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RESEARCH ARTICLE

Biopotential Features and Pesticidal Study of *Cascabela peruviana*, *Nerium oleander*, and *Mimusops elengi* against Armyworm *Spodoptera litura* (*Noctuidae*: *Lepidoptera*) and Pod Borer Larvae of *Helicoverpa armigera* (*Noctuidae*: *Lepidoptera*)

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ABSTRACT

To study the report, the different solvents of methanol, ethyl acetate, chloroform, and acetone for *Cascabela peruviana* (*C. peruviana*), *Nerium oleander* (*N. oleander*), and *Mimusops elengi* (*M. elengi*) were used the experimental analysis in pest control of most dangerous notorious *Lepidopteran* pests of *Spodoptera litura* (*S. litura*) and *Helicoverpa armigera* (*H. armigera*). The antifeedant activity of *C. peruviana* against *S. litura* 98.6%, *H. armigera* 94.6%, *N. oleander* against *S. litura* 94.2%, *H. armigera* 90.8% and *M. elengi* against *S. litura* 92.8%, *H. armigera* 86.4%. Lethal concentration 50 (L_{C50}) and LC_{90} values of *C. peruviana* against *S. litura, H. armigera* the values are *S. litura* (LC_{50} = 88.3 and LC_{90} = 204.91) and *H. armigera* (LC_{50} = 103.19 and LC_{90} = 232.10), *N. oleander* against *S. litura* (LC_{50} = 102.10 and LC_{90} = 228.01) and *H. armigera* (LC_{50} = 121.10 and LC_{90} = 254.69) and *M. elengi* against *S. litura* (LC_{50} = 120.55 and LC_{90} = 250.43). The oviposition deterrent activity of *C. peruviana* against *S. litura* 90.8%, *H. armigera* 86.2%, *N. oleander* against *S. litura* 88.6%, *H. armigera* 82.8% and *M. elengi* against *S. litura* 78.2%, *H. armigera* 73.6%. When same species it is proof that methanol extract of *C. peruviana*, *N. oleander*, and *M. elengi* plant flower extracts was most effective insecticidal activity of armyworm *S. litura* and pod borer larvae of *H. armigera*. Performance of maximum antifeedant activity, lethal activity, and oviposition deterrent activity recorded in the methanol extract of *C. peruviana* than could be utilized in pest control program.

Keywords: *Cascabela peruviana, Helicoverpa armigera, Mimusops elengi, Nerium oleander, notorious, Spodoptera litura*

INTRODUCTION

One possible way to reduce the high consumption of synthetic insecticides is through the application botanical pesticides commonly considered to be environmentally and medically safe.[1,2] Botanical properties are highly toxic to many insect species and more than 2000 plant verities are known to possess some medical properties.[3] Biopesticides are alternative to synthetic pesticides due to their generally low environmental pollution, low toxicity to humans, and other applications. Essential oils and their constituents have been reported to be an effective source of botanical pesticides.[4,5]

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Cascabela peruviana, family: Apocynaceae, is a most toxicant plant motherland of Southern Mexico and Central America plantation as an ornamental. *C. peruviana* is commonly used as domestic medicine in Tropical America and also in Tropical Asia. These toxic substances have experiments for uses in the biopest control. *C. peruviana* seed oil was used to antifungal, antibacterial, and anti-termite products.[6] The clinical advantage of antidotes, atropine, and digitoxin antibodies and treatment include oral management activities of charcoal.[7] *C. peruviana* Plant materials reduced the toxic fragment that produces antibody of ovine polyclonal as used for many countries.[8] The plant latex is applied to decayed teeth to recover toothache, it is used to treat chronic sores and ulcers, and it is applied to soften corns and calluses. The chemical

constituents of flavonol glycoside have been isolate from the *C. peruviana* leaves. Particular chemical constituents found to the inhibitory effects against HIV-1 reverse transcriptase HIV-1 integrase. *Nerium oleander,* family Apocynaceae, is an evergreen shrub growing up to 4 m in height. It is one of the ornamental plants distributed in Tropical Asia. Oleander is one of the most toxicness plants in the world and contains numeric toxic contents, many of which can be died human beings, especially young children. *N. oleander* is considered extremely high and it has conclusions of some cases that only a small amount had lethal effects. The most significant of these toxins is oleandrin, which are cardiac glycosides.[9]

