

STUDIES ON INSECTICIDAL POTENTIAL
OF EXTRACTS OF *Gmelina arborea* PRODUCTS
FOR CONTROL OF FIELD PESTS OF COWPEA,
Vigna unguiculata (L.) WALP: THE POD BORER,
Maruca vitrata AND THE COREID BUG,
Clavigralla tomentosicollis

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Abstract: The insecticidal efficacy of *Gmelina arborea* L. product extracts was assayed for suitability in controlling the legume pod borer *Maruca vitrata* Fab. (Lepidoptera: Pyralidae) and the pod sucking bug *Clavigralla tomentosicollis* Stål (Hemiptera: Coreidae) on cowpea. Field studies conducted in 1999 and 2000 cropping seasons at the research farm of the Institute for Agricultural Research, Samaru showed that extract of *Gmelina arborea* fruit at 10% (w/v) caused impressive reduction of both pests and protected the pods from serious damage. Grain yield was higher in the fruit extract treated plants compared to the leaf, bark treatments and the untreated control. However, all the *Gmelina* products' extracts were superior ($p < 0.05$) to the untreated control but was not better than the synthetic insecticide (Sherpa Plus) used in all the assessments made. This study is the first reported case of the potential of *Gmelina arborea* products' extracts for control of *Maruca* pod borer larvae and pod sucking bug on field cowpea. This plant could add to the pool of herbal landraces already found to be insecticidal to insect pests of tropical crops if explored and exploited for use by limited resource farmers in tropical countries.

Key words: *Gmelina arborea*, insecticide, *Maruca* pod borer, Coreid bug, cowpea.

INTRODUCTION

Gmelina arborea L. (Family: Vernabaceae) is a tropical, evergreen perennial tree growing over 20 m high. The tree has a high alkaloid content particularly in the fruit, stem bark and root and some little amount in the leaves (Amadi Augustine personal communication) and is less attacked by insect pests all through the season probably due to its high alkaloid and tannin contents. Liquid from the fruits has

been found to be toxic to larvae of moths and butterflies (Oparaeke A. M. unpublished). In Nigeria, the stem bark is boiled as a concoction for the treatment of chest and waist pain, lumbago and rheumatism (Amadi Augustine personal comm.). The fruits are fermented and extracted for insecticidal purposes and sprayed on vegetable crops such as okra, pepper, eggplants, pumpkins and melons by peasant farmers in the eastern Nigeria. The tree is grown in the Nigerian savannas to provide shade and for shelterbelt establishment. The wood is soft and used in the manufacture of pulp for newsprint production and cardboard.

In Nigeria, the present harsh economic realities caused by low productivity and high exchange rates against the local currency and the removal of government subsidies on agricultural goods including importation of pesticides have created the urgent need to explore and develop new sources of chemical compounds from plants which are non-toxic, safe, biodegradable and of broad activity spectrum. Fortunately, Nigeria has a wide range of herbal landraces spread across the various ecological zones, which are largely unexploited. Some species have been reported to have insecticidal properties against some stored and field pests of crops. Neem products have shown efficacy against *Maruca* pod borer, *Clavigralla tomentosicollis* (Jackai and Oyediran 1991; Jackai et al. 1992) and other insect pests (Zongo et al. 1993; Mong and Sudderuddin 1978; Saxena 1981; Warthen et al. 1978). Olaifa et al. (1987) in a screen house study have shown that *Lippia adoensis* Hoschst, *Monodora tenuifolia* Benth, *Piper guineense* Schum & Thonn, *Petiveria alliacea* L. etc are effective against larvae of *Acrae eponina* Cramer, *Dysdercus superstitionus* (F.), *Ootheca mutabilis* Sahlberg and *Riptortus dentipes* (F.). Cashew, Clove and African nutmeg extracts have also shown insecticidal properties against some flowering pests of cowpea (Oparaeke et al. 1999; 2000; 2003).

There is limited information on the possible use of extracts from *Gmelina arborea* for field pest control on arable crops. In the present study, the efficacy of *Gmelina* products was evaluated for insecticidal activity against *Maruca* pod borer larvae and pod sucking bug *C. tomentosicollis* on field cowpea.

