

# Antifeedant, larvicidal and ovicidal efficacy of *Citrus limetta* and *Syzygium cumini* against pod borer larvae of *Helicoverpa armigera* (Hub.) (Noctuidae:Lepidoptera) and cotton caterpillar *Achaea janata* (Noctuidae:Lepidoptera)

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**ABSTRACT:** To estimate the feeding deterrent, larvicidal and ovicidal activity of ethyl acetate, chloroform, methanol and hexane extracts of important medicinal plants of *Citrus limetta* and *Syzygium cumini* at various concentrations against most devastating agricultural field pest of *Helicoverpa armigera* and *Achaea janata*. The feeding deterrent activity were used as various solvent of methanol, ethyl acetate, chloroform, and hexane, the valuable medicinal plants *C. limetta* and *S. Cumini*, used in the experimental site. The highest antifeedant activity of methanol crude extract of *C. limetta* against *H. armigera* and *A. janata* 99.8%, 96.2%, and *S. cumini* against *H. armigera* and *A. janata* 94.2% and 90.8%. Highest ovicidal activity of *C. limetta* and *S. cumini* methanol extract was 98.6 and 95.2% against *H. armigera* at 375ppm. To study report that the important medicinal plant *C. limetta* and *S. Cumini* it is a potential source of natural antifeedant, larvicidal and ovicidal properties against the lepidopteran pest of *Helicoverpa armigera* and *Achaea janata*.

**KEYWORDS:** Medicinal plants, *Helicoverpa armigera*, Antifeedant activity, Larvicidal activity.

## I. INTRODUCTION

Noctuidae is the largest family in order lepidoptera, and it contains some of the most destructive insect pest of agriculture [1]. The noctuid moths feed on commercial important of plant varieties and severe infestation of worldwide agricultural crop. *Helicoverpa armigera* is a severe polyphagous plant pest distribution in many countries of Asia, Africa, Europe and Australia. It causes severe infestation and damaged the field and vegetable crop of fibre plants, okra, chilli, tomato, potato, corn, rice, sorghum, peanut, pigeonpea and chickpea. *H. armigera* feeds on 182 plant species across 47 families in the Indian subcontinent, in which a No of 56 heavily infect and 126 are rarely affected[2]. The boll worms are relatively safe from the predators because of the cryptic feeding habits of the larvae with in cotton bolls. This pest is considered as the major devastating lepidopteran species [3]. The most important agricultural pest of Cotton boll worm high feeding and leading to heavy yield losses in a diverse range of crops. It is also widely distributed in India and destructs the different plant families [4].

*Achaea janata* is a serious Castor or croton pest in India. caterpillar, It is estimated that yield can reduce by 30-50% due to the semi-looper alone. *A. janata*, a Noctuid moth, generally known as castor oil semi-looper or croton caterpillar feeds on different species of plants such as banana, cabbage, Chinese cabbage, macadamia, mustard, poinsettia, rose, sugarcane and tomato as well as some legumes, teas, and other *Brassica* species[5]. The preferred hosts are castor and croton. The croton caterpillar feed voraciously do not eat only veins and petioles, causing severe infestations to the crop. An estimated one third of global agricultural production valued at several billion dollars is destructed annually by over 20,000 spp. of insect pests in field and storage [6].

*Citrus limetta* Family: Rutaceae it is known as Sweet lime, it is native to south and Southeast Asia. The citrus species are potential source of valuable oil which might be utilized for edible oil and other industrial advantages. Medicinal plants have been used for centuries as remedies for human diseases because they contain chemical components of therapeutic value [7]. The chemical composition of the citrus fruits is generally composed of 90% terpene, 5% oxygenated compounds, and less than 1% non-volatile compounds such as waxes and pigments [8]. It consist of the chemical properties present in the citrus limetta seed are  $\alpha$ -thujene,  $\alpha$ -pinene, camphene, sabinene  $\beta$ -pinene, myrcene,  $\alpha$ -terpinene,  $p$ -cymene, linalool and d-limonene; this last terpene was the most abundant compound in

the four citric fruits, with a concentration of 90% in sweet orange and bitter orange. Likewise, each citrus fruit has particular components present in minor quantities; these components differ between fruits and can be used in identifying the various oils and controlling their quality and authenticity [9].