In addition to their antioxidant and their very marked antimicrobial activity, the polyphenols have other activities such as vasculoprotectrice activity anti-inflammatory and antitumor.[10] The aqueous extract of *N. oleander* L. has been undergoing clinical investigations as an anticancerous agent. Oleandrin and its aglycone oleandrigenin are the active compounds that are isolated from this plant which shown to have anticancerous properties, and the glycosides are beneficial in lowering blood pressure.[31] Anvirzel has also revealed cytotoxicity in human tumor cell lines with evidence of apoptosis as a principal mode of cell death.[11] *Mimusops elengi* Linn, family Sapotaceae, generally known as bakul is a small to large evergreen tree showed all over the different parts of India. *M. elengi* plant materials were used as anthelmintic, anti-anxiety, antihyperlipidemic, antiulcer, anti-inflammatory, analgesic, antipyretic, and anticonvulsant to be used. Natural antioxidants such as flavonoids, tannins, and phenols are increasingly attracting because they are disease preventing, health promoting, and antiaging substances.[32] The traditional medicinal valuable reported many plant parts used as cardio tonic, alexipharmic, stomachic, anthelmintic, tonic astringent which curable biliousness, disease of the gums and teeth.[33] The flower is good aroma and cooling, astringent to the bowels are used to curable disease to the blood, liver complaints, disease of the nose, headache and then curable to the asthma disease.[12] The developmental practices of traditional medicine are based on centuries of belief and observations and noted, which need help in the development of innovation medicine. In recent days, there is worldwide interest in herbal drugs. The natural flora has been used in a number of systems of medicines in our country as well as in other countries. India is well known as the 'Emporium of Medicinal Plants'.[13] *Spodoptera litura*, the armyworm, is a major devastating pest which is the host varieties of 180 plant specious and 45 families of worldwide.[14,15] This pest of armyworm plays a major role in infestation of agriculture forming. It causes commercial economic losses to various vegetables and field crops from 10% to 30%.[16] The neonate larvae earlier attack the foliage of the plants and later stage feed on matured seeds in the pod. The selected pest is considered as the serious pests of various commercial important crops such as cotton, peanut, chilly, tobacco, castor bean, legumes, and teases.[17]

Helicoverpa armigera is another devastating pest of worldwide occurrence inflicting crop damage in India to the sum of one billion dollars at the end of the year attacks over 200 variety species of field crop belonging to 45 families.[18] This pest was damaged potential of average infestation single larvae can be destroyed 30–40 pods per plant in cotton the field.[19] *H. armigera* is a cosmopolitan insect and has gained importance as a major devastating pest due to its capacity to feed on many verities of plant species, some of which are important agricultural crops.[20] Therefore, extensive studies are carried out to screen plants as insect growth control agents. Over the past decades, better attention has been focused on the bioactivity of phytochemicals for their potential as pesticides against phytophagous insects.[21] Hence, the present study has been made on the important medicinal plant of *C. peruviana*, *N. oleander*, and *M. elengi* against *S. litura* and *H. armigera* to study of eco-friendly approaches of agriculture pest control.

MATERIALS AND METHODS

Collection and extraction of plant material

C. peruviana, N. oleander, and *M. elengi* the mature flowers are collected from Naduvalur village of Salem district, Tamil Nadu, India. The bulk plant raw material was dried in the shade at room temperature. The dried 1eaves 150 g were extracted with hexane, ethyl acetate, chloroform, and methanol (750 ml), in a Soxhlet apparatus individually until

exhaustion. The extract was concentrated under reduced pressure of 22–26 mm Hg at 45°C by "Rotovapor" and the residue obtained was stored at 4°C by in an amber vial. Then, the vials labeled with silver foil and transported to the laboratory.

Rearing of insects

The taro caterpillar *S. litura* and *H. armigera* were collected from the field in Kumaramangalam village, Cuddalore district of Tamil Nadu, India, and the collected larvae were reared individually in plastic container vials and fed usually peanut leaf (*Arachis hypogea*) until the larvae became pupae under the laboratory condition (27 ± 2°C) and 75 ± 5% relative humidity. Usually, hale and healthy uniform sized fourth instar larvae, the recently emerged matured eggs, and adult moths of genteel species were used in the pesticidal activity.

