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Screening of plant extracts for oviposition activity against *Spodoptera litura* (Fab). (Lepidoptera: Noctuidae)

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ABSTRACT
Crude extracts of twenty five plants were screened for their oviposition activity against the third instar larvae of *Spodoptera litura.* Among the twenty five plants tested, oviposition deterrent activity (above fifty per cent) was recorded in only three plants *viz*., *Aegle marmelos* ethyl acetate, *Cinnamomum zeylanicum* hexane and *Ocimum americanum* ethyl acetate extracts against *Spdoptera litura* while rest of the plants exhibited varying degree of lesser or moderate effects.

Keywords: *Spodoptera litura*, oviposition activity, plant extracts.

1. Introduction
Noctuid moths from genera *Spodoptera* are polyphagous pests causing economic damage to several agricultural crops in Southeast Asia, India, China, and Japan [1,2] and also throughout the world [3]. *Spodoptera litura* (Fab.) (Lepidoptera: Noctuidae) has a wide range of host, feeding on 112 species worldwide [4] of which 40 species are known from India [5, 6, 7, 8]. Broad spectrum insecticides used for control of *Spodoptera litura* has resulted in development of resistance to many of the registered pesticides for its control [9, 10, 11]. The absence of resistance to *Spodoptera litura* in host plants and the lack of adequate control measures make it difficult to manage this pest in the fields. In this scenario, new types of insecticides originating from natural products, targeting *Spodoptera litura* could be a useful alternative for integrated pest management [12].
Plants are important natural sources of bioactive compounds and many such plant compounds have been included in commercial botanical pesticides [13]. Many plant products are safer to non-target organisms and effective against phytophagous insects [14]. Plant products bring about wide range of behavioral and physiological effects on the insects [15, 16]. Several plant products have been tested against *Spodoptera litura* and some promising plants have been reported [17, 18, 19, 20, 21, 22, 23, 24]. However the screening of plant extracts against insects are still continuing throughout the world to find out different kinds of effects of botanicals to obtain an ecofriendly and economic biopesticide. Very few reports are present pertaining to the oviposition activity of plant extracts against *Spodoptera litura* [20, 23]. Therefore the present study deals with screening of various plant extracts for their oviposition activity against *Spodoptera litura.*

2. Materials and Methods
2.1 Collection of plants and preparation of plant extracts
A total of twenty five plants belonging to diverse families and genera were collected from Siruvani Hills (near Coimbatore), Western Ghats of Tamil Nadu, and India.

The plants were selected based on available literature, abundant availability, medicinal and insecticidal properties. List of plants collected and utilized for the present study are presented in Table 1. Hexane, diethyl ether, dichloromethane and ethyl acetate extracts of the collected plants obtained by sequential extraction method were stored at 4^0C reported elsewhere by Arivoli and Samuel [22].

Table 1: List of plants utilized for the present study from Western Ghats of India

