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Research Article

INSECTS INFESTING SELECTED VEGETABLES IN LAGOS AND THE CONTROL OF INFESTATION ON *CELOSIA ARGENTEA* (L.) WITH TWO PLANT ESSENTIAL OILS

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ABSTRACT

There is a dearth of information on insects infesting vegetables in Lagos, Nigeria, and farmers depend heavily on synthetic insecticides for control. A field study was therefore conducted in the Ojo campus of Lagos State University to investigate the insect species associated with *Abelmoschus esculentus* (L. Moench), *Celosia argentea* (L.) and *Corchorus olitorius* (L.) on one hand, and the effect of n-hexane extracts of *Chenopodium ambrosioides* L. (Chenopodiaceae) and *Zanthoxylum zanthoxyloides* (Watern.) (Rutaceae) on the incidence of *Aspavia acuminata*, *Cletomorpha* sp and *Euophryum* sp on *Celosia argentea* for eight weeks after treatment with Actellic 20 – EC as check. The vegetables were planted on prepared beds following a Randomized Complete Block Design. Insects were collected weekly on all the vegetable crops for eight weeks and identified. The results show that 12 species represeting four Orders namely Coleoptera, *Euophryum* species (Curculionidae), *Lixus* sp (Chrysomelidae), *Podagrica* sp (Chrysomelidae), *Agrilus viridator* (Buprestidae); Heteroptera, *Aspervia acuminata* (Pentatomidae), *Carbula carpito* (Coreidae), *Hermietta* sp (Stratiomyidae), *Dysdercus* species (Pyrocoreidae); Homoptera, *Lycus folliaceus* (Lycidae), *Lycus sermianplexus* (Lycidae); and Hymenoptera, *Crematogaster africana* (Formicidae), infested the test vegetabels. *Euophryum* was the most abundant followed by *A. acuminata* while the least was *Lixus* sp with 41.94%, 12.90 % and 1.54 % abundance respectively. N-hexane extracts of *Z. Zanthoxyloides* and *C. ambrosioides* respectively caused significant ($p<0.05$) reduction in the number of insects on *C. argentea* relative to the controls. These results show insecticidal potentials of the test essential oils for the control of some insect pests of *C. argentea*.

Key Words: Actellic, *Aspavia, Celosia, Chenopodium ambrosioides, Cletomorpha, Euophryum, Zanthoxylum zanthoxyloide.*

INTRODUCTION

Vegetables are important in the human diet for the carbohydrates, proteins, vitamins and trace elements they contain, and they are highly relished in many local cuisines, delicacies and herbal medicines in Nigeria (Bakre *et al*., 2004). In addition to such dietary benefits, vegetables are also high value crops and they often provide excellent income-generating opportunities to small scale farmers (Selleck and Opena, 1985). In quantitative terms, vegetables constitute the fourth largest group of commodities produced in Africa (FAO, 2000).

Vegetables are extensively cultivated throughout Lagos State, Nigeria either on a subsistent or commercial scale. Farmlands in Ojo Local Government Area of Lagos State constitute a prime focus of the government for

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vegetable production (Bakre *et al*., 2004). Commonly grown vegetables in the state include okra (*Abelmoschus esculentus*), Soko (C*elosia argentea*) and Jute (*Corchorus olitorius*). Jute mallow (*C. olitorius*) is widely known as the most important fibre crop next to cotton (Rahman and Khan, 2010). Jute is a very important crop in Nigeria where its leaves are used as leafy vegetable in food. The leaves possess mucilagenous and emoluent properties that facilitate the swallowing of coarse starchy local delicacies like Eba (Cassava paste), fufu and Amala (Yam powder paste) which are well relished in the southwestern part of Nigeria. In traditional medicine an infusion made from soaking the leaves of *C. olitorius* is used to treat constipation while its root bark when scraped off and soaked in water or other suitable solvents is used for toothache. Also, seeds and fruits of the crop are used as tonic and diuretic (Osawaru *et al*., 2012). *Abelmuschus esculenta* L (Moench) is the third in rank in terms of the area of production and use for consumption following tomato and pepper. The immature pods are used as leafy vegetable while they are in the dried form. The green pods are sources of vitamins, calcium, pottasium and other minerals (Ijoyah and Dzer, 2012). Okra mucilage has medicinal applications where it serves as a plasma replacement or 'blood – volume expander'. Also, the mucilage of okra binds cholesterol and bile acid carrying toxins dumped into it by the liver thus serving as a cleanser (Adetuyi *et al*., 2011). *Celosia argentea* is an annual herbaceous traditonal vegetable food plant in Africa with potentials to improve nutrition, boost food security, foster rural development and support sustainable landcare (Elemo *et al*., 2011). In south-western Nigeria, the leaves and stems are cooked into soups, sauces or stew with other ingredients but in other parts of Africa they are used variously as bodywash for convalescents, and the seeds serves as medicine for the treatment of diarrhea, dysentery and muscle troubles (Ayodele and Olajide, 2011).