*Syzygium cumini* linn Family: Myrtaceae it is known as jamun in English java plum, it is one of the very large evergreen tropical plant and slow growing species, it can reach heights of up to 30m and can live more than 100 years. Today the trees found growing throughout the Asian subcontinent, eastern Africa, south Africa, and Madagascar. The tree fruits or berries are sweetish sour to taste. The ripe fruits are used for health drinks, making preserves, squashes, jellies, and wine [10]. It consists mainly of mono or sesqui-terpene hydrocarbons which are very common in essential oils. Constituents of *S. cumini* seeds are fatty oils (30 g/kg), including lauric (2.8%), myristic (31.7%), palmitic (4.7%), stearic (6.5%), oleic (32.2%), linoleic (16.1%), malvalic (1.2%), sterculic (1.8%) and vernolic acid (3%) and phytosterols such as  $\beta$ -sitosterol. Further constituents are tannins (6%), predominantly corilagin, ellagitannins, ellagic acid, galloyl-galactoside and gallic acid [11]. Ethanolic extract of *Syzygium cumini* seed kernel extract also lowering the thiobarbituric acid reactive substance and increased in reduced glutathione, superoxide dismutase, and catalase. The jambolan has received far more recognition in folk medicine and in the pharmaceutical trade than in any other field. Medicinally, the fruit is stated to be astringent, stomachic, carminative, antiscorbutic and diuretic.

In recent years botanical properties are one of the most prominent alternatives for insect pest control in recent and future requirements. Several plant crude extracts have been evaluated for their activity against important agricultural pests for a few decades in different countries [12]. One possible way to reduce all these death-defying effects of synthetic insecticides and pesticides is to use plant derived insecticides which are more ecofriendly and medically safe. The present study of maintained the most effective medicinal plants of *C. limetta* and *S. cumini* the effective crude seed extract to control the F1 generation in noctuid larvae of *H. armigera* and *A. janata*.

## II. MATERIALS AND METHODS

### Collection and extraction of plant material

*Citrus limetta* and *syzygium cumini* plant seeds are collected from Sirkali, Nagapattinam District. The dried seeds 150g were powdered mechanically using commercial electric grinder and extracted with hexane, ethyl acetate, chloroform and methanol (500ml), in a Soxhlet apparatus individually until exhaustion. The extract was concentrated under reduced pressure of 22-26 mm Hg at 45°C by 'Rotovapour' and the residue obtained was stored at 4°C by in an amber vial. Then the vials labeled with aluminium foil and transported to the laboratory. Until use those vials were kept in cool and dark place condition at 4°C.

### Rearing of insects

The pod borer larvae of *H. armigera* and *A. janata* were collected from the field in Keezh Kumaramangalam village, Cuddalore district of Tamilnadu, India, and the collected larvae were reared individually in plastic container vials and fed usually peanut (*Arachis hypogaea*) and castor (*Ricinus communis*) till the larvae became pupae under the laboratory condition (27.0°C±2°C) and 75±5% relative humidity. After pupation, the pupae were collected from the soil and placed inside the cage for the emergence of soaked with 10% and honey solution mixed with a few drop of multivitamins was provided for adult feeding the fecundity. Potted peanut plant and castor was provided was kept inside the adult emergence cage for egg laying. After hatching, the larvae were collected from the cage and fed with quality artificial substances. Laboratory reared insect cultures was used for bioassay [6].

### Antifeedant activity

Antifeedant activity of the methanol extracts are used leaf disc method. Fresh peanut and castor leaf were used the experimental studies. Leaf disc of 4.0 cm diameter was punched using leaf eater and were dipped in individually 100, 200, 300, 400 and 500 ppm concentrations. The leaf disc dipped in ethyl acetate, chloroform, methanol and hexane, was used to extracts. In each plastic Petridis (40cm×90cm), wet filter paper was placed to avoid early drying of the tested leaves. The fourth instars larvae of *H. armigera* and *A. janata* were reared in each and jurisdiction Petridis. The consumption of leaf disc in the treated and control by *H. armigera* and *A. janata* larvae after 48 hrs 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 hrs illumination and dark photoperiod and 75±5% relative humidity activity were calculated according to the formula [7].

### Ovicidal activity

25 Individuals eggs of *H. armigera* and *A. janata* were separated and immersed in 75, 150, 225, 300 and 375 ppm concentrations of five replicates were maintained (n=100) number of eggs hatched in the control and the treatments were recorded. The laboratory conditions were the same as the antifeedant activity treatment. Percentage of ovicidal activity was calculated according to the formula [9].

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

**Statistical analysis**

The biological experiment reports were portion to analysis of variance; significant differences between treatments were decided by tukeys multiple range tests (p<0.05) value was calculated using probit analysis.