S.No.	Plant name	Family	Vernacular name (Tamil)	Part used
1.	*Abrus precatorious* Linn	Papilionaceae	Kundumani	Seed
2.	*Aegle marmelos* (L) Corr	Rutaceae	Vilvam	Leaf
3.	*Alstomia scholaris* (L) R Br	Apocynaceae	Mukampalai	Leaf
4.	*Aristolochia indica* Linn	Aristolochiaceae	Karudakkodi	Root
5.	*Cassia fistula* Linn	Caesalpiniaceae	Sarakonnai	Flower
6.	*Cinnamomum zeylanicum* Breyn	Lauraceae	Sirunagapoo	Bark
7.	*Cleistanthus collinus* (Roxb) Benth	Euphorbiaceae	Oduvan	Leaf
8.	*Cymbopogon citrates* (Dc) Stapt	Poaceae	Vasanapullu	Whole plant
9.	*Drosera indica* Linn	Droceracea	Azukanni	Leaf
10.	*Evolvulus alsinoides* (L) Linn	Convolvulaceae	Vishnukarandi	Whole plant
11.	*Garcinia morella* (Gaertn) Desr	Clusiaceae	Makki	Leaf
12.	*Hydrocotyle javanica* Thunb	Apiaceae	Malaivallarai	Leaf
13.	*Ichnocarpus frutescens* (L) R Br	Apocyanaceae	Palvalli	Leaf
14.	*Lantana camara* Linn	Verbenaceae	Unnichedi	Leaf
15.	*Leucas aspera* (Willd) Link	Lamiaceae	Thumbai	Whole plant
16.	*Memecylon malabaricum* (Cl) Cong	Melastomataceae	Malamthetti	Leaf
17.	*Murraya koenigii* (L) Spreng	Rutaceae	Kariveppilai	Leaf
18.	*Ocimum americanum* Linn	Lamiaceae	Nayithulasi	Whole plant
19.	*Plumbago zeylanica* Linn	Plumbaginaceae	Neelakodaveri	Leaf
20.	*Sphaeranthus indicus* Linn	Asteraceae	Kottakkarandai	Whole plant
21.	*Strebulus asper* Lour	Moraceae	Pirayam	Leaf
22.	*Strychnos nuxvomica* Linn	Loganiaceae	Yetti	Fruit
23.	*Syzygium cumini* (L) Skeets	Myrtaceae	Neredom	Leaf
24.	*Vitex negundo* Linn	Verbenaceae	Notchi	Leaf
25.	*Zanthoxylum limonella* (Roxb) Dc	Rutaceae	Veersingapattai	Bark

2.2 Establishment of *Spodoptera litura*

Spodoptera litura egg masses were collected from groundnut fields at Vellore and Kancheepuram districts of Tamil Nadu, India were cultured and reared according to the method reported by Arivoli and Samuel [22].

2.3 Oviposition Activity

Oviposition activity were studied at 1.0% concentration for screening. Castor leaves sprayed with plant extracts served as treated while those sprayed with acetone and water acted as negative and positive control respectively. Leaf petiole was tied with cotton and dipped in water to avoid drying. Single pair of newly emerged adult (male and female) moths was introduced into a cage having treated castor leaves. After 48 hours the number of eggs laid (counted from egg batch) by the female moth was recorded in treated and control leaves. A total of three trials with five replicates per trial was carried and per cent oviposition deterrent activity calculated. The data obtained were subjected to angular transformation. Significant difference within various crude extracts were compared with Least significant difference (LSD) test to differentiate individual mean significant difference at 0.05% level.

$$\text{Per cent oviposition deterrent activity} = \frac{\text{Number of eggs laid in control} - \text{Number of eggs laid in treated}}{\text{Number of eggs laid in control} + \text{Number of eggs laid in treated}} \times 100$$

Table 2: Plant extracts screened for oviposition deterrent activity at 1.0% concentration against *Spodoptera litura*

S. No.	Plant	Hexane	Diethyl ether	Dichloromethane	Ethyl acetate
1.	*Abrus precatorious*	-	+	-	-
2.	*Aegle marmelos*	++	++	+	+++
3.	*Alstomia scholaris*	+	-	-	-
4.	*Aristolochia indica*	+	-	-	+
5.	*Cassia fistula*	-	-	-	-

6.	*Cinnamomum zeylanicum*	+++	+	+	+
7.	*Cleistanthus collinus*	++	-	+	+
8.	*Cymbopogon citrates*	+	+	-	+
9.	*Drosera indica*	-	-	-	-
10.	*Evolvulus alsinoides*	+	-	-	-
11.	*Garcinia morella*	-	-	+	-
12.	*Hydrocotyle javanica*	-	-	-	-
13.	*Ichnocarpus frutescens*	+	-	+	++
14.	*Lantana camara*	+	-	+	-
15.	*Leucas aspera*	-	-	-	-
16.	*Memecylon malabaricum*	+	-	-	-
17.	*Murraya koenigii*	+	+	-	++
18.	*Ocimum americanum*	++	+	+	+++
19.	*Plumbago zeylanica*	-	-	-	+
20.	*Sphaeranthus indicus*	-	-	-	-
21.	*Strebulus asper*	+	-	-	-
22.	*Strychnos nuxvomica*	-	-	-	++
23.	*Syzygium cumini*	++	-	-	+
24.	*Vitex negundo*	+	-	-	++
25.	*Zanthoxylum limonella*	+	-	-	+

