Plant Archives Vol. 22, No. 1, 2022 pp. 320-323 e-ISSN:2581-6063 (online), ISSN:0972-5210

Plant Archives

Journal homepage: http://www.plantarchives.org
DOI Url : https://doi.org/10.51470/PLANTARCHIVES.2022.v22.no1.050

EVALUATION OF BIOEFFICACY OF *LIPPIA JAVANICA* AGAINST *HYBLAEA PUERA* (LEPIDOPTERA: HYBLAEIDAE) FROM THE FOREST OF ANDHRA PRADESH, INDIA

Deepa M.* and Meera D.
Institute of Forest Biodiversity
Indian Council of Forestry Research, Hyderabad, India
*Email: deepa.icfre@gmail.com
(Date of Receiving : 11-10-2021; Date of Acceptance : 23-01-2022)

ABSTRACT

Laboratory experiment was conducted to evaluate the bioefficacy of ethnobotanical plant *Lippia javanica* at Entomology laboratory at IFB, Hyderabad during 2016-2018. Experiment was carried out in Completely Randomized Design and antifeedant activity and toxicity was observed in 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. The insect culture was 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. Hence depending upon the pest problem, a particular type of extract has to be applied for effective control of the pest.

Keywords: Bioefficacy, Ethnobothany, Toxicity, Antifeedant, Teak

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.

Method and Materials

The extraction was carried out in the soxhlets extraction apparatus. The sample containing leaves of the selected plant material was 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.

Preparation of standard solutions

Before actually making the required test concentrations, stock solution was prepared for plant extract. The stock solution was prepared as and when necessary instantly and was preserved in the deep freezer at -5^{o} C, for few days. Since the extract is soluble in different organic solvents, each was dissolved in any one of the selected solvents viz. Acetone, Methanol, Petroleum ether or Chloroform. That extract was weighed individually in an Ainsworth electrical monopan balance as per the required quantity, stock solution was prepared on weight/ volume (w/v) basis.

Dilution of different concentration from stock solution

For the present studies, six to seven concentrations were prepared from plant extract (viz., 1,000, 2,000, 4,000, 6,000, 8,000, 10,000 and 12,000 ppm) and the plant extract was tested at the above said concentrations on the test insect. The required concentrations for a extract was prepared from stock solutions of 20,000 ppm (2%). In the process of dilution of the stock solution to prepare different concentrations, Acetate was used as a solvent.

Method of testing the plant extract for antifeedant properties

A extract was tested to know whether it had any stomach poison activity or not. The chosen feeding material for the test insect consisted of teak leaves in case of teak defoliator. The fresh leaves brought from the field was 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 sides 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 teak defoliator was utilized as test insect. After a lapse of 24 hours of release of the insect, number of the insect dead, weight measures of leaf material consumed, leaf material left uneaten were made as per the procedure indicated earlier.

Assessment of Results for toxicity

According to Pradhan (1949), the insecticidal effect on the test insect was assigned to one of the following five categories.

1. Normal: Where there is no noticeable abnormality.
2. Slightly affected: Wherein the effect was noticeable, the test insect could move about or make some progress.
3. Badly affected: Wherein the test insect could not leave from the place where it was, but vigorous movement of various parts of the body was apparent.
4. Moribund: Those which appeared to be dead but on prodding could show some sign of life by feeble movement in some part of the body.
5. Dead: Those which showed no sign of life, despite prodding.

Accordingly the dead and the moribund individuals were taken into account for mortality counts. The percentage mortalities, using Abbot's formula (1925). The Lethal concentrations (LC_{50}) values have been worked out, subjecting the corrected percentage mortality date to "probit analysis" as suggested by Finney (1952).

