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Studies on Feeding Behavior of different Leaf Feeding Insect Pest of Forest under Treatments of Different Ethno-Insecticidal Plant Extracts

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Abstract: ***Botanicals act not only as insecticides but also function as antifeedants, oviposition deterrents and ovicides. The present investigation reports on the antifeedant property of leaf components of (07) seven plant extracts (Azima tetracantha, Chloroxylon sweietenia, Clerodendrum viscosum, Cleistanthus collinus, Lippia javanica, Ocimum americanum and Sphearanthus indicus) against (04) four test insects (Hyblea purea Tinolius eburneigutta, Eutectona machearalis, and Atteva fabricella) at different concentrations was done. All insect cultures were maintained in a growth chamber in the laboratory at a temperature of 27 ± 2° C, 12: 12 L:D and with 70 ± 5 % RH during the experiments and the antifeedant activity observed in all the plant extracts based on the feeding behavior of the test insect and arranged in the descending order is 1.0%>0.8%>0.6%>0.4%>0.2%>0.1% concentrations and uncontrol. At 1.0 per cent concentration found to be the most effective and potent antifeedant against these leaf feeding insect pest.***

Keywords: % Antifeedant, % plant extracts, Feeding behaviour, Ethno-insecticides. Insect pests

1. Introduction

Insect pests are one of the major limiting factors in crop production. Synthetic organic insecticides have emerged as major tools of pest management. However, due to indiscriminate use of synthetic chemicals, insect pests have developed resistance to insecticides. Resurgence of secondary pests, reduction in the population of natural enemies and harmful residues in food, feed and fodder are some of the aftermaths of the use of pesticides. These concerns have led to the surge of alternative pest control technologies by which relatively environmentally safe pesticides/insecticides solely of biological origin are intended to develop. The pesticide formulations based on extractives from organisms have attracted particular attention because of their specificity to insect pests, biodegradable nature and a potential for commercialization.

The plant world comprises of a rich array of biochemicals that could be tapped for use as insecticides. The toxic constituents present in plants represent the secondary metabolite groups. Their particular role in many of the plant species are not completely known to the science. However, it is assumed that they have only insignificant role in the primary physiological processes in plants that synthesize them. Some of the secondary metabolites are merely end products of aberrant biosynthetic pathways and others excretory products.

Knowledge of the toxic plants, and the toxic principles and their biological activity is important not only to utilize them as natural insect control agents and replace the toxic commercial chemical insecticides but also to understand the nature of their toxicity in non-targeted species. Over 2,000 plant species out of about 2,50,000 have been reported to possess insecticidal activity in which only a fraction of them are analyzed for biocidal properties and many more insecticidal plants awaits discovery.

2. Review of Literature

Literature on pesticides from higher plants is abundant [1], [6] & [4]. Over 2,000 plant species have been reported to possess insecticidal activity [2] out of about 2,50,000 angiosperms so far documented and only a fraction of them analysed. Studies compiled a list of Indian plants that have been utilized for the control of insect pests [5]. Most of the plants reported are used locally by the natives and their utility on a wider scale is yet to be explored. Work reported 12 species that are being used as insecticides or piscicides from the indigenous tribes of Eastern Ghats in Andhra Pradesh [3]. Studies reported that 46 plant species are useful in the control of teak skeletonizer and opined that the desirable plant species that maintain reserve forces of polyphagous parasites of teak defoliators are encouraged in the plantation and in miscellaneous mixed forests [7]. Repellent and insecticidal property of medicinal and natural plant extracts was studied [8] against teak skeletonizer in the laboratory. This investigation revealed that the extract of *Calotropis procera* followed by *Datura metel* and *Azadirachta indica* were found to be the most effective.

3. Method and Materials

The extraction was carried out in the Soxhlet's extraction apparatus at Entomology laboratory, IFB, Hyderabad. The samples containing leaves of the selected plant materials were air-dried for 6-7 days. After complete drying the plant parts were pulverized into powder with the help of mixer grinder. The plant material was extracted by Soxhlet extraction method.

In all the cases, the extracts were tested to know whether they had any stomach poison activity or not. The chosen feeding material for the test insect consisted of teak leaves in case of teak defoliator and teak skeletonizer, and ailanthus leaves in case of ailanthus webworm and soapnut leaves in case of soapnut semi looper. The fresh leaves brought from the field were cut into uniform circular shape of 3.5 cm diameter so as provide uniform area and quantity of food

material to the insect also to facilitate uniform distribution of insecticidal material to the leaf discs and for easy accommodation of the leaf discs into the petridishes.