The average yields of vegetables in Africa is low (about 6.5t/ha) compared to the world average (13.8t/ha) (FAO, 2000). Several abiotic and biotic stress especially insects, adversely affects productivity of vegetables in Africa (Parh *et al*., 1997). Insects cause damage to vegetables by feeding on the foliage and trasmitting diseases and thus warrants control. Consequently farmers rely heavily on synthetic insecticides for the control of these insects, which has in turn led to various problems (Okonkwo and Okoye, 1996; Ajayi and Ajimoko, 2005). In addition, synthetic insecticides are expensive for subsistence farmers and risky owing to lack of adequate technical knowledge needed for their safe use.

One rational alternative to the use of synthetic insecticides is botanicals (also referred to as Plant Based Insecticides – PBIs) have been used from ancient times mainly for their medicinal and culinary properties, there is however, a contemporary drive to use them for the control of insect pests (Tapondjou *et al.*, 2006; Denloye *et al*. (2009). In recent years, the use of PBIs in the control of field pests is rapidly gaining attention among researchers such as Baidoo and Adam (2012), Oparaeke (2007), Okunlola (2007), and Oparaeke *et al.* (2005). The present study is aimed at identifying insects associated with *A. esculentus, C. argentea* and *C. olitorius* grown in Ojo Local Government Area of Lagos State and determining the ability of essential oils from *C. ambrosioides* leaf and *Zanthoxylum zanthoxyloides* root bark relative to Actellic – 20 EC in protecting *C. argentea* from infestation by *Aspavia acuminata*, *Cletomorpha* sp and *Euophryum* sp.

MATERIALS AND METHODS

The study area

The study was carried out in Ojo Local Government Area of Lagos State. The soil type in this location is sandy, between 0.02-2.00 mm in diameter (Olaitan and Lombin 1984). The topography is described as lowland sandy plain with very porous light grey sandy soil. The rainfall season is from April to October (Noah *et al.*, 1995).

Distribution of questionnaires

In order to ascertain the types of vegetables commonly grown in Ojo Local Government Area (LGA), the insect pests prevalent on them, the type of damage insect's cause, control methods used by farmers, effectiveness of the control methods, and so on, questionnaires were distributed to farmers in Ojo LGA. Areas covered within Ojo are Agric, Iyana-Iba, Barracks and LASU. Out of 80 questionnaires, 64 were completed by the farmers. The questionnaires were distributed to each of the farmers. In most cases, due to the low literacy level of the farmers, questions in the questionnaires were translated verbally using the farmers' native dialect (Awori) for better understanding and their responses written in the questionnaires.

Insect species infesting selected vegetables

Three vegetables namely *Abelmoschus esculentus, Celosia argentea* and *Corchorus olitorius* were used in this study. An experimental farm was set up within the Ojo campus of Lagos State University (LASU) to identify insect species infesting *C. argentea*, *C. olitorius* and *A. esculenta* respectively. The farm was divided into five sub-plots. Each sub-plot measuring 2.6m in length and 3.9m in breath. Prior to planting, each subplot was cleared and tilled manually using hoe and cutlass. Thereafter, four beds measuring 2.1m in length and 0.37m wide were made on each of the five sub-plots. The spacing between each bed was 0.27m.