Table 1: Ethno botanical plant and target insect selected for the study

Plant selected for the study			
Lemon bush	*Lippia javanica*	Lamiales	Verbenaceae
Target insect selected for the study			
Teak defoliator	*Hyblaea puera*	Lepidoptera	Hyblaeidae

Table 2: Preparation of different concentrations of a plant extract 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

Results and Discussion

Perusals of the results presented in the Table-3 indicate that the differences between the treatments were significant. Reductions in the feeding activity of test insect correspond to the increase in the treatment in the treatment concentrations. The degree of anti-feedant activity based on the feeding behavior of the test insect at different concentrations, arranged in descending order is 1.2 per cent (0.414 gm) > 1.0 per cent (0.900 gm) > 0.8 per cent (1.381 gm) > 0.6 per cent (1.883 gm) 0.4 per cent (2.475 gm) > 0.2 per cent (2.873 gm) > 0.1 per cent concentration (3.214 gm) > and untreated control (3.977 gm).

Regarding the unconsumed leaf feed, significant differences were recorded between the treatments and the untreated control and also among the treatments. Maximum leaf feed was left over in 1.2 per cent concentration (4.474 gm) and lowest quantity of leaf feed was left over in 0.1 per cent concentration (1.674 gm) followed by untreated control (0.911 gm).

Regarding fecal pellet excretion, significant differences existed between the treatments and control and also among the treatments. Excretion of fecal matter was maximum in the treatment of 0.6 per cent concentration (1.824 gm) and lowest in the untreated control (0.843 gm) followed by treatment of 0.1 per cent concentration (0.931 gm).

L. javanica was active against *Aedes aegypti* larvae and *Sitophilus zeamais* Motschulsky (maize weevil). Katsvanga and Chigwiza (2004) reported that *L. javanica* is an effective natural pesticide which can be used to control aphid species *(Brevicoryne brassicae)*. In their study, Katsvanga and Chigwiza (2011) found that 1:1 powdered aqueous leaf extract of *L. javanica* reduced *B. brassicae* by 53.2% against 78.3% and 96.7% of two synthetic pesticides, Aphid kill and Bexadust "L," respectively. Chikukura *et al*. (2011) found *L. javanica* powdered leaf extracts to have insecticidal properties with potential to control grain damage by 21–33%. In the present investigation *Lippia javanica* shows toxicity lc_{50} values 0.65 mg/ml for the test insect teak defoliator, khamvilker,1983 and chavan, 1984 mentioned that neem belongs to braoad group of botanicals and it is possessing insecticidal properties which is an unbetable point. neem oil lc_{50} values 0.4390 mg/ml against teak defoliator, so compare to neem oil the *lippia javanica* showed least antifeedant properites but it found that effective alternative natural pesticide which can be used for control of teak defoliator test insect.

Table 3: Relative feeding potentiality of teak defoliator at different concentration of *Lippia javanica*

S.No	Treatment Concentration (%)	Average wt. of leaf feed eaten (gms)	Average wt. or leaf feed uneaten (gms)	Average wt. of faecal pallets excreted (gms)
1	0.1	2.407	2.207	0.719
2	0.2	2.164	2.269	0.930
3	0.4	1.592	3.024	1.169
4	0.6	0.825	3.790	1.240
5	0.8	0.220	4.395	0.752
6	1.0	0.165	4.449	0.494
7	1.2	0.098	4.523	0.472
7	Control	2.296	2.344	0.588
	C.D	0.1377	0.1409	0.0435

Conclusion

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 *Lippia javanica,* against test insect *Hyblea purea* at different concentrations was done. At 1.2 per cent concentration found to be the most effective and potent antifeedant against these leaf feeding insect pest. The toxicity of leaf components of plant extracts against test insects at different concentrations shows LC_{50}-0.6501 aganist *H. purea* was found to be effective and toxic against selected major insect pest of teak that tested.

Acknowledgements

The Principal Investigator thanks the Director General, Indian Council of Forestry Research and Education,. The PI also thanks the Director Institute of Forest Biodiversity, Hyderabad for constant encouragement.

