EVALUATION OF NATIVE SOAP (BLACK SOAP) FOR THE CONTROL OF MAJOR INSECT PESTS AND YIELD OF COWPEA *(VIGNA UNGUICULATA* (L.) WALP) IN ABRAKA, DELTA STATE

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ABSTRACT
The experiments were carried out during the early and late planting seasons on a public land adjacent to Campus 2, Delta State University, Abraka, Nigeria. The study evaluated native soap at 1, 2 and 3 percent concentrations for insecticidal property in the control of cowpea insect pests, namely cowpea aphid, *Aphis craccivora* Koch, legume bud thrips *Megalurothrips sjostedti* Tryb, legume pod borer, *Maruca vitrata* Fab. and pod sucking bugs. It also assessed influence of control on cowpea yield. The result showed that native soap at 3% concentrations significantly reduced ($P<0.05$) *A. craccivora* in the early season. *M. sjostedti* damage, thrip population, *Maruca* damage and pod sucking bug were generally low in this season. In the late season, colonies of *A. craccivora* were reduced at 1 and 2% concentrations. Similarly, all the tested concentrations checked flower thrips. *Maruca* damage was slightly suppressed at 1 and 2% native soap concentrations. The control plots had the highest population of sucking bugs suggesting that native soap had effect on bugs. Yields were 1,355.90kg ha^{-1}, 1105.20kg ha^{-1} and 919.80kg ha^{-1} for 3%, 2% and 1% soap concentration respectively in the early season. Late season grain yield were 570.80kg ha^{-1}, 510.10kg ha^{-1} and 358.90kg ha^{-1} for 3%, 1% and 2% respectively. Based on the high yields, particularly in the early season, the study suggests that native soap can be an effective insecticide against cowpea insect pests, and could form component of the integrated pest management. It was however, observed in the field that native soap caused delay and reduction in copious cowpea flowering. Eliminating this factor could be necessary to increase the efficacy of soap in the management of cowpea insect pests.

Keywords: Cowpea, insect pests, native soap, Abraka, Southern Nigeria.

INTRODUCTION
Among the crops cultivated in the arid and semi-arid regions of the world, is cowpea, *Vigna unguiculata* (L) Walp of the family Fabaceae. It is widely grown and useful to man in several ways: its grains are rich sources of cheap protein (IITA, 1984), it contains mineral salts and fats, it serves as cover crop in erosion control (Okigbo, 1978) and equally important are its role as fibre producer (Rachie, 1985. In some African communities, the crop is consumed as vegetables (Duke, 1981). Cowpea is largely grown in the northern states of Nigeria - in the Sudan savannah region, although the crop is now cultivated in southern part of the country (Ejiga, 1979; Federal Office of Statistics (FOS), 1995).

However, yields at the farm level are very low, rarely more than 200kg/hectare (Omongo *et al*., 1997). The considerable low yields are attributable to a number of production constraints. The activities of pests and diseases both in the field and storage have been clearly identified as one of such major constraints in cowpea production. The major insect pests which severely damage cowpea during all growth stages are the cowpea aphid (*Aphis craccivora*, Koch), foliage beetles (*Ootheca sp, Medythia spp*), the flower bud thrips, (*Megalurothrips sjostedti*, Trybom) the legume pod borer (*Maruca vitrata,* Fabricius) and the sucking bug complex such as *Clavigralla spp*, *Anoplocnemis spp, Riptortus spp, Mirperus spp, Nezara viridula* and *Aspavia armigera*. The storage beetle, *Callosobruchus maculatus* is also important pest of cowpea in storage. The activities of several insect pests on cowpea reduce yield by well over 60% (Booker, 1965; Singh and Allen, 1980) and may rise up to 80 percent, if left uncontrolled

(Jackai and Daoust, 1986; Suh *et al*., 1986). Good grain yields are obtained only with the use of insecticides in areas where the crop is intensively cultivated (Matteson, 1982; Jackai and Singh, 1986). The use of insecticides, the most common method of insect pests control on this crop is being de-emphasized because of serious deleterious side effects especially environmental pollution (Alabi *et al*., 2003), and secondly because of non-availability and high cost of chemicals and spray equipment (Afun *et al*., 1991).