The cut leaf discs were washed in distilled water to remove dust etc., and were air dried under ceiling fan for few minutes. Each concentration was spread at the rate of one ml/ leaf disc for each treatment. A pinch (2mg) of Methyl cellulose was added to the solution to make it slurry for uniform distribution on the leaf surface. This was smeared on either side of the leaf disc with a fine camel hair brush uniformly. Then the treated leaves were hung to a thread with clips, for air drying under ceiling fan for about 2 hours till they were free from solvent and moisture. The dry but turgid leaf discs were placed into petridishes which were thoroughly washed and sterilized as described before. For each replication ten insects were released into the petridishes. Each concentration including control was replicated four times. The third instar larvae of different insects viz., teak defoliator and teak skeletonizer, ailanthus webworm and soapnut semi looper were utilized as test insects. After a lapse of 24 hours of release of the insects, number of the insects dead, weight measures of leaf material consumed, leaf material left uneaten were made as per the procedure indicated earlier.

4. Results

Soapnut semi looper: A perusal of the results presented in the table-4 indicate that among all the plant extracts tested *Clerodendrum viscosum* at 1.0 percent concentration found to have maximum antifeedant property as indicated by the least leaf feeding by weight (0.341gms) as against 5.286 gms in the untreated control. The order of antifeedant activity of the different plant extracts at 1.0 per cent concentration, arranged in the descending order is *C viscosum* (0.341 gms) > *S indicus* (0.406 gms) > *O americanum* (0.664 gms) > *C collinus* (0.979 gms) > *A tetracantha* (1.062 gms) > *L javanica* (2.962 gms). Regarding the highest feeding rate at 0.1 percent concentration of different plant extracts maximum feeding by weight was recorded in *S indicus* treatment (5.695 gms) The order of maximum conception of the treated leaf by the larvae of *T eburneigutta* at 0.1 percent concentration of different plant extracts arranged in descending order is *S indicus* (5.695 gms) > *L javanica* (5.121 gms) > *A tetracantha* (4.724 gms) > *O americanum* (4.694 gms) > *C collinus* (4.604 gms). It is noteworthy to mention that *S indicus* treatment recorded more feeding by the larvae at 0.1 percent concentration (5.695 gms) than that in the respective untreated control (5.286 gms).

Teak defoliator: A perusal of the results presented in the table-4 indicate that among all the plant extracts tested A *tetracantha* at 1.0 percent concentration found to have maximum antifeedant property as indicated by the least leaf feeding by weight (0.094 gms) as against 2.148 gms in the untreated control. The order of antifeedant activity of the different plant extracts at 1.0 per cent concentration, arranged in the descending order is *A tetracantha* (0.094 gms) > *L javanica* (0.165 gms) >*C viscosum* (0.195 gms) > C *sweietenia* (0.209 gms) > *S indicus* (0.399 gms) > *O americanum* (1,360 gms) > *C collinus* (0.373 gms). Regarding the highest feeding rate at 0.1 percent concentration of different plant extracts maximum feeding by weight was recorded in *L javanica* treatment. The order of maximum conception of the treated leaf by the larvae of *H purea.*, at 0.1 percent concentration of different plant extracts arranged in descending order is *L javanica* > (2.407 gms) > *C collinus* (2.263 gms) > *S indicus* (2.198 gms) > *O americanum* (2.116 gms) > *C viscosum* (2.063 gms) > *C sweietenia* (2.023 gms) > *A tetracantha* (4.724 gms).

Teak skeletonizer: A perusal of the results presented in the table-4 indicate that among all the plant extracts tested *T skeletonizer*, *O americanum* at 1.0 percent concentration found to have highest antifeedant property as indicated by the least leaf feeding by the test insect (0.371 gm) as against 3.977 gms in the untreated control. The order of antifeedant activity of the different plant extracts at 1.0 per cent concentration, arranged in the descending order is *O americanum* (0.371 gms) > *C viscosum* (0.427 gms) > *C collinus* (0.415 gms) > *L javanica* > (0.900 gms) > *C sweietenia* (1.098 gms) > *A tetracantha* (1.451 gms) > *S indicus* (gms). Regarding the highest feeding rate at 0.1 percent concentration of different plant extracts maximum feeding by weight was recorded in *C sweietenia* (3.580 gms) as against 3.977 gms in the untreated control. The order of maximum conception of the treated leaf by the larvae of *E macheaeralis* at 0.1 percent concentration of different plant extracts arranged in descending order is C *sweietenia* (2.023 gms) > *A tetracantha* (4.724 gms) > *C viscosum* (2.063 gms) > *O americanum* (2.116 gms) >*S indicus* (2.198 gms) > *L javanica* (2.407 gms) > *C collinus* (2.263 gms).

