



Evaluation of Repellent Activity of Oils Obtained from the Seeds of *Azadirachta indica* and *Jatropha curcas* on the Insect Pest- *Aphis craccivora* Found in Cowpea

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Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

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ABSTRACT

Aphis craccivora is one of the major pest of *Vigna unguiculata* due to its nature of damage caused to this crop. It feeds on all parts of the plant, mostly at the tender stage of the crop. Bioassay was conducted and repeated ten times using live insects, botanicals and an olfactometer which contained the test compound in one arm and the remaining 3 arms served as a control in a four-

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armed olfactometer in order to determine its effectiveness as a repellent. The treatment odour source contained either 10µL *Azadirachta indica* or *Jatropha curcas* oil while the control arms contained no oil and there were tested against adult *A. craccivora*. The data obtained included the time spent by *A. craccivora* in the different arms of the olfactometer and the number of visits to each arm. Each of the data was analyzed using paired t-test. *Aphis craccivora* spent significantly less time in the arm of the olfactometer that contains *J. curcas* oil (0.11min) than the arms that did not contain the oil (4.06 min). Similarly, *A. craccivora* spent significantly more time in the arms of the olfactometer that were not treated with oil (4.23 min) than the arm treated with *A. indica* oil (0.51 min). Also, the number of entries made into the arms treated with *J. curcas* (0.10 min) and *A. indica* (0.40 min) were significantly less than the number of entries made by *A. craccivora* into their respective arms without *J. curcas* (1.87 min) and *A. indica* (2.33 min). The results indicated that both oils significantly repelled *A. craccivora* as less time was spent in the plant oil-treated arms. Similarly, more visits were made by *A. craccivora* to the control arms. This showed the efficacy of both oil extracts as a repellent to *A. craccivora*.

Keywords: *Aphis craccivora*; olfactometer; *Azadirachta indica*; *Jatropha curcas*; *Vigna unguiculata*; repellent.

1. INTRODUCTION

Cowpea is the most important member of the Fabaceae family in Africa because of its nutritive value [1,2]. Cowpea has *Aphis craccivora* as one of the major field pests, due to its economic importance to the crop [3,4,5] Adult *A. craccivora* has a medium size of 1.50mm-2.28mm long. The adult aphid is a shiny black pear shaped, while the nymph is gray in colour [6,7,8]. It can be distinguished from other species by their first segment of hind tarsus having two hairs [9,8]. It has blackish dorsum of abdomen, usually completely scleroitic and a pale area around the siphunculi with a dark continuous median patch [10,11]. It feeds on the under surface of young leaves, young stem tissues and on pod of mature plants [12,13]. Their large population directly feeding on cowpea caused stunted growth in the plant, leaf distortion, premature defoliation and seedlings death [7]. It has been reported that the most widely harmful effect of the insect is its transmission of Cowpea Aphid-borne Mosaic Virus (CAMV) [3].

The problems associated with the use of synthetic pesticides has necessitated the search for user and environment- friendly/ecological tolerable methods of control which are safe, affordable (cheap), locally available and provide adequate supply to meet the insecticide shortage [14,15]. Jackai and Adalla [16] opined that insect pest problems on cowpea persist at least in part because of lack of diversity in control measures.

The use of botanicals notably, *Jatropha curcas* and *Azadirachta indica* remains one of the most

viable options for control of crop pests [17]. Several studies have attributed the potency (toxicity) of *J. curcas* to its rich content of phorbol esters [18,19]. Phorbol-12-myristate-13-acetate (PMA) is the most common phorbol ester [20]. The seed contains 25-35 % crude oil while the kernel contains about 50-60 % oil [21,22,19]. The "oil contains 21% saturated fatty acids and 79 % unsaturated fatty acids" [21, 23]. There are two species in the genus, *Azadirachta*; *A. indica* A. Juss, native to Indian sub-continent and *A. excelsa* Kack, native to Phillipines and Indonesia. Another morphologically similar species of tree to *A. indica* is *Melia azadirachta* (Boadu et al., 2011; Lokeshwar et al., [24]. Rajkumar et al. [25] reported "47 of triterpenoids and steroids isolated from neem (*A. indica*) and 15 non-terpenoid and non-steroid constituents from various parts of neem". Azadirachtin has been reported, as the most active ingredient in *A. indica* [26,27,28,29]. Azadirachtin A has been reported to be the most active of all azadirachtin compounds (FAO, 2006).