MATERIALS AND METHODS

Fresh fruits, tree bark and leaves of *Gmelina arborea* were collected from trees around the institute's Head office in Samaru, Zaria (11°11'N and 07°38'E). These were washed to remove sand and other contaminants. Five hundred grammes of the fruits were weighed into four separate plastic buckets and covered with lids and allowed to ferment for four weeks before pounding in a mortar with a pestle. The bark and the leaves each weighing 500 g and 1000 g, respectively, were also pounded separately in a mortar with a pestle. Each of the materials was then poured into buckets containing 3 l of water and allowed to stand for 24 h. These were filtered with 1.5 l of water using a muslin cloth. Two hundred and fifty milliliters of 50 g (w/v) starch and soap solutions each were poured into the extracts to bring the concentration of the fruit and bark to 10% while that of the leaf was 20% (w/v). The content in each of the plastic buckets was vigorously stirred to obtain a thorough mixture. A spray volume of 150 l ha⁻¹ was used in all cases. There were four spray applications conducted at weekly intervals beginning from flower bud formation phase.

Cowpea variety, SAMPEA 7 used in the trials was purchased from the National Seed Service in Samaru, Zaria. The seeds were dressed with Fernasan-D at the rate of one satchel, per two kilograms of seeds and planted at 25 cm on ridges 0.75 m apart. The field layout was a Randomized Complete Block Design (RCBD) with three replications. Plot size was 6.0 × 5.0 m and separated by unplanted areas of 1.5 m on all sides. There were an untreated control and a synthetic insecticide check. The plots were sprayed with a mixture of pre-emergent (Galex) and post-emergent (Gramoxone) herbicides at the rate of 5 l ha⁻¹ immediately after sowing to get rid of weeds. Fertilizer NPK (15:15:15) applied at 250 kg ha⁻¹ was used for top-dressing the seedlings at 14 days after sowing. At 21 days after planting, the seedlings were thinned to two seedlings per stand. A tank mixture of 0.33 a.i. kg ha⁻¹ each of benomyl + mancozeb was sprayed on the seedlings every week for four weeks beginning from the fourth week after planting to control fungal diseases. Manual weeding was also carried out at six weeks after planting to ensure clean plots.

Maruca vitrata Fab. (Lepidoptera: Pyralidae) and *Clavigralla tomentosicollis* (Hemiptera: Coreidae) were sampled before each spraying for four weeks beginning at flower bud initiation. *Maruca* pod borer larvae were sampled by removing 20 flowers per plot and placing them in vials containing 30% alcohol. These were taken to the laboratory and dissected the next day and the insects found were counted and recorded. Both *Maruca* pod borer larvae and pod sucking bugs were also sampled on plants randomly located in three quadrants in each plot and each pest identified was counted and recorded. Plants were examined for phytotoxicity effect (discoloration, burning, wilting and terminal bud stunting) by randomly sampling 20 plants in each plot. Pod damage (shriveling, twisting, stunting, constriction) was assessed by examining 20 pods randomly selected per plant on nine plants per plot. Yields were recorded from each plot after harvesting and threshing.

Data obtained were compared after square root transformation (for insect sampling) and analyzed using analysis of variance while Student Newman-Keuls ($p < 0.05$) test was applied to separate treatment means (SAS 1990).

RESULTS

All the *Gmelina* extracts did not differ significantly from each other and the synthetic insecticide (Sherpa plus) in the control of *M. vitrata* larvae (Tab. 1). However, the results indicated that all the treated plots caused significant ($p < 0.05$) reduction of *M. vitrata* compared to the unsprayed plots throughout the spraying periods in both years of study. The numbers of *C. tomentosicollis* like *M. vitrata* was not significantly different among the extracts sprayed plots but were significantly ($p < 0.05$) lower than in the unsprayed plots (Tab. 2). However, Sherpa plus sprayed plots had less number ($p < 0.05$) of *C. tomentosicollis* than *Gmelina* leaf extract only during the first week of spraying and were superior to all the extracts' sprayed plots at the second week of spraying. From 3rd to 4th week of treatment application, the number of *C. tomentosicollis* in all the sprayed plots did not differ significantly but were superior to that in the unsprayed plots.

