CONTROL OF *CLAVIGRALIA TOMENTOSICOLLIS, MARUCA VITRATA AND SPODOPTERA EXEMPTA* WITH PLANT EXTRACTS

O.A. ADOUM+
Department of Chemistry, Bayero University, PMB 3011, Kano, Nigeria.

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Abstract

Extracts of *Annona squamosa (twigs); Trianthema pentandra whole plant* and *Ximenia americana* roots were screened for activity in the brine shrimp lethality assay. Significantly active fractions were evaluated for insecticidal activities against *Clavigralla tomentosicollis, Maruca vitrata* and *Spodoptera exempta.*
The methanol extract of *X.americana* was found to be more active than those of *A.squamosa* and *T. pentandra* when tested against the cowpea pests.

Keywords: control; *Annona squamosa; Trianthema pentandra; Ximenia americana; Clavigralla tomentosicollis; Maruca vitrata; Spodoptera exempta;* brine shrimp; insecticidal.

1. Introduction

Cowpea, *Vigna unquiculata* (L.) Walpers (Fabaceae), is a popular and important legume crop in West and Central Africa (McWatters *et al.*, 1990). A substantial part of cowpea production comes from northern Nigeria (F.A.O., 1996). Alghali, (1991) reported that the average farm size in Minjibre, Kano state is 3.37 ha, with cowpea occupying 30-50% of cultivated land area.

Cowpea production is considered a very risky investment by many farmers because of the numerous pest problems associated with it. Insect pests damage cowpea from germination in the field to post harvest storage.

The most damaging post-flowering pests of cowpea in northern Nigeria include the legume pod borer *Maruca vitrata* F., seedling pest, African army worms, *S.exempta* Wlk. and the pod, sucking bug, *Clavigralla tomentosicollis* Stal. Estimates put the loss of produce to pests at about 60-90%.

Pod-sucking bugs and African armyworms are effectively controlled with endosulfan, dimethoate, cyperthrin, monocrotophos and pyrenthroids. However, these insecticides are seldom available because of cost. The aim of this investigation is to develop procedures which peasant farmers could use to control cowpea pests and to identify the components of plant extracts that are insecticidal.

2. Experimental Procedure

(a) Plant Materials: The plants were collected from Borno and Kano states of Nigeria and authenticated by Baba Ali Garko at Herbarium, Bayero University, Kano. They were air-dried and milled.

(b) Extraction and Fractionation: Air dried and ground plant material were extracted and fractionated as previously described (Fatope *et al.*, 1993). A 200-g sample of plant material was percolated with absolute ethanol and the residue (F_{001}) was solvent portioned to give chloroform (F_{002}), water (F_{003}), petroleum ether (F_{004}), and 90% aqueous methanol soluble (F_{005})fractions. The fractions were stored in a freezer until tested.

(c) Brine Shrimp lethality Test (BST): Extracts were evaluated for lethality to brine shrimp larvae (Meyer *et al.*, 1982; Anderson *et al.*, 1991). In this test, survivors counted and LC_{50} (μg/ml) values with 95% confidence intervals were calculated using "Finney's prohibited analysis program".

(d) Insecticidal Test: 80 mg of each test sample was mixed with 7 drops of 2% tween 20. The volume was then brought up to 2ml by adding distilled water (dosage $4X10^4$ μg/ml). Lower concentrations were prepared by gradient dilution of the stock solution ($4x10^4$ μg/ml), cowpea pods (grass for army worms) were sprayed with the test samples and placed in labelled glass jars containing 7 to 10 insects and covered with nets. The essay was carried out in triplicate. Controls were prepared using drops of 2% Tween 20 (10 drops for *A.squamosa*)and distilled water. The mortality was counted for 3 days. Correction for the deads in controls were computed using Abbott's formula:

$$\%control = \frac{\%dead(treatedgroups) - \%dead(untreatedgroups)}{100 - \%dead(untreatedgroup)} x100\%$$

+ *corresponding author* (email:adoum01@yahoo.com)

Table 1: The yield and activity (BST) of the various-extracts derived from the plants under investigation