The cultivation of cowpea is highly challenged by pests attack. Chemical (synthetic insecticides) control is one of the most widely used management approaches despite the fact that it has adverse effects on the ecosystem and human health. There is urgent need for alternative means of control of pest, which are environment- friendly, effective and could reduce the cost of production and thereby increasing yield of the crop. The objective of this study is to evaluate the repellency activity of the *A. indica* and *J. curcas* oils against *Aphis craccivora*.

2. MATERIALS AND METHODS

2.1 Plant Materials Collection and Extraction of Oil

Mature seeds of neem, *A. indica* (5kg) were collected from Murtala Muhammed High way; IBB way and Atimbo Road in Calabar, Cross River State. The *J. curcas* seeds (5kg) were obtained from Ijegu Yala of Cross River State. The seeds, were washed thoroughly with tap water and dried in a shade for three days. *J. curcas* and *A. indica* seeds were cracked manually using mortar and pestle but separately to obtain their kernels (Plate 1 and Fig. 1, respectively) into two different containers. The dried kernels of both plants were heated at the temperature of 50°C for 5 minutes in an oven prior to the extraction period in order to enhance the quantity of the oils [30]. The kernels were now packed into two clean white muslin clothes and tied with rope. Then the kernels were subjected to mechanical press to extract 1.02L and 1.6L oils of *A. indica* and *J. curcas*, respectively.

The sediment in each of the oils was allowed to settle down for one week after which, they were separated from the oils to make the oil available for use. Cowpea seeds (Vita 7 variety) used for the experiments were obtained from "International Institute of Tropical Agriculture (IITA)", Ibadan, Nigeria.

2.2 Field Establishment for Aphid Infestation

Top Soil was collected from the University of Calabar Botanical Garden and was air-dried. The air-dried soil was properly sieved to remove all

the large particles using a wire mesh of 0.4cm x 0.4cm. Eight perforated plastic buckets were used in the experiment. Three kilogrammes (3kg) of the air-dried and sieved soil was weighed into each perforated plastic bucket of 4500cm². All the plastic buckets containing the soil were watered to field capacity and left overnight to drain, before planting the Vita 7 variety of cowpea the following morning. The cowpea plants were allowed to grow for 4 weeks when there was abundant aphid on the cowpea (Plate 1). Mature *Aphis craccivora* were collected for the laboratory experiment, from four weeks old cowpea plant.

2.3 Repellence Bioassay Test

Behavioural bioassay was performed in an Olfactometer Ukeh *et al.*, [31] involving the responses of active cowpea aphids, *A. craccivora* to *A. indica* and *J. curcas* in 4-ways (arms) Olfactometer. Bioassays were conducted and repeated ten times using live insects, botanicals and Olfactometer which contained the test compound in one arm and the remaining 3 arms served as controls [32]. The treatments odour source contained either 10µl *Azadirachta indica* or *Jatropha curcas* oil while the control arms contained no oil tested against adult *Aphis craccivora*. Ten micrometer of the oils (*A. indica* or *J. curcas*) were put into the filter paper strips (6cmx4cm) and allowed to dry for 4 minutes. Then the filter paper was placed inside the arm of the olfactometer. For control, filter paper without any oil treatment was placed in different arms of the olfactometer. The *A. craccivora* was then introduce inside the middle chamber of olfactometer linked to the four chambers. The timing of the experiment was aided with the use of stop clock.



Plate 1. Cowpea plants being raised at the botanical garden for *Aphis craccivora* infestation (Mag=x0.1)

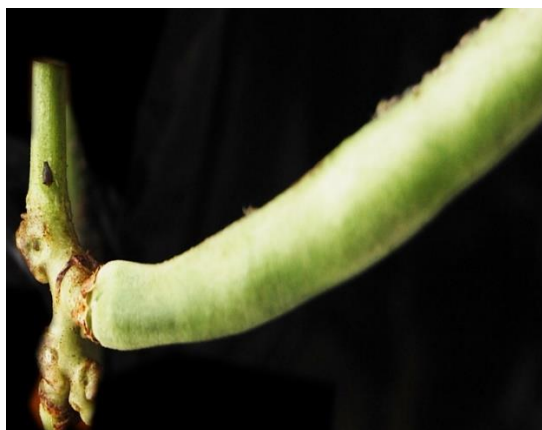


Fig. 1. *Aphis craccivora* feeding on the cowpea stem (Mag=x2)

2.4 Data Collection

Computer programme was used for collecting and analyzing "Behavior" data with the four armed Olfactometer (OLFA programme) [31,32]. The data that were recorded include; the time spent by the *Aphis craccivora* in the different arm of the olfactometer and the number of visit into each arm [31].