The seeds of the *C. argentea* and *C. olitorius* were first raised in the nursery for four weeks and two days before transplanting, while the seeds of the *A. esculentus* were planted directly in the sub-plots. The *Abelmoschus* seeds were sown on one bed on each of the five sub-plots, while the *Corchorus* and *Celosia* were transplanted from the nursery to one bed each on each of the five sub-plots. After planting, each of the 5 sub-plots was watered twice daily (0800 hrs and 1800 hrs). Occasionally, the farm was weeded to prevent unwanted plants from competing with the vegetable crops for the available nutrients. The vegetable species were left to grow and be infestated by various insect species following natural succession.

Effect of vegetable treatment with plant essential oils or actellic on infestation of *Celosia argentea* by insect species

A separate farm was set up in the site of the Botanical garden of Lagos State University, Ojo Campus as earlier described above. The farm had five sub-plots with the same dimensions. Also five beds with the same dimensions were made using same spacing apart. Each bed was planted with seeds of *C. argentea* procured from Iyana Iba market, Ojo, Lagos.

The essential oils of *C. ambrosioides* and *Z. zanthoxyloides* were each dissolved in Hexane, which served as the carrier, at a concentration of 10ml of the oil per Litre of Hexane (10mlL^{-1}). Four 250ml spray pumps were purchased and labeled A, B, C and D. 200ml of the solvent, Hexane was poured into the pump labeled A, while 200ml of Actellic – 20EC was contained in the pump labeled B, 200ml of the *Chenopodium* oil, already dissolved in Hexane, was poured into the pump labeled C and 200ml of the *Zanthoxylum* oil, already dissolved in Hexane, was put in the pump labeled D. The Hexane, Actellic- 20EC *Chenopodium* and *Zanthoxylum* oils were than sprayed respectively on one sub-plot each, with the fifth sub-plot serving as control (i.e no chemical or oil was applied). The experiments and controls were replicated four times respectively. Insects found on any part of test Celosia plants in each treatment were collected every week, identified and the data recorded.

Extraction of oils from plant materials

Leaves of *C. ambrosioides,* and root bark of Fagara, Z. *zanthoxyloides,* were obtained from Ilogbo Eremi in Badagry LGA of Lagos State. The plant materials were oven-dried at 60^{0}C for five days. The plant materials were then cut into smaller pieces and kept at room temperature until they were needed. The dried *C. ambrosioides* and *Z. zanthoxyloides* were subjected to hydrodistillation using a Clavenger apparatus for 6 hours on each occasion and the oil collected respectively over N-hexane as previously reported by Denloye *et al.* (2009).

Collection and identification of insects

The insects were collected from crops in each case on Saturday mornings between 0730 and 1000 hrs after treatment with either plant oil or insecticide for eight weeks. Insect collection was by hand-picking. Insects were counted and kept in glass jars containing ethanol, which served as preservative before being arranged in an insect preservation box. Identification of insects in each collection was carried out using type specimens already identified in our previous collections and also at the Entomology Museum, Department of Crop and Environmental Biology, University of Ibadan.

Data analyses

Insects of the species collected from each experimental plot were pooled together and analysed for means, standard error and ANOVA to determine significant differences between means at p = 0.05 using Statitistical Package for Social Sciences (SPSS) version 17.0. Further seperation of means was carried out using Least Significant Difference (LSD) statistic.

Percent abundance was computed as:

$$\frac{\text{Total number of individuals species}}{\text{Total number of all insects collected of each}} \times 100$$

Each datum of percent abundance is a mean of four replicates (i.e. n = 4).

RESULTS

Analysis of questionnaires

Analysis of the questionnaire showed that 21 of the respondents, representing 32%, claimed that they have not come across any insect pest on the vegetables they grow. On the other hand 43 cases, representing 67.2% of the respondents stated that the number of insect pests was said to be negligible causing little or no damage to their crops (Table 1).