Pod damage was significantly higher ($p < 0.05$) in the unsprayed plots compared to the sprayed plots. Sherpa plus sprayed plots had the least pod damage and were

Table 1. Mean number of *Maruca vitrata* larvae after weekly spraying of *Gmelina* products' extracts on cowpea plants in 1998 and 1999 seasons

Treatment	Mean <i>M. vitrata</i> population per flower and /or pod							
	1998				1999			
	Weeks				Weeks			
	1	2	3	4	1	2	3	4
Control (0.0)	4.33 a	4.67 a	5.67 a	2.0 a	4.67 a	5.0 a	7.33 a	2.33 a
<i>Gmelina</i> leaf	0.67 b	0.67 b	0.33 b	0.33 b	1.0 b	1.0 b	0.67 b	0.67 b
<i>Gmelina</i> bark	0.67 b	0.67 b	0.0 b	0.0 b	1.0 b	1.0 b	0.0 b	0.0 c
<i>Gmelina</i> fruits	0.67 b	0.33 b	0.33 b	0.0 b	1.0 b	0.67 b	0.67 b	0.0 c
Uppercott	0.67 b	0.0 b	0.0 b	0.0 b	1.0 b	0.67 b	0.0 b	0.0 c
S.E. \pm	0.15	0.17	0.11	0.10	0.19	0.18	0.15	0.11

Means followed by the same superscript(s) in a column are not significantly different ($p < 0.05$; SAS-SNK test)

S.E \pm = Standard Error

Table 2. Mean number of *Clavigralla tomentosicollis* (adults and nymphs) after weekly spraying of *Gmelina* products' extracts on cowpea plants in 1998 and 1999 cropping seasons

Treatment	Mean <i>C. tomentosicollis</i> / cowpea plant							
	1998				1999			
	Weeks				Weeks			
	1	2	3	4	1	2	3	4
Control (0.0)	5.33 a	8.33 a	9.0 a	6.0 a	5.67 a	8.67 a	9.67 a	6.67 a
<i>Gmelina</i> leaf	1.67 b	0.67 b	0.33 b	0.33 b	2.0 b	1.0 b	0.67 b	0.67 b
<i>Gmelina</i> bark	1.0 bc	1.0 b	0.33 b	0.33 b	1.33 bc	1.33 b	0.67 b	0.33 b
<i>Gmelina</i> fruits	1.0 bc	0.67 b	0.33 b	0.0 b	1.33 bc	1.0 b	0.67 b	0.0 b
Uppercott	0.33 c	0.33 c	0.0 b	0.0 b	0.67 c	0.33 c	0.67 b	0.0 b
S.E. \pm	0.18	0.16	0.17	0.12	0.23	0.21	0.18	0.12

Means followed by the same superscript(s) in a column are not significantly different ($p < 0.05$; SAS-SNK test)

S.E \pm = Standard Error

superior to all the extracts sprayed plots. However, *Gmelina* fruit extract protected cowpea pods better than other extracts (Tab. 3). The grain yields of plots sprayed with *Gmelina* extracts were significantly different ($p < 0.05$) from one another and Sherpa plus but all were significantly higher than that in unsprayed plots. Grain quality, which is a measure of acceptability of the produce by discriminating buyers in the markets, followed similar pattern as the yield with Sherpa plus sprayed plots producing better ($p < 0.05$) quality grains compared to the extracts sprayed plots followed by *Gmelina* fruit extract (Tab. 3). On toxicity of extracts to cowpea plants, the result showed that none of the materials exhibited any phytotoxic effect on the sprayed plants.

DISCUSSION

The results of the study indicated that plots sprayed with *Gmelina* extracts recorded considerable reduction of the target pests compared to the unsprayed plots.

Table 3. Mean pod damage, grain yield and grain quality of cowpea after *Gmelina* extracts' application in 1998 and 1999 seasons

Treatment (Extracts w/v)	1998			1999		
	Pod damage (%)	Grain yield (kg/ha)	Grain quality (%)	Pod damage (%)	Grain yield (kg/ha)	Grain quality (%)
Control (0.0)	99.44 a	38.62 e	4.52 e	94.01 a	47.56 e	5.38 e
<i>Gmelina</i> leaf	29.25 b	552.45 d	79.24 d	28.48 b	578.52 d	80.83 d
<i>Gmelina</i> bark	23.88 c	690.11 c	80.64 c	23.27 c	687.56 c	82.26 c
<i>Gmelina</i> fruits	22.47 d	712.99 b	87.31 b	22.0 d	720.67 b	89.06 b
Uppercott	10.49 e	1213.33 a	95.39 a	12.63 e	1150.46 a	97.29 a
S.E. \pm	0.23	4.96	0.25	0.23	5.11	0.26

Means in a column bearing the same superscript(s) do not differ significantly

($p < 0.05$; SAS-SNK test)

