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EVALUATION OF ETHANOL LEAF EXTRACTS OF *SIDA ACUTA* AND *CHROMOLAENA ODORATA* ON INSECT PESTS OF *CELOSIA ARGENTEA* L. AND *AMARANTHUS CRUENTUS* L.

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ABSTRACT

A field experiment was carried out to evaluate the effect of leaf extracts of *Sida acuta* Burm. f. and *Chromolaena odorata* L. in controlling insect pests of *Celosia argentea* L. and *Amaranthus cruentus* L. The experiment was laid out in randomized complete block design and the treatments were replicated three times. Extracts obtained from the plants at 240 g/L of ethanol were applied as botanical insecticides. These extracts were examined along with a synthetic insecticide (Cypermethrin) including untreated control. Data were collected on number of *Cletus* spp. and *Hymenia recurvalis* per plant. Result shows that *C. argentea* sole treated with *S. acuta* and *C. odorata* was not infested by *Cletus* spp., and significantly ($p<0.05$) different from *A. cruentus* and *C. argentea* intercrop treated with *S. acuta* and *C. odorata* at 2 weeks after treatment. *C. argentea* treated with *S. acuta* had the least number of *H. recurvalis* (1.00) which was not significantly ($p>0.05$) different from Cypermethrin in both sole and intercrop at 4 WAT. *A. cruentus* and *C. argentea* planted sole or in intercrop treated with botanical and synthetic insecticides had lower numbers of *H. curvalis* which were significantly different from untreated control at 8 and 10 WAT. This study showed that *S. acuta* performed better than *C. odorata* against the target insect pests and therefore recommended for incorporation into Integrated Pest Management irrespective of whether sole or intercropping was adopted.

Keywords: *Amaranthus*, *Celosia*, *Cletus*, extracts, pests, *Hymenia*, vegetables

INTRODUCTION

Amaranthus spp. L. is an important vegetable in Nigeria, grown mainly for its highly nutritious leaves. Leaf amaranth is used as a steamed vegetable in soups and stews. The leaves, stem and head are reportedly high in protein (15 to 24% on a dry matter basis) (Directorate Plant Protection, 2010). Marin *et al*. (2008) listed Amaranthus as one of the crops that can respond to different ecological conditions and has become important for agro-food production and non-food sectors (biomass, biofuels, natural dyes, medicines). The leaves are very rich in proteins and micronutrients such as iron, calcium, zinc, vitamin C and vitamin A (Achigan-Dako *et al.*, 2014). It has been reported that the amount of minerals such as calcium, magnesium, iron and zinc in wheat grain are 5.2-, 2.9-, 2.8- and 1.3-fold lower than in amaranth seeds, respectively (Alvarez-Jubete *et al*., 2010). However, whole grains contain significant amounts of phytic acid, a well-known inhibitor of iron absorption and other minerals (Sanz-Penella *et al.*, 2012). Amaranths can therefore, be used to reduce hunger and malnutrition, particularly in sub-Saharan Africa. This necessitated the establishment of Biodiversity International`s African leafy vegetables programme conducted in Botswana, Cameroon, Kenya, Senegal and Zimbabwe on growing, consumption, marketing and nutritional awareness of African leafy vegetables including amaranths (Gotor and Irungu, 2010). *Amaranthus hybridus* is consumed as a staple food in Africa and North America, Asia, the Caribbean and parts of Europe (Abbasi *et al.*, 2013). Amaranthus leaves show significant energy value ranging from 27 to 53 kcal/100 g of fresh leaves and high nutrient value ranging from 4 to 6 g of protein, 0.2 to 0.6 g of fat, and 4 to 7 g of carbohydrates per 100 g of fresh leaves (Uusikua *et al*., 2010). As compared to lettuce, Amaranthus leaves contain 18 times more vitamin A, 13 times more vitamin C, 20 times more calcium and 7 times more iron (Srivastava, 2011). The folic acid in amaranth reduces the risk of neural defects in pregnant women and their new-borns (AVRDC, 2011).