- No activity
+ Below 25% oviposition deterrent activity
++ Between 25-50% oviposition deterrent activity
+++ Above 50% oviposition deterrent activity

Table 3: Per cent oviposition deterrent activity of promising plant extracts against *Spodoptera litura*

Plant species	Solvents			
	Hexane	**Diethyl ether**	**Dichloromethane**	**Ethyl acetate**
Aegle marmelos	32.67 ±7.13^{b} (34.82)	27.50 ±7.09^{b} (31.63)	10.35 ±8.48^{b} (18.72)	52.85 ±7.49^{c} (46.61)
Cinnamomum zeylanicum	50.81 ±10.21^{c} (45.46)	10.51 ±5.64^{b} (18.91)	14.96 ±10.50^{b} (22.71)	13.77 ±10.64^{b} (21.72)
Ocimum americanum	34.64 ±5.64^{b} (36.03)	9.29 ±5.05^{b} (17.66)	15.59 ±4.99^{b} (23.18)	57.79 ±5.24^{c} (49.43)
Control (-)	1.3 ±0.4^{a}	2.6 ±0.6^{a}	2.1 ±0.8^{a}	2.8 ±0.7^{a}
Control (+)	0.0 ±0.0^{a}	0.0 ±0.0^{a}	0.0 ±0.0^{a}	0.0 ±0.0^{a}

Values are mean of five replicates of three trials ±standard deviation; Values in parentheses are angular transformed; Different superscripts within the column indicate statistically significant difference (P<0.05) by LSD.

3. Results and Discussion

The extracts of twenty five plants were screened for their oviposition activity against *Spodoptera litura* and the results are presented in Table 2. Among the twenty five plants screened, *Aegle marmelos* ethyl acetate, *Cinnamomum zeylanicum* hexane and *Ocimum americanum* ethyl acetate extracts showed maximum oviposition deterrent activity (Table 3). Remaining plants also showed oviposition deterrent activity but was below 50 per cent hence, results not presented. The results of the present study are in agreement with the earlier findings on the ovipositional deterrent effect of different plant origins. Venkateswarlu *et al*. [25] observed ovipositional deterrence of neem oil on *Spodoptera litura*. Ayyangar and Rao [26] reported that the methanol and hexane of neem seed kernel extracts are not only larval repellents, but also ovipositional deterrent to the adults of *Spodoptera litura*. In a cage study, crude oil emulsion of neem seed extract reduced egg laying properties of *Spodoptera litura* on treated cabbage plant [27]. Raja *et al*. [28] analyzed the effects of plant extracts on *Spodoptera litura* and established that the hexane, diethyl

ether, dichloromethane, ethyl acetate, methanol and aqueous extracts collected from leaves and roots of *Artemisia nilagirica*, and from the leaves of *Acorus calamus*, *Anisomeles malabarica*, *Cassia auriculata*, *Holoptelea integrifolia*, *Lobelia lescheinaultiana*, *Perguilaria daemia*, *Tarirena asiiatica* and *Wedelia calenidulacea* showed significant ovipositional deterrent activities. Raja *et al*. [17] reported oviposition deterrent activities of hexane extract of *Aegle marmeles* and *Coleus aromaticus* and methanol extract of *Cyperus rotundus* and *Cyperus aromaticus* at 5% concentration. Pure essential oil and individual compounds *viz*., geijerene and pregeijerene isolated from *Chloroxylon swietenia* showed oviposition deterrent activity against *Spodoptera litura* [29]. Likewise, Anandan *et al*. [30] reported ovipositional deterrent activity of *Hyptis suaveolens* and *Melochia corchorifolia* fractions isolated from ethyl acetate extract against gravid moths of *Spodoptera litura*. Lakshmanan *et al*. [31] reported that lavender, rosemary, cedarleaf lime, calamus, lemon and *Tagetes* oil showed remarkable oviposition deterrent activity against *Spodoptera litura*.

