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Studies on the control of major insect pests and yield of cowpea (*Vigna Unguiculata* (L) Walp under calendar and monitored application of synthetic chemical in ABRAKA, Southern Nigeria

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ABSTRACT

The application of insecticides by farmers to curtail the menace of insect pests of cowpea, sometimes may be as high as 8 to 10 times in the growing season. Experiments were conducted in the early and late planting seasons of cowpea, on a public land ½ kilometre to Campus II, Delta State University, Abraka, Nigeria. The study aimed at reducing the number of times chemicals were applied to control four major insect pests of cowpea and influence on yield. Insect pests studied were the cowpea aphid, Aphis craccivora Koch, legume bud thrips Megalurothrips sjostedti Tryb, legume pod borer, Maruca vitrata Fab. and pod sucking bugs. Fixed number of sprays - calendar sprays - 5 times at 7 days' intervals (CA.S7) and 4 times at 10 days' intervals (CA.S10) and monitored sprays (MOS) sprayed only when insect pests damage/infestation reached action threshold, were compared to determine their effect on insect pest number and yields. The results revealed that cypermethrin in the different treatments effectively controlled A. craccivora and M. sjostedti in the early season. During the late season, the chemical was effective on the major insect pests. Yields were 2,886.20kg ha^{-1}, 2,349.20kg ha^{-1}, 2087.20kg ha^{-1} for MOS, CA.S7 and CA.S10 respectively in the early season. In the late season, yields were 1,814.00kg ha^{-1} 1787.40kg ha^{-1} and 1577.00kg ha^{-1} for CA.S10, CA.S7 and MOS respectively. The study provides the information that (i) the calendar schedules - 7 and 10 days' and monitored sprays were not significantly different in their effect on insect pest number and yield (ii) CA.S10 and monitored sprays could be beneficial to cowpea farmers as this practice would reduce number of chemical application, cost and environmental pollution.

Keywords: Cowpea, insect pests, cypermethrin, calendar and monitored sprays, Abraka.

INTRODUCTION

Cowpea (*Vigna unguiculata* (L.) Walp) is a legume crop which several people in African countries depend upon for several purposes: its dry grains are source of plant protein for those that are unable to afford meat, fish and egg protein. Cowpea is their hope for cheap protein [1] and cowpea has appropriately been called "poor man's meat" [2]. The abundance of vitamins, mineral salts and fats and oils in cowpea has further highly endeared the crop to man. Moreover, its usefulness as fodder crop in livestock [3] is well recognised.

Cowpea cultivation is mainly a business in the tropical and sub-tropical regions where the crop grows in various soil types and climatic conditions [4]. In Nigeria, it is cultivated mainly in the drier zones of Northern region, particularly the Sudan savanna. The cultivation, lately has been adopted by farmers in Southern Nigeria [5-6] and it is being successfully grown in the West and East. Nigeria produces the largest quantity of cowpea in the world [7]; [6] and this comes mainly from Northern Nigeria.

Yields can be high if production constraints are adequately addressed. Production constraints which include attacks and damages to the crops by insect pests [8] largely contribute to low yield [9] and good grains cannot be obtained in farms without any form of control on insect pests [10]. The major/key insect pests include the foliage beetle, *Ootheca mutabilis* Sahl, cowpea aphid *Aphis craccivora* Koch, the flower bud thrips, *Megalurothrips sjostedti* Trybom, the legume pod borer, *Maruca vitrata* Fab and a complex of pod sucking pods which include *Clavigralla tomentosicollis, Anoplocnemis curvipes*, etc. Various control measures to suppress insect species include host plant resistance (HPR), biological control, cultural control and the use of synthetic insecticides. The application of synthetic insecticides in insect pest control is an ancient method which all through the years has proved more reliable and effective than other control measures. Triple yields have been recorded in farms which received insecticide sprays [11]. The market today is heavy with various insecticides under different trademarks and new ones are being developed. This is against the outcry that chemicals, though useful constitute danger to crops, users, consumers and environment especially pollution [12]. In Uganda farmers during the growing season spray their crops from 8 to 10 times [13], [9]. However, abandonment of insecticides in favour of other control measures does not provide solution because this would worsen the present food situation [14]. The recommendation is that insecticides should be judiciously used to minimise the number of sprays and often incorporate other control methods.