Webworm: A perusal of the results presented in the table-4 indicate that among all the plant extracts tested *A fabricella*, *C viscosum* at 1.2 percent concentration found to have highest antifeedant property as indicated by the least leaf feeding by the test insect (4.356 gm) as against 14.100 gms in the untreated control. While the lowest antifeedant activity at 1.2 percent was recorded with *A fabricella* (10.973 gms). The order of antifeedant potentiality of the different plant extracts at 1.2 per cent concentration arranged in the descending order is *C viscosum* (4.356 gms) > *A tetracantha* (5.989 gm) > *O americanum* (8.101 gms) > *C collinus* (8.176 gms) > *S indicus* (10.973 gms). Regarding the highest feeding rate at 0.1 percent concentration of different plant extracts maximum feeding by weight was recorded in *S indicus* treatment. The order of maximum feeding by the test insect at 0.1 percent concentration of different plant extracts arranged in the descending order is *S indicus* (13.78 gms) > *C collinus* (13.104) > *A tetracantha* (12.932) > *O americanum* (12.31) *C viscosum* (11.972) as against 14.100 gms in the untreated control.

5. Discussion

Sphearanthus indicus found to possess some insecticidal properties in root and leaf caused >50% mortality in an Indian mosquito species [9]. Purified fraction of acetone extract of *Azima tetracantha* showed mosquito antifeedant effect [9]. Methanolic extract of *Azima* sp. showed repellent and feeding deterrent activities against *Tribolium castaneum* in the lower concentration of 1% [11]. Some workers reported that maximum ovicidal activity was found in *Ocimum americanum* and *Zingiber officinale* [10]. The

essential oil of *C. swietenia* exhibited significant larvicidal activity, with 24h LC_{50} 131.20 ppm and LC_{90} 224.68 ppm. Larvicidal activities of the five major compounds of essential oil were also tested. *L. javanica* also known as fever tea or lemon bush used extensively for controlling aphids and red spider mites in cabbage, rapes and tomatoes [11]. Polar extracts of *Lippia* species have potential as environmentally friendly alternatives for the control of various insect pests [3].

6. Conclusion

Among all the plant extracts tested, *Clerodendrum viscosum* 1.0 percent exhibited highest antifeedant activity against a *T eburneigutta* larva, while *L javanica* afforded least antifeedant activity against *T eburneigutta*. Among the plant extracts tested against *H purea* larvae *A tetracantha* 1.0% showed highest least antifeedant activity while *C collinus* exhibited the least antifeedant activity. *O americanum* showed highest antifeedant activity against *T skeletonizer* larvae while *S indicus* afforded least antifeedant activity to the same insect. *C viscosum* 1.2 per cent exhibited highest antifeedant activity against *A fabricella* while *S indicus* afforded least antifeedant activity. The degree of antifeedant activity of different plant extracts varied from insect to insect. Hence depending upon the pest problem, a particular type of extract has to be applied for effective control of the pest.

7. Future Scope

The traditional knowledge pertaining to insect control was validated. This will lead to future work on fractionation and purification of the effective crude plant extracts and identification of active compounds.

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References

[1] Arnason, J.T., Philogene, B.J.R., Morand, P. 1989. *Insecticides of Plant* Origin. *ACS Symp*. *Ser*. 387, American Chemical Society, Washington, D.C., 213 p.
[2] Crosby, D.G. 1971. *Minor Insecticides of Plant Origin*. In *Naturally Occurring Insecticides*. p. 177-239. (Eds. M. Jacobson and D.G. Crosby). Marcel Dekker, New York.
[3] Ramarao, N and Henry, A.N. 1996. Ethnobotony of Eastern Ghats in Andhra Pradesh, India. Botanical Survey of India, Calcutta. 259 P.
[4] Jacobson .M 1971. In *Naturally Occurring Insecticides*. (Eds. M. Jacobson and D.G. Crosby). Marcel Dekker, New York.
[5] Subramaniam, B. 1993. *Potential Pesticidal Plants of India*. P. 74-100. In *Botanicals and Biopesticides*. (Eds. B.S. Parmar and C. Deva Kumar.) 197 p. Westvill Publishing House, New Delhi.
[6] Whitehead, D.L. and Bowers, W.S. (Eds) 1983. *Natural Products for Innovative Pest Management*. Pergamon Press, Oxford.
[7] Mathur, R.N., 1960, Pests of teak and their control. Indian Forester, 10: 43-65.
[8] Meshram, P.B., 1995, Evaluation of some medicinal and natural plant extracts against teak skeletonizer *Eutectona machaeralis* Walker. Indian Journal of Forestry, 12 (3): 528-532.
[9] Sharma M, Saxena RC. *Sphaeranthus indicus* as mosquito larvicide. J Appl Zool Res. 1996;7:87–8.
[10] Bergamasco, R. & Horn, D.H.S. 1983. Distribution and role of insect hormones in plants. In: Downer, G.H. & Laufer, H (Eds) Endocrinology of Insects 1. 627-654. Alan R. Liss, New York.12
[11] Gupta SK, Banerjee AB. Screening of selected West Bengal plants for antifungal activity. Econ Bot 2008; 26(3): 255-259.