Insect infestation on untreated experimental vegetable species

A total of 12 insect species (Table 2) were collected from all the three test vegetable species devoid of any insecticide or chemical treatment. There was variation in the species of insects collected from each of the three vegetables; whereas some insects such as *Aspavia acuminata* and *Agrillus viridator* were collected from all the vegetables grown, others such as *Podagrica* sp were found on only one crop (*Abelmoschus*) or *Lycus semianplexus* picked from *Celosia* alone. The highest incidence of insect pest species on untreated vegetables was recorded on *Celosia* (8), while the least was recorded on *Abelmoschus* (5) (Table 2). Among the 12 insect species collected from the three vegetables, *Europhryum* had the highest percent abundance (41.75) followed by *Crematogasta* (9.75) while the least were *Lixus* sp (1.5) and *Hermettia* sp (1.5). ANOVA showed that there was siginficant difference in the number of insects collected (F = 387.09). The abundance of insects collected from vegetables is shown in Figure 1.

Weekly incidence of insects on treated experimental vegetable species

The weekly incidence of *Aspavia acuminata*, *Cletomorpha* sp or *Euophryum* species respectively on *Celosia argentia* after treatment with *Chenopodium ambrosioides*, *Zanthoxylum zanthoxyloides* or Actelllic for eight weeks after spraying are shown in Table 3 and Figures 2a, 2b and 2c respectively. The results shows that treatments with either *C. ambrosioides* or *Z. zanthoxiloides* caused statistically significant reduction in number of all test insect species relative to each of the controls. Actellic treatment significantly reduced the total number of each test insect species more than either *C. ambrosioides* or *Z. zanthoxyloides* when the data were subjected to ANOVA (F = 59.60, 72.00 and 177.18 for *Aspavia*, *Cletomorpha* and *Euophryum* respectively) and (LSD) statistics.

Table 1. Analysis of questionnaires.

S.No.	Effect	Response	Number of Farmers	Percentage (%)
1	No visible effect	No visible insect pest	21	32.80
2	Little or no damage to crops	Negligible number of pests	43	67.20
3	Insect pests controlled by using insecticide, supermatrin	Controllable number of pests	31	48.44
4	Insect pests controlled by using insecticide, DDT	Controllable number of pests	15	23.44
5	No visible effect insecticides	Negligible number of pests	18	28.13

Table 2. Insect species collected from untreated vegetables**.**

S.No.	Vegetable	Insect species	(Order; Family)
1.	*Abelmoschus esculenta*	(a) *Aspavia acuminata* (b) *Agrillus viridator* (c) *Carbulo capito* (d) *Dysdercus superstitiosus* (e) *Podagrica* Chrysomelidae)	(Heteroptera; Pentatomidae) (Coleoptera; Buprestidae) (Heteroptera; Pentatomidae) (Heteroptera; Pyrrhocoridae) (Coleoptera;
2.	*Celosia argentea*	(a) *Aspavia acuminata* (b) *Agrillus viridator* (c) *Carbulo capito* (d) *Cletomorpha unifasciata* (e) *Dysdercus superstitiosus* (f) *Euophryum* (g) *Lycus foliaceus* (h) *Lycus semiamplexus*	(Heteroptera; Pentatomidae) (Coleoptera; Buprestidae) (Heteroptera; Pentatomidae) (Heteroptera; Coreidae) (Heteroptera; Pyrrhocoridae) (Coleoptera: Curculionidae) (Homoptera; Lycidae) (Homoptera; Lycidae)
3.	*Chorchorus olitorius*	(a) *Aspavia acuminata* (b) *Agrillus viridator* (c) *Cletomorpha unifasciata* (d) *Crematogaster africana* (e) *Dysdercus superstitiosus* (f) *Hermietia* (g) *Lixus* species	(Heteroptera; Pentatomidae) (Coleoptera; Buprestidae) (Heteroptera; Coreidae) (Hymenoptera; Formicidae) (Heteroptera; Pyrrhocoridae) (Heteroptera; Stratiomyidae) (Coleoptera; Curculionidae)

Table 3. Weekly insect infestation on *Celosia argentea* after treatment with test plant extracts or actellic.

