Efficacy of three plant extracts on insect pests of three vegetables

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ABSTRACT

The efficacy of *Vernonia amygdalina, Momordica charantia* and *Morinda lucida* extracts were tested for insecticidal activities on insect pests of *Corchorus olitorus, Amaranthus cruentus* and *Cucumis sativus*. Twenty grammes of each botanical were soaked in hot water at 100°C, allowed to cool for 24 h and filtered. The extracts were used on the vegetable crops. Cypermethrin (a synthetic insecticide) was used to compare the efficacy of the extracts while distilled water was used as the control. The experimental design was randomized complete block in a 5 x 3 factorial layout. Insect counts were taken on the vegetable crops at 5, 6 and 7 weeks after planting (WAP). The botanicals and Cypermethrin significantly reduced the number of insects on the vegetables compared with the control. The average percentage efficacy were; Cypermethrin (85.06%), *V. amygdalina* (71.40%), *Momordica charantia* (65.16%) and *Morinda lucida* (59.89%). There was no significant difference in insect population count on the three vegetables at 5 and 6 WAP. Insect population found on *C. olitorus* and *A. cruentus* were significantly higher than those found on *C. sativus* at 7 WAP. The plant extracts proved effective in controlling insect pests on these vegetables and are therefore recommended for use by farmers.

Key words: Efficacy, Plants extracts and Vegetables.

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INTRODUCTION

Vegetables are essential component of most meals served in Africa and are consumed in relatively small quantities as a side dish or a relish with staple food (Rice, *et. al*. 1990). The leaves, roots or stems constitute the edible portions of most vegetables, although flowers, calyces, immature seeds or fruits may also be consumed. Vegetables are good sources of nutrients, containing vitamins, protein, minerals and fibre. Besides being medicinal, this group of plants contributes to balanced diet, especially in areas where animal protein is expensive or deficient. Vegetables are sources of quick cash to farmers during the dry season. Schippers (2000) reported lack of technical advice, non-availability of seeds/planting materials and misuse of synthetic insecticides as the major constraints to sustainable vegetable production in Africa.

Certain plants have been shown to exhibit insecticidal properties (Banjo and Oduala 1996; Banjo and Olaleye 1998; Kembonta and Okogbue 2000; Ameh and Ogunwolu 2000). *Azadirachta indica, Vernonia amygdalina, Piper tuberculatum, Nicotiana tabacum, Morinda lucida, Momordica charantia* and a host of others have proved to be insecticidal. They have been reported to exhibit the following attributes: less destructive effect on the natural enemies of pests, less harmful to the health of humans and farm animals, cause no damage to the environment and to water supplies and cheaper than synthetic pesticides. Oke *et al* (2010), for instance, observed that *M. charantia* is more effective in reducing the green peach aphids on pepper than the synthetic insecticide, Lambda-Cyhalothrin.

Pesticides of plant origin have been in existence for many years (Umeh and Ivbijaro 1999) and have been used in pest control (Umeh and Onukwu 2002). There is increasing awareness that plants manufacture and store chemical substances that protect them from insects, bacteria, fungal and viral attacks. The need to develop non-toxic, environment friendly, safe and biodegradable alternatives to synthetic insecticides has come to limelight (Olaifa and Akingbohungbe, 1987). It is estimated that only about 10% of the over 250,000 plant species in the world have been examined for insecticidal activities (Farnsworth, 1990). Therefore, several plant species still exist in the tropical forest which needs to be exploited.

Furthermore, fresh produce of vegetables are sometimes consumed raw as salads and if sprayed with synthetic insecticides can be hazardous to the consumers. It is therefore imperative to develop pest control measures that are safe, cheap and simple to adopt. In view of this and the increasing interest in developing plant-based insecticides as an alternative to chemical insecticides, this study was undertaken with the aim of finding alternative to the use of synthetic insecticides in reducing pest damage on vegetables.

MATERIALS AND METHODS

The study was conducted at the experimental field of the National Horticultural Research Institute (NIHORT) Headquarters, Ibadan, Oyo State, Nigeria, in April 2011 at the onset of the rainy season. Seeds of *C. olitorus* var. *Angbadu* and *A. cruentus* var. NHAc 3 were collected from the Seed Unit of NIHORT, while seeds of *C. sativus* were purchased from Royal Seeds, a local seed distributor in Ibadan. *Corchorus olitorus* seeds were heat-treated to break the dormancy before planting. The heat treatment was achieved by tying the seeds in a piece of clean cloth, followed by immersion in hot water at 100°C for five seconds. The seeds were then dipped in cold water for five minutes after which they were untied and spread out to dry.