While synthetic chemicals are still in use, there is increasing search by cowpea growers for naturally occurring chemicals and non-conventional products with insecticidal property but devoid of the dangers associated with conventional chemicals. One of such non -conventional chemicals is the use of soap. Native soap have been used for the treatment of skin ailments such as eczema and rashes in some communities in Africa (Iliyasu, 2004).

The present study investigates insecticidal property in native soap for the control of insect pests and yield of cowpea, during the early and late planting season in Abraka, southern Nigeria.

MATERIALS AND METHODS

The experiments were conducted during the early and late planting seasons of 2005 on a plot of land, about 100 metres to Campus II, Delta State University, Abraka. The beds for planting were prepared with shovels and hoes. Each experimental plot measured 3x5m with 1.5m inter-plot space. Planting in the early season took place on 14th June 2005 and in the late season on the 29th September 2005. The seeds planted were Ife brown obtained from the International Institute of Tropical Agriculture (IITA), Ibadan. Three seeds were planted per hole at planting space of 60 x 30cm (Remison, 1978e). Seeds that failed to sprout four days after planting were replaced. Thinning to 2 plants per stand was carried out seven days after plant emergence. The farm was regularly weeded. There were 6 rows of 36 stands per plot. The protective product applied was native soap. Cypermethrin, a conventional synthetic pyrethroid was included for comparison purposes. The soap concentrations used were 0%, 1%, 2% and 3% of soap solution. The concentration of the native soap used were prepared as follows: 10gm, 20gm and 30gm of native soap were weighed with triple beam balance (Haus model). Each weight was then dissolved in 1000ml of water. The solution was left for 12 hours and then filtered after this period with a muslin cloth. Effects of treatment of soap concentrations on major insect pests of cowpea were compared with effects of conventional insecticide (cypermethrin). The experiment consisted of 5 treatments and 3 replicates. It was a randomized complete block design (RCDB). Application of protective products on crops commenced 25 days after planting (DAP) and sustained at intervals of 7 days. The response of the four key insect pests to the treatments was determined.

Insect observation and data collection

(i) Aphis craccivora: Aphid infestation was rated in the field weekly between 8.00am and 10.00am, from 20 randomly tagged cowpea plants in the 2 middle rows. By gently working through the middle rows, each plant was carefully inspected for infestation. The size of aphid colony in each plant was visually rated and the mean score calculated and recorded. The scoring was based on a 10 point scale as used by Litsinger *et al*., (1977) (Table 1). Six weekly observations were made.

(ii) Megalurothrips sjostedti (flower bud thrips), Damage to cowpea by *M. sjostedti* was determined by visual rating according to Jackai and Singh (1988) on a scale of 1-9 points based on *M sjostedti* symptoms as shown in Table 2. Observations and scoring commenced at 30 DAP (when peduncles were 2-3cm long) and ended at 45DAP From 20 randomly tagged cowpea plants, in the 2 middle rows of each plot¸ the plants were inspected for symptoms, scored and the mean score was calculated. Four observations were made, at the intervals of 6 days between 8.00am and 10.00am

(iii)*Maruca vitrata* (legume pod borer). Damage to cowpea by *M. vitrata* was assessed by observing (examining) 20 flowers in the field, selected randomly from the 2 outer rows of each plot. Each of the twenty flowers was carefully opened and examined on the spot for *Maruca* larva or damage (presence of holes on flowers) between 3.00-5.00pm. Flower examination commenced at 45 DAP, at five days' intervals and ended at 60DAP. Four observations were made. Population of *M. sjostedti* (number per flower), an insect which fed on cowpea flower pollen, was also visually counted and recorded when each flower was opened and examined for *Maruca* damage.

(iv) Pod sucking bugs. Damage to cowpea by pod sucking bugs (PSB) was assessed from the 2 middle rows of each plot between 8.00 and 10.00am. All bugs beyond the nymphal stage were counted. Because damage done to cowpea by bugs are similar, all bugs were counted together. Observations commenced at 45 DAP at 5 days' interval and ended at 55 DAP. Three observations were made. Counts were recorded and mean score calculated.

Yield related components

Pod load and pod damage were assessed in the field by visual rating on a scale of 1-9 (Table 3) from the 2 central rows of each plot. Assessment was done at 60 DAP when the pods were fully filled and matured but still green. Holes and presence of frass on pods and sticking of pods were used as pod damage index by *Maruca*. Pod evaluation index (Ipe) was determined with the formula below:

PL x (9-PD) where PL refers to pod load and PD, pod damage (Jackai and Singh, 1988).

