LABORATORY ASSESSMENT OF THE REPELLENT PROPERTIES OF ETHANOLIC EXTRACTS OF FOUR PLANTS AGAINST *Raphidopalpa foveicollis Lucas* (COLEOPTERA: CHRYSOMELIDAE)

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ABSTRACT

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Ethanolic extracts of four plants were assessed in a laboratory for repellent properties against the most damaging pest of cucurbits crop *Raphidopalpa foveicollis Lucas* (Coleoptera: Chrysomelidae). The aim is to further explore the use of natural pesticides in management programmes to control red pumpkin beetle. The investigation was done in the research laboratory of Department of Zoology, D.A-V Degree College, Kanpur, India during June to September 2008. Laboratory reared adults were exposed to 5% and 10% concentrations of the extracts of *Azadirachta indica, Annona squamosa*, *Convolvulus microphyllus and Melia azedarach* respectively in laboratory bioassays. Repellency assays were conducted using the area preference method on filter papers. Result showed that plant *Azadirachta indica* elicited repellency of class IV (60.1-80%), *Anona squamosa* and *Melia azedarach* elicited class III (40.1-60%) and *Convolvulus microphyllus* elicited repellency of class II (20.1-40%). All of these plant extracts were found significantly effective in repelling red pumpkin beetles. Results indicated attractive potentials for field trails.

Key words: cucurbits, biopesticide, repellent

INTRODUCTION

In India the main vegetables grown in summer are the cucurbits. They are extensively cultivated in plains, but their production is sternly affected by a number of insect pests. Among these insect pests the *Raphidopalpa foveicollis* Lucas is the most destructive pest. It belongs to Coleoptera: Chrysomelidae, the adult beetle is red in colour and widely distributed all over the South East Asia (Bhutani & Jotwani, 1984). A number of workers worked on the host preferences and nature of damage caused by red pumpkin beetle, *Cucurbita maxima* and *Cucumis sativus* are the preferred choice of red pumpkin beetles, adults damages the leaves by making regular and irregular holes including flowers, stems and sometimes fruits whereas larvae and grubs damages the roots, stem below the ground and fruits contact with the soil (Bogawat & Pandey, 1967; Bhutani & Jotwani, 1984; Khan & Hazela, 1987; Johri & Johri, 2003a). The adult beetles feed ravenously on the leaf and also attack on flowering parts (Bhutani & Jotwani, 1984). Farmers mainly control insect pests with synthetic pesticides for last sixty years. Most insecticidal compounds fall within four key categories the organochlorines, organophosphates, carbamates and pyrethroids. These synthetic insecticides work well against the wide range of insect pests but they remain toxic much longer. A dose that was efficient against insect pest was not necessarily directly toxic to human beings; however, the insecticides persisted for decades and accumulated in food chain. Organochlorines are particularly harmful for all living system, owing to their high affinity to fatty tissue and their perseverance in the environment. Their half lives have been found to be at least 20 years in both soil and water. That's why it's very essential to replace these synthetic pesticides, with some least toxic substance which is not harmful for our living planet as well as effective in controlling insect pests. Pawlacos (1945) reported that farmers are completely depended on the use of insecticides to control red pumpkin beetles. But the excessive use of synthetic pesticides promotes faster evolution of insect pests, destroys natural enemies, turns innocuous species into pests, harms other non target species and contaminates food. In early nineties Metzger & Grant (1932) studied 474 plant extracts representing 390 different plants and tested for their repellency against Japanese beetle but only 56 have given positive repellency test. The seed extract of *neem* shows very good repellent properties against *Aulacophora foveicollis* (Lucas) as reported by Chakravorty *et al*. (1969). Panji (1964) had done experiment to check the insecticidal properties of *melia azedarach* ethanolic extract and stated that 10% ethanolic extract of dried fruit of *melia azedarach* caused 48.3% mortality of *Aulacophora foveicollis* Lucas within 96 hours, he further stated that 5% ethanolic extract repelled adults of *Aulacophora foveicollis* L. Carbofuran gave best protection from red pumpkin beetles to cucurbits crop. Rahaman & Prodhan (2007) compared mosquito net barrier, carbofuran, foliar spraying of Diazinon-60EC and control (without any treatment) and they stated that maximum control of red pumpkin beetle as well as high yield of cucumber is found in carbofuran followed by control plot where the infestation of beetle is higher but yield of

