorded at 1M:1C row arrangement being the least.

Table 1. Influence of cowpea genotype and row arrangement on number of days to 50% flowering and to maturity of cowpea intercropped with millet at Minjibir, Kano State.

Treatments	Number of days to 50% flowering		Number of days to 75% maturity	
	1999	2000	urity1999	2000
Cowpea genotype				
Danila	54.50a	50.33a	88.92a	88.58a
IT90K-277-2	45.08d	43.08c	71.67d	71.75d
IT95K-1091-3	46.50d	40.08d	72.25d	72.46d
IT96D-740	52.58b	46.50b	78.08b	78.25b
IT96D-757	50.50c	47.00b	77.67b	77.46b
IT96D-772	50.67c	46.75b	76.54c	76.54c
SE ±	0.66	0.37	0.34	0.31
Row arrangement				
1M : 1C	51.06a	45.72	77.78	77.69
2M : 2C	49.61b	45.44	77.39	77.58
1M : 2C	49.67b	45.5	77.47	77.33
2M : 4C	49.56b	45.83	77.44	77.42
SE ±	0.21	0.19	0.16	0.15
CG x RA interaction	ns	ns	ns	Ns

Means followed by the same letter (s) within treatment are not significantly different at 5% using DMRT.

Table 2. Influence of cowpea genotype and row arrangement on aphids and thrips on cowpea in mixture with millet at Minjibir, Kano State.

Treatments	Aphids		Thrips	
	1999	2000	1999	2000
Cowpea genotype				
Danila	1.29	2.46a	1.50a	2.13a
IT90K-277-2	1.25	1.42d	1.17b	1.17c
IT95K-1091-3	1.25	1.67cd	1.08b	1.54b
IT96D-740	1.17	2.08a	1.13b	1.54b
IT96D-757	1.46	1.92bc	1.04b	1.42bc
IT96D-772	1.29	1.83bc	1.04b	1.42bc
SE ±	0.11	0.11	0.05	0.12
Row arrangement				
1M : 1C	1.22	2.11	1.00b	1.53
2M : 2C	1.22	1.81	1.06b	1.47
1M : 2C	1.28	1.83	1.11b	1.47
2M : 4C	1.42	1.83	1.47a	1.67
SE ±	0.09	0.11	0.04	0.09
CG x RA interaction	ns	ns	ns	Ns

Means followed by the same letter (s) within treatment are not significantly different at 5% using DMRT.

Table 3. Influence of cowpea genotype and row arrangement on total dry matter (TDM) and grain yield of cowpea in mixture with millet at Minjibir, Kano State.

Treatments	Total dry matter (g)		Grain yield (kg/ha)	
	1999	2000	1999	2000
Cowpea genotype				
Danila	47.63a	34.05a	367c	691b
IT90K-277-2	35.30bc	29.77b	702a	1019a
IT95K-1091-3	30.11d	30.60b	616a	795b
IT96D-740	35.40bc	28.33bc	487bc	765b
IT96D-757	32.65cd	25.92c	434c	511c
IT96D-772	37.15b	29.49b	606ab	779b
SE ±	1.39	0.85	41.65	41.72
Row arrangement				
1M : 1C	26.22c	20.68c	357b	587c
2M : 2C	36.43b	30.25b	427b	668c
1M : 2C	36.88b	30.12b	487b	804b
2M : 4C	45.96a	37.78a	870a	981a
SE ±	1.78	1.45	37.0	28.0
CG x RA interaction	ns	ns	ns	Ns

Means followed by the same letter (s) within treatment are not significantly different at 5% using DMRT.

DISCUSSION

Danila flowered later than the improved cultivars because the improved cultivars are early maturing. The local cultivar Danila recorded the highest aphids infestation in 2000 only but higher thrips infestation in both 1999 and 2000 cropping seasons and this might be associated with its inherent susceptibilities to infestation by aphids and thrips. This is probably due to the fact that the thick foliage resulting from the spreading local Danila shelters the pests and encourages reproductive activities and thereby attracts more of the pests to this environment. Ofuya (1987) reported that cultivars with dense vegetation and overlapping foliage suffer greater damage by *Cydia ptychora* than non-vigorous types. The foliar cover has been reported to be dependent on two factors: the growth habit and population of plants (Pitan and Odebiyi, 2002). Climatic factors also affect the foliar cover. The higher aphid infestation on Danila in both seasons was similar to that of the improved variety IT96D-740. However, other genotypes offered some kind of resistance to thrips damage in both 1999 and 2000. The study also revealed that varietal resistance offered some protection to cowpea against thrips infestation in millet-cowpea mixture by reducing the level of thrips. This indicates that the improved cultivars were resistant to thrips infestation. Ofuya (1993) attributed the resistance exhibited by the resistant cultivars to a strong antibiosis. It is also probable that the apparent resistance exhibited by some of the cowpea genotypes to aphids and thrips infestation might be due to the inherent genetic properties.

However, 1M:1C millet-cowpea mixture offered longer days to 50% flowering in 1999 only. Similar finding was reported by Sharma and Franzmann (2000). More so, the higher thrips population found on 2M:4C row arrangement in 1999 indicates that probably the presence of millet in the mixture offered little protection against the population built-up of the pest. Similar findings on the combined effects of the varietal resistance and millet-cowpea mixture had been reported by Olabanji *et al.* (2002). On the contrary, the lower thrips infestation on 1M:1C row arrangement in 1999 could be attributed to the fact that 1 row of millet on the boarder offered sufficient physical barrier against the pest than at the more wider 2M:4C row arrangement. Similar previous study by Mohammed and Miko (2006) had shown that at more intimate stand/row arrangement, higher canopy crops such as millet in the present study, served as better physical barriers against insect pest movement and build-up than the lower canopy intercrops.

