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Comparison of seed yielding performance of deltamethrin unprotected and protected plants of five cowpea cultivars at Foumbot, Cameroon.

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Keywords: Cowpea — Deltamethrin — Insecticide — Seed-pests — Yield loss — Cameroon.

Summary

Losses in seed yields due to damage by seed insect pests were studied on unsprayed and sprayed cowpea plants at Foumbot, located in the western highland savanna zone of Cameroon, in 1988 and 1989. Major pests recorded in the study site were Melanagromyza vignalis *Spencer (Diptera: Agromyzidae),* Maruca testulalis *Geyer (Lepidoptera: Pyralidae),* Cydia ptychora *Meyrick (Lepidoptera: Tortricidae),* Heliothis armigera *Hübner (Lepidoptera: Noctuidae),* Aphis craccivora *Koch (Homoptera: Aphididae),* Apion *species (Coleoptera: Curculionidae),* Coreid bugs *(Heteroptera: Coreidae), and* Bruchids *(Coleoptera: Bruchidae). Yields of undamaged cowpea seeds from unsprayed and sprayed plants of local cultivars acquired from Badun, Melong, Foumbot and Befang were comparable with those from MA 2/1, an improved cultivar from the International Institute for Tropical Agriculture that has been released in Cameroon by the Institute for Agronomic Research.* Melanagromyza, Maruca *and* Coreid *bugs caused 70-80% of seed damage on unsprayed and sprayed plants. Fortnightly spraying of plants with deltamethrin at 12.5 g. a.i./ha, significantly reduced yield loss due to damage by* Maruca *sp., the overall loss in seed yields/ha and % loss of potential seed yield, in all five cowpea cultivars used in this study. However, deltamethrin appeared ineffective in reducing seed yield loss caused by* Melanagromyza *and Coreid bugs.*

Résumé

Afin d'estimer les pertes de rendement en grain de niébé, pertes dues aux attaques d'insectes, des investigations ont été menées en 1988 en 1989 sur parcelles traitées et non traitées dans la localité de Foumbot, Ouest Cameroun. Parmi les insectes recencés sur cette culture lors de cette étude on retrouve : Melanagromyza vignalis *Spencer (Diptera: Agromyzidae),* Maruca testulalis *Geyer (Lepidoptera: Pyralidae),* Cydia ptychora Meyrick (Lepidoptera: Tortricidae), Heliothis armigera *Hübner (Lepidoptera: Noctuidae),* Aphis craccivora *Koch (Homoptera: Aphididae),* Apion *spp. (Coleoptera: Curculionidae), les Coreidae (Heteroptera: Coreidae) et les Bruchidae (Coleoptera: Bruchidae). Les rendements en grains sains des plantes traitées et non traitées des cultivars locaux provenant de Badun, Melong, Foumbot et Befang ont été comparés à ceux du MA 2/1, un cultivar amélioré de l'IITA distribué par l'IRA. On note que 70 à 80% de pertes en grains sur plantes traitées ou non traitées sont attribuées aux dégâts de* Melanagromyza, Maruca *et* Coreidae. *L'application d'une dose de 12.5 g de m.a. à l'hectare de deltamethrine réduit de façon significative, non seulement les dégâts dus à* Maruca *sur les 5 cultivars de niébé utilisés pour cette étude, mais aussi les pertes totales en rendement des grains à l'hectare et le % de perte en rendement global potentiel. Toutefois, la même dose apparaît sans effet sur* Melanagromyza *et les* Coreidae.

Introduction

Cowpea (*Vigna unguiculata* (L) Walp) is a major cultivated edible grain legume in the forest and derived savanna ecological zones of the southern and middle belts of Cameroon. Many Cameroonian households in these zones use the tender leaves of cowpea plants as green vegetable and the seeds for main local recipes such as «khoki» (steamed cowpea cake) and cowpea porridge.

A wide range of insects which have been shown to attack all stages of the cowpea plants in the field in the cowpea producing countries in Africa, have also been observed on cowpea in the forest and derived savanna zones in Cameroon (4, 7, 9). These insects include *Alcidodes* spp. (Coleoptera: Curculionidae), *Empoasca* spp. (Homoptera: Cicadellidae), *Serricothrips occipitalis* Hood (Thysanoptera: Thripidae), *Megalurothrips sjostedti* Thrybom (Thysanoptera: Thripidae), *Aphis craccivora, Melanagromyza vignalis, Apion* spp. and many species of Coreid bugs. Many of these insects have also been known to cause significant losses in cowpea yields in African countries such as Nigeria (2, 11); Republic of Benin, Upper Volta (Burkina-Faso), Niger and Togo (1); Ghana (12); Uganda (8); Tanzania (5) and Kenya (6).