Number of pods per plant. At 60 DAP, the number of pods per plant was determined from the two middle rows of each plot. One metre length of cowpea row was taken with 1 metre long ruler. The length was marked with 2 sticks. The pods and stands that fell within this distance were counted. The number of pods were then divided by the number of cowpea stands and the value recorded:

$$\text{Number of pods/plants} = \frac{\text{Number of pods}}{\text{Number of plants}}$$

Pod and seed damage. Damage to pods and seeds by pod sucking bugs was assessed by examining the pods and seeds in the laboratory. Cowpea pods in the two middle rows in each plot were harvested at maturity into bags according to plot number. They were sundried for one week. From the bags, 20 pods were handpicked randomly. With a flexible thread, each was measured to determine its length. Each pod was then opened with hand to expose the seeds. The number of seeds per pod, aborted seeds per pod, wrinkled seeds per pod and seeds with feeding lesion per pod were observed, recorded and the means calculated.

Yield data

At maturity, 65-70 DAP, pods from the 2 central rows in each plot were harvested with hand. They were sundried for 1 week and then shelled. The dry grain yields in each plot were weighed with a weighing balance (triple beam balance, Haus model) and the weight recorded. The yield per plot was extrapolated to kg ha^{-1}. One hundred seeds were picked from the grains in each bag (plot); they were weighed and the weights recorded, to give weight of 100.

The data for insect observation, yield and yield related components were subjected to analysis of variance (ANOVA) and significant means separated by Fisher's Least Significant Difference Test (LSD), at 5% level of significance.

RESULTS

The effect of native soap and conventional insecticide applied for the control of major insect pests on cowpea on the population of the insect pests in the early and late seasons at Abraka is presented in Table 4.

All the major insect pests occurred during the early season experiment in the study area. CPM and 3% soap treatment significantly ($P < 0.05$) reduced *A. craccivora* population when compared to the control and 1% and 2% soap concentrations. With respect to *M. sjostedti*, all the treatments did not significantly reduce *M. sjostedti* damage to cowpea. There was no significant difference among the different treatments. All the treatments did not reduce significantly ($P > 0.05$) the thrip population. Moreover, no significant difference among the soap treatments, though

2% concentration was slightly more effective in suppressing the thrip population.

The soap treatment did not significantly reduce *Maruca* damage with respect to the control and there was no significant difference among the soap treatments. However, 2% soap concentration was slightly more effective in reducing *Maruca* damage than 1 % and 3% concentrations. The CPM -treated plots, did not record *Maruca* damage. No PSBs were recorded in the different treatments including control.

All the major insect pests were encountered during the late season experiment in the study area (Table 4).

Apart from CPM treatment, all other treatments were not significantly($P>0.05$) different in reducing *A. craccivora* population when compared to the control.

The damage to cowpea by *M. sjostedti* was not significantly reduced by the various treatments when compared to the control. Similar trend was observed with the flower bud thrips and *M. vitrata*.

On PSBs, the population was generally low. The unprotected plots had more PSBs than protected plots. However, the treatments were not significantly different among them.

A. craccivora population was not significantly different when the two seasons were compared (Table 5). However, early season population was slightly more. Similar observation was made for *M. sjostedti*, i.e., the two seasons were not significantly different. On flower bud thrips, late season population was more and significantly ($P <0.05$) higher than early season population. *M. vitrata* in damage to cowpea flowers, showed no significant difference between the two seasons, though late season was slightly more. With respect to PSBs, similar trend was encountered in the two seasons.

The effect of native soap and cypermethrin on cowpea yield and yield related components in the early season in Abraka is presented in Table 6 .

Chemically treated plots did not significantly ($P > 0.05$) increase yield compared to plots without insecticide protection. Yields were however, slightly more in 2% and 3% soap concentrations and CPM treatments than the control. Moreover, 2% and 3% soap treatments had slightly higher yields than CPM treatment. In the case of 100 seed weight, all the treatments did not differ significantly except 1% soap treated plots that had significantly lower seed weight than control. All the yield related components studied did not show significant difference in the various treatments and when compared to control. However, damage to pods were slightly higher in pods from control than pods with insecticide protection except CPM. Similar situation was encountered with seeds with feeding lesions.

The effect of native soap and cypermethrin application on cowpea yields and yield related components in the late season in the study area is presented in Table 6.