2.5 Data Analysis

The time spent in each Olfactometer arm and the number of visit made by *Aphis craccivora* in the laboratory experiment was analyzed using paired t-test [33]. The mean of the control arms was tested against the treatment arm.

3. RESULTS AND DISCUSSION

3.1 Repellent Effect of Plant Oils on *Aphis craccivora*

The effects of *Azadirachta indica* and *Jatropha curcas* oils on the time spent and number of entries made by *Aphis craccivora* in the treated and control arms of the olfactometer are presented in Table 1. The results indicated that both plant oils significantly ($p < 0.05$) repelled *A. craccivora* as less time was spent in the plant oil treated arms. Similarly, more number of visits were made by *A. craccivora* to the control arms (1.87, 2.33) than plant oil treated arms (0.10, 0.40). *Aphis craccivora* spent significantly ($p < 0.05$) less time in the arm of the olfactometer that contains *J. curcas* oil (0.11min) than the arms that did not contain the oil (4.06 min). Similarly, *A. craccivora* spent significantly ($p < 0.05$) more time in the arms of the olfactometer that were not treated with oil (4.23 min) than the arm treated with *A. indica* oil (0.51

min). Also, the number of entries made into the arms treated with *J. curcas* (0.10 min) and *A. indica* (0.40 min) were significantly ($p < 0.05$) less than the respective number of entries made by *A. craccivora* into their respective arms without *J. curcas* (1.87 min) and *A. indica* (2.33 min).

3.2 Discussion

These results imply that the use of oils with strong odour enhance olfactory sensation which are easily manipulated and use as spray to repel insect pests of crops [34,29]. Many researchers have reported that seeds of *A. indica* and *J. curcas* contain the highest amount of azadirachtin and phorbol esters respectively [35,36,37]. Both *J. curcas* and *A. indica* have insecticidal properties of antifeedant, anti-oviposition, deterrent, ovicidal and fecundity inhibition to insect pests of crops [38,39,40]. Saponin content have high insecticidal properties due to their interaction with cholesterol that impedes ecdysteroid synthesis and the bitterness quality exhibited by aqueous extracts of *J. curcas* is due to high content of the saponin [41,17,28,42,15]. Saponin ingestion cause stunting and reduce energy value in insect (Makker and Becker, 2010; Nayak and Patel, [43] Nesseim *et al.*, 2012). When the *Jatropha curcas* oil, is applied to the cell membrane of the insect, the enzymes, Protein Kinase C (PKC), is hindered of its performance, by the phorbol esters [44]. Federation of Free Farmers, 2012; [45]. The phorbol esters interfere with the normal message transfer system in the midgut cell, thereby preventing normal signal transduction that regulates the physiological/biochemical reactions stopping cell growth and differentiation (Nesseim *et al.*, 2012; Masry *et al.*, [15] This eventually may cause cell turbulence and death in some insects [46-49].

Table 1. The repellent activity of *Azadirachta indica* and *Jatropha curcas* oils

Treatments	Mean Time spent (min)	Mean no. of entries
<i>J. curcas</i>		
Test arm	0.11±0.02	0.10±0.01
Control arm	4.06±0.44	1.87±0.17
P-value	0.05	0.05
<i>A. indica</i>		
Test arm	0.51±0.39	0.40±0.32
Control arm	4.23±0.34	2.33±0.84
P-value	0.05	0.05

4. CONCLUSION

The research showed that seed oil extracts of *J. curcas* and *A. indica* were able to control *A. craccivora* on cowpea and can be effectively use as repellent of the pest and as such may serve as replacement for synthetic insecticides that are currently being used for controlling this insect pest of cowpea.

DISCLAIMER (ARTIFICIAL INTELLIGENCE)

Author(s) hereby declare that NO generative AI technologies such as Large Language Models (ChatGPT, COPILOT, etc) and text-to-image generators have been used during writing or editing of manuscripts.

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COMPETING INTERESTS

Authors have declared that no competing interests exist.

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