Celosia argentea is one of the important leafy vegetable in south-western Nigeria. It is a vegetable of high economic value particularly in the dry season, as it provides a source of living for most rural vegetable farmers (Akinfasoye *et al.*, 2008). The leaves and succulent stem are consumed as vegetable because it constitutes a cheap and rich nutrient source for the low income earners, and the seeds could also be processed into food items, supplement and additives. It also has some medicinal properties for example, in Kenya, the Mai Sai use the liquid extract from the leaves and flowers to bath a patient recovering from illness and also as an antidote for snake bites.

One of the limiting factors that affecting the productivity of amaranths is the range of insect pests (Aderolu *et al*., 2013). Borisade (2019) recorded a total of nine pests on amaranth from three insect orders namely, Ortoptera (62.5%), Coleoptera (12.5%) and Lepidoptera (25.0%). The insect pests that are responsible for the most economic damage to leaf amaranth in the Southwest Nigeria belong to Lepidoptera and Orthoptera orders (Borisade and Uwaidem, 2017). Along with Lepidoptera the other orders namely; Coleoptera, Hemiptera and Orthoptera are affect amaranths. Lepidoptera largely attack amaranths among the other order insect pests. The production of *Amaranthus* spp. is challenged by insect infestation including Amaranth stem weevils, *Hypolixus truncatulus* (F.), *H. nubilosus* (B.), Beeworm moth, *Spoladea recurvalis* (F.), leaf miner, *Liriomyza huidobrensis* B.), Aphid, *Myzus persicae*; plant bugs, *Cletus* sp. (Seni, 2018).

The use of synthetic insecticides in vegetable pest management particularly at unsafe levels causes pesticide residues and harm to the consumer. Despite the ban on use of DDT in the management of agricultural pests, Borisade *et al*. (2019) reported that the pesticide is still being used in the management of vegetable pests by subsistent farmers. Efforts should therefore be intensified by stakeholders on the need to find environmentally friendly alternatives to the use of inorganic pesticides in the control of pests of leaf vegetables. A sustainable alternative should be sought to the use of these synthetic insecticides.

The work therefore aims at evaluating the effects of ethanolic leaf extracts of common wire weed, *Sida acuta* Burm f. and siam weed, *Chromolaena odorata* on insect pests of *A. cruentus* and *C. argentea* planted sole or intercrop.

MATERIALS AND METHODS

The experiment was carried out during the rainy season of 2018 behind the Faculty of Agriculture, University of Ilorin, Ilorin, Nigeria. The study location falls within the southern Guinea Savannah agro-ecological zone of Nigeria between latitude 8°25'N and longitude 4°67'E. The rainfall ranges between 1200 and 1500 mm per annum. The climate includes rainy season which starts in April and ends in September while the dry season commences in October and ends in March. The dry spell is experienced in August of every year. The site has an average temperature of 35^0C and is characterized by sandy loam soil (Babatunde *et al.* 2020).

The total land area was 21 m × 43 m (903 m^2). The nursery was situated beside the main plot. The land was manually cleared, tilled and then pegged and divided into 12 blocks of 3 m × 21 m from which each was sub-divided into 3 plots of 3 m × 5 m and 1 m spacing between plots. The seeds of *A. cruentus* and *C. argentea* used were obtained from Agro Mall at Zango Area, Ilorin, Kwara State, Nigeria. The seeds were sown using broadcasting method and routine nursery management was carried out. The seedlings were transplanted at 5-leaf stage at a spacing of 1 m ×1 m. The seedlings were randomly assigned to plots as *A. cruentus* sole and *C. argentea* sole, and *A. cruentus* and *C. argentea* intercrop.

Chromolaena odorata and *S. acuta* leaves were sourced from the University of Ilorin. These leaves were air dried for three (3) weeks and ground using electric blender, sieved by passing through 2 mm mesh to obtain a uniform particle size. The preparation of the extracts was done by maceration of 240 g/L of ethanol for 24 h separately and then filtered using muslin cloth. Each filtrate was made up to 2 L by adding distilled water and a 2 ml of liquid soap per litre of the solution was used as surfactant (Anjarwalla, 2016). The synthetic insecticide was prepared according to the manufacturer's recommendation (2 mL L^{-1} of water) while application of treatments commenced 2 weeks after transplanting (WAT) of seedlings according to Ezena *et al*. (2016) using hand sprayer and repeated at 2 weeks intervals up to 10 WAT. There were 12 treatment combinations that gave 48 experimental units. Ethanolic leaf extracts of *S. acuta* and *C. odorata* were used as botanical insecticides and (Cypermethrin) served as synthetic insecticide including an untreated control which was sprayed with water only. The experiment was laid out in a randomized complete block design with three replications.