A survey of insect pests on cowpea at Foumbot, which is one of the major cowpea production areas in the western highland savanna zone of Cameroon, indicated that the above insect species occur on cowpea plants at the various growth stages. It is probable that these insects are causing significant losses in seed yields of cowpea in the western highland

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savanna zone and in Foumbot area in particular. However, the degree of loss has not been studied. The present work was carried out to estimate the quantitative loss in seed yields of one exotic and four Cameroonian local cowpea cultivars, due to damage by some major insect pests of cowpea seeds at Foumbot.

Material and Methods

Studies were carried out on seed weight loss in cowpea due to damage by major insect pests of cowpea seeds, during the cropping seasons of 1988 and 1989. The cropping season starts in September and ends in December of each year. The experiment was set up on 26 September of each year, at the research station of the Institute of Agronomic Research (IRA) at Foumbot.

Five cowpea cultivars earlier described by Parh (9) were planted. These included MA 2/1, an exotic pinkish white seeded variety from the International Institute for Tropical Agriculture (IITA), Ibadan, Nigeria and which was selected for use in Cameroon by IRA at Maroua in north Cameroon. The four local cultivars were respectively acquired from Badun village in the forest zone and Melong, Foumbot and Befang villages in the derived savanna zone.

The five cowpea cultivars were all sown in main plots (Blocks). Each block comprised of two subplots with unsprayed and sprayed plants, and each measured 14.5 × 3.0 metres. The distance between the two subplots was 1.5 metres. In each subplot, each cowpea cultivar was sown in an area of 3.0 × 2.1 metres and the distance between the cowpea cultivars within the subplot was 1.0 metre. The distance between the blocks was 2.0 metres. The experiment was replicated four times in a randomised complete block design. The seeds of each cowpea cultivar were sown at 3 per hill on the flat at a spacing of 25.0 cm within rows and 70.0 cm between rows. The plants were thinned to one per stand at 20 days after sowing, giving a density of 57,143 plants per hectare.

Deltamethrin (Decis) was used fortnightly at 12.5 g. a.i./ha to protect plants against insects in the subplot with protected plants and spraying was effected by use of a pneumatic knapsack sprayer. Spraying commenced at 21 days after planting and terminated 10 days before harvest. The plants received a total of four insecticide sprays before harvest.

The yields of undamaged dry seeds were obtained by harvesting all pods from 10 randomly selected plants of the two middle rows of the four rows of plants of each unsprayed and sprayed subplots. The pods were handshelled and the undamaged seeds were weighed on a Mettler PE 160 electronic balance. Seeds of each cultivar that were damaged by different insect species, were separated on the basis of the characteristic damage symptoms caused by each insect pest and counted. Such characteristic damage symptoms included frass on seeds due to feeding by *Cydia* sp., shrivelled seeds due to sucking by Coreid bugs and seed with terminal holes and both external and internal soiled galeries, due to feeding by *Melanagromyza vignalis*. Seeds damaged by each insect species were counted in order to obtain the contribution of each insect species to weight loss of seeds in unsprayed and sprayed subplots.

The mean weight of an undamaged seed of each cultivar in each subplot was obtained by weighing 500 seeds. This was then multiplied by the number of damaged seeds to obtain the weight of damaged seeds of each cultivar in each subplot. The percentage contribution to weight loss in seeds of each cultivar in each subplot due to each insect species, was calculated by multiplying the weight of damaged seeds by 100 and dividing by the total weight of seeds damaged by all insects. The mean % loss in seed weight due to each insect species was then recorded from 4 replicates. The calculated weights of seeds from 10 plants of each cultivar that were damaged in each subplot by all insect species, were added and converted to weight loss in Kg/ha. This weight loss was multiplied by 100, and divided by the sum of the weights of undamaged (a) and damaged (b) seeds, to obtain the percentage weight loss of potential cowpea seed yield for unsprayed and sprayed plants of each of the five cowpea cultivars.

The mean yield in Kg/ha of undamaged seeds, the mean yield loss in Kg/ha and the mean % loss of potential seed yield, were all statistically analysed by analysis of variance. The treatment means that differed significantly were separated by use of Duncan Multiple Range Test (DMRT) at 5% level of significance.

