International Journal of Natural Sciences Research
2014 Vol. 2, No. 5, pp. 78-84
ISSN(e): 2311-4746
ISSN(p): 2311-7435

ANTIFEEDANT ACTIVITY OF BARLERIA BUXIFOLIA (LINN.) (ACANTHACEAE) AGAINST SPODOPTERA LITURA FABRICIUS AND HELICOVERPA ARMIGERA HÜBNER (LEPIDOTERA:NOCTUIDAE)

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ABSTRACT

To investigate the antifeedant activity of crude extracts of Barleria buxifolia tested against fourth instar larvae of Spodoptera litura and Helicoverpa armigera. Antifeedant activity of hexane, chloroform and ethyl acetate extracts were prepared and tested against fourth instar larvae of selected insect pests. Ethyl acetate extracts of B. buxifolia, showed higher percentage of antifeedant, activity. This is first report on selected economically important pests. Further, the active compounds will be isolate from the ethyl acetate extracts which will be useful for controlling economically important insect pests.

Keywords: Barleriabuxifolia, Helicoverpa armigera, Spodoptera litura, Antifeedant, Insecticidal.

Contribution/ Originality

Use of Chemical pesticides in agriculture plays an important role such as development of resistance by insect pests, toxicity to non-target organisms and hazardous effects on the environment. Plant derived chemicals offer a more natural and environmentally friendly approach to pest control an alternative to chemical pesticides. One of the important innovative approaches in the present investigation is the first hand report of Barleriabuxifolia with special reference to the selected polyphagous field pests. Thus it paves the way for further exploration of possible utilization of the selected plant against some other field pests which are of economically important.

1. INTRODUCTION

The cotton bollworm *Helicoverpa armigera* (Hübner) (Lepidoptera: Noctuidae) is a polyphagous pest of Worldwide occurrence inflicting crop damage in India to the sum of one billion dollars annually and it attacks over 200 crop species belonging to 45 families [1, 2]. In India, it is one of economically important insects and its damages occurs in many economically important crops including cotton, pigeonpea, chickpea, tomato, okra, and blackgram. The tobacco caterpillar *Spodopteralitura* (Fabricius) (Lepidoptera: Noctuidae) is an economically important

polyphagous pest in India, China and Japan, causing considerable economic loss to many vegetable and field crops. It causes economic losses of crops from 25.8 to 100% based on crop stage and its infestation level in the field. It has large host range of more than 120 host plants in India including crops, vegetables, weeds and ornamental plants [3, 4]. These pests status is well justified in its polyphagy on all economically important crops and the hurdles in its management. In this context need to search for more effective insecticides which are safer to the user and consumer. Among the control measures, plant derived compounds are more specific and environmentally safer.

Insect pests play a major role in damaging the agricultural crops and the crop loss varies between 10% and 30% for major crops [5]. India is basically an agro-based country more than 80% of population depends on agriculture and Indian economy is largely determined by agricultural productivity. The intensification of agriculture to fulfill food needs has increased the number of insect pest species attacking different crops and as a result the annual production losses of the standing crops. In the past decade, pesticides have played a major role in agriculture crop protection programmes and have enormously benefited mankind. Nevertheless, their indiscriminate use has resulted in the development of resistance by pests (insects, weeds, etc), resurgence and outbreak of new pests, toxicity to non-target organisms and hazardous effects on the environment endangering the sustainability of ecosystems [6]. Among current alternative strategies aiming at decreasing or minimizing the use of chemical insecticides, eco-chemical control based on plant-insect relationships is one of the most promising methods. Plant derived chemicals offer a more natural and environmentally friendly approach to pest control than synthetic insecticides. However, this plant has no report on biological properties against agricultural insect pests.Hence, in the present investigation to evaluate the antifeedant activity of *Barleriabuxifolia*against economically important pests.

