The pesticidal Potential of *Alternanthera brasiliana* (L.) o. Kuntze in Solving pest problem in organic agriculture

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Key words: *Amaranthus cruentus*, *Alternanthera brasiliana*, *Hymenia recurvalis*, phytochemicals, pesticidal activity, toxicity

Abstract

This study was carried out at the Teaching and Research Farm of University of Ibadan, Nigeria between March and May 2013, to evaluate the pesticidal potential of A. brasiliana on H. recurvalis pest of A. cruentus. There were six treatments of different serial concentration levels of 100, 75, 50 and 25% of A. brasiliana extract, Cypermethrin (1ml/100mls) and control (no insecticide), replicated four times and laid out in a randomized complete block design (RCBD) and applied on A. cruentus at 3 and 5 Weeks After Sowing (WAS). Data collected were on plant height , number of leaves, stem girth, leaf area and fresh weight/yield of A. cruentus and analyzed using descriptive statistics and ANOVA at P = 0.05. Results revealed the presence of saponins, flavonoids, reducing sugar, glycosides and resins as the phytochemical compounds present in A. brasiliana leaf powder. Significant differences (p<0.05) were observed among the treatments in growth and yield parameters of A. cruentus. The pesticidal efficacy of A. brasiliana extract at 100% on H.recurvalis insect pest compared favourably with synthetic cypermethrin and other treated plots in recording highest while control recorded the lowest values in all parameters in the study. This study revealed that A. brasiliana extract could suppress H. recurvalis insect pest and could be used as botanical pesticide in Amaranthus cruentus production in organic farming.

Introduction

Synthetic pesticide misuse around the world has been known to cause costly environmental pollution (Adesiyan, 2005) and disruption of the balance of nature. The indiscriminate use of chemicals in the control of pests has led to problems such as pest resistance; toxic residues in agricultural produce, health hazards to the users and unintentional deaths annually (Fuglie, 1998). Indiscriminate applications of synthetic insecticides to vegetables have been reported to cause variable changes in brain on consumption (Ecobichon *et al*., 1994).

Besides, generalized toxic effects of the insecticides include, decreased number of implantation sites, decreased number of viable foetuses and weight gain of foetuses in rabbits have been reported (Elbetieha *et al.,* 2001). Some botanical pesticides with no toxic effects as that of synthetic have been reported by several researchers as insecticides, acaricides, bactericides, antifungal and nematicides, include Essential oils from sunflower, Neem (*Azadiracta indica*), (Bakali *et al*., 2008; Akhtar *et al*., 2008;). However, the need to screen for more naturally occurring compounds in plants as bio-rational pesticides with low cash input, readily available to farmers and eco-friendly in pest management and crop protection (Isman, 2006, Fayinminnu, 2010) led to the choice of *A. brasiliana*; an important perennial herb, native to tropical and subtropical regions of Australia and South America, traditionally used as a galactagogue (induces milk secretion), abortifacient (causes abortion) and febrifuge (alleviates fever), whose leaves are used like spinach in soups and also used for indigestion being prospected for its insecticidal properties. The plant is known to be medicinal: antibiotic and antiviral, antioxidant, antimicrobial and insecticidal properties (Mariani *et al*., 2008) but not much has been done to exploit its insecticidal potentials.

Therefore, the objective of this work was to evaluate the pesticidal potential of *A. brasiliana* leaf extract on *H. recurvalis* insect pest of *A*. *cruentus* (green leafy vegetable) in organic agriculture.

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Material and methods

The experiment was carried out between March and May 2013, at the Teaching and Research Farm and Toxicology Laboratory of The Department of Crop Protection and Environmental Biology (CPEB), University of Ibadan, Ibadan, Nigeria. Seeds of *A*. *cruentus* used were collected from germplasm of the Faculty of Agriculture and Forestry while the leaves of *A. brasiliana* were harvested from the Teaching and Research Farm, University of Ibadan.

- **Phytochemical Screening:**

This was performed on the leaf powder of *A. brasiliana* in the Organic Laboratory of the Chemistry Department, University of Ibadan. The phytochemical compounds were determined by the method of Harbone and Sofola (2007).

- **Preparation of *Alternanthera brasiliana* Leaf Powder Extract:**

Extraction procedure was carried out in Toxicology Laboratory (CPEB) according to the method of Ahn and Chung (2000) with a modification; One hundred and forty-four grams (144gms) of the leaves were used. The leaves were air-dried for seven (7) days, cut into chips and milled into powder. The powder was soaked for 24 hours and the solution was filtered through muslin cloth to remove the debris. Filtrate obtained was passed through Whatman No.1 filter paper. The final filtrate of plant part was considered as the full strength (100%) of the aqueous extract. Serial dilutions were made to obtain 75%, 50% and 25% (v/v) strength. The extracts were stored in refrigerator at 20oC for 24hours prior to use to prevent putrefaction and degradation of phytochemicals present in them. The extracts were used for the bioassay.

- **Field Work:**

This was carried out at the Teaching and Research Farm University of Ibadan, Ibadan, Nigeria. Each experimental plot size was 2m x 1m, replicated four times and laid out in a randomized complete block design (RCBD). *A*. *cruentus* seeds were sown by drilling and later thinned to one seedling per stand at 2WAS. The six treatments of 100, 75, 50 and 25% of *A. brasiliana* extract, Cypermethrin (1ml/100mls) and control (no insecticide) were applied as insecticide on *A*. *cruentus* at 3 and 5WAS.