**Table 1:** Antifeedant activity of *Citrus limetta* and *Syzygium cumini* against fourth instars larvae of *Helicoverpa armigera* and *Achaea janata*

Plant name	Pest name	Extract	Concentration (%) ppm				
			100	200	300	400	500
<i>C. limetta</i>	<i>H. armigera</i>	Ethyl acetate	19.2±1.09	32.4±2.19	54.2±3.19	68.4±2.19	96.4±2.19
		Chloroform	14.6±2.50	28.4±1.51	45.2±1.78	52.2±1.09	89.2±2.48
		Methanol	21.4±2.50	39.6±3.28	56.4±2.96	74.2±3.86	99.8±3.89
		Hexane	9.2±0.89	19.2±1.78	36.4±2.19	48.4±2.19	82.6±1.94
	<i>A. janata</i>	Ethyl acetate	18.4±2.07	30.6±1.94	52.4±1.51	67.2±1.78	89.4±1.78
		Chloroform	13.2±1.09	25.4±1.51	43.6±1.94	57.6±2.60	78.2±2.48
		Methanol	20.8±1.64	37.2±1.78	54.2±1.09	72.6±1.94	96.2±1.78
		Hexane	8.4±1.51	16.2±2.48	31.2±4.91	46.2±1.09	70.4±1.51
<i>S. cumini</i>	<i>H. armigera</i>	Ethyl acetate	16.4±1.81	30.2±2.04	58.4±2.07	72.6±1.94	92.4±3.57
		Chloroform	13.6±1.94	24.4±1.51	41.8±1.30	66.6±1.94	86.2±2.48
		Methanol	19.2±1.78	36.4±2.19	66.2±1.64	84.4±2.88	94.2±6.72
		Hexane	8.2±2.48	17.6±1.94	32.6±2.60	43.4±2.07	79.4±1.54
	<i>A. janata</i>	Ethyl acetate	14.6±0.89	25.2±1.78	42.2±2.48	59.4±1.51	82.2±1.78
		Chloroform	11.8±1.30	24.8±1.94	39.4±2.19	53.2±3.19	75.6±1.94
		Methanol	17.4±2.19	34.2±2.48	50.4±1.51	69.4±2.19	90.8±2.38
		Hexane	6.4±1.51	13.4±2.88	28.2±2.48	42.4±1.51	68.4±2.19

Values represent mean±SD of 5 replicates, *Citrus limetta*: *C. limetta*, *Syzygium cumini*: *S. cumini*, *Helicoverpa armigera*: *H. armigera* and *Achaea janata*: *A. janata* SD: Standard deviation.

**Results**

The results of antifeedants potential of the various solvents crude extracts of both plants and two important devastating field pests of *H. armigera* and *A. janata* were recorded in table 1. Antifeedant activity was assessed based on antifeedant index. Higher antifeedant index normally indicates decreased rate of feeding. In the present study of individual antifeedant activity of *C. limetta* against *H. armigera* and *A. janata* the highest antifeedant activity of 500ppm concentration of methanol extract, the values are 99.8%, 96.2%. Followed by, ethyl acetate 96.4%, 89.4%, chloroform 89.2%,78.2%, hexane 82.6%,70.4%. and *S. cumini* against *H. armigera* and *A. janata* the highest antifeedant activity of 500ppm concentration of methanol extract the values are 94.2%, 90.8%, methanol extract, followed by ethyl acetate 92.4%, 82.2%, chloroform86.2%, 75.6%, hexane79.4%, 68.4%. Ovicidal activity of seed extract of *C. limetta* and *S. cumini* against two important noctuidae pests at five different concentrations and four solvent used the experimental studies of ethyl acetate, chloroform methanol and hexane the very best concentration limit of methanol extract *C. limetta* and both pest values are 98.6%, 96.6% and *S. cumini* both pest values are 95.2%, 92.4% the very best ovicidal responses noted in methanol extract concentration at 375ppm, respectively.

**Table 2:** Ovicidal activity of *Citrus limetta* and *Syzygium cumini* against fourth instars larvae *Helicoverpa armigera* and *Achaea janata*

Plant name	Pest name	Extract	Concentration (%) ppm				
			75	150	225	300	375
<i>C. limetta</i>	<i>H. armigera</i>	Ethyl acetate	18.6±1.94	31.2±1.78	56.2±1.09	62.6±1.94	96.4±3.36
		Chloroform	15.6±1.94	25.8±1.92	49.2±2.48	59.4±2.19	92.2±3.19
		Methanol	20.6±1.74	37.2±4.38	65.4±2.19	76.2±3.89	98.6±3.26
		Hexane	11.4±2.50	19.4±1.51	42.6±1.94	47.2±2.48	88.6±1.94
	<i>A. janata</i>	Ethyl acetate	16.2±1.78	30.4±2.19	52.4±2.88	59.6±1.94	92.2±2.48
		Chloroform	13.4±2.19	25.2±1.09	44.6±1.94	53.4±3.54	86.6±4.44
		Methanol	18.2±2.48	36.2±1.09	60.6±3.28	71.8±2.38	96.6±1.34
		Hexane	9.8±2.38	19.4±2.19	36.2±1.09	47.6±2.60	82.8±2.38
<i>S. cumini</i>	<i>H. armigera</i>	Ethyl acetate	17.6±2.60	28.6±1.94	53.4±2.19	58.2±2.48	92.6±3.28
		Chloroform	14.2±2.48	22.4±2.19	46.2±2.48	48.6±2.60	88.6±1.94
		Methanol	19.2±1.64	34.2±2.48	60.8±3.03	70.4±2.88	95.2±4.60
		Hexane	10.8±3.03	16.6±1.94	39.4±2.19	42.2±3.19	82.4±2.70
	<i>A. janata</i>	Ethyl acetate	15.4±1.51	27.2±3.19	48.8±3.03	57.2±3.19	88.6±1.94
		Chloroform	12.8±2.38	22.6±2.60	39.4±1.51	46.6±3.28	82.4±2.88
		Methanol	17.4±2.88	32.6±2.60	58.6±1.94	68.6±3.26	92.4±1.51
		Hexane	8.6±1.94	16.4±1.51	28.4±3.57	38.4±2.19	76.2±3.19