The seeds of *A. cruentus* and *C. olitorus* were planted directly in a hole by drilling on a plot size of 2mx1m at a spacing of 20cm x 50cm. The seedlings were thinned to one plant per stand four weeks after planting. *Cucumis sativus* seeds were planted directly at a spacing of 50cm x 50cm. Two seeds were planted per hole and thinned to one plant per stand two weeks after planting. The plants were staked four weeks after planting (Schippers, 2000). The experiment was laid out in a randomized complete block design of 5 x 3 factorial layout in three replicates.

The botanicals used were the leaf extracts of *Vernonia amygdalina, Momordica charantia* and *Morinda lucida.* The leaves of *M. charantia* and *M. lucida* were collected in the wild while *Vernonia amygdalina* was obtained from the backyard of NIHORT residential staff quarters in Ibadan. The plant materials were identified according to the description of Akobundu and Agyakowa (1998). The leaves of *V. amygdalina, M. charantia* and *M. lucida* were air dried at room temperature and then ground using Marlex grinder. Twenty percent (20%) concentration of extract was realized by adding 20g of each ground leaf to 100ml of hot distilled water and soaking for 24 hours (Banjo and Olaleye 1998). The mixtures were filtered using cheese cloth and the filtrates used as extracts. The extracts were sprayed at the rate of 30ml per plant using Harry hand sprayer. The synthetic insecticide, Cypermethrin, was applied at the recommended dose of 0.5L/ha. The treatments were applied thrice at 5, 6 and 7 weeks after planting. The five middle plants were tagged for sampling. Insects found on tagged plants 24 h before and 24 h after each spraying were counted and recorded. The insects collected were taken to NIHORT Museum for identification. The Henderson Tilton formula adopted by Okunlola *et al.,* (2007) was used to determine the percentage efficacy of the extracts as follows:

$$\textbf{\% efficacy} = 1 - \left(\frac{Ta}{Ca} \times \frac{Cb}{Tb}\right) \times 100$$

Where Ta = Infestation in the treated plot after application

Ca = Infestation in the check plot after application

Tb = Infestation in the treated plot before application and

Cb = Infestation in the check plot before application

The data collected were subjected to analysis of variance (ANOVA), using a General linear model (GLM) procedure (SAS, 2000). Significantly different treatment means were separated, using the least significant difference test (LSD) at P = 0.05

RESULTS AND DISCUSSION

Insects found on the vegetables were *Zonocerous* species, *Aphis* species, *Podagrica uniforma, Podagrica sjostedti, Psara bipuncatulis, Crytoflata* species, *Lycus lattisimus, Aspervia armigera, Asbencesta nigripennis, Lixus truncalatuss, flies* and *Hymenia* species. On *C. olitorius, Podagrica* species (fleabeetle), *Zonocerous* species (grasshopper), and *Aphis spp.* are the most prevailing. On *A. cruentus, A. armigera* (stink bug) *L. truncalatus* (weevil), *P. bipuncatulis* and *Hymenia* species (leaf caterpillars) are rampant while on *C. sativus, Podagrica* specie (flea beetle) and some flies are present. Other insects found on the field, like *Crytoflata* species and *Asbencesta nigripennis* can be classified as occasional insects.

Momordica charantia recorded the highest percent efficacy among the botanicals for *Cochorus olitorious* 49 – 75% during the sampling period. *Vernonia amygdalina* recorded the least (38.94%) at the fifth week sampling period (Table 1). *C. olitorius* treated with Cypermethrin performed best (94.98%, 86.80% and 95.70%) during the three sampling periods (Table 1). *Amaranthus cruentus* treated with *Vernonia amygdalina* at 7 WAP performed best among the botanicals (76.58%) (Table 1). *Momordica charantia* was the poorest among the botanicals (42.55%) at 5th week sampling period. Cypermethrin, on *Amaranthus,* had the best efficacy (100%) at 7 WAP. *Momordica charantia* botanical stood out to be the best (87.20%) at 7 WAP in controlling insect pests of *Cucumis sativus* (Table 1). The interactions effect of the botanicals and the vegetables on the insect population and the percent efficacy is also presented in Table 1.

Table 1: Interactive effects of botanicals on three selected vegetables on insects' population and percentage efficacy.