Results and discussion

Cowpea seed yield

The mean yields of undamaged seeds in Kg/ha from unsprayed and sprayed plants for the 1988 and 1989 experiments, are presented in table 1. The overall seed yields of 2112.23 Kg/ha from sprayed plants was significantly higher ($P < 0.05$) than the 974.57 Kg/ha from unsprayed

TABLE 1

Mean yield in Kg/ha of undamaged cowpea seeds from unsprayed and sprayed plants of 5 cowpea cultivars at Foumbot in the western highland savanna zone of Cameroon in 1988 and 1989.

Cowpea cultivars	1988 mean yield from: A		Overall Mean	1989 mean yield from: B		Overall mean
	Unsprayed plants	Sprayed plants		Unsprayed plants	Sprayed plants	
Foumbot local	1373.89 a	2738.18 a	2056.01 a	1136.03 ab	1077.89 a	1106.96 ab
Badun local	644.97 b	1793.38 b	1219.20 b	903.17 b	1182.80 a	1042.99 b
Melong local	538.40 b	1523.20 b	1030.80 b	888.42 b	979.93 a	934.18 b
Befang local	1168.06 a	1664.23 b	1416.17 b	894.08 b	1005.08 a	949.58 b
MA 2/1 IITA/IRA Selection	1147.72 a	2842.06 a	1994.86 a	1302.62 a	1375.14 a	1338.88 a
Cowpea means of each year	974.57 b	2112.23 a		1024.86 a	1124.17 a	

N.B.: Means of each year that are followed by the same letters in the same row or column, do not differ significantly. (P = 0.05: DMRT).

plants of all cultivars for the 1988 experiment. However, the 1124.17 Kg/ha from sprayed plants of the 1989 experiment, was not significantly higher than the 1024.86 Kg/ha from unsprayed plants.

Table 1 also indicates that in 1988, the overall mean yield of undamaged seeds of 2056.01 Kg/ha from Foumbot local cultivar and that of 1994.86 Kg/ha from MA 2/1, were not significantly ($P > 0.05$) different. These yields were however significantly higher ($P < 0.05$) than the yields of 1416.17, 1219.20 and 1030.80 kilograms per hectare, that were obtained respectively from Befang, Badun and Melong local cowpea cultivars during the 1988 experiment.

Similarly, the 1338.88 Kg/ha from MA 2/1 was significantly higher ($P < 0.05$) than 1042.99, 949.58 and 934.18 Kg/ha that were obtained respectively from Badun, Befang and Melong local cowpea cultivars during the 1989 experiment.

The results in Table 1 show also that, Melong local which is highly cherished locally, had low seed yields/ha of 538.40 Kg in 1988 and 888.42 Kg in 1989 in unsprayed plots, while yields/ha in sprayed plots were 1523.20 Kg in 1988 and 979.93 Kg in 1989. The above results indicate that increased yields of undamaged cowpea seeds could best be achieved with the use of insecticides and that, the different cowpea cultivars used in this study have different seed yield potentials. It is therefore evident that insecticide spraying of cowpea plants is necessary for increased seed yields in the production of cowpea in Foumbot area. These results are in conformity with those of other workers in cowpea production areas in Africa. For example, many workers in Nigeria such as Taylor (11) and Dina (3), and in Tanzania such as Price *et al.* (10), have demonstrated in their respective localities, that spraying cowpea plants with insecticides, significantly increases the seed yields.

It can also be seen from Table 1 that seed yields from local Cameroonian cultivars such as Foumbot local and Befang local, were comparable with the yield from MA 2/1, an improved IITA variety that was selected by IRA for use in Cameroon. In the circumstances, local Cameroonian cowpea cultivars appear to have high yield potential that could be exploited for cowpea germplasm improvement in Cameroon.