Antifeedant activity

Antifeedant activity of the methanol extracts is used leaf disc method. The fresh peanut (*A. hypogea*) plant leaf was used the experimental studies. Leaf disc of 4.0 cm diameter was punched using leaf eater and was dipped individually 25, 75, 125, 175, and 225 ppm. The leaf disc dipped in hexane, ethyl acetate, methanol, and chloroform was used to extracts. In each plastic Petri dish (40 cm × 90 cm), wet filter paper was placed to avoid early drying of the tested leaves. The fourth instar larvae were pioneered in each and every jurisidiction Petridis. The consumption of leaf disc in the treated and control *S. litura* and *H. armigera* larvae after 48 h of the experience was measured using leaf area meter. Leaf discs consumed by the larvae in the test were corrected from the negative jurisdiction. Five replicates were maintained for each treatment with 25 larvae. The investigation was conducted at laboratory condition (27.0°C ± 2°C) with 14:10 h illumination, and dark photoperiod and 75 ± 5% relative humidity activity were calculated according to the formula.[22]

Larvicidal activity

Larvicidal activity was studied using leaf no-choice method. Peanut leaf disc was used; they were dipped in various concentrations of 25, 75, 125, 175, and 225 ppm plant extracts as used for the larvicidal activity. After 48 h experiment, the larvae *S. litura* and *H. armigera* were continuously maintained on untreated fresh peanut and castor leaves. Diet was changed every 48 h. Larval mortality was recorded up to 24 h experiment. The number of larvae 25 replicates used and laboratory conditions were the same as the percentage of larval mortality was calculated using Abbot's formula.[23]

$$\text{Mortality}\% = \frac{\%\text{MT} - \text{MT}}{100 - \%\text{MC}} \times 100$$

Oviposition-deterrent activity

Twenty-five individual eggs of *S. litura* and *H. armigera* were separated and immersed in 25, 75, 125, 175, and 225 ppm concentrations. Five replicates were maintained (n = 100); number of eggs hatched in the control and the treatments was recorded. The laboratory conditions were the same as the antifeedant activity treatment.

$$\%\text{OA} = \frac{\%\text{EHC} - \%\text{EHT}}{\%\text{EHC}} \times 100$$

Statistical analysis

The normal mortality information was focused to probit[24] investigation for ascertaining lethal concentration 50 (LC_{50}), LC_{90}, and Chi-square values which were figured by utilizing the product utilizing Statistical Package of the Social Sciences rendition 16.0 for windows, and the significant level was set at $P < 0.05$.

RESULTS

Antifeedant activity of various solvent extracts of *C. Peruviana, N. Oleander,* and *M. Elengi*

Antifeedant activity observed against fourth instar larvae of *S. litura* and *H. armigera* is shown in Table 1. The present study results showed that the antifeedant activity was assessed based on antifeedant index which normally indicates the decreased rate of feeding. The experiment study maintained three different most important medicinal plants and controlled the two notorious *Lepidopteran* pests. Plant extract used as both

Table 1: Antifeedant activity of *C. peruviana, N. oleander,* and *M. elengi* against *S. litura* and *H. armigera*