cucumber is also higher than the other two treatments. (Hussain *et al*., 1995) tested the insecticidal properties of *Anona squamosa* extract on *Tribolium castaneum* (Herbst) and found satisfactory results. Current research focus on repellent effects of some plant originated biopesticides, which contain a mass of active ingredients with different mode of action. This lessens the chance of pest resistance developing in beetle populations. Previous promising attributes led to evaluate the potential use of different plant extracts on *Raphidopalpa foveicollis* Lucas. The objectives in the wake of this experiment are as follows: To evaluate the effectiveness of four selected plants extracts to control the red pumpkin beetles; to find some fruitful results which helps to reduce crop loss due to insect pests; and to find some effective biopesticides which does not create complications and are acceptable to both public and health authorities.

MATERIALS AND METHODS

Seeds of *Azadirachta indica,* bark and leaves of *Anona squamosa*, seeds of *Melia azedarach* and leaves and seeds of *Convolvulus microphyllus* were collected and cut into small pieces, powdered and dried. The air dried materials were then further dried in an oven at 50^0C. The dried materials were grinded to powder using hand grinder. Extractions were done in a Soxhlets apparatus with ethanol used as a solvent. 20gms of each powder was taken in the Soxhlets apparatus and 100 ml distilled ethanol was added for digestion under boiling point at 45^0C for 24 hours. The ethanolic mixture was filtered and then evaporated under reduced pressure at 50^0C in a rotatory evaporator to remove solvent. The resultant crude material was diluted in ethanol for 5% and 10% concentrations.
Adults of *Raphidopalpa foveicollis* Lucas captured from field and cultured in laboratory at 27 ± 2^0C, they were fed upon Luffa gourd leaves. The repellent properties of all four extracts were assessed in research laboratory of Department of Zoology, D.A-V College, Kanpur, India during the months of June to September 2008 by area preference method as reported by Obeng-Ofori *et al*. (1998). In this study, test areas consist of 22cm filter papers cut in half. Different test extracts and concentrations were applied to a half filter paper disc with pipette. The other halves were treated with ethanol+emulsified water alone. Both the treated filter paper halves dried under electric fan and full discs remade by attaching treated and untreated halves with sellotape. Each filter paper was placed in a petridish and ten adults placed at the centre of the paper and covered with perforated lids lined with 4mm wire mesh and banned with rubber band. Three replications of each treatment was maintained and laid out in a completely randomized design (CRD). The repellent effect of all plant extracts was judged by counting the number of adults present on the treated (T) (extract treated) and the control (C) (ethanol+emulsified water) strips after 1 hour, 2 hours, 3 hours, 24 hours and 48 hours. Percentage repellency (PR) values were computed using the formula:

$$PR= ((C-T)/(C+T))*100$$

Where:

PR= percentage repellency

C= number of adults present on the control strip

T= number of adults present on the treated strip

PR Data were analysed using Analysis of Variance after arcsine transforming them. Negative PR values were treated as zero. Repellency values obtained during the study on filter paper bioassay was classified as reported by Dales (1996). The final classification took into consideration values obtained from the two concentrations of the extracts from the filter paper bioassay. The mean values were weighted to obtain the classes.