Mean % loss caused by different insects

Data on mean % seed weight loss caused by the different insect pests of cowpea seeds identified in this study for the 1988 and 1989 experiments, are presented in Table 2. The results show that, *Melanagromyza vignalis* caused an overall mean % seed weight loss of 28.25 in unsprayed and 54.09 in sprayed plots of all cowpea cultivars in 1988. The loss by *Melanagromyza vignalis* in 1989 was 18.58% in unsprayed and 33.35% in sprayed plots. The mean % loss due to Coreid bugs in unsprayed and sprayed plots were 27.35 and 23.59 respectively in 1988, and 27.28 and 35.75 respectively, in 1989. The mean % loss due to *Maruca testulalis* in unsprayed and sprayed plots were 20.64 and 11.84 respectively in 1988, while those in 1989 were 40.09 and 14.02 respectively. From these results, *Melanagromyza*, Coreid bugs and *Maruca* apprear to be the major pests of cowpea seeds on all experimental cowpea cultivars used in this study in Foumbot area during the cropping seasons of

TABLE 2

Contribution to mean % seed weight loss for unsprayed (B1) and sprayed (B2) plants of 5 cowpea cultivars, due to damage by different seed insect pests at Foumbot, Cameroon.

Cowpea cultivars	Unsprayed & sprayed pls.	Mean wt. loss in Kg/ha	Different insect spp. and mean % wt. loss of seeds due to their respective damage							
			Maruca	Cydia	Heliothis	Aphis	Apion	Melana-gromyza	Coreids	Bruchids
1988 CROP										
Foumbot	B1	332.25	33.74	9.12	3.04	0.54	0.00	12.88	35.31	5.37
local	B2	57.44	22.52	5.03	0.51	0.00	0.00	30.84	37.91	3.18
Badun	B1	371.58	14.77	8.18	1.25	0.00	0.00	43.96	30.57	0.00
local	B2	300.16	4.52	4.90	0.25	0.00	0.00	71.22	19.04	0.07
Melong	B1	297.83	14.31	14.85	1.12	0.00	0.00	36.02	31.94	1.76
local	B2	203.77	4.16	4.20	0.13	0.00	0.00	72.80	18.33	0.39
Befang	B1	236.98	27.89	4.50	1.76	1.81	0.00	39.59	22.65	1.07
local	B2	58.47	5.48	0.46	0.00	10.13	0.00	68.55	13.92	1.46
MA 2/1	B1	573.93	12.47	1.43	1.68	56.80	0.00	8.78	16.30	1.46
	B2	33.91	22.53	0.00	0.59	10.29	0.00	27.06	28.76	6.55
MEANS	B1	362.51	20.64	7.62	1.77	11.83		28.25	27.35	1.93
	B2	130.75	11.84	2.92	0.30	4.08		54.09	23.59	2.33
1989 CROP										
Foumbot	B1	134.99	40.87	5.86	8.49	0.46	1.72	12.70	28.07	1.82
local	B2	19.71	19.70	5.36	1.56	0.00	0.68	16.52	47.68	0.00
Badun	B1	90.73	43.56	8.40	1.32	0.00	0.45	17.18	28.58	0.52
local	B2	13.53	29.86	0.00	0.00	0.00	0.00	28.76	40.42	0.96
Melong	B1	102.18	43.65	16.24	2.56	0.00	0.14	10.03	25.16	0.81
local	B2	15.36	14.42	0.00	0.00	4.69	1.56	36.64	40.90	2.30
Befang	B1	51.90	35.99	1.99	0.84	0.00	1.77	35.12	23.09	1.20
local	B2	6.47	2.59	0.00	0.00	0.00	2.00	47.88	22.54	0.00
MA 2/1	B1	71.85	36.38	10.24	0.44	2.41	1.15	17.88	31.51	0.00
	B2	22.05	3.52	15.00	3.13	11.04	0.00	36.97	27.22	3.13
MEANS	B1	90.33	40.09	8.55	2.73	0.57	1.05	18.58	27.28	0.87
	B2	15.42	14.02	4.07	0.94	3.15	0.85	33.35	35.75	1.28

September 1988 and 1989.

Furthermore, the results in Table 2 indicate that, deltamethrin appeared to be ineffective against *M. Vignalis* Coreid bugs and bruchids when used fortnightly at 12.5 g. a.i./ha, from 21 DAP to 10-14 days before harvest. This is because high % seed weight loss due to these insects were recorded in both unsprayed and sprayed plots. Systemic insecticides such as furadan or dimethoate might therefore be more advisable for the control of *Melanagromyza* and Coreid bugs. It is therefore recommendable to study the efficacy of such systemic insecticides in the control of these pests which have been observed during the period of study, to be prominent in the Foumbot area during periods of intensive cowpea production. The application of such systemic insecticides must however be well timed, to avoid the occurrence of high levels of insecticide residues in the cowpea seeds at harvest.