Table 1: Plant Materials collected for extraction

Sl.no.	Botanical name	Vernacular name	Family	Plant part used
1	*Azima tetracantha*	Needle bush, Beesting bush	Salvadoraceae	leaf
2	*Chloroxylon sweietenia*	Satin wood tree	Meliaceae	leaf
3	*Clerodendrum viscosum*	Hill glory	Lamiaceae	leaf
4	*Cleistanthus collinus*	Karra, Garari	Euphorbiaceae	leaf
5	*Lippia javanica*	Fever tea, lemon bush	Verbenaceae	leaf
6	*Ocimum americanum*	Hoary basil, American basil	Lamiaceae	leaf
7	*Sphearanthus indicus*	East Indian globe thistle	Asteraceae	leaf

Table 2: Test insects selected for the study

Sl.No.	Common name	Scientific name	Family	Order
1	Teak defoliator	*Hyblaea puera*	Lepidoptera	Hyblaeidae
2	Teak skeletonizer	*Eutectona macheralis*	Lepidoptera	Pyralidae
3	Ailanthus web worm	*Atteva fabriciella*	Lepidoptera	Attevidae
4	Soapnut semi looper	*Tinolius eburneigutta*	Lepidoptera	Noctuidae

Table 3: Preparation of different concentrations of different plant extracts from stock solutions of two percent concentration (20,000 ppm) V/V

Sl.No	Required concentration in ppm	Volume of stock solution taken in ml	Volume of Acetone used for dilution (ml)	Total volume of solution obtained (ml)
1.	1,000	1.25	23.75	25
2.	2,000	2.50	22.50	25
3.	4,000	5.00	20.00	25
4.	6,000	7.50	17.50	25
5.	8,000	10.00	15.00	25
6.	10,000	12.50	12.50	25
7.	12,000	15.00	10.00	25

Table 4: Feeding behavior of different leaf feeding insects under treatments of different plant extracts

Sl.no	Test insect/Plants	*C collinus* (%)	*S indicus* (%)	*O americanum* (%)	*L javanica* (%)	*A tetracatha* (%)	*C viscosum* (%)	*C sweietenia* (%)
A. Lowest rate of feeding by different leaf feeding insects								
1	*T.eburneigutta*	0.979 (1.0)	0.406 (1.0)	0.664 (1.0)	2.962 (1.0)	1.062 (1.0)	0.341 (1.0)	- -
2	*H. purea*	0.373 (1.0)	0.399 (1.0)	1.360 (1.0)	0.165 (1.0)	0.094 (1.0)	0.195 (1.0)	0.209 (1.0)
3	*E.machearalis*	0.415 (1.0)	1.618 (1.0)	0.371 (1.0)	0.900 (1.0)	1.451 (1.0)	0.427 (1.0)	1.098 (1.0)
4	*A. fabricella*	8.176 (1.2)	10.97 (1.2)	8.101 (1.2)	- -	5.989 (1.2)	4.356 (1.2)	- -
B. Highest rate of feeding by different leaf feeding insects at 0.1 percent concentration								
1	*T.eburneigutta*	4.604 --	5.695 -	4.694 -	5.121 -	4.724 -	2.814 -	-
2	*H. purea*	2.263 -	2.198 -	2.116 -	2.407 -	1.337 -	2.063 -	2.023
3	*E.machearalis*	3.118 -	3.227 -	3.444 -	3.214 -	3.579 -	3.509 -	3.580
4	*A.fabricella*	13.104 -	13.78 -	12.31 -	- -	12.932 -	11.972 -	-