This paper reports on the benefits of control of cowpea insect pests and influence on yield under calendar and monitored application of cypermethrin in Abraka, Southern Nigeria during the early and late seasons.

MATERIALS AND METHODS

The trials took place during the early and late cropping seasons of 2005, in the Research and Teaching Farms of the Agronomy Department, Asaba Campus, Delta State University, Oshimili South Local Government, Delta State, Nigeria. In both seasons, the land was prepared manually with shovels and hoes. The experimental plots measured each 5 x 3m and in between the plots was 1.5m. Planting during the early season was done on 14th June and 29th September, 2005 for the late season. Cowpea seeds planted were Ife brown obtained from the International Institute of Tropical Agriculture (IITA) Ibadan. Three seeds per hole were planted at planting space of 60 x 30cm [15]). Seeds that failed to germinate four days after planting were replaced. The plants were thinned to two per stand 10 days after planting. Each plot contained 6 rows of 36 plants. Cypermethrin, a conventional chemical was applied on the crops starting from 25 days after planting. The experiment was arranged into a randomised complete block design with 4 treatments as follows:

(i) Calendar spray at 7 days' intervals, carried out 5 times;
(ii) Calendar spray at 10 days' intervals, carried out 4 times;

(iii) Monitored spray, carried out only when insect pest damage/infestation reached or exceeded the action threshold, and
(iv) Plots without chemical protection (control).

The farms were regularly weeded.

The effect of chemical application on 4-key insect pests of cowpea and influence on yield was observed.

Insect pest observation and data collection

Insect Infestation / Damage

Aphis craccivora: Observations commenced when the plants were 14 days old between 8-10 a.m. Aphid infestation was assessed weekly from 20 cowpea plants in the 2 central rows. The stands were randomly selected and tagged. Each was carefully inspected for infestation and the size of aphid colony was visually rated on a 10 point scale (Table 1). The mean value for the 20 stands was calculated. Six observations were made.

Megalurothrips sjostedti: Damage assessment to cowpea by *M. sjostedti* commenced at 30 DAP from 8 - 10.00 a.m. at 6 days' interval. Twenty stands from the 2 central rows were selected randomly and tagged. Each stand was carefully inspected for *M. sjostedti* damage and visually scored on a 1-9 point scale based on known symptoms (e.g. drying and browning of stipules, leaf buds or flower buds (Table 2). The mean score for the 20 stands was calculated and recorded. Five observations were made.

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	>50	large continuous colonies

Source: Litsinger *et al*. [16]

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 [17]

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

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

After Jackai and Singh [17]

Damage to flowers by *Maruca vitrata*: Damage assessment to cowpea flowers was done at 45DAP, between 3 and 5 p.m. Twenty flowers were randomly selected from the 2 outer cowpea rows. Each was carefully opened and inspected on the spot for larvae or larval damage. The mean score for the 20 flowers was calculated and recorded. Four observations were made at 5 days' intervals.

Pod sucking bugs (PSBs): Observations began at 45 DAP between 8.00-10.00 a.m. The number of PSBs that rested on cowpea was counted in the 2 central rows. PSBs have similar damage on cowpea and so all were counted together. Three observations were made.

Pod load and pod damage by *Maruca vitrata*: At 60 DAP, pods were fully filled, matured but green. Pod load was assessed in the field by visual scoringon a 1-9 point scale (Table 3). Pod damage was determined by the presence of holes and frass on pods and sticking of pods.

Pod evaluation index (Ipe) was determined with the formula below:
(PL x 9 x PD) where PL is pod load and PD pod damage [17].