The data in table 2 also show that the % seed damage by *M. Vignalis* on Badun, Melong and Befang local cultivars in 1988 and 1989, are higher than those on MA 2/1 and Foumbot local. These cultivars therefore appear to be less susceptible to *Melanagromyza* damage.

It was observed in this study that, pod attack by *Aphis craccivora* was not regular in the field, since pods in many unsprayed and sprayed plots were relatively free of aphid infestation. The 1988 and 1989 data in Table 2 show however that, Foumbot, Badun, Melong and Befang local cultivars of cowpea were less damaged by *Aphis craccivora*. These low % yield loss in seeds due to aphids, indicate that these local cultivars are probably less susceptible to *A. craccivora* than MA 2/1 which is an exotic improved cultivar.

Seed weight loss and % loss of potential seed yield

The mean seed yield loss in Kg/ha and the % loss of potential seed yield for 1988 and 1989 are shown in Table 3. The overall mean weight loss of seeds from all unsprayed plants were significantly higher ($P < 0.05$) than those from sprayed plants of all cultivars, for both the 1988 and 1989 experiments. Similarly, the % loss of potential seed yield from unsprayed plants, were significantly higher ($P < 0.05$) than those from sprayed plants for both the 1988 and 1989 experiments. These results show that the total of four deltamethrin insecticide sprays used in this study, significantly reduced losses in seed yields of the different cowpea cultivars.

Although the mean loss for Foumbot local was higher in 1989, the data in Table 3 show that, the weight loss and % loss of potential yield were respectively lower in Foumbot local and Befang local, than in Badun local, Melong local or MA 2/1 cultivars of cowpea in both 1988 and 1989. The data in Table 3 show further that the % loss of potential yield recorded for unsprayed plants of Foumbot and Befang local respectively in 1988, were significantly lower ($P < 0.05$) than those recorded for either Badun local, Melong local or MA 2/1 cowpea cultivars. This indicates that, Foumbot and Befang local cultivars of cowpea appear to be less susceptible to the insect pests of cowpea seeds that have been recorded in this study.

The relative quantitative estimation of cowpea yield loss in this study, has indicated the level of loss that farmers incur in the Foumbot area of intensive cowpea production. This level of loss is probably the same in other cowpea production centres in the forest and derived savanna zones. This is because the same spectrum of seed pest of cowpea in Foumbot area has been shown to commonly occur in such cowpea production centres (9).

This study has also indicated the need for use of appropriate insecticides, without which insect pests of cowpea seeds appear to significantly reduce seed yields of most cowpea cultivars. The study has highlighted also, the need to study the screening and timing of insecticide application in the Foumbot area of intensive cowpea production. This would enhance the establishment of the appropriate stage at which minimum insecticide application would enhance effective control of insect pests of cowpea seed. The result of such studies would also enhance minimum use of insecticides on

TABLE 3

The mean loss in seed yield in Kg/ha (A) and mean % loss of potential seed yield (B), due to seed damage by insect pests for unsprayed and sprayed plants of 5 cowpea cultivars, at Foumbot, Cameroon.

Cowpea Cultivars	A Mean loss is seed yield from unsprayed and sprayed plants		MEANS	B Mean % loss of potential seed yields $= \frac{b}{a+b} \times 100$		MEANS
	Unsprayed	Sprayed		Unsprayed	Sprayed	
988 CROP						
oumbot local	332.25 b	57.43 bc	194.84 bc	19.13 b	2.05 b	10.59 bc
adun local	371.58 b	300.16 a	335.87 a	37.96 a	14.64 a	26.30 a
elong local	297.82 b	203.77 ab	250.80 abc	36.24 a	11.59 ab	23.92 a
efang local	236.98 b	58.47 bc	147.73 c	15.89 b	3.49 b	9.69 c
A 2/1	573.93 a	33.91 c	303.92 ab	34.91 a	1.23 b	18.07 ab
EANS	362.51 a	130.75 b		28.83 a	6.60 b	
989 CROP						
oumbot local	134.99 a	19.71 a	71.35 a	10.48 a	1.95 a	6.22 a
adun local	90.73 ab	13.53 a	52.13 ab	9.69 a	1.20 a	5.45 ab
elong local	102.18 ab	15.36 a	58.77 ab	10.28 a	1.67 a	5.98 a
efang local	51.90 b	6.47 a	29.19 b	5.40 b	0.59 a	3.00 b
A 2/1	71.85 b	22.05 a	46.95 ab	5.32 b	1.56 a	3.44 ab
EANS	90.33 a	15.42 b		8.23 a	1.39 b	

a = calculated yield of undamaged seeds in Kg/ha.
b = Estimated wt. loss of seed in Kg/ha.
olumn or Row means of either «A» or «B» followed by the same letters, do not differ significantly (P = 0.05; DMRT).

cowpea plants in the Foumbot area, and probably in other cowpea growing areas in the forest and derived savanna ecological zones of Cameroon.