RESULTS AND DISCUSSION

Results are shown in tables 1 and 2 for repellencies at 5% and 10% concentrations respectively for the four plant extracts. Repellency values generally altered from one exposure time to the other and appeared to stabilize with longer exposure time. The percentage repellency values on filter paper are shown on Figure 1. It is evident from the Table 1 and 2 that the *Azadirachta indica* extract was found most effective in the repellency of red pumpkin beetles; its 5% concentration repels minimum 38% beetles in 1 hour and maximum 88% beetles in 48 hours, whereas 10% concentration repels 46% beetles in 1 hour and 90% beetles in 48 hours. These results were in accordance with the observations made by Khan & Wasim (2001) who reported a *neem* extract in benzene was highly effective as repellent on red pumpkin beetle. Dales (1996), Isman (2006), Schmutterer, H. (2002) reported

that *neem* plant (*A.indica*) and its derived products have shown a variety of insecticidal properties on a broad range of insect species. Kreutzweiser (1997) and Goektepe *et al*. (2004) studied the adverse effects of *neem* based products on non target biota and stated that they are reasonably safe towards non target biota, with only minimal risk of direct unfavorable effects on aquatic macro invertebrates due to contamination of water bodies with *neem* based insecticides. *Anona squamosa* also gave excellent results it repels minimum 41% (1 hour) and maximum 68% (48 hours) of beetles in 5% concentration whereas 10% concentration repels 43% (1hour) and 80% (48 hours) beetles. Hussain *et al.* (1995) tested the custard apple (*Anona squamosa*) extract on *Tribolium castaneum* (Herbst) and was successful in controlling it infestation due to extract repellency properties. Epino & Chang (1993) stated that extracts of seeds of *A. squamosa* had repellent and antioviposition properties when applied to *Ceratitis capitata*.

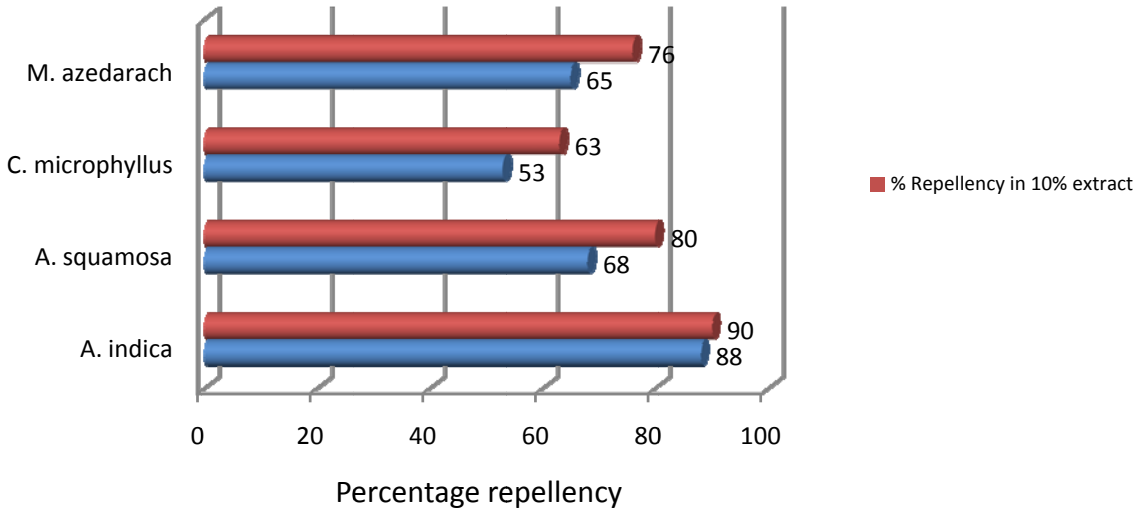

Figure 1. Percentage repellencies of ethanolic extracts of four plants against the red pumpkin beetle on filter paper bioassay.