All the soap and CPM treated plots were not significantly higher in grain yield than the control. The CPM - treated plots produced significantly higher yield than 2% soap - treated plots but was not significantly better than other soap treated plots. In the case of 100 seeds weight, there were no significant differences among the treatments in terms of weight and when compared to the control. Similarly, number of pods/plant and seeds with feeding lesions were not significantly different in the various treatments. All other yield related components such as pod length, number of seeds/pod, pod load, pod damage, pod evaluation index, aborted seeds/pods and wrinkled seeds/pods showed significant difference in the various treatments.

The season effect on yield and yield related components from cowpea under the application of native soap and cypermethrin in the early and late seasons in the study area is presented in Table 7.

Early season gain yields were significantly ($P<0.05$) higher than late season yield. The late season 100 seeds weighed significantly ($P<0.05$) higher than early seeds. For number of pods per plant, pod length, number of seeds per pod and pod load early cowpea were significantly higher in pod number, seed number per pod, pod load and longer in pod length than late season cowpea. In the case of pod damage, damage was significantly ($P<0.05$) higher in the late season than early season. Similar trend was encountered with aborted seeds per pod. Pod evaluation index was significantly (P<0.05) higher in early cowpea season than late season. There was no significant difference in terms of seed wrinkling per pod in the two seasons. However, late season had slightly more wrinkled seeds than early season. On seeds with feeding lesions, both seasons did not differ significantly, although more feeding lesions occurred in the late, slightly higher than early season feeding lesions.

Table 1. Scale for rating aphid infestation on cowpea

Rating	Number of aphids	Appearance
0	0	no infestation
1	1-4	a few individual aphids
3	5-20	a few isolated colonies
5	21-100	several small colonies
7	101-500	large isolated colonies
9	>500	large continuous colonies

Source: Litsinger *et al*. (1977)

Table 2. Scale for rating flower bud thrips infestation on cowpea

Rating	Appearance
1	no browning/drying (i.e. scaling) of stipules, leaf or flower buds; no bud abscission
3	initiation of browning of stipules, leaf or flower buds; no bud abscission
5	distinct browning/drying of stipules and leaf or flower buds; some bud abscission
7	serious bud abscission accompanied by browning/drying of stipules and buds; non elongation of peduncles
9	very severe bud abscission, heavy browning, drying of stipules and buds; distinct non-elongation of (most or all) peduncles.

After Jackai and Singh (1988)

Table 3: Scale For Rating *Maruca vitrata* Damage to Cowpea

	Pod load (PL)	Pod damage (PD)	
Rating	Degree of podding	Rating	%
1	most (<60% peduncles bare (i.e. no pods)	1	0-10
3	31-50% peduncles bare	2	11-20
		3	21-30
5	16-30% peduncles bare	4	31-40
		5	41-50
		6	51-60
7	Up to 15% peduncles bare	7	61-70
		8	71-80
9	Occasional bare peduncles	9	81-100

After Jackai and Singh (1988)

Table 4: Effect of native soap application on major insect pests of cowpea in the early season at Abraka

	Treatments	*Aphis craccivora* (rating)**	*Megalurothrips sjostedti* (rating)	Flower bud thrips* (actual counting)	*Maruca vitrata** (actual counting)	PSB** (actual counting)
Early season	CONTROL	3.33	1.00	0.09	0.05	0.00
	1%	2.22	1.00	0.11	0.09	0.00
	2%	2.11	1.00	0.09	0.06	0.00
	3%	1.56	1.00	0.11	0.07	0.00
	CPM	0.83	1.00	0.00	0.00	0.00
	LSD(0.05)	1.24	NS	NS	NS	NS
Late season	CONTROL	2.22	1.00	2.41	0.09	0.11
	1%	1.72	1.00	2.31	0.03	0.00
	2%	2.17	1.00	2.14	0.06	0.00
	3%	2.22	1.00	1.97	0.17	0.00
	CPM	1.06	1.00	1.94	0.31	0.00
	LSD(0.05)	0.67	NS	NS	NS	NS

* Means of 20 flowers
** Number per 2 middle rows
NS-Not significant

Table 5: The seasonal effect of the application of native soap on the major insect pests of cowpea at Abraka