Conclusions

Fortnightly application of deltamethrin to cowpea plants at 12.5 g. a.i./ha, enhanced higher yields of undamaged seeds of cowpea from treated plants than from untreated plants in the Foumbot area of cowpea production. This shows that insecticide spraying is imperative in cowpea production in Foumbot area.

The cowpea seed weight loss in Kg/ha and the mean % loss of potential seed yields from unsprayed plants for both 1988 and 1989 respectively, are higher than those from sprayed plants. This shows that deltamethrin was effective in reducing the overall yield loss in cowpea seeds due to insect damage.

However, deltamethrin was not very effective in reducing damage to seeds caused by *Melanagromyza vignalis*. This was probably because the sprayed insecticide did not get in contact with the larvae of *Melanagromyza* which feed inside the cowpea seeds in the pods. The seed loss by Coreid bugs in sprayed plots was not also lower than that in unsprayed plots, because deltamethrin appeared to be less effective against the Coreid bugs. This therefore indicates that deltamethrin cannot be highly recommended for the control of *Melanagromyza vignalis* and Coreid bugs on cowpea in the Foumbot area where these insects are major cowpea seed pests, although the overall seed yields from cowpea plants that were sprayed with this insecticide were significantly higher than those from unsprayed plants.

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Literature

1. Appert, J., 1964. Pests of cowpea. *Vigna unguiculata* (L) Walp. L'Agronomie Tropicale, Extrait du N° 10. IRAT, 788-799.
2. Booker, R.H., 1964. Pests of cowpea and their control in Northern Nigeria. Bull. ent. Res. **55**. (4): 663-672.
3. Dina, S.O., 1976. Effect of insecticidal application at different growth phases on insect damage and yield of cowpea. J. Econ. Entomol. **69** (2). 186-188.
4. Ghogomu, R.T., 1984. «Some observations on pod legume insects in Nkolbisson area of Yaoundé, Cameroon». An unpublished «Rapport Technique N°3» submitted to Centre Universitaire de Dschang, Cameroon, 1984; 10 pp.
5. Kayumbo, H.Y., 1975. Cowpea insect pests in Tanzania. Proc. IITA Collaborators' Meeting on grain legume Improvement, IITA, Ibadan, Nigeria. 89-94.
6. Khamala, C.P.M., 1978. Pests of grain legume and their control in Kenya: In: Pests of Grain Legumes: Ecology and Control: eds. Singh, S.R., H.F Van Emden and T.A. Taylor. Academic Press, London.
7. Nonveiller, G., 1984. Catalogue des insectes du Cameroun d'intérêt agricole: Memoires XV, published by Institut pour la protection des Plantes; Beograd, Yougoslavia. 210 pp.
8. Nyiira, Z.M., 1971 The status of insect pest of cowpea (Vigna unguiculata (L) Walp) in Uganda, and their control. Pestic. Abstr. **17** (2): 194-197.
9. Parh, I.A., 1989. Preliminary study on documentation of cowpea (Vigna unguiculata (L) Walp) cultivars, cowpea cropping seasons and major cowpea insect pests in the forest and derived savanna zones of Cameroon. A paper presented at the 1st Annual Conference of the Cameroon Society of Biosciences (CSB) held at the University of Technology, Ngaoundere, Cameroon, from 5-9 December, 1989.
10. Price, M., Chambuya, R.I. & Machange F.Z., 1983. Insecticide evaluation and timing of spray application for insect control in cowpeas in Tanzania. Trop. Grain Legume Bull., **28**: 4-8.
11 Taylor, T.A., 1965. An attempt at quantitative estimation of major insect damage on cowpeas. Proc. agric. Soc. Niger. **4**: 50-53.
12. Van Halteren, P., 1971. Insect pests of cowpea, Vigna unguiculata (L) Walp in the Accra Plains. Ghana J. agri. Sc., **4**: 121-123.

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