Insect species	Treatment	Weeks							
		1	**2**	**3**	**4**	**5**	**6**	**7**	**8**
Aspavia	Untreated Control	7	3	0	3	0	1	4	3
Cletomorpha	Untreated Control	0	3	0	2	3	0	3	0
Euophryum	Untreated Control	8	5	11	14	12	12	14	18
Aspavia	Hexane Control	5	5	0	4	2	4	2	2
Cletomorpha	Hexane Control	2	1	0	4	3	0	3	3
Euophryum	Hexane Control	11	7	8	9	13	14	12	12
Aspavia	Actellic	2	2	0	1	0	2	3	1
Cletomorpha	Actellic	0	0	0	1	0	0	1	1
Euophryum	Actellic	0	0	6	3	3	6	4	9
Aspavia	*Chenopodium*	0	3	1	3	1	5	2	4
Cletomorpha	*Chenopodium*	0	1	2	0	2	2	2	2
Euophryum	*Chenopodum*	3	0	5	7	7	10	6	10
Aspavia	*Zanthoxylum*	3	0	0	2	1	3	3	3
Cletomorpha	*Zanthoxylum*	0	1	2	3	1	1	1	2
Euophryum	*Zanthoxylum*	2	0	9	2	7	13	7	10

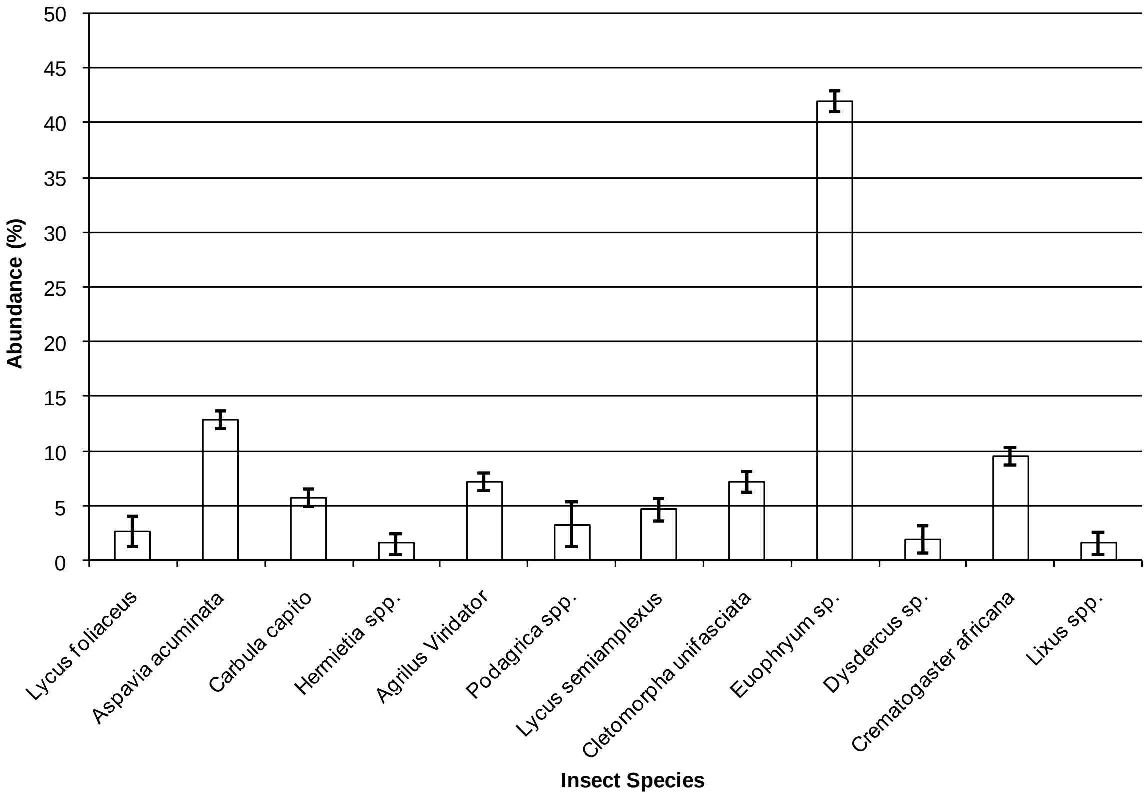

Figure 1. Percentage abundance of Insect Species on untreated vegetables**.**

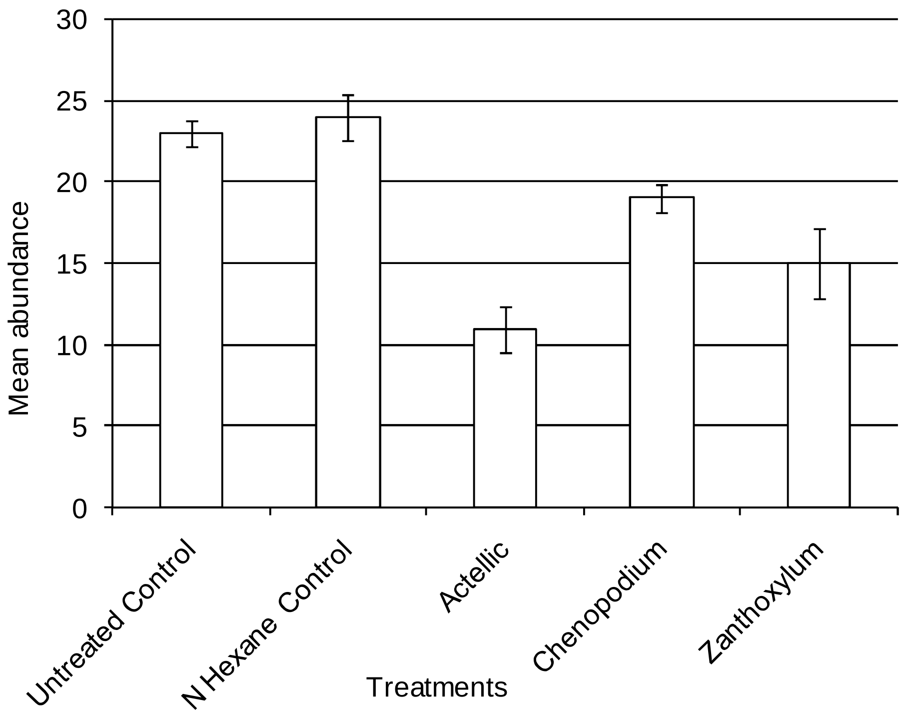

Figure 2a. *Aspavia* infestation on *Celosia argentea* treated with plant extracts and Actellic.

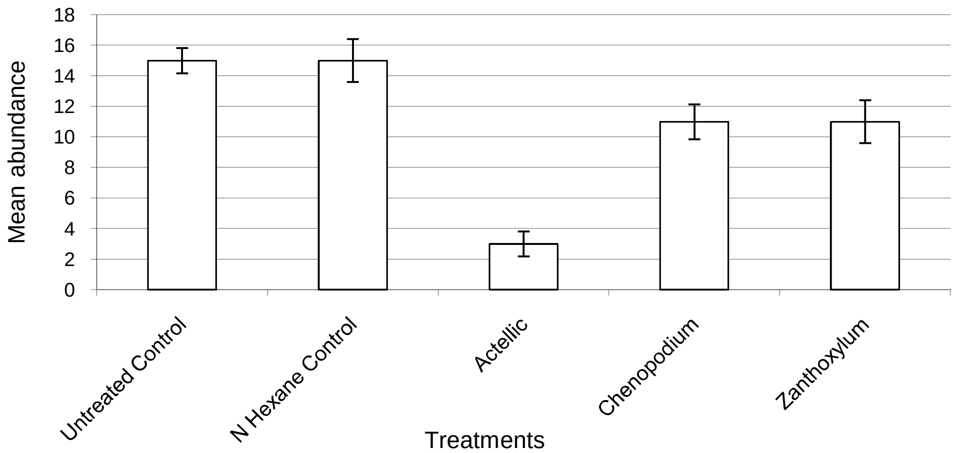

Figure 2b. *Cletomorpha* infestation on *Celosia argentea* treated with plant extracts and actellic.