2. MATERIALS AND METHODS

2.1. Plant Collection and Extraction

The leaves of *Barleria buxifolia* were collected from Pulliansolai, Kolli hills, namakkal District, Tamil Nadu, India during the July 2013. Collecetd plant specimen was identified by Dr. S. John Britto, Director, The Rapinat Herbarium and Centre for Molecular Sytematics, St' Joseph's College, Tiruchirapalli, Tamil Nadu, India and The Voucher specimen (IPH 16) was deposited in Entomology lab, Arignar Anna Government Arts College, Musiri, Tamil Nadu, India.

The plant leaves were carefully washed with clean water and shade dried under room temperature (27.0 ± 2°C) at Entomology lab, PG & Research Department of Zoology, Arignar Anna Government Arts College, Musiri, Tamil Nadu, India. Dried plant leaves were powdered using electric blender and sieved through kitchen strainer. Plant powder (1000 g) was extracted with hexane, chloroform and ethyl acetate, sequentially and extract was filtered through Whatman's No.1 filter paper. Crude extract of solvents were evaporated to air dryness at room

temperature and crude extracts were collected in clean borosil vials and stored in the refrigerator at 4°C for subsequent bioassay against selected insect pests.

2.2. Insects Rearing

The selected insect pests were collected from vegetable field at Vadukapatti, MusiriTaluk, Tamil Nadu, India. Larvae were reared in laboratory condition at 28 ± 2°C, 70–85% relative humidity (RH) at the Department of Zoology, Government Arts College, Musiri, Tamil Nadu, India. Laboratory-reared second generation larvae were used for subsequent bioassay.

2.3. Antifeedant Bioassay

Antifeedant bioassay of crude extracts was studied using leaf disc no choice method [7]. 5% of crude extract was prepared by dissolving in acetone and mixing with dechlorinated water used as stock concentration. Tween 20 (Polysorbate) at 0.05% was used as emulsifier. Fresh castor leaf (for *S. litura*) and tomato leaf (for *H. armigera*) discs of 2-cm diameter were punched using cork borer and dipped with 0.625, 1.25, 2.50 and 5.0% concentrations of crude extracts, individually. Leaf discs treated with acetone and water were considered as control. Each leaf disc (treated and control) was placed in petridish (1.5 cm X 9 cm) containing wet filter paper to avoid drying of the leaf disc and a single 2hrs pre-starved fourth instar larva was introduced. Five replicates was maintained for each concentration. Progressive consumption of leaf area by the larva after 24 hrs feeding was recorded in control and treated discs using Leaf Area Meter (Systronics 211). The percentage of antifeedant index was calculated using the formula of [8].

$$\text{Antifeedant Index} = \frac{C - T}{C + T} \times 100$$

Where C and T represent the amount of leaf eaten by the larva on control and treated discs respectively.

2.4. Data Analysis

Collected data was analysed using Microsoft Excel 2007. Probit analysis [9] was used to determine FI_{50} and the corresponding 95% confidence intervals. Two – Way ANOVA was performed for all the experimental data from that Least Significant Difference was calculated and the significant differences were marked with different alphabet.

3. RESULTS

Antifeedant activity of the different crude extracts of *B. buxifolia* was studied at four different concentration and the results are presented in figure 1 & 2. Based on the solvent crude extracts was assessed by the antifeedant index. Percentage of antifeedant index usually indicates decreased rate of larval consumption. Present investigation clearly indicate that irrespective of concentration and solvents system used for extracting the crude material was varied significantly in antifeedant activity. Data pertaining to the above experiment clearly showed that the highest antifeedant activity was recorded in ethyl acetate extract at 5% concentration *i. e.* 78.5% on *S.*

litura and 75.4% on *H. armigera*, compared to control. Data was analysed using one-way analysis of variance (ANOVA) followed by Tukey's multiple range test ($P \leq 0.05$) test showed statistical significance ($p<0.05$). Further, ethyl acetate extract was subjected to preliminary phytochemical analysis for the confirmation of major group of compounds presented in table 1. Extracts showed positive results for confirmation of terpenoids, flovonoids, phenols and quinines in the preliminary analysis of phytochemicals.