Values represent mean±SD of 5 replicates, *Citrus limetta*: *C. limetta*, *Syzygium cumini*: *S. cumini*, *Helicoverpa armigera*: *H. armigera* and *Achaea janata*: *A. janata*, SD: Standard deviation.

### III. DISCUSSION

Data pertaining to the above experiment clearly revealed that maximum antifeedant activity was recorded in ethyl acetate extract on *S. litura* (80.3%) and *H. armigera* (78.18%) at 5% concentration, followed by chloroform extract and petroleum ether extract at the same concentration. Ovicidal activity indicates mortality of eggs by potential active principles present in the particular extracts. In the present study, maximum ovicidal activity against *S. litura* (72.04%) and *H. armigera* (68.96%) was recorded in ethyl acetate extract at 5% concentration [7].<sup>1</sup> Methanol extract of *C. bonducella* showed (19.67±1.93), (29.37±1.53), (78.52±2.86), (86.87±2.82) and (96.73±2.36) feeding deterrence against the fourth instar larvae of *H. armigera* at 100, 200, 300, 400 and 500 mg/L concentration [9]. Reported that the line of experiment was attempted with plant oil formulation, showed maximum percentage of ovipositional repellent activity against the gravid moths of *H. armigera* followed by *S. litura* and *Earias vitella* were 84.75, 79.90 and 76.55 respectively. The most significant antifeedant activity was observed *Achaea janata* at 1000 mg/L concentration *Salvia officinalis* (85.56), *S. litura*, *Mentha spicata* (82.85), *H. armigera* and *Mentha spicata* (90.55) [7-8].

Reported the percentage of antifeedant activities of *Strychnos nux-vomica* and *Semecarpus anacardium* seed extracts against *H. armigera* third instar larvae at 0.5, 1.0, 1.5 and % concentrations. Maximum antifeedant activity (74.27%) was recorded by chloroform extract of *S. anacardium* seeds at 2% concentration. The hexane extract of *S. nux-vomica* presented 70.57% antifeedant activity at 2% concentration. *F. leucopyrus* ethyl acetate extract at 5% concentration also recorded a marked amount of larvicidal activity of 81.77% with LC<sub>50</sub> and LC<sub>90</sub> values of 2.09 and 5.32%, respectively. Chloroform extract at 5 and 2.5% exhibited notable amount of larvicidal activity against *H. armigera* [10, 11].

Report The feeding deterrence of the crude extracts of *Punica granatum*, *Cassia fistula* and *Erithrina variegata* at completely different concentrations against the fourth arthropod larvae of *S. litura*. Statistically important feeding deterrent activity (83.8%) was discovered in methanol extract of *P. granatum* at 5.0% concentration followed by ethyl acetate (69.2%), chloroform (47.8) and hexane (42.8%) extracts. Plant leaf and bark used for the extraction of antifeedant activity *T. arjuna* and *T. roxburghianum* against *H. armigera* were used methanol, ethyl acetate, chloroform, and hexane extracts of *T. arjuna* were 99.6%, 95.6%, 88.2%, and 83.8% at 225 ppm, respectively. Ovicidal activity was methanol, ethyl acetate, chloroform, and hexane extracts of *T. arjuna* were 91.8%, 85.6%, 78.6%, and 72.2% and *T. roxburghianum* were 90%, 88.8%, 81.4%, and 70.8%, respectively [12-14].

#### IV. CONCLUSION

Two different medicinal important plants are *Citrus limetta* and *Syzygium cumini* provide the potential of bio active compounds against *H. armigera* and *A. janata* maintained the antifeedant, larvicidal and ovicidal effects were used the different solvent extracts could be used in laboratory condition. The very best Pesticidal effects present and better than *Citrus limetta* compared to the *Syzygium cumini* against *H. armigera* and *A. janata*. The active botanical properties are using the controlling agents of economical important of the agriculture field pest.

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