Treatments	*Aphis craccivora* (rating)	*Megalurothrips sjostedti* (rating)	Flower bud thrips* (actual counting)	*Maruca vitrata** (actual counting)	PSB** (actual counting)
Early	2.01	1.00	0.08	0.06	0.00
Late	1.88	1.00	2.15	0.13	0.02
LSD (0.05)	NS	NS	0.31	NS	NS

NS-Not significant

Table 6: Effect of native soap and cypermethrin on yield and yield related components of cowpea in the early season in Abraka

	Treatments	Dry Grain yield (kg ha^{-1})	100 seeds wt(g)	Number of pods/ plant (approx)	Pod length (cm)	Number of seeds/pod	Pod load	Pod damage	Pod evaluation index	Aborted seeds/pod	Wrinkled seeds/pod	Seeds with feeding lesions
Early season	CONTROL	1045.10	13.20	10.63	14.51	13.55	9.00	1.33	69.00	2.07	0.15	0.12
	1%	919.80	12.23	8.81	13.34	12.07	9.00	1.00	72.00	2.50	0.70	0.10
	2%	1105.20	12.37	10.39	14.06	11.75	9.00	1.00	72.00	4.23	0.55	0.18
	3%	1355.90	12.37	11.62	13.55	12.83	9.00	1.00	69.00	2.58	0.12	0.07
	CPM	1085.90	13.00	9.29	14.25	13.78	9.00	1.33	69.00	2.37	0.33	0.00
	LSD(0.05)	NS	0.95	NS	NS	NS	NS	NS	NS	NS	NS	NS
Late season	CONTROL	374.30	17.67	8.63	13.17	10.35	3.00	6.33	10.67	0.08	1.02	0.07
	1%	510.10	16.87	6.81	13.49	10.90	6.67	2.67	42.00	0.15	0.58	0.15
	2%	358.90	17.00	8.39	12.98	9.85	4.33	3.33	26.33	0.05	0.70	0.15
	3%	570.80	17.47	9.62	13.44	0.97	5.33	2.67	34.67	0.07	0.65	0.10
	CPM	847.20	16.57	7.29	13.33	11.28	9.00	1.33	69.00	0.33	0.18	0.02
	LSD(0.05)	472.90	NS	NS	0.49	1.21	4.31	2.34	30.56	0.19	0.66	NS

NS-Not significant

Table 7: The effect of early and late season on yield and yield related components from cowpea under native soap application at Abraka

Season	Dry Grain yield (kg ha^{-1})	100 seeds wt(g)	Number of pods/ plant (approx)	Pod length (cm)	Number of seeds/pod	Pod load	Pod damage	Pod evaluation index	Aborted seeds/pod	Wrinkled seeds/pod	Seeds with feeding lesions
Early	1102.40	12.63	10.15	13.94	12.80	9.00	1.20	70.20	2.75	0.37	0.09
Late	532.30	17.11	8.15	13.28	10.67	5.67	3.27	36.53	0.14	0.63	0.10
LSD(0.05)	275.67	0.63	1.61	0.50	0.95	1.17	0.66	8.56	0.80	NS	NS

NS-Not significant

DISCUSSION

The effect of native soap during the early season on cowpea insect pest control as observed in this study suggested that native soap had some insecticidal effect against aphid at 3% concentration; finding which agreed with IITA (2002). However, the tested soap concentrations were ineffective against *M. sjostedti* damage, thrip population and *Maruca* damage to cowpea. Jackai (1983) reported that *Maruca* larvae emerge at night and move on leaf surfaces to attack new sites and only chemicals with greater residual activity will be expected to cause larval mortality. He reported further that *Maruca* larvae have the ability to detoxify chemicals. Possibly, this behaviour of the insect was responsible for the non-effectiveness of soap. The absence of PSBs may be due to the season of planting when the weather was not favourable for coreid bugs activities due to heavy rain (Degri and Hadi, 2000; Dina, 1982). Judging from the data, all the cowpea insect pests except *Maruca*, were controlled by CPM. This is consistent with previous reports of CPM in controlling cowpea insects. (Jackai, 1985)

Native soap was not effective on most of the cowpea insect pests, at any concentration during the late season. This perhaps, was due to low residual activity of soap. Furthermore, it may be, there was chemical dilution by rain, some hours after application. However, native soap reduced the coreid bug population to threshold level. Of the four major insect pests targeted for study, only *M. sjostedti* showed significant difference in their population/damage when the two seasons were compared. The late season being significantly higher showed that probably this insect thrive better with less rain and higher sunshine, as experienced during the late season cropping. Possibly too, a drying off of the soap solution on the crop could have reduced its effect on the insect in this season.