CONCLUSION

The present study showed that millet-cowpea mixture and the use of improved varieties of cowpea may reduce the effect of the thrips and aphids infestation. From these and other reports, it would then appear that the role of millet-cowpea intercropping in insect control depends on the cowpea variety, type of insects and other factors that have not really been studied. Intercropping at 1M:1C appears to reduce foliar overlap and therefore reduce aphid and thrips population and is therefore most appropriate in controlling these cowpea pests. Planting of IT90K-277-2 and millet-cowpea intercropping at 1M:1C row arrangement, could also serve as invaluable inputs to the integrated pest management of aphids and thrips in cowpea in Kano State, Nigeria.

REFERENCES

Allen, D. J., Ampofo, J. K. O. and Wortmann, C. S. (1996). Pests, Diseases and Nutritional Disorders of the Common bean in Africa: A field guide. Cali, Columbia. International Centre for Tropical Agriculture (CIAT) Wageningen, The Netherlands. Technical Centre for Agriculture and Rural Cooperation, 132 pp. CIAT Publication No. 260. Fisher, N. M., Raheja, A. K. and Elemo, K. A. (1987). Insect pest Control for cowpea in mixtures. *Experimental Agriculture*, 23: 9-20.

Bressani, R. (1985). Nutritive value of cowpea. In: Singh, S. R. and Rachie, K. O. (Eds.). *Cowpea Research, Production and Utilization*. John Wiley and Sons Limited, London. 359 pp.

Champ, B. R. and Dyte, C. E. (1976). Report of the FAO global survey of pesticide susceptibility of stored grain pests. FAO plant production project. Paper no. 5, FAO/UN, Rome.

Carsky, R. J., Vanlauwe, B. and Lyasse, O. (2002). Cowpea rotation as a resource management technology for cereal-based systems in the Savannas of West Africa. In: Fatokun, C. A., Tarwali, S. A., Singh, B. B., Kormawa, P. M. and Tamo, M. (eds). Challenges and opportunities for enhancing sustainable cowpea production. Ibadan, Nigeria. 252-266pp.

Duncan, D. B. (1955). Multiple range and Multiple F. test. *Biometrics*, 11:1-42.

Emechebe, A. M. and Singh, B. B. (1997). Technology options and research challenges to increased cowpea production under Striga and drought stress in semi – arid Africa. In: Benzumeh, T., Emechebe, A. M. Sedgo, J. and Oedraogo, M. (Eds.). Technology options for sustainable agriculture in Sub-Saharan Africa. SAFRGRAD, Ouagadougou, Burkina Faso. Pp 20 – 217.

Helbig, J. (1997). Host plant resistance to storage insect pests. In: Anonymous (Ed.) Integrating biological control and host plant resistance. Proceedings of CTA/IAR/IIBC Seminar. Addis- Ababa, Ethiopia, 1995. pp66-72.

Kwasi, I. D. A. (1992). Studies on genetics of *Striga gesneroides* (Wild), Vatke and Alectra (*Alectra vogolli* (Benth) resistance in cowpea (*Vigna unguiculata* L. Walp.). Unpublished M. Sc thesis, A. B. U. Zaria, Nigeria.

Mohammed, I. B. and Miko, S. (2006). Effect of cowpea genotype and row arrangement on *Maruca* pod borer and yield of cowpea intercropped with millet. *Journal of Science, Management and Technology.* Vol.. 1 No. 2.pp 101-107.

Ofuya, T. L. (1987). Effect of spacingin cowpea (*Vigna unguiculata* L. Walp.) on damage by the black cowpea moth, *Cydia ptychora* (Lepidoptera: Tortricidae). *Annals of Applied Biology*, 111: 773-776.

Ofuya, T. L. (1993). Evaluation of selected cowpea varieties for resistance to *Aphis craccivora* Koch. (Hemiptera: Aphididae) at the seedling and pod stage. *Annals of Applied Biology* 123: 19-23.

Olabanji, O. G., Elemo, K. A., Ogunlela and Tabo, R. (2002). Productivity of pearl millet and cowpea mixture as influenced by component proportion, cowpea variety and sowing date. *Samaru Journal of Agricultural Research,* 18: 3-15.

Pitan, O. O. R. and Odebiyi, J. A. (2002). Effect of intra row spacing of cowpea on pod-sucking bug population and damage in Ibadan, Nigeria. *Nigerian Journal of Entomology*, 19: 31-39.

Rachie K. O. (1995). Introduction. In: Singh, S. R. and Rachie, K. O. (eds.). *Cowpea: Research, Production and Utilization*. John Wiley and Sons, Chichester, U. K. pp xx–xxviii.

Roberts, J. M. F., Hodgson, C. J., Jackai, L. E. N., Thottappilly, G. and Singh, S. R. (1993). Interaction between two synthetic pyrethroids and the spread of two non-persistent viruses in cowpea. *Annals of Applied Biology*. 122: 57-67.

Sharma, H. C. and Franzmann, B. A. (2000). Biology of the legume pod borer, *Maruca vitrata* (Fabricius) and its damage to pigeon pea and Adzuki bean. *Insect Science and its Application*. 20(2): 99-108.

Singh, B. B. and Tarawali, S. A. (1997). Cowpea and its improvement: Key to sustainable mixed crop-livestcok farming systems in West Africa. Pp 79-100. In: crop residues in sustainable mixed-crop livestock farming systems. In: C. Renald (Ed). International Livestock Research Institute (ILRI), and CAB International, Willingford, UK.

Snedecor, G. W. and Cochran, W. G. (1967). Statistical methods. The Iowa State University Press, Ames, Iowa. U. S. A. 507pp.

Steiner, K. G. (1982). Intercropping in tropical small holder agriculture with special reference to West Africa. GTZ No. 137.