Full Length Research Article

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Research Journal of Agricultural Sciences
Volume 15; Issue 06 (Nov–Dec 2024); pp 1275–1278

ISSN: 0976-1675 (P)
ISSN: 2249-4538 (E)

The Crude Extracts of Biopesticides for Management of Semilooper in Gmelina Arborea

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Received: 04 Jun 2024; Revised accepted: 16 Nov 2024

Abstract

Botanicals act not only as insecticides but also function as antifeedants, oviposition deterrents and ovicides. The biopesticidal property of plant extracts against test insect *Achaea janata* at different concentrations was done. 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 experiment and the data pertaining to overall efficacy of different plant products showed that Tree PAL was significantly more effective than others, followed by *Spherathus indicus* and Crawl clean which was also proved to be prominent. Efficacy of plant extracts and some developed products used in bringing down the population of test insect was studied in the nursery.

***Key words*:** Extracts, Semilooper, Biopesticide, Efficacy, Neem

Insect pests are one of the major limiting factors in crop production. Synthetic organic insecticides have emerged as major tools of pest management. Insect pests represent a significant limitation in crop production, leading to substantial yield losses and impacting overall agricultural productivity [1]. To combat this challenge, synthetic organic insecticides have become the primary tool in pest management. These insecticides provide rapid and effective control over a broad spectrum of pests, making them highly valuable for ensuring crop health and yield stability [2]. However, the extensive use of synthetic insecticides has raised concerns about environmental safety, non-target effects, pest resistance, and potential health risks. This scenario has intensified interest in developing alternative pest control methods, including biopesticides derived from plants, which offer a more sustainable and environmentally friendly approach. Plant-based extracts and natural compounds have shown promising insecticidal properties with fewer adverse environmental impacts [3-4].

The use of biopesticides, alongside careful integration with conventional insecticides, can help create balanced pest management strategies that not only reduce reliance on synthetic chemicals but also preserve ecological health and support long-term agricultural productivity [5]. Integrating biopesticides with conventional insecticides can create a balanced and effective pest management strategy. However, the indiscriminate use of synthetic chemicals in pest control has led to a major setback: many insect pests have developed resistance to these insecticides, reducing their effectiveness and necessitating higher doses or alternative chemicals to achieve control. This cycle not only increases production costs but also exacerbates environmental contamination and health risks. Botanical insecticides have emerged as attractive alternatives to synthetic chemicals for pest management. Derived from plants, these natural compounds are believed to pose minimal risks to the environment, non-target organisms, and human health. Botanical insecticides are often biodegradable and less likely to contribute to pest resistance due to their complex, diverse bioactive compounds [6]. As a result, they offer a promising, eco-friendly solution for integrated pest management strategies, aligning well with sustainable agricultural practices and the need to protect both ecological balance and public health. In addition to the challenges posed by synthetic insecticides, there remains a vast, largely untapped potential within the plant kingdom for new pesticidal resources [7].

Although approximately 2,000 plant species out of an estimated 250,000 have been reported to exhibit insecticidal properties, only a small fraction of these have been thoroughly analysed for their biocidal activity, chemical composition, and specific modes of action [8-9]. This suggests that many more insecticidal plants and active compounds are yet to be identified and evaluated. Exploring these plants could reveal novel bioactive compounds with unique mechanisms for pest control, potentially overcoming resistance issues and offering targeted, environmentally benign options for pest management. Further research and discovery in this area hold promise for expanding the arsenal of natural, sustainable pest control agents and strengthening integrated pest management practices in agriculture and forestry [10]. Tropical forests are rich in biodiversity. Native people use various plant products for different and specific purposes. Many workers recorded use of certain plant species by the native people for insect repellent, attractant, antifeedant and insecticidal activity. On the other hand, world over intense efforts are on to identity newer

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Citation: Deepa M, Kumar NS, Praveen NY. 2024. The crude extracts of biopesticides for management of semilooper in gmelina arborea. *Res. Jr. Agril. Sci.* 15(6): 1275-1278.

compounds of insecticidal properties with novel modes of action. So, ICFRE-IFB Hyderabad has studied the bio-pesticidal property of plant extract *Spherathus indicus* against test insect concerned.