Many insects prefer to oviposit on certain plant species because those hosts enhance larval development and survival by providing a suitable diet [32,33], although there are exceptions [34, 35]. Oviposition was deterred by exposing insects to substrates treated with compounds that are bitter tasting [36]. Female moths could have sensory receptors sensitive to host plant biochemical compositions in which contact chemoreceptors on their tarsi and ovipositor would be useful in assessing the suitability of the host for oviposition [37, 38]. Plant characteristics, such as chemicals, colour, trichomes, and architecture, in concert with the insect's internal milieu, form the basis for discrimination between acceptable and unacceptable plants for feeding or oviposition by various species of phytophagous insects [36, 39, 40]. Whatever the interplay of mechanisms or cues that govern insect oviposition preference for one host plant or another, the extent to which the insect propagates itself is in the balance [41].

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5. References

1. Hadapad A, Chaudhari CS, Kulye M, Chaudele AG, Salunkhe GN. Studies on chitin synthesis inhibitors against gram pod borer, *Helicoverpa armigera* (Hub.). Journal of Natcon 2001; 13(2): 137-140.
2. Hummelbrunner LA, Isman MB. Acute, sublethal, antifeedant, and synergestic effects of monoterpenoid essential oil compounds on the Tobacco cutworm, *Spodoptera litura* (Lepidoptera: Noctuidae). Journal of Agriculture and Food Chemistry 2001; 49: 715-720.
3. EI-Aswad AF, Abdelgaleil SAM, Nakatani M. Feeding deterrent and growth inhibitory properties of limnoids from *Khaya senegalensis* against the cotton leafworm *Spodoptera littoralis*. Pest Management Science 2003; 60: 199- 203.
4. Sharma AK, Seth RK. Combined effect of gamma radiation and azadirachtin on the growth and development of *Spodoptera litura* (Fabricius). Current Science 2005; 89: 1027-1031.
5. Rao GVR, Wightman JA, Rao DVR. World review of the natural enemies and diseases of *Spodoptera litura* (F.) (Lepidoptera: Noctuidae). Insect Science and its Applications 1993; 14: 273-284.
6. Singh AK, Parasnath, Ojha JK. Antifeeding response of some plant extract against *Spodoptera litura* (Fab.) of groundnut. Indian Journal of Applied Entomology 1998; 12: 9-13.
7. Ali SS, Talaey MP Rane AE. *Helicoverpa armigera* (Hub.) and *Spodoptera litura* (Fab.) on flowering plants around Nagpur district. Insect Environment 1999; 5: 1-28.
8. Paulraj MG. Integration of intercrops and plant product on chosen groundnut pests management. Ph. D. thesis, St. Joseph's College (Autonomous), Bharathidasan University. Trichy, Tamil Nadu, India, 2001.
9. Smagghe G, Carton B, Wesemael W, Ishaaya I, Tirry L. Ecdysone agonists – mechanism of action and application on *Spodoptera* species. Pesticide Science 1999; 55: 343-389.
10. Kranthi KR, Jadhav DR, Kranthi S, Wanjari RR, Ali RR, Russell DA. Insecticide resistance in five major insect pests of cotton in India. Crop Protection 2002; 21: 449-460.
11. Aydin MH, Gurkan MO. The efficacy of spinosad on different strains of *Spodoptera littoralis* (Boisduval) (Lepidoptera: Noctuidae). Turkish Journal of Biology 2006; 30: 5-9.
12. Dhadialla S, Carlson R, Le P. New insecticides with ecdysteroidal and juvenile hormone activity. Annual Review of Entomology 1998; 43: 545-569.
13. Ballesta AMC, Pascual VMJ, Rodríguez B. The antifeedant activity of natural plant products towards the larvae of *Spodoptera littoralis*. Spanish Journal of Agricultural Research 2008; 1: 85-91.
14. Kareem A. Biopesticides and insect pest management. In: Ignacimuthu, S. and Sen, A. (eds.) Biopesticides in Insect Pest Management. New Delhi: Phoenix publishing house Pvt Ltd., 1999; 1-6.
15. Koshiya DJ, Ghelani D. Antifeedant activity of different plant derivatives against *Spodoptera litura* on groundnut. In: Botanical Pesticides in IPM. Symposium Proceedings, 1993; 175-182.
16. Gokce A, Stelinski LL, Whalon ME, Gut LJ. Toxicity and antifeedant activity of selected plant extracts against larval oblique banded leafroller, *Choristoneura rosaceana* (Harris). The Open Entomology Journal 2010; 4: 18-24.
17. Raja N, Jayakumar M, Elumalai K, Jeyasankar A, Muthu C, Ignacimuthu S. Oviposition deterrent and ovicidal activity of solvent extracts of 50 plants against armyworm *Spodoptera litura*, Fab. (Lepidoptera: Noctuidae). Malaysian Applied Biology Journal 2004; 33(2): 73-81.
18. Baskar K, Sasikumar S, Muthu C, Kingsley S, Ignacimuthu S. Bioefficacy of *Aristolochia tagala* Cham. against *Spodoptera litura* Fab. (Lepidoptera: Noctuidae). Saudi Journal of Biological Sciences 2011; 18: 23–27.
19. Jeyasankar A, Raja N, Ignacimuthu S. Insecticidal compound isolated from *Syzygium lineare* Wall. (Myrtaceae) against *Spodoptera litura* (Lepidoptera: Noctuidae). Saudi Journal of Biological Sciences 2011; 18: 329–332.