Data were collected on target species such as *Cletus* spp. and *Hymenia recurvalis* plant after each spraying and continued at two weeks intervals up to 10 WAT. The insect populations from the different plots were sampled between 7 and 8.00 a.m. on each day of sampling. Number of insects/plant was sampled from inner parts of the plot. Data collected were subjected to two way analysis of variance using Genstat 17th edition, and significantly different means were compared using Fishers Least Significant Difference (LSD) test at 5 % level of significance.

RESULTS

Table 1 shows the effect of botanical and synthetic insecticides and *A. cruentus* and *C. argentea* planted sole or intercrop on the mean number of *Cletus* spp. The result shows that *C. argentea* sole treated with *S. acuta* and *C. odorata* was not infested by *Cletus* spp. and significantly ($p<0.05$) different from *A. cruentus* and *C. argentia* intercrop treated with *S. acuta* and *C. odorata* at 2 WAT. The *A. cruentus* sole and *A. cruentus* and *C. argentea* intercrop had mean numbers of *Cletus* spp. which were not significantly ($p>0.05$) different with Cypermethrin treated crops and the untreated control at 2 WAT.

At 4 WAT, *A. cruentus* treated with *C. odorata* had mean number of *Cletus* spp. of 5.33 which was significantly ($p<0.05$) higher than the mean number of the insect in other treatments and the untreated control. The result shows that *A. cruentus* treated with *C. odorata,* and *A. cruentus* and *C. argentea* intercrop treated with *C. odorata* had mean number of *Cletus* spp. of 5.00 and 4.73 respectively, were not significantly ($p>0.05$) different from the mean number of *Cletus* spp. on untreated control (6.53) at 6 WAT.

Table 1 also shows that *A. cruentus* and *C. argentea* planted sole or intercrop treated with botanical and synthetic insecticides had mean numbers of *Cletus* spp. which were significantly ($p<0.05$) different from untreated control at 8 WAT. Similarly, *A. cruentus* and *C. argentea* planted sole or intercrop treated with botanical and synthetic insecticides had lower mean numbers of *Cletus* spp. which were significantly ($p<0.05$) different from untreated control except for *A. cruentu*s treated with *C. odorata* at 10 WAT.

Table 1: Effect of insecticides and *Amaranthus cruentus* and *Celosia argentea* and sole and intercrop on number of *Cletus* spp.

		Cletus. Spp (WAP)				
Crop	Treatment	2	4	6	8	10
A. cruentus	*S. acuta*	0.53ab	0.06 a	2.60ab	2.80abc	4.93ab
	C. odorata	0.40ab	5.33c	5.00bc	4.60bcd	8.00bc
	Cypermethrin	0.20ab	0.66ab	1.06a	1.80ab	2.20a
C. argentea	*S. acuta*	0.00a	0.20a	5.06bc	2.20ab	3.00a
	C. odorata	0.00a	2.06ab	3.06ab	5.46cd	5.66ab
	Cypermethrin	0.13ab	1.46ab	0.53a	3.26abcd	3.16a
A. cruentus + C. argentea	*S. acuta*	0.93b	1.40ab	2.80ab	5.66cd	4.06ab
	C. odorata	0.93b	2.80b	4.73bc	6.20d	5.73ab
	Cypermethrin	0.33ab	1.13ab	2.20ab	0.80a	2.73a
	Control	0.13ab	2.66b	6.53c	9.33e	10.73c
SEM		0.29	0.78	1.08	1.02	1.52
$LSD_{(0.05)}$		0.86	2.3	3.18	3.01	4.47

Values in the same column followed by the same letter(s) are not significantly different at p = 0.05 according to Fisher's protected Least Significant Difference (LSD) test

Table 2 shows the effect of botanical and synthetic insecticides and *A. cruentus* and *C. argentea* planted sole or intercrop on the mean number of *Hymenia recurvalis*. There was no significant ($p>0.05$) difference in the mean number of *H. recurvalis* in the treated crops and untreated control at 2 WAT. It was observed that *C. argentea* treated with *S. acuta* had the least mean number of *H. recurvalis* (1.00) which was not significantly ($p>0.05$) different from Cypermethrin in both sole and intercrop at 4 WAT. *Amaranthus cruentus* sole, *C. argentea* sole and *A. cruentus* and *C. argentea* intercrop treated with *C. odorata* had no significant difference in the mean numbers of *H. recurvalis* and not significantly different from control at 6 WAP. *Amaranthus cruentus* and *C. argentea* planted sole and *A. cruentus* and *C. argentea* intercrop treated with botanical and synthetic insecticides had lower mean numbers of *H. curvalis* which were significantly ($p<0.05$) different from untreated control at 8 and 10 WAP.