MATERIALS AND METHODS

The extraction was carried out in the Soxhlet's extraction apparatus. The samples containing leaves of the selected plant materials (Table 1, Fig 1) 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 (Fractional Distillation Method).

Fig 1 Laboratory of IFB Hyderabad, processing of plant extracts

Fig 2 Nursery plot experiment

Table 1 List of plant species used in the laboratory evaluation

S. No.	Botanical name	Vernacular name	Telugu name	Family	Plant part used
1.	*Spheranthus indicus*	East Indian globe thistle	Bodasaram	Asteraceae	Leaf
2.	*Chloroxylon sweietenia*	Satin wood tree	Billudu	Meliaceae	Leaf

Table 2 Test insect selected for the study

S. No.	Common Name	Scientific name	Family	Order
1.	Gmelina semilooper	*Achaea janata*	Lepidoptera	Noctuidae

Table 3 Nursey plot experiment

For nursery		
Number of extracts	:	4
Number of concentrations	:	2 (0.5% and 1%)
Total number of formulations	:	4
Control (Neem Formulation and Synthetic pesticide)	:	2
Concentration of control	:	0.05 %
Total number of controls	:	2
Number of treatments	:	6 (Total number of formulations + control)
Number of replicates	:	10 (25 plants each)
Total number of replications	:	40 (Number of treatments × replicates)
Total number of plants	:	1000 (Total no. of replications × 25 plants)

Treatment duration form the age of 30 days – 100 days old seedlings

RESULTS AND DISCUSSION

The data regarding the percentage reduction of larval population due to application of plant extracts are presented in the (Table 4, Fig 2). Results obtained at 24 hours after spraying indicated that Neem brought about a significant reduction in the populations of larvae. It resulted in 91.75% reduction of synthetic chemical followed by Neem and Tree Pal and *Spherathus indicus* each with 75.00 per cent efficacy [11]. The performance of *Chloroxylon swietenia* 66.67% in reducing the larval population was significantly lower than other plant extracts. A further reduction in population of larvae was noticed on third day after spraying with all treatments except Tree PAL (91.75%) [12-13]. *Spherathus indicus* and crawl clean has resulted in 83.25 per cent reduction over control. The data pertaining to overall efficacy of different plant products showed that Tree pal was significantly more effective than others with 83.37 per cent efficacy, followed by *Spherathus indicus* and crawl clean which was also proved to be prominent, as it resulted in 79.12 per cent reduction *Chloroxylon swietenia* showed the least performance 70.83 per cent [14]. The order of the plant extracts according to their overall efficacy was Profenophos > Neem > Tree PAL > *Spherathus indicus* > Crawl clean > *Chloroxylon swietenia* [15]. The study found that Neem and Tree PAL were most effective in reducing larval populations, with Neem achieving 91.75% reduction after 24 hours and Tree PAL showing the highest overall efficacy at 83.37%. Spherathus indicus and Crawl Clean also performed well, while Chloroxylon swietenia showed the least effectiveness.

The present investigation is the outcome of the aforesaid thought and studies were made in the Department of Entomology, Institute of Forest Biodiversity. A total of two Ethano-botanical plant extracts (Fig 1) and 2 products Tree PAL and Crawl clean developed and popularized not only among the tree growers but also agriculture farmers of Tamil Nadu, Kerala and Karnataka by Institute of Forest Genetics and Tree Breeding (IFGTB) was tested in nursery (Table 3) against important forest insect pest (Table 2) *Gmelina arborea* semilooper (*Achaea janata*) in nursery trail. *Spherathus indicus* has been tested by Chellappandian [11] and he indicated that larvicidal response against two mosquitoes *Culex quinquefasiatus* and *Aedes aegypti* at different dosages (62.5, 125, 250, 500 and 1000 ppm). The *Spherathus indicus* displayed prominent larvicidal activity at higher concentrations (1000 ppm). The laboratory bioassay of the essential oil and isolated sesquiterpenes from *Chloroxylon sweteiana* demonstrated significant insecticidal and antifeedant activities against *Helicoverpa armigera* [16-19]. Thus it is concluded that the degree biopesticidal property of different plant extracts varied from insect to insect, hence depending upon the pest problem and a particular type of extract has to be applied for effective control of the pest.