Vegetable	Plant extracts	5 WAP			6 WAP			7 WAP		
		No. of Insects Before Application	No. of Insects After Application	% Efficacy	No. of Insects Before Application	No. of Insects After Application	% Efficacy	No. of Insects Before Application	No. of Insects After Application	% Efficacy
C.	Control	12.33	13.67	-	10.33	15.67	-	11.67	12.39	-
olitorious	*V. amygdalina*	4.67	3.72	38.94	7.33	5.00	55.03	7.33	2.67	65.69
	M. charantia	13.67	7.67	49.40	10.33	4.00	74.50	9.67	3.33	67.56
	M. lucida	11.33	6.00	52.24	8.00	5.00	58.79	7.00	3.67	50.59
	Cypermethrin	12.66	1.33	90.52	10.00	2.00	87.64	7.33	0.33	95.77
A.	Control	13.67	17.67	-	14.33	15.67	-	14.33	18.33	-
cruentus	*V. amygdalina*	11.67	6.67	55.78	8.00	4.00	54.28	6.67	2.00	76.58
	M. charantia	10.33	7.67	42.55	10.00	4.00	68.10	6.33	3.00	62.95
	M. lucida	8.00	4.0	61.31	8.33	4.00	72.03	7.00	3.00	86.96
	Cypermethrin	10.67	5.67	58.89	7.67	2.33	79.93	7.00	0.00	100.00
C. sativus	Control	9.00	16.00	-	9.67	12.30	-	10.67	9.33	-
	V. amygdalina	6.67	3.67	69.05	6.00	1.67	78.11	7.00	2.00	67.32
	M. charantia	8.33	3.67	75.21	7.33	4.30	63.42	6.00	0.67	87.23
	M. lucida	9.67	5.67	67.02	8.67	3.67	66.80	4.67	2.67	34.62
	Cypermethrin	10.30	2.33	87.27	5.00	1.67	73.74	5.0	0.67	84.67
LSD 0.05		Ns	Ns		ns	Ns		4.85	3.86	

TABLE 2: Effects of the botanicals on insect pests population of three selected vegetables

Treatment	5 W A P			6 W A P			7 W A P		
	Number of Insects Before Application	**Number of Insects After Application**	**% Efficacy**	**No. of Insects Before Application**	**No. of Insects After Application**	**% Efficacy**	**No. of Insects Before Application**	**No. of Insects After Application**	**% Efficacy**
Control	11.67	15.78	-	11.49	14.56	-	12.22	15.00	-
V. amygdalina	9.33	5.22	58.62	7.11	3.67	59.41	7.00	2.22	96.18
M. charantia	10.78	6.33	56.58	9.22	4.11	64.80	7.33	2.33	74.11
M. lucida	9.67	5.2	60.23	8.33	4.22	60.17	6.22	3.11	59.27
Cypermethrin	11.58	3.11	80.14	7.56	2.00	79.20	6.44	0.33	95.83
LSD 0.05	**Ns**	**3.74**		**2.6**	**2.11**		**2.69**	**2.31**	

TABLE 3: Insects population of three selected vegetables

	5 W A P		6 W A P		7 W A P	
Vegetable	**Number of Insects Before Application**	**Number of Insects After Application**	**Number of Insects Before Application**	**Number of Insects After Application**	**Number of Insects Before Application**	**Number of Insects After Application**
C.olitorius	12.13	6.80	9.2	6.33	8.6	5.47
A.cruentus	10.87	8.33	9.67	6.07	8.27	5.27
C.sativus	8.80	6.27	7.33	4.73	6.67	3.07
LSD 0.05	**1.93**	**Ns**	**2.02**	**Ns**	**Ns**	**1.79**

There was no significant interaction among the pesticides (botanicals and synthetic) and the vegetables in the number of insect population before and after treatments 5 and 6 weeks after planting. At five weeks after planting, Cypermethrin sprayed on *C. olitorious* and *C. sativus* had the best percent efficacy of 90.52 and 87.27 respectively. *C. sativus* sprayed with *M. charantia* and *V. amygdalina* with 75.21 and 69.05 percent efficacy recorded the best among the botanicals. *Cochorus olitorius* sprayed with *V. amygdalina* and *M. charantia* performed least among the botanicals with 38.94 and 49.40 percent efficacy among the botanicals. The trend of percent efficacy for interactions for their sixth week was similar to the fifth week with Cypermethrin sprayed with *C. olitorius* and *A. cruentus* having the best performance with 87.64 and 79.93 percent efficacy respectively. However, the combination of *C. sativus* and *V. amygdalina* (botanical) had higher efficacy (78.11) compared with *C. sativus* sprayed with Cypermethrin synthetic insecticide with 73.74% (Table 1). Significant differences were recorded at seven weeks after planting before and after spraying without application (control) treatment in combination with the vegetables, had significant number of insects population than the pesticides (botanicals and synthetic) treated vegetables (Table 1). The same trend was observed after application as the insect populations found on the non-treated vegetables were significantly superior to the treated vegetables. Cypermethrin treated with *A. cruentus* and *C. olitorious* had the best percent efficacy with 100 and 95.77% respectively (Table 1). Interaction of *C. sativus* and *M. charantia* botanical had the best percent efficacy for *C. sativus* than any other interactions (synthetic and botanicals).