References

Attri, B.S. (1975). Utility of neem oil extractive as feeding detternt to lowest. *Indian J. Ent*. 37(4): 417-418.

Atwal, A.S. and Panji, H.R. (1964). Preliminary insecticidal properties of drupes of *Melia azadarach* against caterpillars of *Pieris brassicae* L. *Indian J. Ent.* 26(11): 221-227

Balasubramanian, M. (1983). Plant protection, visayas St. Coll. of Agr. Baybay, *Phil. Pers. Comm*., as quoted in 'Plant species reportedly possessing pest control properties-A data base'. Publ. by Resource systems institute East-West Center, Nonolulu, Hawai, USA, 33pp.

Batra, R.C. and Sandu, G.S. (1981). Comparison of different insecticides for te control of citrus leaf miner in the nursery. *Pesticides* 15(2): 5-6. Gupta, S.K. Banerjee A.B. Screening of selected West Bengal plants for antifungal activity. Econ.

Chikukural, B.M.; Mvumil, R.; Chikonzol and Chenzara, C. (2011). Evaluation of selected indigenous pesticidal plant powders against stored maize and cowpeas insect pests. *African Crop Science Conference Proceedings,* 10: 189 – 192.

Jacobson, M. (1971). In Naturally Occurring Insecticides. Marcel Dekker, New York.

Jotwani, M.G. and Srivastava, K.P. (1981). Neem insecticide of the future 1-As protectant against stored grain pests. *Pesticides* 15(11): 40-41.

Kadam, (1976). Entomological experiments on neem oil, Dept. of Ent., M.P.K.V. and Rahuri (M.S).

Kalyanasundaram, M. and Dos, P.K. (1985). Larvicidal and synergistic activity of plant extracts for mosquito control. *Ind. J. Med. Res*. 82, 1–19.

Katsvanga, S.; Chigwa Brighton Mvumi, and Robert, C. (2011). effectiveness of natural herbs, fever tea *(Lippia javanica)* and Mexican marigold. *African Crop Science Conference Proceedings*, 10: 189-192.

Khanvilkar, V.G. (1983). Plant species reportedly possessing pest control properties–A data base' publ. by Resource systems institute, East-West center, Honolulu, Hawai, USA 20 pp.

Rimpler and Sauerbier, H. (1986). "Iridoid glucosides as taxonomic markers in the genera *Lantana*, *Lippia*, *Aloysia* and *Phyla*," *Biochemical Systematics and Ecology*, 14(3): 307–310.

Umerie, S.C. and Anaso, H.V. (1998). Insecticidal potentials of *Ocimum basilicum* leaf extract, *Bioresource Techn.,* 64(3): 237- 239.

Valsala, K.K. and Gokuldas (2015). Repellent and oviposition deterrent effects of *Clerodendrum infortunatum* on the pulse beetle *Callosobruchus chinensis* L. (Coleoptera: Bruchidae) ME-ISSN: 2320-7078 P-ISSN: 2349-6800 JEZS 2015; 3(4): 250-253. *J. Entomogy and zoology studies.*

Vikneshwaran, M. (2008). A survey of the Ethnomedicinal flora of the Sirumalai hills, Dindugul District, India, *Ethnobotanical Leaflets*, 12, 948- 53, 62.

Wandscheer, C.B.; Duque, J.E.; da Silva MAN.; Fukuyama, Y.; Wohlke, J.L.; Adelmann, J. and Fontana, J.D. (2004). Larvicidal action of ethanolic extracts from fruit endocarps of *Melia azedarach* and *Azadirachta indica* against the dengue mosquito *Aedes aegypti. Toxicon* 44: 829–835.

Zebitz, C.P.W. (1984). Effects of some crude and azadirachtin enriched neem *Azadirachita indica* seed kernel extracts on larvae of *Aedes aegypti*. *Entomol. Exp. Appl*. 35: 11–14.