Number of pods per plant: At 60 DAP, the pods were partially matured. The number of pods per plant was determined from the 2 central rows of each plot. With one metre long ruler, a metre long area of cowpea was marked out with 2 sticks. The plants with their pods which fell within this length were counted. The number of pods was divided by the number of plant stands.

$$\text{No. of pods per plant} = \frac{\text{No. of pods/plant}}{\text{Number of plants}}$$

Pod length: At 65 DAP, pods were matured. They were hand-harvested according to plot number and kept in labelled black polythene bags. 20 pods were randomly picked from each bag and the length of each was measured with a flexible thread. The mean value for the 20 pods was then calculated and recorded.

Pod and seed damage by pod sucking bugs: Pods and seeds were examined in the laboratory to assess the damage by pod sucking bugs. Cowpea pods from the 2 central rows in each plot were harvested at maturity and kept in labelled black polythene bags, according to treatments. Pods were sun-dried for 1 week. Twenty pods from each bag (according to plot number) were hand-picked randomly. Each pod was carefully inspected for PSB punctures and each was then opened to expose the seeds. The seeds were classified into number of seeds per pod, aborted seeds per pod, wrinkled seeds per pod and seeds with feeding lesions per pod.

Grain yield: At 65-70 DAP, all pods from the two middle rows of each plot were hand-harvested into labelled black polythene bags. They were sun-dried for one week and then shelled with hands. 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}.

Grain weight: This was determined by hand-picking 100 seeds from each plot contained in labelled polythene bags. They were weighed and the weight recorded.

The data collected 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

Tables 4 shows the effect of cypermethrin for the control of major insect pests on cowpea under calendar and monitored application during the early and late season experiments. All major insect pests were encountered in the early season in the study area. The different treatments did not significantly ($p > 0.05$) reduce *A. craccivora* population when compared with the control. However, the plots without insecticidal protection and monitored plots, had slightly higher population, than the calendar schedules (7 and 10 days' spray interval) (Table 4). All the treatments significantly ($P < 0.05$) reduced *M. sjostedti* damage to cowpea when compared with plots without insecticide protection. Protected plots did not show significant difference among them. However, the 7 and 10 days' spray intervals were slightly more effective in reducing *M. sjostedti* damage to cowpea than monitored spray. The calendar schedule significantly ($P < 0.05$) reduced the flower bud thrips population compared with the control. There was however, no significant difference between the 7 and 10 days' spray in reducing thrip population. Monitored spray was not significantly different from the control. The treatments did not significantly ($P > 0.05$) reduce *Maruca* damage when compared with control. The 10 days spray intervals and monitored application were slightly more effective in reducing *Maruca* damage than the 7 days interval application. There was no significant difference among the treatments. The PSB population was low and only the monitored plots recorded PSB. No significant difference among the treatments.

All the major insect pests were recorded on the crop during the late season in the study area. The insecticide protected plots significantly ($P < 0.05$) reduced *A. craccivora* when compared with plots without chemical protection (control). There was no significant difference among the insecticidal treatments. However, the 10 days' calendar application was slightly more effective in reducing *A. craccivora* than 7 days' spray interval and the monitored application (Table 4).

All treatments did not significantly ($P > 0.05$) reduce *M. sjostedti* damage to cowpea. Moreover, there was no significant difference among the treatments. However, the unprotected plots received more damage than chemically protected plots.

On flower bud thrips, CA.S7 - treated plots significantly ($P > 0.05$) reduced the thrips population. The 7 days' spray intervals was slightly more effective in reducing thrip population than 10 days' spray intervals and monitored sprays.

With the exception of MOS, all the treatments significantly ($P < 0.05$) reduced *Maruca* damage, when compared with the unprotected plots. The calendar spray schedules (7 and 10 days' spray intervals) and MO.S were not significantly different in their effectiveness in reducing *Maruca* population.