4. DISCUSSION

There are numbers of naturally occurring compounds that possess plant protection properties. So far more than 10,000 secondary metabolites have been chemically identified. In nature many plants have unpalatable substances like high content of phenols, alkaloids, flavanoids, terpenes, quinone, coumarin etc., which play a significant self-protective role against herbivorous insects. These substances possess wide range of biological activities including antifeedant, insecticidal, and insect growth regulators (IGRs). Identifying bioactive compounds from plant sources with useful biological activity is only the starting point in the long process of development of a plant based pesticides for the management insect pests. Success of botanical in the field depends on number of factors such as, ongoing availability of the natural resources, adequate biomass to justify extraction, the feasibility of extraction near the harvest site and the stability of the extract in storage after preparation [10]. Plant chemicals (botanicals) with antifeedant peroperties against economically important insects pests has been studied in many countries. Effect of botanicals in quantification of antifeedant is of enormous importance in the field of insect pest management (IPM programme). In ecological point of view, antifeedants are significant role since they never kill the target insects pests directly and allow them to be available to their natural enemies (predator and parasites) and thus help in the safeguarding of natural balance. Further, monophagous, oligophagous and polyphagous insects die due to the application of antifeedants on their food plants, due to starvation.

The present study, ethyl acetate extract of *B. buxifolia* was promising in reducing feeding rate of selected economically important pests.Depending upon the concentration of the plant extracts the rate of feeding significantly varied. This indicates that the active principles present in the particular crude extracts inhibit larval feeding behaviour or make the food unpalatable or the substances directly act on the chemosensilla of the larva resulting in feeding deterrence (antifeedant). These substances that reduce consumption (feeding) by an insect. They are behavior modifying substances that deter feeding, through a direct action on peripheral sensilla (= taste organs) in insects [11]. This definition excludes chemicals that suppress feeding by acting on the central nervous system (following ingestion and absorption) or a substance that has sub-lethal toxicity to the insect [12]. Recently, Jeyasankar and Chinnamani [13] who have reported that ethyl acetate extract *Pseudocalymmaalliaceum* showed significant antifeedant and insecticidal activities against selected pests. Earlier findings are in agreement with the earlier reports of Jeyasankar, et al. [14]. Several authors have reported that plant extracts possess similar type of antifeedant activity against lepidopteran pests [15-17].

Antifeedants is the naturally occurring chemicals in certain plants which play a major role in the unsuitability of non-host plants as food for insects. Chemical isolation of these active ingredients is important not only for understanding the ecological aspects of insect pest's relationship, but also for their potential in insect pest's control. In our findings, preliminary phytochemical analysis revealed that terpenoids, flovonoids, phenols and quinines present in the ethyl acetate extracts indicate that higher percentage of antifeedant activity. Morimoto, et al. [18] who have reported that quinone, remirol and cyperquinone isolated from the plants of the family Cyperaceae had strong antifeedant activity against *S. litura*