Plant	Pest	Solvent	Concentration % ppm				
			25	75	125	175	225
C. peruviana	*S. litura*	Methanol	23.6±1.94^{ab}	38.2±1.30^{c}	60.2±2.48^{d}	82.4±1.81^{e}	99.2±1.94^{f}
		Ethyl acetate	21.4±3.57^{ab}	36.4±1.51^{c}	57.4±2.07^{d}	76.2±2.68^{e}	97.2±2.48^{f}
		Chloroform	19.6±1.94^{ab}	33.2±2.48^{bc}	54.2±2.28^{cd}	72.6±1.81^{e}	94.4±0.89^{f}
		Acetone	17.2±1.78^{a}	30.6±1.94^{b}	52.4±1.51^{cd}	69.4±2.19^{de}	90.8±2.38^{ef}
	H. armigera	Methanol	21.4±4.27^{ab}	35.6±1.30^{c}	56.8±3.56^{d}	77.6±3.13^{e}	96.6±2.60^{f}
		Ethyl acetate	18.8±2.38^{a}	32.6±2.60^{bc}	53.4±2.88^{cd}	75.4±2.96^{e}	93.2±2.48^{f}
		Chloroform	15.4±2.19^{a}	30.2±1.78^{b}	52.6±0.89^{cd}	69.2±2.86^{de}	91.6±1.94^{f}
		Acetone	12.8±2.38^{a}	26.4±2.50^{b}	43.2±1.64^{c}	55.2±1.92^{cd}	82.2±2.04^{e}
N. oleander	*S. litura*	Methanol	22.4±2.19^{ab}	37.4±2.88^{c}	58.2±2.48^{d}	79.6±2.88^{e}	96.6±2.30^{f}
		Ethyl acetate	20.2±1.09^{ab}	34.6±2.60^{bc}	55.4±2.19^{cd}	73.2±2.48^{e}	92.2±2.48^{f}
		Chloroform	18.4±2.19^{ab}	32.4±1.67^{bc}	50.6±2.60^{c}	69.8±2.19^{de}	87.6±1.94^{ef}
		Acetone	16.6±1.94^{a}	27.4±2.88^{b}	48.4±1.67^{c}	65.4±2.19^{de}	84.6±1.94^{ef}
	H. armigera	Methanol	20.2±0.83^{ab}	32.2±1.78^{bc}	53.8±1.64^{cd}	74.6±3.04^{e}	94.8±1.09^{f}
		Ethyl acetate	17.4±2.88^{a}	30.6±1.94^{b}	50.2±2.68^{c}	71.4±1.51^{e}	91.4±2.70^{f}
		Chloroform	14.8±2.38^{a}	28.2±2.86^{b}	46.2±1.09^{c}	65.8±1.92^{de}	88.6±1.14^{ef}
		Acetone	11.2±3.19^{a}	23.6±1.94^{ab}	39.8±1.92^{c}	51.6±2.50^{cd}	79.6±1.51^{e}
M. elengi	*S. litura*	Methanol	21.8±1.78^{ab}	35.8±1.30^{bc}	56.6±2.60^{d}	77.2±2.48^{e}	94.8±1.92^{f}
		Ethyl acetate	19.4±1.01^{ab}	31.6±1.94^{b}	53.4±2.07^{cd}	70.2±1.64^{de}	89.2±3.70^{ef}
		Chloroform	17.2±1.78^{a}	30.4±2.88^{b}	48.2±2.48^{c}	64.6±1.94^{de}	87.4±2.19^{ef}
		Acetone	15.4±1.78^{a}	24.2±2.68^{ab}	46.4±2.88^{c}	62.4±2.30^{de}	81.2±1.14^{ef}
	H. armigera	Methanol	18.6±1.34^{a}	30.8±1.64^{b}	51.6±2.60^{cd}	72.6±1.94^{e}	92.4±1.51^{f}
		Ethyl acetate	16.2±1.64^{a}	28.4±1.81^{b}	48.2±2.48^{c}	68.4±1.14^{de}	87.2±4.49^{ef}
		Chloroform	13.8±2.16^{a}	25.2±1.92^{ab}	42.4±1.81^{c}	66.2±1.92^{de}	85.6±1.94^{ef}
		Acetone	10.4±2.88^{a}	19.4±2.19^{ab}	37.6±1.51^{c}	48.4±2.07^{c}	70.2±2.38^{de}

Within the column, means±SD followed by the same letter indicates different significantly (ANOVA, Tukey's HSD test, $P<0.05$ levels), *C. peruviana: Cascabela peruviana*, *S. litura: Spodoptera litura*, *H. armigera*: *Helicoverpa armigera, M. elengi: Mimusops elengi, N. oleander: Nerium oleander*

larvicidal activity and ovicidal activity at the same control methods plants and pests. The maximum antifeedant activities were recorded in methanol extract on *C. peruviana* against *S. litura* and *H. armigera*, and the values are *S. litura* 98.6% and *H. armigera* 94.6%. The antifeedant activity of N. oleander against *S. litura* and *H. armigera*, and the highest values are represented *S. litura* 94.2% and *H. armigera* 90.8%. The antifeedant activity *N. oleander* against *S. litura* and *H. armigera* and the highest values are noted at the values are *S. litura* 92.8% and *H. armigera* 86.4%. The maximum antifeedant activity was observed in the methanol extract of *C. peruviana* plant extract. The higher concentration limit such as 225 ppm followed by four solvent.