The treatments did not significantly ($P > 0.05$) reduce PSB population compared with the control. Also, there were no differences among the treatments. However, the 10 days calendar sprays was slightly more effective in reducing PSB population than 7 days spray interval and monitored spray.

There was no significant difference in the two seasons with regards to *A. craccivora* population. (Table 5). *M. sjostedti*, damage to cowpea flower buds was more in the early season and was significantly ($P <0.05$) higher than the late season damage. On flower bud thrips, more thrips occurred in the late season and the population differed significantly ($P <0.05$) when compared with early season population. For *M. vitrata*, there was no significant difference in the two seasons. With respect to PSB, the late season population was significantly($P < 0.05$) higher than early season population.

The effect of cypermethrin on cowpea yield and yield related components in the early and late seasons in Abraka is presented in table 6.

Calendar spray at 7 days' and 10 days' intervals did not significantly ($P > 0.05$) increase yield when compared with the control. However, calendar spray at 7 days' intervals was higher in yield and significantly ($P < 0.05$) higher than calendar spray at 10 days' intervals. Also, monitored sprays had yield that was significantly higher than control and the other treatments. (Table 6). Weight for one hundred seeds was significantly lower ($P <0.05$) in calendar spray plots when compared with the control and MO.S. Apart from pod length, all the yield related components were not significantly different from the control.

In the late season, the insecticide treated plots produced higher yield and were significantly ($P<0.05$) higher compared with yield in control. The calendar spray at 7 and 10 days' intervals had slightly more yield than the monitored spray. With 100 seeds weight, there was no significant difference between seeds from insecticide treated plots and seeds from control. However, seeds from control weighed slightly less than those from chemically protected plots. Yield related components such as pod length, number of seeds/pod and aborted seeds/pod were not significantly different among the treatments and when compared to control. However, yield related components such as number of pods/ plant, pod load, pod damage, pod evaluation index, wrinkled seeds/pod and seeds with feeding lesions showed significant difference among the treatments and when compared to control.

The seasonal effect on cowpea yield and yield related components under the calendar and monitored application of cypermethrin in the early and late seasons in Abraka is presented in table 7.

Grain yields were significantly ($P < 0.05$) higher in the early season than late season yield. The two seasons did not differ significantly in 100 seed weight. On number of pods per plant, no significant difference existed between both seasons. Pod length was significantly longer in the late season than early season. The number of seeds per pod was higher in the early season and significantly ($P < 0.05$) higher than the late season seed number. For pod load, cowpea in the early season had more pod load and significantly ($P < 0.05$) higher than late season cowpea.

Pods in the late season had significantly ($P < 0.05$) higher pod damage than early season pod. Pod evaluation index was significantly higher in the early than late cowpea season. Wrinkled seeds per pod were significantly ($P < 0.05$) higher in the late season than early. On seeds with feeding lesions, significant difference did not exist between the two seasons, though feeding lesions were slightly more in the early than late.

Table 4: Effect of cypermethrin on the major insect pests of cowpea under calendar and monitored application in the early and late seasons at Abraka

	Treatments	*Aphis craccivora* (rating)**	*Megalurothrips sjostedti* (rating)	Flower bud thrips* (actual counting)	*Maruca vitrata** (actual counting)	PSB** (actual counting)
Early season	CONTROL	1.56	2.00	0.10	0.10	0.00
	CA.S7	1.11	1.00	0.01	0.01	0.00
	CA.S10	0.94	1.01	0.02	0.00	0.00
	MO.S	1.83	1.17	0.05	0.00	0.01
	LSD(0.05)	NS	0.24	0.08	NS	NS
Late season	CONTROL	1.89	1.50	3.33	0.07	0.02
	CA.S7	1.22	1.00	1.85	0.02	0.04
	CA.S10	1.00	1.00	2.25	0.02	.0.02
	MO.S	1.11	1.00	2.83	0.04	0.04
	LSD(0.05)	0.42	NS	1.37	0.05	NS