20. Jeyasankar A, Elumalai K, Raja N, Ignacimuthu S. Effect of plant chemicals on oviposition deterrent and ovicidal activities against female moth, *Spodoptera litura* (Fab.) (Lepidoptera: Noctuidae). International Journal of Agricultural Science Research 2013; 2(6): 206-213.
21. Arivoli S, Samuel T. Antifeedant activity of plant extracts against *Spodoptera litura* (Fab.) (Lepidoptera: Noctiduae). American-Eurasian Journal of Agricultural and Environmental Sciences 2012; 12(6): 764-768.
22. Arivoli S, Samuel T. Antifeedant activity, developmental indices and morphogenetic variations of plant extracts against *Spodoptera litura* (Fab) (Lepidotera: Noctuidae). Journal of Entomology and Zoology Studies 2013; 1(4): 87-96.
23. Packiam SM, Anbalagan V, Ignacimuthu S, Vendan SE. Formulation of a novel phytopesticide Ponneem and its potentiality to control generalist herbivorous Lepidopteran insect pests, *Spodoptera litura* (Fabricius) and *Helicoverpa armigera* (Hübner) (Lepidoptera: Noctuidae). Asian Pacific Journal of Tropical Disease 2012; 2: S720-S723.
24. Krishnappa K, Mathivanan T, Elumalai K. Field evaluation of Plant oil formulations (POF's) against the armyworm *Spodoptera litura* (Fab.) with special reference to pest predator population in groundnut ecosystem (Lepidoptera: Noctuidae). International Journal of Interdisciplinary Research and Reviews 2013; 1(2): 30-39.
25. Venkateswarlu P, Raghavaiah G, Nagalingam B. Effect of neem oil on certain behavioural aspects of *Spodoptera litura* Fabricius in urdbean. Indian Journal of Pulses Research 1988; 1: 118-123.
26. Ayyangar GSG, Rao PJ. Neem (*Azadirachta indica* A. Juss) extracts as larval repellents and ovipositional deterrents to *Spodoptera litura* (Fabr.). Indian Journal of Entomology 1989; 51: 121-124.
27. Naumann K, Isman MB. Evaluation of neem *Azadirachta indica* seed extracts and oils as oviposition deterrents on noctuid moths. Entomologia Experimentalis et Applicata 1995; 76(2): 1115-120.
28. Raja N, Elumalai K, Jayakumar M, Jeyasankar A, Muthu C, Ignacimuthu S. Biological activity of different plant extracts against armyworm, *Spodoptera litura* (Fab.) (Lepidoptera: Noctuidae). Journal of Entomological Research 2003; 27: 281-292.
29. Kiran SR, Reddy AS, Devi PS, Reddy K. Insecticidal, antifeedant and oviposition deterrent effects of the essential oil and individual compounds from leaves of *Chloroxylon swietenia* DC. Pest Management Science 2006; 62(11): 1116-1121.