Lc_{50} of various solvent extracts of *C. Peruviana, N. Oleander,* and *M. Elengi*

LC_{50} observed against fourth instar larvae of *S. litura* and *H. armigera* is shown in Table 3. LC_{50} and LC_{90} values of *C. peruviana* against *S. litura* values are LC_{50} = 88.803 and LC_{90} = 204.91 and *H. armigera* values are LC_{50} = 103.19 and LC_{90} = 232.10, respectively. LC_{50} and LC_{90} values of *N. oleander* against *S. litura* and *H. armigera* the values are *S. litura* (LC_{50} = 102.10 and LC_{90} = 228.01) and *H. armigera* (LC_{50} = 121.55 and LC_{90} = 254.69). LC_{50} and LC_{90} values of *M. elengi* against *S. litura* and *H. armigera* the values are *S. litura* (LC_{50} = 120.55 and LC_{90} = 250.43) and *H. armigera* (LC_{50} = 137.60 and LC_{90} = 279.85) [Table 2]. The maximum lethal activity was observed in the methanol extract at *C. peruviana* plant extract. The higher concentration limit such as 225 ppm followed by four solvent.

Oviposition-deterrent activity of various solvent extracts of *C. Peruviana, N. Oleander,* and *M. Elengi*

Oviposition-deterrent activity observed against fourth instar larvae of *S. litura* and *H. armigera* is

Table 2: LC_{50} and LC_{90} values of *C. peruviana*, *N. oleander*, and *M. elengi* against *S. litura* and *H. armigera*

Plant	Pest	Solvent	LC_{50} (ppm)	95% confidence limit		LC_{90} (ppm)	95% confidence limit		χ^*
				LCL	UCL		LCL	UCL	
C. peruviana	*S. litura*	Methanol	88.803	76.046	100.18	204.91	184.17	229.83	4.860 n.s
		Ethyl acetate	104.70	91.159	117.25	239.38	216.75	271.16	4.818 n.s
		Chloroform	124.49	110.71	138.33	272.20	244.35	312.69	5.882 n.s
		Acetone	145.06	131.06	160.55	297.86	266.03	345.00	7.286 n.s
	H. armigera	Methanol	103.19	90.075	115.31	232.10	211.05	261.20	1.877 n.s
		Ethyl acetate	122.84	109.76	135.84	261.33	236.23	296.97	1.633 n.s
		Chloroform	145.92	133.46	160.72	291.74	262.00	335.07	2.023 n.s
		Acetone	166.77	153.12	182.97	307.01	276.11	352.04	3.621 n.s
N. oleander	*S. litura*	Methanol	102.10	89.240	114.05	228.01	207.73	255.85	1.366 n.s
		Ethyl acetate	120.94	107.54	134.11	262.23	236.67	298.73	0.481 n.s
		Chloroform	142.75	129.35	157.28	288.33	259.06	330.92	1.951 n.s
		Acetone	164.55	150.65	180.96	309.39	277.39	356.51	2.532 n.s
	H. armigera	Methanol	121.10	108.35	133.64	254.69	231.17	287.62	1.981 n.s
		Ethyl acetate	143.66	130.16	158.33	290.47	260.84	333.69	0.511 n.s
		Chloroform	163.86	149.66	180.70	312.96	279.79	362.20	0.389 n.s
		Acetone	184.33	169.35	203.29	327.78	293.11	379.49	1.439 n.s
M. elengi	*S. litura*	Methanol	120.55	108.09	132.78	250.43	227.85	281.80	0.535 n.s
		Ethyl acetate	140.04	127.52	153.32	274.52	248.78	310.98	0.512 n.s
		Chloroform	163.04	149.93	178.28	299.33	270.20	341.39	1.214 n.s
		Acetone	181.72	168.36	198.09	309.52	280.14	352.00	3.153 n.s
	H. armigera	Methanol	137.60	124.45	151.43	279.85	252.36	319.38	2.720 n.s
		Ethyl acetate	159.67	145.55	176.12	310.18	277.26	359.08	1.409 n.s
		Chloroform	183.41	167.93	203.14	333.78	297.00	389.49	1.803 n.s
		Acetone	202.96	187.10	224.02	338.57	302.94	392.30	2.287 n.s