CA.S7 - Calendar spray at 7 days' intervals CA.S10 - Calendar spray at 10 days' intervals
MOS - Monitored spray N.S - Not significant
* Means of 20 flowers; ** Number per 2 middle rows

Table 5: The seasonal effect of the application of cypermethrin on the major Insect pests of cowpea at Abraka

Season	*Aphis craccivora* (rating)**	*Megalurothrips sjostedti* (rating)	Flower bud thrips* (actual counting)	*Maruca vitrata** (actual counting)	PSB** (actual counting)
Early	1.36	1.29	0.05	0.05	0.00
Late	1.31	1.13	2.06	0.04	0.03
LSD (0.05)	NS	0.08	0.48	NS	0.02

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

DISCUSSION

A. craccivora appeared early, 14DAP in all plots in the study area. The occurrence of aphid at this period probably was due to a dry spell which could have enhanced the establishment of the insect colonies. However, chemical treatments reduced the population and the calendar schedules (7 and 10 days) had the same effect in controlling aphid. Similarly, the chemical was effective on *M. sjostedti* damage. The results indicated that spraying at 10 days' interval is as effective as 7 days' spray interval and either of them is more effective than monitored spray. This result did not agree with [18] who reported monitored spray to have the same effect with 7 days' and 10 days' sprays in terms of insect infestation. On flower bud thrips, the chemical was effective and again, 7 and 10 days' sprays gave similar result in controlling thrip population and both were more effective than monitored spray.

Table 6: effect of cypermethrin on yield and yield related components from cowpea under calendar and monitored application in the early and late seasons 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	2266.40	14.17	13.82	12.39	13.32	9.00	2.67	57.00	4.03	0.32	0.08
	CA.S7	2349.20	13.53	13.67	11.91	13.63	9.00	1.00	72.00	5.22	0.43	0.03
	CA.S10	2087.20	13.83	11.09	11.84	13.43	9.00	2.00	63.00	4.75	0.52	0.12
	MO.S	2886.20	14.17	12.19	12.66	13.45	9.00	1.00	72.00	3.87	0.27	0.00
	LSD(0.05)	773.59	0.52	NS	0.51	NS	NS	NS	NS	NS	NS	0.18
Late season	CONTROL	424.10	12.37	11.82	12.94	10.37	3.00	7.33	7.67	0.37	1.88	0.10
	CA.S7	1787.40	15.60	11.67	12.80	11.02	8.67	2.00	60.67	0.43	0.70	0.00
	CA.S10	1814.00	15.63	9.09	13.01	11.28	9.00	2.00	63.00	0.82	0.48	0.00
	MO.S	1577.00	16.23	13.52	13.46	11.52	7.67	4.00	38.00	0.35	0.85	0.02
	LSD(0.05)	963.15	NS	4.34	NS	NS	2.40	2.08	13.33	NS	0.87	NS

CA.S7 - Calendar spray at 7 days intervals CA.S10 - Calendar spray at 10 days intervals MOS - Monitored spray N.S - Not significant

Table 7: The effect of early and late seasons on yield and yield related components from cowpea under the application of cypermethrin at Asaba

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	2397.30	13.93	12.70	12.20	13.46	9.00	1.67	66.00	4.47	0.38	0.06
Late	1400.60	14.92	11.53	13.05	11.05	7.08	3.83	42.33	0.49	0.98	0.03
LSD(0.05)	391.09	NS	NS	0.34	0.48	0.70	1.28	10.43	0.68	0.29	NS

NS = Not significant

The non effectiveness of chemical on *Maruca*, according to the result, might be due to the behaviour of *Maruca* larvae which live within the cowpea stems and therefore escaped sprays. Jackai [19] noted 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. Possibly this behaviour of the insect was responsible for the non-effectiveness of the cypermethrin. Generally, PSB population was low at this season, probably the cypemethrin efficacy was reduced by rain water.