Plant Name (Family)	Plant part	F001 *(a)* g µg/ml	F002 g µg/ml	F003 g µg/ml	F004 g µg/ml	F005 g µg/ml
Annona squamosa L. (Annonaceae)	Twigs	-	Dark green oily subst .3-9 3(9-0)	-	-	-
Trianthema pentandra L. (Aizoaceae)	Whole plant	Dark green Oily subst. 12.6	Dark green Oily subst. 4.7 15(29-5)	Dark green Oily subt 3.1 4.62(860-281)	Dark green Oily subst. 2.1 85(137-52)	Dark green Oily subst. 1.3 4(10-0)
Ximenia americana L. (Olacaceae)	Roots	Red brown Cryst.subst. 8.3 51(120-24)	Brown Cryst. Subt. 3.2 1(5-0)	-	Reddish brown Oily subst. 3 55(104-26)	Brown Oily subst. 0.6 0.7(4.9-0)

[a] LC_{50} µg/ml(95% confidence interval).

3. Results and Discussion

In the search for savanna plants with bioactive compounds that can control agronomic pests, brine shrimp lethality test was employed as an indicator. It has a respectable record of identifying natural products with antitumor and pesticidal activities (Fatope *et al.*, 1993; Anderson *et al.*, 1991).

The methanol soluble fraction (F_{005})of *T.pentandra* exhibited a very high activity in BST at LC_{50} 4(10-0) µg/ml. From the results (Table 1) extracts prepared from the roots of *X.americana* were very active with methanol soluble fraction (F_{005}) constitutes the highest activity in BST (LC_{50} 0.7(4.9-0) µg/ml). The results support the uses of these plants in the various folk medicine as pesticides. They reflect also the nature of substances that may be present in them. The chloroform soluble extract (F_{002}) of the twigs of *A.squamosa* is also very active in the BST LC_{50} {3(9-0) µg/ml}. (Table 1)

This fraction has previously been shown to be insecticidal and rich in acetogenins (Kawazu *et al.*, 1989; Rprecht *et al.*, 1990). The fraction was thus used in this work as reference against which the activities of the extracts of *X.americana* and *T.pentandra* were compared.

Methanol soluble extracts (F_{005}) of the whole plant of *T.pentandra* and the roots of *X.americana* and chloroform soluble extract (F_{002}) of the twigs of *A.squamosa* were screened against insect pests of cowpea.

F_{005} of *X.americana* from the roots, killed 53% control of *S.exempta,* at 5000 µm/ml. When the armyworms larvae were introduced into the Petri dishes, they avoided the treated grass and clustered around the edges of the Petri dishes. At the same concentration (5000 µm/ml), the methanol and chloroform extracts of *T.pentandra* and *A.squamosa* were less lethal, killing <25% control of Africa armyworms (Table 2A). Lower rates of feeding were recorded in the two treatments while in the controls, the feeding of insects was prominent (Fig.1).

Mortality tests against *C.tomentosicallis* showed that the methanol extract (F_{005}) of *X.americana* is more active than the F_{005} of *T.pentandra* and F_{002} of *A.squamosa.* The percentage mortality of *M.vitrata* (MPB) larvae is shown in Table 2B

From the pesticidal assay results displayed in Tables 2A, 2B and 2C, the bugs did not appear to suffer as much from the treatments as did the armyworms and the borers. The highest mortality record on the bugs was 22% compared to 96.2% and 53.3% mortality on the borers and armyworms, respectively. The root extracts of *X.americana* showed the best activity.

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Table 2: Effect of methanol soluble extracts of *X.americana, T.pentandra* and chloroform soluble extract of *A. squamosa* on *S.exempta, C.tomentosiscollis* and *M.vitrata*

(A)

Plant Name	Plant fraction	No of Treated Armyworms	Mortality Aftar 24h	48h	72h	% control	Remarks
Ximenia americana L.	Test control	17	2	2	2	53.3	Prominent Feeding
	F_{005}	17	7	10	10		No feeding
Trianthema pentandral L.	Test control	13	2	2	2	22.2	Prominent feeding
	F_{005}	13	4	4	4		Little feeding
Annona squamosa L.	Test control	17	4	6	6	18.2	Prominent feeding
	F_{002}	17	6	8	8		Very Little feeding

(B)

Plant Name (family)	Plant fraction	No of Treated Nymphs	Mortality After 24h	48h	72h	% control[b]
Ximenia americana L. (Olacaccae)	Test control	10	0	1	1	22.2
	F_{005}	10	0	1	3	
Trianthema pentandra L. (Aizoaceae)	Test control	10	0	2	2	0.0
	F_{005}	10	1	1	2	
Annona squamosa L. (Annonaceae)	Test control	10	0	2	2	2.8
	F_{002}	9	0	2	2	