LC_{50}=Lethal concentration that kills 50% of the exposed larvae, LC_{90}=Lethal concentration that kills 50% of the exposed larvae. LCL=Lower confidence limit; UCL=Upper confidence limit; χ^2=Chi-square; n.s.=Not significant, *C. peruviana*: *Cascabela peruviana*, *S. litura*: *Spodoptera litura, H. armigera: Helicoverpa armigera, M. elengi*: *Mimusops elengi, N. oleander: Nerium oleander*

shown in Table 3. Methanol extract of *C. peruviana* showed that *S. litura* 90.8% and *H. armigera* 86.2%. The oviposition deterrent activity of *N. oleande*r the values are *S. litura* 88.6% and *H. armigera* 82.8%. The oviposition deterrent activity *M. elengi* the values are *S. litura* 78.2% and 73.6%. The maximum lethal activity was observed in the methanol extract of *C. peruviana* plant extract. The higher concentration limit such as 225 ppm followed by four solvent.

DISCUSSION

The maximum larvicidal activity was recorded from the highest concentration of methanol extract of *Abrus precatorius* at 500 ppm, and the least larvicidal activity was recorded from the 100 ppm concentration of hexane extract. Furthermore, the larval mortality observed from the 100, 200, 300, 400, and 500 ppm concentrations extracts showed 67.414 ± 2.26, 78.73 ± 2.63, 95.28 ± 2.49, 100.00 ± 0.00, and 100.00 ± 0.00. LC_{50} observed against fourth instar larvae of *S. litura* with various solvent extracts of hexane, diethyl ether, dichloromethane, ethyl acetate, and methanol extract of *A. precatorius* was 255.91, 266.21, 265.98, 251.84, and 225.76 ppm, respectively. The methanol extract was responsible for strong lethal activity observed against selected pest species.[25] Asia has abundant species of medicinal and aromatic plants and traditional medicines have practiced in Asia since ancient times. India has made use of medicinal plants to cure ailments for thousands of years.[34] The results of the antifeedant potential of the solvent crude extracts of *Duranta erecta* were investigated against *S. litura* and *H. armigera* larvae. Antifeedant activity was assessed based on antifeedant index. Higher antifeedant index normally indicates decreased rate of feeding. In the current year report, irrespective of concentration and solvents used for extraction, the antifeedant activity varied significantly. Data pertaining to the above experiment clearly revealed that maximum antifeedant activity was recorded in ethyl acetate

Table 3: Oviposition deterrent activity of *C. peruviana*, *N. oleander* and *M. elengi* against *S. litura* and *H. armigera*