Yields from native soap application were relatively high in the early season, (Table 6). Soap concentration at 3% had the highest yields (1355.90kg ha^{-1}) and this was followed by 2% soap concentration (1105.20 kg ha^{-1}). The 1% soap concentration had the least. Yields from control were quite high, higher than yields in 1% concentration. The high yields obtained with soap application suggest that soap can be an effective insecticide against cowpea insect pests, although insect load during the season was low. Probably this factor was responsible for the high yield from the control plots. Apart from the one hundred seed weight, all the other yield related components were similar statistically in value in the different treatments.

Grain yield was moderately high with native soap application during the late season planting (Table 6). Cypermethrin yield was highest (847 kg ha^{-1}). This was followed by 3% soap concentration (570.80kg ha^{-1}) while 2% soap concentration had the least (358.90kg ha^{-1}) among the treatments. This again supported earlier reports from IITA (2002) on the use of soap in cowpea production. The yields from native soap application compared favourably with yields obtained in cowpea elsewhere such as Bauchi (Degri and Hadi, 2000). The results suggested that native soap can be a useful insecticide in cowpea production especially in resource paid farmers farm. The lower yield recorded in 2% soap concentration when compared to the control may be due to light insect pest load on the crop in the control during this season. Among the soap treatments most of the yield related components were statistically similar in values and this also explained their closeness in yields

In the study area, grain yields were high, particularly in the early season. The higher yields in the early season(1102.40 kg ha^{-1}) compared to the late season (533.30 kg ha^{-1}) may be due to sufficient rains which the cowpea received to develop better foliage. In the late season, the plants were planted in late September and by late October, rains reduced drastically. This factor, perhaps could have contributed to less foliage development and thus affected podding. Second, insect load was light during the early season and this also reduced insect damage to grains. The data obtained suggest that late planting should be done in late August. Nevertheless, late season seeds had better weight, than early season, suggesting better pod filling during this season. Other yields related components like number of pods per plant, number of seeds per pod, pod load, pod damage, pod evaluation index had values in the early season which favoured production more than late season components. On the other hand, yield related components like pod length, pod damage, wrinkled seeds per pod and seeds with feeding lesions had values in late season which did not favour production compared with early season components.

Grain yields obtained from this study were higher than yields from Ibadan and compared favourably with yield from Mokwa and Bida (IITA, 1985; Afun *et al*., 1991), suggesting that the crop could be profitably cultivated in the study area. Grain yields are comparable with yields in Ibadan (IITA, 1985), Ile-Ife (Akinyemiju and Olaifa, 1991) and Mokwa and Bida (Afun *et al*., 1991). This study supported earlier reports that soap can be an effective insecticide in cowpea production (IITA, 2002). However, native soap has some inherent deleterious property such as suppressing flowering and causing wilting at higher concentration. Apart from aborted seeds, all other yield related components had values which favoured cowpea production in the early season.

CONCLUSION

Based on the high yields, particularly in the early season, the study suggests that native soap can be an effective insecticide against cowpea insect pests, and could form component of the integrated pest management. It was however, observed in the field that native soap caused delay and reduction in copious cowpea flowering. Eliminating this factor would be necessary to increase the efficacy of soap in the management of cowpea insect pests, and its incorporation into the integrated pest management system for the crop.

REFERENCES

Afun, J.V.K., Jackai, L.E.N. and Hodgson, C.J. (1991). Calendar and monitored insecticide application for the control of cowpea pests. *Crop Protection* **10:** 363-370.

Akinyemiju, O. A. and Olaifa, J. I. (1991). Relative importance of weed and insect pest control in cowpea production. *Nigerian Journal of Weed Science* **4:** 43-45

Alabi, O.Y., Odebiyi, J.A. and Jackai, L.E.N. (2003). Field evaluation of cowpea cultivars (*Vigna unguiculata* (L) Walp.) for resistance to flower bud thrips (*Megalurothrips sjostedti* Trybom) Thysanoptera: Thripidae) *International Journal of Pest Management*. **49 (4):** 287-291

Booker, R.H. (1965). Pests of cowpeas and their control in Northern Nigeria. *Bulletin of Entomological Research.* **55:** 663-672.