Table 4 Effect of plant extracts on the semilooper of *Achaea janata* under nursery conditions

S. No.	Treatments	Mean population of larvae per tree 24 hr after spraying	Mean percent reduction over control	Mean population of Larvae 72 hr after spraying	Mean percent reduction over control	Mean efficacy
1.	*Chloroxylon swietenia*	1.33	66.67 (54.73)	1.00	75.00(60.00)	70.83(57.30)
2.	*Spherathus indicus*	1.00	75.00(60.00)	0.67	83.25(65.84)	79.12(62.80)
3.	Tree PAL	1.00	75.00 (60.00)	0.33	91.75(73.30)	83.37(65.92)
4.	Crawl clean	1.00	75.00 (60.00)	0.67	83.25(65.84)	79.12(62.80)
5.	Profenophos	1.00	91.75(73.30)	0.33	91.75(73.30)	91.75(73.30)
6.	Neem	0.67	83.25 (65.84)	0.33	91.75(73.30)	87.50(69.30)
7.	Control	4.00	_	4.00	-	-
	F test		Sig		Sig	Sig
	SEm		0.82		0.74	1.32
	C.D. at 5%		2.52		2.28	4.06

Note: 1. Figures in parentheses are angular transformed values
2. Population and per cent reduction are mean of 3 replications

CONCLUSION

The investigation highlights the varying efficacy of different plant extracts and products in controlling the larval population of Gmelina arborea semilooper (*Achaea janata*) in nursery settings. Neem demonstrated the highest initial impact, achieving a 91.75% reduction in larvae 24 hours after application. This was followed by Tree PAL and *Spherathus indicus*, both showing 75% efficacy. Over time, Tree PAL emerged as the most effective overall, with an 83.37% reduction, followed by *Spherathus indicus* and Crawl Clean at 79.12%. The extract from *Chloroxylon swietenia* was

consistently the least effective, with an efficacy of 70.83%. The findings align with previous research that has noted the insecticidal properties of *Spherathus indicus* and *Chloroxylon swietenia* against different pests, illustrating that the effectiveness of these extracts can vary widely depending on the target insect species. This study confirms that while biopesticides like Neem and Tree PAL hold potential as effective alternatives to synthetic chemicals, the choice of a specific biopesticide should be guided by the nature of the pest to maximize efficacy. The outcomes of this research may provide valuable insights for forestry and agricultural pest management, encouraging further exploration and application of eco-friendly pest control solutions.

Acknowledgement

The authors would like to express their gratitude to the DG ICFRE Dehradun for fund allocation through MoEF New Delhi and the Director, IFB, Hyderabad, Telangana for providing the facilities to carry out the experiments, and for sample collection team (Shiva kumar PA and Gayatri. JPF).