A. craccivora was recorded in the late season. It was however, effectively controlled by CPM during this season. The study indicated that 10 days' interval spray was more profitable than 7 days' spray and monitored spray. The CPM was also effective against *M. sjostedti* and gives support to 7 days' spray intervals as better than 10 days' and monitored sprays. Similar trend as above was observed with thrip population. Also, the chemical was effective against pod borer damage. On coreid bug infestation, the study revealed that 10 days' application performed better than 7 days' spray interval. This observation is contrary to the general reports that 7 days' spray intervals is more effective than 10 days' spray. Most probably, the plots sprayed at 7 days' interval, had more pods which could have attracted more PSBs in these plots after the chemical has lost its potency.

The early and late seasons aphid populations in the study area, were not significantly different. Possibly, the prevailing conditions during the two seasons equally favoured the aphid activities. The more *M. sjostedti* damage in the early season encountered in this study indicated that perhaps the insect suddenly increased its damage after the insecticide may have lost its insecticidal integrity. On the higher flower bud thrips population in the late season, the study agreed with Alabi *et al*. [12] who reported increased flower bud thrips in the same season, and this suggested that the increase may have to do with seasonal changes. In terms of occurrence and damage, there was on significant difference in the two seasons with *Maruca.* Probably the weather factors in the two seasons were similar. Higher coreid bug populations as reported here in the late season was expected and agreed with the report of [20].

Grain yield under the application of CPM in the early season in the study area was very high when compared with cowpea yields reported from most parts of Nigeria such as Bauchi [21], Calabar [22] and Kamboinse, Badeggi, Mokwa, Samaru, Kano and Ilora [23]. The monitored plots had the highest yields with 2886.20kg h^{-1}. This is followed by calendar spray at 7 days' interval (2349.20 kg h^{-1}). Yields from the control were unusually high (2266.40 kg h^{-1}). This was probably because pods in the control plots were not attacked by insects. The high yields in the early season probably were due to favourable climatic conditions and low insect pests pressure on the crop. The study noted that coreid bugs, flower thrips and pod sucking bugs which are major yield limiting agents were virtually absent in the early season. However, the monitored spray had more yields than CA.S7, CA.S10 and the control. This record is contrary to the report of Afun [18] who reported that significant differences did not exist in grain yields among the calendar schedule spray and monitored spray. Except for the one hundred seed weight and pod length, all other yield related components from the different treatments were significantly different ($P < 0.05$).

Grain yield during the late season planting under CPM were similarly high. The CA.S10 had the highest yield (1814.00 kg ha^{-1} , followed by CA.S7 with 1787.40 kg ha^{-1}). Monitored spray followed closely (1577.00 kg ha^{-1}). The control had low yield (424.10 kg ha^{-1}). The result indicated that CPM is highly effective in cowpea protection. The yields from the experiments confirmed previous reports [24] that synthetic chemicals increased yield remarkably and also that unprotected plots usually had the least yield. Again, the results agree with Afun *et al*. [18]

who stated that grain yield in 7 days' and 10 days' calendar sprays and monitored spray were not significantly different. The yield related parameters (except aborted seeds per pod) performed poorly in the unprotected plots. These were usually the case when crops were not treated with chemicals against insect pests [25-26].

Grain yields in both seasons were very high with early season yield (2397.30kg ha^{-1}), significantly higher than late season (1400.60 kg ha^{-1}). The higher yields in the early season may be attributed to the sufficient rains which the cowpea plants 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. 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 yield components.

Grain yields obtained from this study were higher than yields from Ibadan and compared favourably with yield from Mokwa and Bida [27], [18], suggesting that the crop could be profitably cultivated in Abraka and environs.

CONCLUSION

The results indicated that calendar schedule (7 and 10 days' sprays) and monitored spray were not significantly different in their effect with pest number and yield. The study therefore recommends the practice of calendar spray at 10 days' interval and monitored spray since this will reduce the number of chemical application, cost and environmental pollution.

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