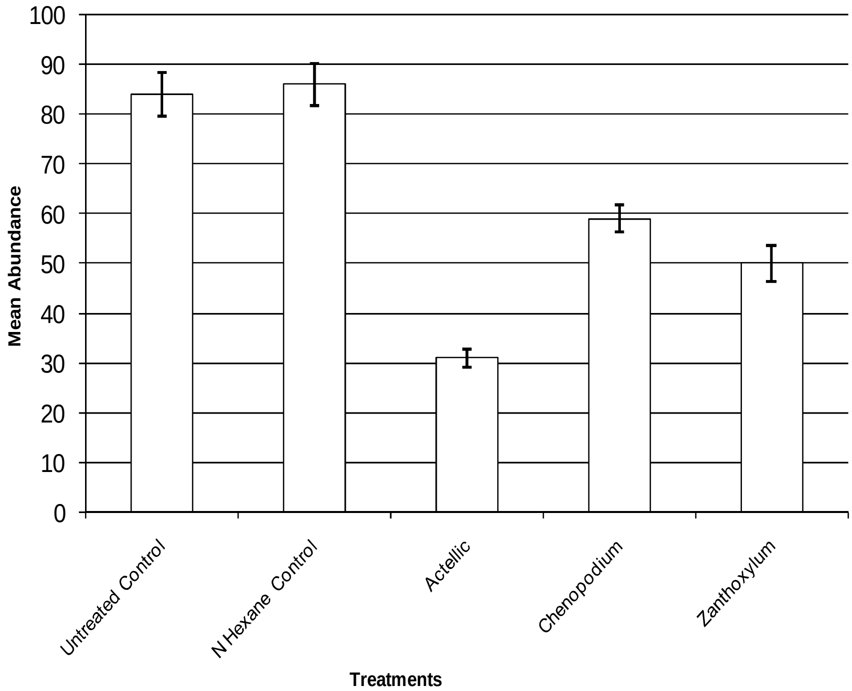

Figure 2c. *Euophryum* infestation of *Celosia argentea* treated with plant extracts and actellic.

DISCUSSION

This study documents the insect pests infesting *Abelmoschus esculenta*, *Celosia argentea* and *Chochorus olitorius* in Lagos, Nigeria and the pest control practices of vegetable farmers in Ojo, Lagos. From the results, it was noted that most farmers in Ojo Local government Area exterminate rather than control insect pests of their vegetable crops, majority applying insecticides on the crops even before the onset of insect infestation.

A wide range of insect pests comprising 12 species were found infesting the three test vegetable species. This result complements the report of Parh *et al*. (1997) adding to the database of insects of vegetable crops in Nigeria. Parh *et al.* (1997) reported that 22 insect species infested vegetable crops on Jos Plateau, Northern

Nigeria. The higher number of insects sampled on the vegetable crops in the study carried by Parh *et al.* (1997) was probably due to the larger number of vegetable crops cultivated and the longer period of study.

The treatments against the insect pests in this study provided varying degrees of protection to the vegetable crops. The Actellic-20EC was observed to provide the highest degree of protection against all the insect pests except *Lycus foliaceus, Hermietia* species and *Agrilus viridator* in which the number of insects collected was not significantly ($P<0.05$) different on the crops treated with Actellic-20 EC, *Chenopodium* and *Zanthoxylum*. It was also observed that the essential oil of *Zanthoxylum zanthoxyloides* was more effective than the oil of *Chenopodium ambrosioides* against *Aspavia acuminata, Cletomorpha sp and Euophryum* species respectively. There is need for further studies to investigate the reasons for these observations.

The incidence of insect pests i.e. the number of insects sampled on the treated crops increased between the sixth and eight week of sampling. This is probably due to the decrease in concentration, and hence toxicity of the treatments. Higher concentrations and longer exposure periods may be needed to achieve a higher level of mortality (Tunc *et al.,* 2000). Studies have shown that these essential oils are readily biodegradable and less detrimental to non-target organisms than synthetic pesticides (Tunc *et al.,* 2000). Compared with a similar work carried out by Tapondjou *et al.* (2006), the differences in responses of the different insect species could be attributed to the morphological and behavioural differences between the insects. These results and the results of Tunc *et al.,* (2000) clearly indicate variations in the activity of essential oils regarding the species of the insect and the plant origin of the essential oil. At an increased concentration and higher dosage, the essential oils may provide greater protection against insect pests of vegetable crops.

CONCLUSION

The results obtained in this study indicate that the essential oils of *C. ambrosioides* and *Z. zanthoxyloides* have the potentials to respectively control the insect pests of *C. argentia* grown on the field. Each of these essential oils however are less potent than Actellic.

CONFLICT OF INTEREST

The authors declare that they have no conflict of interest.

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