Degri, M. M. and Hadi, H. M. (2000). Field evaluation and economies of some insecticides against the major insect pests of cowpea (*Vigna unguiculata* (WALP) in Bauchi, Nigeria. ESN Occasional Publication **32:**113-118.

Dina, S. O. (1982). Interactions between rate, spray interval and number of applications of the synthetic pyrethroid Decis in Cowpea (*Vigna unguiculata*) pest control. *Journal of Agricultural Science* **99:** 471-478

Duke, J.A. (1981). *Vigna unguiculata* (L) Walp. Spp *unguiculata* In: legumes of world economic importance. Plenum Press, New York, p. 303-305.

Ejiga, N.O. (1979). The efficiency of the indigenous food grain marketing systems in Nigeria, *Savannah* **8 (2):** 70-83

FOS (1995). *Annual abstract of statistics,* Federal Office of Statistics, Lagos, Nigeria.

IITA (1984). Annual Report for 1982. International Institute of Tropical Agriculture, Ibadan, Nigeria

IITA (1985). Annual report for 1984, International Institute of Tropical Agriculture, Ibadan, Nigeria.

IITA (2002). Improving and intensifying cereal-legume systems in the moist and dry savannas of the West and Central Africa. Annual Report 2002. IITA, Ibadan pp 23.

Iliyasu, A.S. (2004). *Evaluation of efficacies of some foliar applied botanicals on the control of aphids, Aphis craccivora Koch (Homoptera: Aphididae) on cowpea.* M.Sc. Thesis, Ahmadu Bello University, Zaria (ABU), Nigeria.

Jackai, L.E.N. (1985). Cowpea Entomology Research at IITA and its impact on food production in the tropics. *Nigeria Journal of Entomology* **6:** 87-97

Jackai, L.E.N. (1983). Efficacy of insecticide applications at different times of day against the legume pod borer, *Maruca vitrata* (Fab) (Lepidoptera: pyralidae) on cowpea in Nigeria. *Protection Ecology* **5:** 245-251.

Jackai, L.E.N. and Daoust, R.A. (1986). Insect pests of cowpeas. *Annual Review of Entomology* **31:** 95 119.

Jackai, L.E.N. and Singh, S.R. (1986). *New foliar insecticides for the control of cowpea pests.* Proceedings of British Crop Protection Conference-Pests diseases. 761-768

Jackai, L.E.N. and Singh, S.R. (1988). Screening Techniques for Host Plant Resistance to Insect Pests of cowpea.

Tropical Grain Legume Bulletin **35**: 2-18.

Litsinger, J.A., Quirino, C.B., Lumaban, M.D. and Bandong, J.P. (1977). Grain Legume Pest Complex of Three Phillipine Rice-Based Cropping System. Cropping Program, IRRI. Los Banos. Philippines, 39.

Matteson, P.C. (1982). The effect of intercropping with cereals and minimal cypermethrin application on insect pests of cowpea and their natural enemies in Nigeria. *Tropical Pest Management* **28:** 372-380.

Okigbo, B.N. (1978). *Grain legumes in the agriculture of the tropics.* In Pests of Grain legumes Ecology and control (Singh, S.R., Van Emden, H.E. and Taylor, T.A. Eds.) *Academic Press,* New York. p454

Omongo, C. A., Adipala, E., Ogenga Latigo, M. W. and Kyamanywa, S. (1997). Insecticide application to reduce pest infestation and damage on cowpea in Uganda. *African Plant Prot*ection **4 (2):** 91-100

Rachie, K.O. (1985). *Introduction.* In: Cowpea research, production and utilization (Singh, S.R. and Rachie, K.O. eds). Wiley, New York. P. Xxi- xxviii.

Remison, S.U. (1978e). Cowpea agronomy works at National Cereals Research Institute. Paper presented at the 1st National meeting. On development of package. Recommendations for legume crops at N.C.R.I, Ibadan, 7-8 February.

Singh, S.R. and Allen, D.J. (1980). *Pests, diseases, resistance and protection in cowpea.* In Advances in legume Science. (Summerfield, R.J. and Bunting, A.H., eds.). Her Majesty's Stationery office, London, 419-443.

Suh, J.B., Jackai, L.E.N. and Hammond, W.N.O. (1986). Observations on pod sucking bug populations on cowpea at Mokwa, Nigeria. Tropical Grain legume Bulletin **33:** 17-19.