Plant	Pest	Solvent	Concentration ppm				
			25	75	125	175	225
C. peruviana	*S. litura*	Methanol	19.2±2.48^{ab}	38.4±1.14^{c}	59.4±2.07^{d}	76.6±1.51^{e}	98.8±1.92^{f}
		Ethyl acetate	17.8±2.07^{a}	35.2±1.78^{bc}	57.2±2.16^{d}	74.4±1.67^{e}	95.2±2.04^{f}
		Chloroform	15.6±1.14^{a}	32.8±1.64^{bc}	54.6±1.34^{cd}	71.8±1.92^{e}	93.4±1.51^{f}
		Acetone	13.2±1.30^{a}	30.2±1.48^{b}	51.2±0.83^{cd}	69.4±1.81^{de}	91.2±2.16^{f}
	H. armigera	Methanol	16.4±2.19^{a}	35.6±0.89^{bc}	56.4±2.30^{d}	73.2±0.83^{e}	96.2±1.64^{f}
		Ethyl acetate	14.4±2.16^{a}	33.2±1.78^{bc}	54.4±1.64^{cd}	71.6±1.34^{e}	92.4±1.51^{f}
		Chloroform	12.8±2.58^{a}	29.6±1.94^{b}	52.2±2.61^{cd}	68.8±1.64^{de}	90.2±2.04^{ef}
		Acetone	10.2±1.30^{a}	24.6±0.86^{ab}	45.6±1.94^{c}	63.4±1.51^{de}	83.6±1.94^{e}
N. oleander	*S. litura*	Methanol	18.2±2.68^{ab}	36.2±2.61^{c}	56.6±1.51^{d}	73.2±1.41^{e}	96.6±1.34^{f}
		Ethyl acetate	16.8±1.81^{a}	33.6±1.51^{bc}	54.4±2.30^{cd}	70.4±1.81^{de}	91.2±2.28^{f}
		Chloroform	14.2±1.09^{a}	30.4±2.96^{b}	51.2±2.48^{cd}	68.2±2.61^{de}	89.4±1.51^{ef}
		Acetone	12.2±1.14^{a}	27.2±1.30^{b}	47.6±2.07^{c}	65.4±1.14^{de}	86.2±2.38^{ef}
	H. armigera	Methanol	15.8±1.30^{a}	32.6±1.14^{bc}	53.2±1.09^{cd}	71.6±1.51^{e}	93.8±1.92^{f}
		Ethyl acetate	13.6±1.51^{a}	30.4±1.18^{b}	51.4±3.04^{c}	69.4±1.51^{de}	88.4±0.89^{ef}
		Chloroform	11.6±1.31^{a}	27.2±1.92^{b}	49.6±1.34^{c}	65.6±2.30^{de}	86.8±0.86^{ef}
		Acetone	9.4±1.14^{a}	21.4±2.19^{ab}	41.2±0.83^{c}	60.8±1.92^{d}	80.8±2.48^{e}
M. elengi	*S. litura*	Methanol	17.2±2.58^{a}	33.4±0.54^{bc}	52.8±1.92^{cd}	71.2±2.68^{e}	93.2±2.86^{f}
		Ethyl acetate	15.2±2.28^{a}	31.2±1.64^{b}	49.4±1.81^{c}	67.6±2.07^{de}	86.6±1.94^{ef}
		Chloroform	13.6±2.40^{a}	26.8±2.28^{bc}	45.6±0.89^{c}	64.4±1.67^{de}	84.6±1.51^{e}
		Acetone	11.2±1.92^{a}	23.4±0.89^{ab}	42.2±1.64^{c}	62.2±2.94^{d}	81.2±1.48^{e}
	H. armigera	Methanol	14.8±1.64^{a}	30.6±1.51^{b}	50.6±1.94^{c}	68.6±1.81^{de}	89.6±2.40^{ef}
		Ethyl acetate	12.8±2.28^{a}	27.2±1.78^{b}	48.2±2.16^{c}	64.2±1.78^{de}	85.4±2.70^{ef}
		Chloroform	10.8±1.92^{a}	23.4±1.51^{ab}	44.2±1.64^{c}	61.4±2.07^{d}	82.4±1.81^{e}
		Acetone	8.2±0.44^{a}	18.6±1.94^{ab}	36.4±1.81^{c}	58.8±2.58^{d}	76.8±1.64^{e}

Values are expressed as mean±S.D of five replications. Within each row, different letters indicate significant differences (ANOVA, Tukey's HSD test, $P<0.05$),
C. peruviana: *Cascabela peruviana, S. litura: Spodoptera litura*, *H. armigera*: *Helicoverpa armigera, M. elengi*: *Mimusops elengi, H. armigera*: *Helicoverpa armigera, N. oleander*: *Nerium oleander*

extract on *S. litura* 80.37% and *H. armigera* 78.18% at 5% concentration; high larval mortality normally indicates potential larvicidal activity of plant extracts. Irrespective of concentration and solvents used for extraction, the insecticidal activity varied significantly. Insecticidal activity data revealed clearly that maximum insecticidal activity was recorded in ethyl acetate extract on *S. litura* 69.88% and *H. armigera* 63.2%, followed by chloroform extract and petroleum ether extract at the same concentration. One-way analysis of variance followed by least significant difference test showed statistical significance $P < 0.05$.[26] The previous study reported that methanol extract of *Rivina humilis* showed 22.55 ± 1.52% feeding deterrency against the fourth instar larvae of *S. litura* at 100 mg/L concentration, whereas 36.49 ± 1.68% and 71.9 ± 2.67% of antifeedant activity were recorded in the methanol extract of *R. humilis* at 200 and 300 mg/L, respectively. Similarly, at higher concentrations such as 400 and 500 mg/L, 86.57 ± 3.80% and 98.54 ± 3.24% antifeedant activities were recorded, respectively. The maximum larvicidal activity was recorded from the highest concentration of methanol extract at 1000 mg/L and the least larvicidal activity was recorded from the 125 mg/L concentration of benzene extract. Furthermore, the larval mortality observed from the 250, 500 750, and 1000 mg/L concentration extracts showed 34.20 ± 1.94%, 62.80 ± 2.35%, 76.60 ± 2.64%, and 98.60 ± 2.22%, respectively with methanol extract.[17] The previous experiment reported that the toxicity of different extracts of *Tinospora crispa* and *Psidium guajava* was tested against *S. litura*. The antifeedant activity of *T. crispa* and *P. guajava* tested against *S. litura* fourth instar larvae was liable during a 24-h test period. All extracts are showed moderate antifeedant activity; however, very least antifeedant activity was noted in benzene and significant antifeedant activity was observed in methanol extract. Methanol extract of *T. crispa* and *P. guajava* showed 100% and 98.38% feeding deterrency against the fourth instar larvae