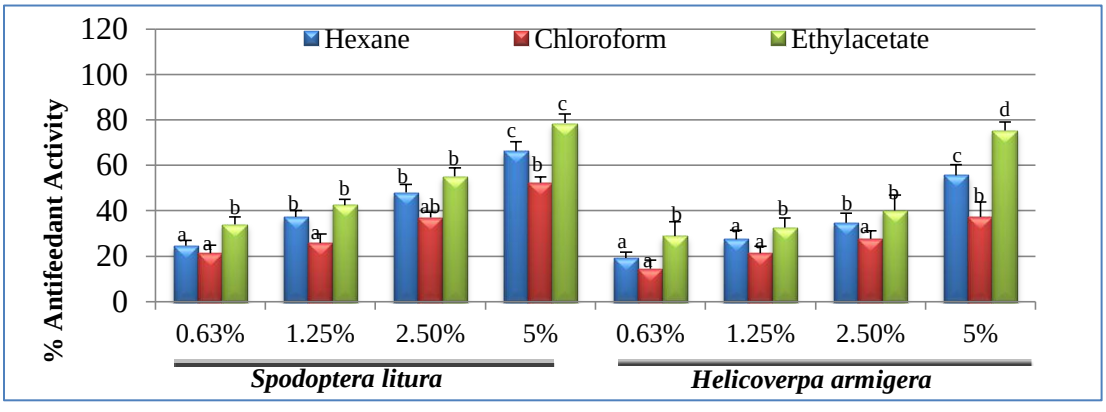
5. CONCLUSION

Crude ethyl acetate extract of *B. buxifolia* showed higher antifeedant activity against agriculture important pests and it is first time report on this field insect pests. Further, it may be suggested that the active crude extract of *B. buxifolia* will be isolate and identify the effective compound (s) which will be used for controlling the economically important insect pests.

6. ACKNOWLEDGEMENTS

The author is thankful Principal and Head of Department of Zoology, Arignar Anna Government Arts College, Musiri-621 211, Tamil Nadu, India, for their support and facilities provided. Author thankful this work was conducted in the laboratory which is financially supported by UGC, New Delhi, India (Ref No. 42-570/2013 (SR)).

Figure-1. Antifeedant activity of crude extracts of *B. buxifolia* against 4th instars larvae of *S.litura* and *H. armigera*



Values are mean of five replications. Within the column similar alphabets are statistically not significant ($p<0.05$ by LSD).

Figure-2. Antifeedant activity (FI_{50} %/cm^2) of crude extracts of *B. buxifolia* against 4th instars larvae of *S. litura*and *H. armigera*

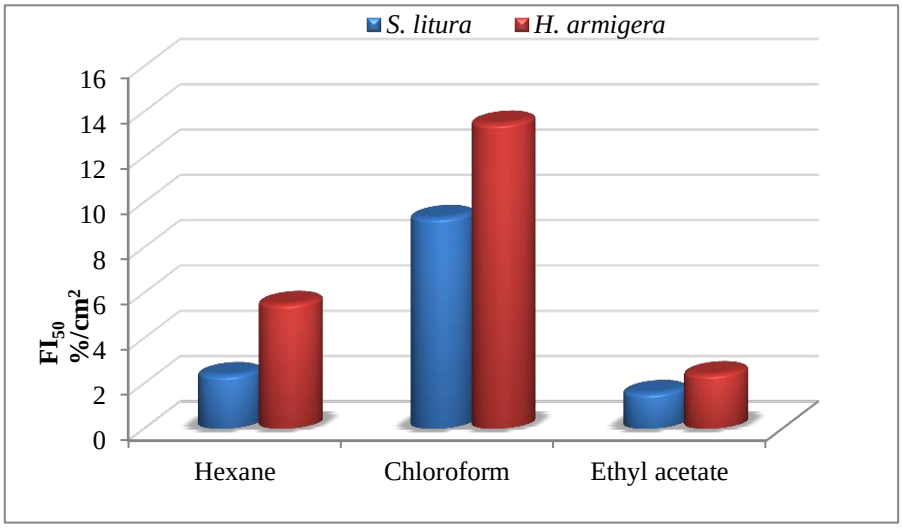


Table-1. Preliminary phytochemical analysis of different solvent extracts of *B. buxifolia*

Constituents	Ethyl acetate extract
Alkaloids	-
Anthraquinones	-
Coumarin	-
Catechin	-
Flavonoids	+
Phenols	+
Quinines	+
Saponins	-
Steroids	-
Terpenoids	+
Sugars/glycoside	-

+ Presence of compound - Absence of compound

REFERENCES

[1] H. Bami, "Pesticide use in India-Tenquestions," *Chemical Weekly*, vol. 4, pp. 7-10, 1997.

[2] A. Jeyasankar, S. Premalatha, and K. Elumalai, "Antifeedant and insecticidal activities of selected plant extracts against Epilachna beetle, Henosepilachna vigintioctopunctata (Coleoptera: Coccinellidae)," *Advances in Entomology*, vol. 2, pp. 14-19, 2014.

[3] T. Katyal and M. Satake, *Environmental pollution. In: Introduction to environmental pollution*. New Delhi: Anamol Publications, 1996.