LITERATURE CITED

1. Subedi B, Poudel A, Aryal S. 2023. The impact of climate change on insect pest biology and ecology: Implications for pest management strategies, crop production, and food security. *Journal of Agriculture and Food Research* 14: 100733.
2. Ofuya TI, Okunlola AI, Mbata GN. 2023. A review of insect pest management in vegetable crop production in Nigeria. *Insects* 14(2): 111.
3. Souto AL, Sylvestre M, Tölke ED, Tavares JF, Barbosa-Filho JM, Cebrián-Torrejón G. 2021. Plant-derived pesticides as an alternative to pest management and sustainable agricultural production: Prospects, applications and challenges. *Molecules* 26(16): 4835.
4. Šunjka D, Mechora Š. 2022. An alternative source of biopesticides and improvement in their formulation-recent advances. *Plants (Basel)*. 11(22): 3172.
5. Ayilara MS, Adeleke BS, Akinola SA, Fayose CA, Adeyemi UT, Gbadegesin LA, Omole RK, Johnson RM, Uthman QO, Babalola OO. 2023. Biopesticides as a promising alternative to synthetic pesticides: A case for microbial pesticides, phytopesticides, and nanobiopesticides. *Front. Microbiology* 14: 1040901. doi: 10.3389/fmicb.2023.1040901.
6. Chakraborty N, Mitra R, Pal S, Ganguly R, Acharya K, Minkina T, Sarkar A, Keswani C. 2023. Biopesticide consumption in India: Insights into the current trends. *Agriculture* 13(3): 557.
7. Deguine JP, Aubertot JN, Flor RJ. 2021. Integrated pest management: good intentions, hard realities. A review. *Agron. Sustain. Dev*. 41: 38. https://doi.org/10.1007/s13593-021-00689-w
8. Daraban GM, Hlihor RM, Suteu D. 2023. Pesticides vs. Biopesticides: From pest management to toxicity and impacts on the environment and human health. *Toxics* 11(12): 983.
9. Reale R, Medeghini L, Botticelli M. 2024. Stealing from phytotherapy—Heritage conservation with essential oils: A review, from remedy to sustainable restoration product. *Sustainability* 16(12): 5110. https://doi.org/10.3390/su16125110
10. Akbar R, Khan IA, Alajmi RA, Ali A, Faheem B, Usman A, Ahmed AM, El-Shazly M, Farid A, Giesy JP, Aboul-Soud MAM. 2022. Evaluation of insecticidal potentials of five plant extracts against the stored grain pest, *Callosobruchus maculatus* (Coleoptera: Bruchidae). *Insects* 13(11): 1047.
11. Chellappandian M, Thanigaivel A, Vasantha-Srinivasan P, Edwin ES, Ponsankar A, Selvaraj SR, Kalaivani K, Sengottayan SN, Benelli G. 2018. Toxicological effects of *Sphaeranthus indicus* Linn. (Asteraceae) leaf essential oil against human disease vectors, *Culex quinquefasciatus* Say and *Aedes aegypti* Linn., and impacts on a beneficial mosquito predator. *Environ. Sci. Pollution Research* 25: 10294-10306.
12. Tembo Y, Mkindi AG, Mkenda PA, Mpumi N, Mwanauta R, Stevenson PC, Ndakidemi PA, Belmain SR. 2018. Pesticidal plant extracts improve yield and reduce insect pests on legume crops without harming beneficial arthropods. *Front Plant Science* 9: 1425.
13. Ali S, Li Y, Haq IU, Abbas W, Shabbir MZ, Khan MM. 2021. The impact of different plant extracts on population suppression of *Helicoverpa armigera* (Hub.) and tomato (*Lycopersicon esculentum* Mill) yield under field conditions. *PLoS One* 16(12): e0260470.
14. Galani VJ, Patel BG, Rana DG. 2010. *Sphaeranthus indicus* Linn.: A phytopharmacological review. *International Journal of Ayurveda Research* 1(4): 247-253.
15. Ahmad HI, Nadeem MF, Shoaib Khan HM, Sarfraz M, Saleem H, Khurshid U, Locatelli M, Ashraf M, Akhtar N, Zainal Abidin SA, Alghamdi A. 2021. Phytopharmacological evaluation of different solvent extract/fractions from *Sphaeranthus indicus* L. flowers: From traditional therapies to bioactive compounds. *Front Pharmacology* 12: 708618. doi: 10.3389/fphar.2021.708618.
16. Kiran SR, Reddy AS, Devi SP, Reddy JK. 2006. Insecticidal, antifeedant and oviposition deterrent effects of the essential oil and individual compounds from the leaves of *Chloroxylon swietenia*. *Pest Management Science* 62(11): 1116-1121.
17. Ramarao N, Henry AN. 1996. Ethnobotany of Eastern Ghats in Andhra Pradesh, India. Botanical Survey of India, Calcutta. pp 259.
18. Subramaniam B. 1993. *Potential Pesticidal Plants of India*. Westvill Publishing House, New Delhi. pp 197.
19. Murugan K, Babu R, Jeyabalan D, Senthil Kumar N, Sivaramakrishnan S. 1996. Antipupational effect of neem oil and neem seed kernel extract against mosquito larvae of *Anopheles stephensi* (Liston). *Jr. Ent. Research* 20: 137-139.