Melia azedarach 5% extract repels minimum 30% beetles (1 hour) and maximum 65% beetles (48 hours) whereas 10% extract repels maximum 76% beetles in 48 hours. Insecticidal and repellent properties of *Melia azedarach* earlier studied by Panji (1964) stated that 10% ehanolic extract of *M. azedarach* dried fruits caused 48.3% mortality of *A. foveicollis*, he further said that 5% ethanolic extract repelled adults of *A. foveicollis*. *Convolvulus microphyllus* showed least repellency effect when compared with other three plants extracts its 5% extract repels maximum 53% beetles at 24 hours and 10% extract repels 63% beetles at 48 hours. The repellency classes are shown on Table 3 the weighted mean of 5% & 10% extracts of *A. indica, A. squamosa, C. microphyllus* and *M. azedarach* is 64, 49, 24 and 36 and their repellency classes are IV, III, II and II respectively. *A. indica* elicited the highest while *C. microphyllus* elicited the lowest repellency. Obeng-ofori *et al.* (1998) stated other workers who reported that filter papers have polar surfaces to which some toxicants when applied may be bound to reduce volatilization and therefore become less effective than non polar surface i.e. food material. Results obtained from this laboratory study demonstrate attractive potentials for repellency trails on food materials in field. All plant used in this study are consumed by human beings and therefore very safe for beetle control. Further studies are necessary to estimate the optimum dosages for efficient beetle control under field conditions from natural least toxic biopesticides.

Table 1. Mean percentage repellency values for 5% concentrations of ethanolic extracts of four plants obtained on different exposure time in a filter paper bioassay on adult red pumpkin beetle

Plant Extracts	Mean percentage* repellency values after				
	1 hour	2 hours	3 hours	24 hours	48 hrs
A. indica	38+0.54 (a)	58±0.52 (a)	70±0.00 (a)	68±0.58 (a)	88±1.18 (a)
A. squamosa	41+0.52 (a)	53±0.51 (a)	46±0.51 (b)	63±0.54 (a)	68±0.58 (b)
C. microphyllus	16+4.08 (c)	31±0.58 (b)	48±0.51 (b)	53±0.51 (b)	46±0.00 (c)
M. azedarach	30+1.83 (b)	40±1.60 (b)	46±0.51 (b)	56±0.52 (b)	65±1.69 (b)

*Values are means of three replicates ± SE
Column means followed by different letters are significantly different at 5% level of Duncan's Multiple Range Test.

Table 2. Mean percentage repellency values for 10% concentrations of ethanolic extracts of four plants obtained on different exposure time in a filter paper bioassay on adult red pumpkin beetle

Plant Extracts	Mean percentage* repellency values after				
	1 hour	2 hours	3 hours	24 hours	48 hrs
A. indica	46±0.51 (a)	55±1.55 (a)	76±0.73 (a)	78±0.73 (a)	90±0.00 (a)
A. squamosa	43±0.52 (a)	56±0.52 (a)	70±0.00 (b)	73±2.74 (a)	80±2.42 (ab)
C. microphyllus	20±2.42 (b)	28±2.44 (b)	41±0.52 (c)	60±0.00 (b)	63±2.25 (c)
M. azedarach	43±2.07 (c)	55±1.55 (a)	66±0.58 (b)	73±2.74 (a)	76±5.26 (b)

*Values are means of three replicates ± SE
Column means followed by different letters are significantly different at 5% level of Duncan's Multiple Range Test.

Table 3. Repellency classes of ethanolic extracts of four plants determined through laboratory bioassay on the red pumpkin beetle

Plant Extracts	Mean PR on filter paper*	Repellency class**
A.Indica	64	IV
A.Squamosa	49	III
C. microphyllus	24	II
M. azedarach	36	II

* Weighted mean 5.0% and 10.0% ethanolic extracts.
** Class 0 = <0.1; class I = 0.1 – 20%; class II = 20.1-40%; class III = 40.1 – 60%; class IV = 60.1 – 80%; class V = 80.1 – 100% (Dales 1996).

REFERENCES

Bogawat, J.K. and Pandey, S.N. 1967. Food preferences in *Aulacophora* Spp. Ind. J. Ent., 29(4):349-352.