30. Anandan A, Krishnappa K, Mathivanan T, Elumalai K, Govindarajan M. Bioefficacy of *Hyptis suaveolens* and *Melochia chorcorifolia* against the armyworm *Spodoptera litura* (Fab.) (Lepidoptera: Noctuidae). International Journal of Current Research 2010; 4: 177-121.
31. Lakshmanan S, Krishnappa K, Elumalai K. Effect of plant oil formulation against armyworm, *Spodoptera litura* (Fab.), cotton bollworm, *Helicoverpa armigera* (Hub.) and fruit borer, *Earias vitella* (Fab.) (Lepidoptera: Noctuidae). International Journal of Current Life Sciences 2012; 2(1): 1– 4.
32. Singer MC. Complex components of habitat suitability within a butterfly colony. Science 1972; 179: 75–77.
33. Singer MC. Determinants of multiple host use by a phytophagous insect population. Evolution 1983; 37: 389–403.
34. Wiklund C. Oviposition preferences in *Papilio machaon* in relation to the host plants of the larvae. Entomologia Experimentalis et Applicata 1974; 17: 189–198.
35. Courtney SP. Coevolution of pierid butterflies and their cruciferous host plants. III. *Anthocharis cardamines* (L.) survival, development, and oviposition on different host plants. Oecologia 1981; 51: 91–96.
36. Ramaswamy SB, Cohen NE, Hanson FE. Deterrence of feeding and oviposition responses of adult *Heliothis virescens* by some compounds bitter-tasting to humans. Entomologia Experimentalis et Applicata 1992; 65: 81-93.
37. Chen C, Dong CYF, Cheng LL, Hou RF. Deterrent effect of neem seed kernel extract on oviposition of the oriental fruit fly (Diptera: Tephritidae) in guava. Journal of Economic Entomology 1996; 89: 162-166.
38. Sharma PD, Jalan MS. Relative efficacy and persistence of different insecticides for the control of *Helicoverpa armigera* on cotton. Pestology 1997; 21: 12-15.
39. Dethier VG. Mechanism of host plant recognition. Entomologia Experimentalis et Applicata 1982; 31: 49-56.
40. Miller JR, Strickler KL. Finding and accepting host plants, In: Bell, W.J. and Care, R.T. (eds) Chemical Ecology of Insects. Sinauer Associates, Sunderland, 1984; 127-157.
41. Showler AT. *Spodoptera exigua* oviposition and larval feeding preferences for pigweed, *Amaranthus hybridus*, over squaring cotton, *Gossypium hirsutum*, and a comparison of free amino acids in each host plant. Journal of Chemical Ecology 2001; 27(10): 2013-2028.