S. E. \pm = Standard Error

However, *Gmelina* extracts which exhibited slow acting effect on insect pests were inferior to the synthetic insecticide in the first two weeks of spraying which was critical for any meaningful control of these pests on cowpea plants. This slow acting process may suggest an antifeedant or repellent mode of action. The reduction in number of the target pests caused by application of *Gmelina* extracts were similar but *Gmelina* fruit extract had better (but non significant) control of *C. tomentosicollis* while *Gmelina* bark extract had the least (but non significant) *Maruca* pod borer number among extracts sprayed plots. This observation suggests that any one of the two materials could be used in the absence of the other. However, considering the fact that peeling off the bark of any tree will tantamount to killing the tree, it becomes reasonable to restrict the use of plant parts to either the fruits and /or the leaves, which will not retard the longevity of the plant used for insecticidal purposes to ensure continuous supplies. The ability of *Gmelina* product extracts to control *Maruca* pod borers and *C. tomentosicollis* might be due to the high alkaloid and tannin contents in the plant which supports the observation made by this author when liquid from the *Gmelina* fruits extract was applied to moths and butterflies resulting in death of both pests after 24 h. This is the first time *Gmelina* product extracts have been reported to possess insecticidal properties.

However, several authors have shown the efficacy of different plant materials as biopesticides for the control of different pest species. Cashew plant extracts have been found to be effective against post-flowering insect pests of cowpea (Oparaeke et al. 2001; Amatobi 2000). Neem, West African black pepper, garlic bulb, African nutmeg, *Lippia adoensis* Hoschst have been reported to be effective against some crop pest species (Jackai and Oyediran 1991; Scott and McKibben 1978; Olaiifa et al. 1987; Oparaeke et al. 2000; Ekesi 2000). Okech et al. (1997) in a field trial found that *Tephrosia volgelii* Hook aqueous extract effectively reduced maize stalk borer (*Chilo partellus* Swinhoe) numbers and damage symptoms and improved grain yield.

The results presented in this study have shown the efficacy of *Gmelina* extracts for *Maruca* pod borer and *C. tomentosicollis* control on cultivated cowpea. This tree is grown all over the northern states of Nigeria to provide shade along the major highways and the fruit is fed to livestock at the peak of the dry season when forage is dif-

difficult to find. Extracts of *Gmelina* fruits and bark could provide a suitable alternative for integrated management of *Maruca* pod borer and *C. tomentosicollis* in smallholder, limited resource farm enterprises commonly found in developing countries such as Nigeria. Further studies are necessary to ascertain the optimum concentration and spraying frequency that would be adequate for effective control of these pests and ensuring reasonable grain yield on the farms. The technology is cheap, safe, easily adoptable, and environmentally friendly.

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POLISH SUMMARY

BADANIA NAD POTENCJĄŁEM INSEKTYCYDOWYM EKSTRAKTÓW Z *Gmelina arborea*, ŚRODKÓW DO ZWALCZANIA *Maruca vitrata* I *Clavigralla tomentosicollis*, SZKODNIKÓW *Vigna unguiculata* (L.) WALP

Określono aktywność insektycydową ekstraktów otrzymanych z *Gmelina arborea* L. w celu zbadania ich przydatności do zwalczania *Maruca vitrata* Fab. (Lepidoptera: Pyralidae) i *Clavigralla tomentosicollis* Stal (Hemiptera: Coreidae), szkodników *Vigna unguiculata*.

Eksperymenty polowe przeprowadzone w sezonach upraw w latach 1999 i 2000 na farmie Instytutu Badań Rolniczych w Samaru wykazały, że ekstrakt z owoców *Gmelina arborea* o stężeniu 10% (w/v) powoduje widoczną redukcję obu szkodników i chroni strąki przed poważnymi uszkodzeniami. Wydajność ziarna w roślinach traktowanych ekstraktem z owoców w porównaniu do traktowanych ekstraktem z liści, kory i nietraktowanych była wyższa, jakkolwiek wszystkie produkty (ekstrakty) otrzymane z *Gmelina* przewyższyły pod tym względem ($P < 0,05$) próbę kontrolną. Żaden z badanych ekstraktów nie wykazał jednak lepszych właściwości od syntetycznego insektycydu (Sherpa Plus) użytego we wszystkich ocenach. Niniejsze badania są pierwszym doniesieniem o aktywności produktów (ekstraktów) z *Gmelina arborea* w zwalczaniu larw *Maruca vitrata* i *Clavigralla tomentosicollis* na plantacjach *Vigna unguiculata*.