Bhutani, D.K. and Jotwani, M.G. 1984. Insects in vegetables. Periodical Expert Book Agency. Vivek-Vihar, Delhi (India). pp. 69-79.

Chakravorty, D.P., Ghosh, G.P. and Dhura, S.P. 1969. Repellent properties of thionimone on red pumpkin beetles. *Aulacophora foveicollis* L. Technology. 6: 48-49.

Dales, M.J. 1996. A review of plant materials used for controlling insect pests of stored products. NRI Bulletin 65, Chatham, UK: Natural resources institute. 84 pp.

Epino, P.B. and Chang, F. 1993. Insecticidal activity of *Anona squamosa* L. seed extracts against the Mediterranean fruit fly, *Ceratitis capitata* (Diptera: Tephritidae). Philippine Entomologist 9: 737-747.

Goektepe, I., Portier, R. and Ahmedna, M. 2004. Ecological risk management of *neem* based pesticides. J. Env. Sci. Hlth. B. 39(2): 311-320.

Hussain, M.M., Ali, S.H., Rahim, A. and Mondal K.A.M.S.H. 1995. Studies on the repellent effect of two indigenous plants, biskaantali (*Polygonum hydropiper*) and ata (*Anona squamosa*) leaf on *Tribolium castaneum* Herbst. Bangladesh J. Sci. Indust. Res. 30: 81-85.

Isman, M.B. 2006. Botanical insecticides, detterents and repellents in modern agriculture and an increasingly regulated world. Annu. Rev. Entomol. 51: 45-66.

Johri, R. and Johri, P.K. 2003a. Food preferences of red pumpkin beetle, *Aulacophora foveicollis* Lucas at Kanpur in Uttar Pradesh. J. Appl. Zool. Res., 14(1): 80-81.

Khan, M.Z. and Hazela, K.P. 1987. Studies on *Aulacophora foveicollis* Lucas (Coleoptera: Chrysomelidae) food preferences and extent of damage. Ind. J. Ent., 49: 457-459.

Khan, S.M. and Wasim, M. 2001. Assessment of different plant extracts for their repellency against red pumpkin beetle (*Aulacophora foveicollis* Lucas) attacking musk melon (*Cucumis melo* L.) Crop. OnLine Journal of Biological Sciences 1(4): 198-200.

Kreutzweiser, D.P. 1997. Non-target effects of *neem* based insecticides on aquatic invertebrates. Ecotoxicol. Env. Safety. 36: 109-117.

Metzger, F.W. and Grant, D.H. 1932. Repellency to the Japanese beetle of extracts made from plant immune to attack. U.S. Dept. Agric. Tech. Bull. pp. 299.

Obeng-Ofori, D., Reichmuth, C.H., Bekele, A.J. and Hannasali, A. 1998. Toxicity and protectant potential of camphor, a major component of essential oil of *Ocimum kilimandscharium*, against four stored product beetles. International Journal of pest management 44: 203-209.

Panji, H.R. 1964. Some observations on the insecticidal activities of the fruit of "Darek" *Melia azedarach* (L). Res. Bull. Punj. Univ. N.S.Sci., 15: 4345-4346.

Pawlacos, J. G. 1945. The biology and control of *Aulacophora foveicollis* (Lucas) in Greece. Rev. Appl. Ent. Ser. A. 33: 16-17.

Rahaman, M.A. and Prodhan, M.D.H. 2007. Effects of net barrier and synthetic pesticides on Red pumpkin beetle and yield of cucumber. Int. J. Sustain. Crop. Prod. 2(3): 30-34.

Schmutterer, H. editor 2002. The *Neem* Tree (*Azadirachta indica* A. Juss) and other Meliaceous Plants:Sources of Unique Natural Products for Integrated Pest Management, Medicine, Industry and other Purposes. 1st edition. Mumbai: *Neem* Foundation.