- **Data Collection and Statistical analysis**

At weekly intervals, *A.cruentus* plants were assessed for growth parameters by measuring the plant height (using meter rule), stem girth diameter at 1cm above soil level (using a pair of Vernier calliper), number of leaves produced, leaf area and fresh weight/yield at harvest. All data obtained were subjected to analysis of variance (ANOVA), the means were compared by Duncan`s Multiple Range Test (DMRT) at
P = 0.05 for significance.

Results

Table 1: Phytochemicals Present in Leaf Powder of *Alternanthera brasiliana*

Compounds	Powdered Leaf Extract
Saponins	**+**
Flavonoids	**+**
Phlobatanins	**-**
Cardiac glycosides	**-**
Alkaloids	**-**
Reducing sugar	**+**
Phenol	**-**
Anthraquinones	**-**
Glycosides	**+**
Resins	**+**
Steroids	**-**
Tannins	**-**

+ indicates presence
- indicates absence

Table 2: Mean values of *A. brasiliana* Extract and Cypermethrin on Growth and Yield Parameters of *A. cruentus.*

	Plant Parameters at 3WAS				Plant Parameters at 5WAS				
	PH (cm)	SG (cm)	NOL	LA (cm^2)	PH (cm)	SG (cm)	NOL	LA (cm^2)	Fr. Wt
Cypermethrin (1ml/100mls)	20.00^{a}	0.11^{c}	10.30$_{a}$	20.00^{a}	20.00^{a}	20.41^{a}	0.11c	12.35a	36.41a
100% Extract	21.53^{a}	0.14^{a}	11.15$_{a}$	25.00^{a}	21.53^{a}	0.14^{a}	13.15$_{a}$	46.04^{a}	57.49^{a}
75% Extract	12.50$^{a}_{b}$	0.13^{ab}	10.45$_{a}$	15.00^{a}	16.23^{b}	0.13^{ab}	14.45$_{a}$	37.29^{a}	38.95^{a}
50% Extract	14.90$^{a}_{b}$	0.13^{ab}	10.00$_{a}$	10.00^{a}	14.92^{b}	0.13^{ab}	12.75$_{a}$	36.41^{a}	42.26^{a}
25% Extract	15.73$^{a}_{b}$	0.12^{bc}	11.50$_{a}$	12.50^{a}	16.74$^{a}_{b}$	0.12^{bc}	11.55$_{a}$	32.08^{a}	32.93^{a}
Control (No Insecticide)	10.00^{c}	0.11^{c}	7.50^{a}	12.50^{a}	17.31$^{a}_{b}$	0.11^{c}	11.35$_{a}$	26.08^{a}	20.93^{ab}
LSD(<0.05)	4.28	0.01	4.12 (NS)	20.70 (NS)	0.01	4.12 (NS)	22.71 (NS)	35.95	

Means followed by the same alphabet(s) in each column are not significantly different from each other.
PH=Plant Height; SG=Stem Girth; NOL=Number of Leaves; LA=Leaf Area; WAS=Weeks After Sowing, NS=Not Significant; Fr. wt. =Fresh weight.

Discussion

The results revealed the presence of saponins, flavonoids, reducing sugar, glycosides and resins (Table 1) as the phytochemical compounds present in *Alternanthera brasiliana* leaf powder extract. The growth parameters of *A.cruentus* (Table 2) showed that, there were no significant differences ($p<0.05$) in NOL and LA amongst all the treatments at 3 and 5 WAS. Although 100% extract of *A. brasiliana* recorded the highest parameters while the control recorded the lowest. However, results shown significant differences ($p<0.05$) amongst treatments in PH and SG at 3 and 5WAS (Table 2). The 100% extract followed the same trend in recording highest parameters. The fresh weight/yield at harvest (Table 2) revealed significant difference ($p<0.05$) between 100% and the control while with no significant difference ($p<0.05$) amongst other treated plots. All plots treated with extracts of *A. brasiliana* at 50, 75 and 100% recorded higher yield over synthetic cypermethrin at1ml/ 100ml (recommended dose). The control however, recorded a significant reduction in yield (Table 2) compared with other treatments. This study showed the efficacy of 100% extract of *Alternanthera brasiliana* and lends credence to Mariani *et al* (2008) who advocated that the plant is known to contain insecticidal properties. The performance may be due to the presence of high concentrations of plant secondary metabolites; saponins (anti-feedant), flavonoids (phenolic compounds) and glycosides (reduces O_2 utilization) that might have affected and suppressed the insect pest as reported by Isman (2006) that secondary compounds like alkaloids, terpenoids, phenolic, flavonoids, chromenes and other minor chemicals are toxic to insects.

Suggestions

The use of synthetic chemicals will be tightly regulated in the future due to the well-documented environmental risks and this may lead to a growing demand for biological plant protection agents because sustainable food security cannot continue to rely on them. The production and utilization of bio-pesticides should become a common practice. It seems evident that extracts of *A. brasiliana as* plant-derived insecticides against *H. recurvalis* fits well with food and agriculture policies directed to the future. It therefore comes highly recommended to farmers.
However, further studies needs to be carried out on pesticidal activity of *A. brasiliana* as a bio-pesticide, to remove limitations in bio-pesticides raw material availability, potency variations, standardization of extraction methods, quality control and shelf life. This will promote organic farming, Integrated Pest Management and increase global food security.

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