[4] S. Kannaiyan, *Insect pest management strategies: current trends and future prospectus In: Strategies in integrated pest management*. New Delhi: Phoenix Publishing House, 2002.

[5] N. Ferry, M. Edwards, J. Gatehouse, and A. Gatehouse, "Plant–insect interaction: Molecular approaches to insect resistance (Edited by Sasaki T, Christou P)," *Curr Opin Biotechnol*, vol. 15, pp. 155–161, 2004.

[6] A. Jeyasankar and R. A. Jesudasan, "Insecticidal properties of novel botanicals against a few lepidopteran pests," *Pestology*, vol. 29, pp. 42-44, 2005.

[7] B. Isman, O. Koul, A. Lucyzynski, and J. Kaminski, "Insecticidal and antifeedant bioactivities of neem oils and their relationship to Azadirachtin content," *J. Agric. Food Chem.*, vol. 38, pp. 1407-1411, 1990.

[8] H. Ben Jannet, H. Skhiri, Z. Mighri, M. Simmonds, and W. Blaney, "Responses of spodoptera littoralis larvae to Tunisian plant extracts and to neo-clerodane diterpenoids isolated from Ajuga pseudoiva leaves,"*Fitoterapia*, vol. 71, pp. 105 – 112, 2000.

[9] D. J. Finney, *Probit analysis*, III ed. Cambridge: University Press, 1971.

[10] T. Subramonithangam and K. Kathiresan, "Toxic effect of mangrove plant extracts on mosquito larvae anopheles stephensi L,"*Current Sciences*, vol. 57, pp. 914-915, 1998.

[11] M. Isman, "Insect Antifeedants: In Pesticide Outlook," *Royal Soc. Chem.*,vol. 13, pp. 152-157, 2002.

[12] M. M. H. Adeyemi, "The potential of secondary metabolites in plant material as deterrents against insect pests: A review," *African Journal of Pure and Applied Chemistry*, vol. 4, pp. 243-246, 2010.

[13] A. Jeyasankar and Chinnamani, "Bioactivity of Pseudocalymma alliaceum (Lam.)," *Sandwith (Bignoniaceae) against Spodoptera litura Fabricius and Helicoverpa armigera Hubner (Lepidotera: Noctuidae)*, vol. 2, pp. 302-307, 2014.

[14] A. Jeyasankar, S. Premalatha, and K. Elumalai, "Biological activities of Solanum pseudocapsicum (Solanaceae) against cotton bollworm, Helicoverpa armigera Hübner and armyworm, Spodoptera litura Fabricius (Lepidoptera:Noctuidae)," *Asian Pacific Journal of Biomedicine*, vol. 2, pp. 981-986, 2012.

[15] A. Jeyasankar, N. Raja, and S. Ignacimuthu, "Antifeedant and growth inhibitory activities of crude extracts and fractions of Syzygium lienare (Myrtaceae) against Spodoptera litura (Fab.)," *Current Resesearch Journal of Biological Scicences*, vol. 2, pp. 173–177, 2010.

[16] A. Jeyasankar, N. Raja, and S. Ignacimuthu, "Insecticidal compound isolated from syzygium lineare wall. (Myrtaceae) against Spodoptera litura (Lepidoptera: Noctuidae)," *Saudi Journal of Biological Sciences*, vol. 18, pp. 329-332, 2011.

[17] K. Elumalai, T. Mathivanan, A. Elumalai , A. Jeyasankar, S. Dhanasekaran, and K. Krishnappa, "Larvicidal and ovicidal properties of selected Indian medicinal plants extracts against american bollworm, helicoverpa armigera (Hub.) (Lepidoptera: Noctuidae)," *International Journal of Interdisciplinary Research and Reviews*, vol. 1, pp. 5-11, 2013.

[18] M. Morimoto, Y. Fujii, and K. Komai, "Antifeedants in Cyperaceae : Coumaran and quinines from cyperus spp. P," *Hytochemistry*, vol. 51, pp. 605 –608, 1999.