Insect population count before application of treatments was not significantly different at 5th week after planting (initial) in all the treatments, thereafter, control treatments before application (6 and 7 WAP) were significantly different from the botanicals and the Cypermethrin pesticides treatments (Table 2). The control treatment was significantly higher in insect population after application throughout the sampling periods. The percentage efficacy of the insecticides increased as the time progressed.

Table 3 shows insect population on each of the vegetables as affected by the insecticide treatments. There were significant differences in insect population before application at 5 and 6 weeks after planting the vegetables, majorly caused by *C. olitorious* and *A. cruentus* in the 5th week and *A. cruentus* in the 6th week after planting. There was no significant different in the insect population on the three vegetables at 5 and 6 week after insecticides application. However, at 7th week application, *C. olitorious* and *A. cruentus* insect population were significantly higher than *C. sativus*.

The insect species found on the vegetables is in consonance with the work of Okunlola *et al* (2007) who recorded the incidence of some of the insects on a field of leafy vegetables. The incidence of *H. recurvalis* on amaranths agreed with the work of Banjo and Olaleye (1998) who described the insect as a major pest of amaranth. Okunlola and Ofuya (2009) recorded the presence of *H. recurvalis* and *P. bicunpalis* on leafy vegetables. They are caterpillars, which eat the foliage of the vegetables until only a network of veins remains, thus reducing yield. The incidence of *A. armigera, Posdagrica* spp. and *Zonocerous* spp. is in agreement with the studies of Akinlosotu (1983), Ogbalu *et al* (2005) and Okunlola and Ofuya (2009). The pests attack the leaves and inflict much injury by making small round holes and pinching off parts of the plants thereby reducing the leaf area, which affects plant assimilation and leaf surface for photosynthesis and consequently economic loss due to reduced yield (Ogbalu and Ekweazor, 2002). The incidence of *Lixus sp*. on vegetable is in agreement with the work of Okunola *et al* (2007). Both adults and larvae of these weevils feed on foliage of the plants (Sorensen, 1988). The incidence of *Podagrica* sp. on *C. olitorius* and *C. sativus* is in terms with the findings of Okunola and Ofuya (2009) who rated the pest as the first among the pests of vegetables. Aphids have been reported by Sorensen (1998) as one of the insect pests of vegetables that cause great damage and transmit diseases into the plants.

Efficacies of botanicals as repellents of insects was observed after each application as time progressed in the reduction in the insect population. This is in consonance with the works of Banjo and Oduala (1996) who established the fact that *V. amygdalina* controls on insect pest of okra. Banjo and Ode (1996) also reported that extracts of *V. amygdalina* controlled *Selepa docilis,* a pest of eggplant effectively. The ability of *M. charantia* was in agreement with the work of Devannard and Rani (2008) who reported on its control of Lepidothera of *Ricinus communis.* Ofuya and Okuku (2005) reported the efficacy of *M. charantia* in causing high nymphal mortality of aphids.

All the plant extracts exhibited some effect on the insect population. This implies that if any of the extracts is chosen for insect control of the vegetables, positive result is likely to be achieved. *V. amygdalina* and *M. charantia* exhibited comparable effect on insect population with cypermethrin. This is in terms with the findings of Bassedow *et al* (2002) and Okunlola *et al* (2007) which showed that *A. indica* based products were effective or even more effective than synthetic insecticide. *Vernonia amygdalina's* bioactivity can be attributed to its composition of insecticidal and unsaturated butylanide like pelliolorine and faqaramide (Cremlyn, 1991). *M. charantia* has also been reported to contain several biologically active compounds like momordicin I and II and cucurbitacin B. It is also known to contain several bioactive glycosides (Wikipedia, 2011) while two soponosides have been isolated from *M. lucida* (Zimudzi and Cardon, 2005). The differences in the botanicals composition may be responsible for the differences observed in their insecticidal activities.

CONCLUSION

The efficacies of *V. amygdalina, M. charantia* and *M. lucida* extracts have been found to be comparable to that of cypermethrin synthetic insecticides. However, while cypermethrin was a broad spectrum, the botanicals performed better on specific vegetables. The results showed that all the plant extracts exhibited insecticidal effects on the insect pests of the three vegetables in this study.

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