of *S. litura* at 500 ppm concentration value of benzene, diethyl ether, ethyl acetate, and methanol leaf extracts of *T. crispa* which were 92.64, 96.25, 94.67, and 84.94 ppm, respectively, and *P. guajava* shows the LC_{50} values of 144.95, 164.22, 135.64, and 121.86ppm, respectively. The Chi-square values are statistically significant at $P = 0.05$ level. Among five solvent extracts, the methanol extract was responsible for vigorous lethal activity observed against selected pest species.[27] The report showed that feeding deterrent activity of solvent extracts of *Caesalpinia bonducella* methanol extract of *C. bonducella* showed 19.67 ± 1.93% feeding deterrency against the fourth instar larvae of *H. armigera* at 100mg/l concentration, whereas 29.3 ± 1.53% and 78.52 ± 2.86% of antifeedent activity were recorded in the methanol extract of *C. bonducella* at 200 and 300 mg/l, respectively. Similarly, at higher concentration such as 400 and 500 mg/l, 86.87 ± 2.82% and 96.73 ± 2.36% antifeedant activities were recorded, respectively. The maximum larvicidal activity was recorded from the highest concentration of methanol extract at 1000 mg/l and the least larvicidal activity was recorded from 125 mg/l concentration of ethyl acetate extract. Furthermore, the larval mortality of the methanol extract at the concentration of 250, 500, 750, and 1000 mg/l was 29.6 ± 1.69%, 57.4 ± 1.94%, 81.2 ± 1.48%, and 98.4 ± 1.55% respectively.[28]

The maximum results showed on the antifeedant activity of flindersine against *H. armigera* and *S. litura.* The maximum antifeedant activity of 84.24 and 78.07% was noted at 1000 ppm concentrations, respectively. All the experiment concentrations showed >50% antifeedant activity against both insects. Flindesines showed concentration-dependent activity against dual pests. LC50 value of hexane, diethyl ether, dichloromethane, ethyl acetate, and methanol extract of *A. precatorius* was 255.91, 266.21, 265.98, 251.84, and 225.76 ppm, respectively, against fourth instar larvae of *S. litura*.[32] Report the flindersines the maximum larvicidal activity of 79.11 and 69.33% at 1000 ppm concentration against *H. armigera* and *S. litura* respectively. At 125 ppm concentration, flindersine exhibited 24.88 and 22.44% larvicidal activity against *H. armigera* and *S. litura,* respectively. Flindesine showed different kinds of growth inhibitory activities against *H. armigera* and *S. litura.* It exhibited maximum larval duration of 14.66 and 15.10 days for *H. armigera* and *S. litura,* respectively, at 1000 ppm concentration. At 125 ppm concentration, it also significantly increased the larval duration to 10.87 and 10.49 for *H. armigera* and *S. litura*, respectively.[29] The results showed that leaf extract of *Catharanthus roseus* was less effective in inhibiting feeding in fourth instar larvae of *S. litura*, both in choice and no-choice conditions, when compared to *Ocimum sanctum*. In choice experiment, feeding was 45.06% at the highest concentration of 5% extract differentiate to 82.47% in control. Antifeedant index was highest in 48.42% at 5% extract and lowest in 12.84% at 1%. At 2, 3, and 4% extract, antifeedant indices were 18.76, 28.44, and 31.06%, respectively.[30]

CONCLUSION

It is proof that methanol extract of *C. peruviana*, *N. oleander,* and *M. elengi* plant flower extracts was most effective insecticidal activity of armyworm *S. litura* and pod borer larvae of *H. armigera.* The flower extract experimented in the present study showed the oviposition-deterrent activity. The three different plants are useful to the active principles for the management of field crop pest and protection of agricultural ecosystem.

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