(C)

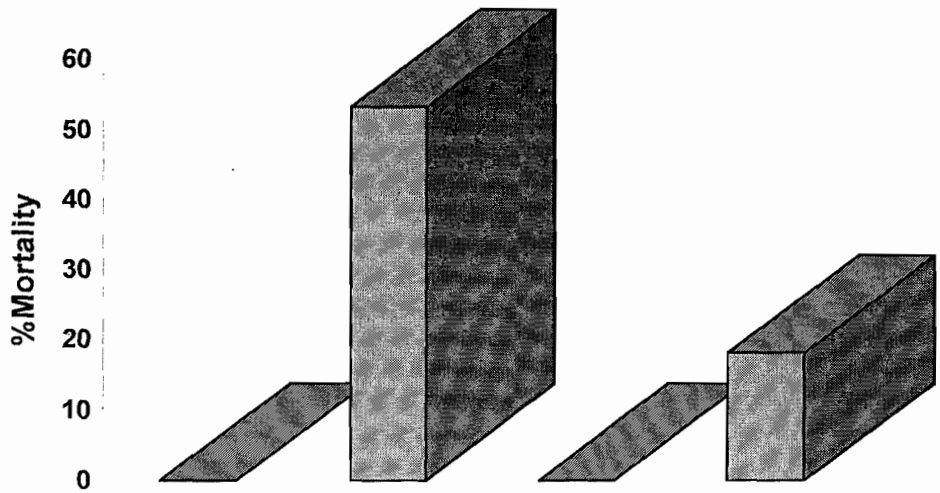
Plant Name (family)	Plant fraction[a]	No of Treated Muruca	Mortality After 24h	48h	72h	%[b] control
Ximenia americana L. (Olacaceae)	Test control	13	1	1	1	69.2
	F_{005}	13	7	7	7	
Trianthema pentandra L. (Aizoaceae)	Test control	13	1	1	1	23.1
	F_{005}	13	2	3	3	
Annona squamosa L. (Annonaceae)	Test control	17	4	6	6	5.2
	F_{002}	17	6	8	8	

a Concentration 5000 µg/ml

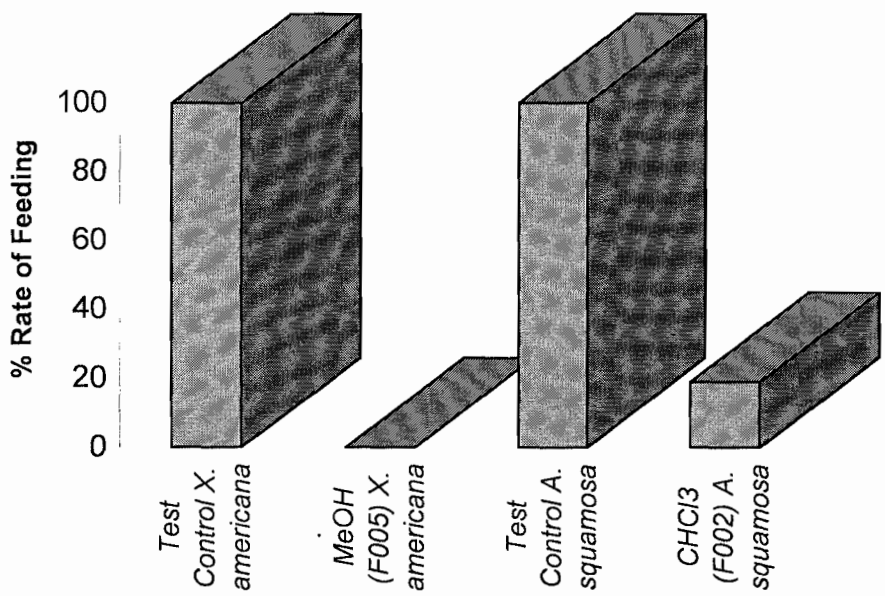
b Computed using Abbott formula:

$$\%control = \frac{\%dead(treated\ groups) - \%dead(untreated\ groups)}{100 - \%dead(untreated\ group)} x100\%$$

cTest Controls



(a)



(b)

Fig 1. Armyworm mortality (a) and rate of feeding (b) on grass treated with methanol (F005), and Chloroform (F002) extracts of *X. americana* and *A. squamosa*.

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