Table 2: Effect of insecticides and *Amaranthus cruentus* and *Celosia argentea* sole and intercrop on number of *Hymenia recurvalis*

		Hymenia recurvalis (WAT)				
Crop	Treatments	2	4	6	8	10
A. cruentus	*S. acuta*	1.33c	1.73ab	3.13ab	3.66abc	5.66abc
	C. odorata	1.40c	4.46bc	4.46abcd	5.60cd	6.93bc
	Cypermethrin	0.80abc	1.86ab	1.93a	2.26ab	2.53a
C. argentea	*S. acuta*	1.33c	1.00a	3.66abc	5.13abcd	4.13abc
	C. odorata	0.20ab	2.73abc	4.86bcd	5.00abcd	7.00c
	Cypermethrin	0.66abc	0.66a	2.93ab	1.86a	2.97ab
A. cruentus + *C. argentea*	*S. acuta*	0.80abc	1.53a	3.80abc	3.53abc	4.13abc
	C. odorata	0.86abc	3.06abc	5.06bcd	5.53bcd	6.73bc
	Cypermethrin	0.33abc	1.66a	3.73abc	3.46abc	4.80abc
	Control	1.20bc	4.93c	6.66d	9.06e	12.13d
SEM		0.36	0.94	0.91	1.12	1.35
$LSD_{(0.05)}$		1.07	2.75	2.67	3.29	3.97

Values in the same column followed by the same letter(s) are not significantly different at p = 0.05 according to Fisher's protected Least Significant Difference (LSD) test

DISCUSSION

Researchers have adopted farming systems capable of improving the socio-economic sustainability in crop production and protection. The farming systems are known to play important role in management of insect pests which may include *Cletus* spp. and *H. recurvalis.* In this study, it was observed that *S. acuta* and *C. odorata* leaf extracts competed with Cypermethrin in reducing number of *Cletus* spp. and *H. recurvalis* irrespective of whether *A. cruentus* and *C. argentea* were planted sole or intercrop. It has been reported that *C. odorata* and neem extracts had significantly reduced number of aphids on cabbage than the conventional insecticide, Sunhalothrin (Ezena *et al*., 2016). The use of *S. acuta* extract performed better than *C. odorata* extract and the untreated control thereby corroborating its insecticidal activity as reported by other authors (Adeniyi *et al.*, 2010; Narasimhon *et al*., 2014; Gadewad and Paedeshi, 2018). It was observed that number of insects varied depending on type of extract, crop and farming technique. However, the effect of plant extracts may have to be increased by repeated application due to quick breakdown of the active components. The efficacy of Cypermethrin against insects has been reported by several authors (Kwaifa *et al*., 2012). Previous researchers studied the insecticidal activity of plant extracts against *Callosobruchus maculatus*, *Dysdercus cingulatus* (Gadewad and Pardeshi, 2017). Studies have revealed that *S acuta* and *C. odorata* contain phytochemicals that are effective in insect pest control (Adeniyi *et al.,* 2010; Govindarajan, 2010; Deepti *et al.,* 2013; Wahab and Akinterinwa, 2015).

CONCLUSION

The findings of this study revealed that ethanol extracts of *S. acuta* and *C. odorata* performed competitively with the synthetic insecticide (Cypermethrin) against the target insect pests. In comparison to imported chemicals, these plant materials are available in Nigeria and easier to prepare and apply with no reported issues of environmental toxicity. The study also showed that the plant extracts were capable of reducing the number of *Cletus* spp. and *H. recurvalis* in *A. cruentus* and *C. argentea* planted sole or intercrop. The incorporation of the plant extracts in Integrated Pest Management is recommended against multiplication of insect pests in the field.

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