Journal of Pharmacognosy and Phytochemistry

Available online at www.phytojournal.com

E-ISSN: 2278-4136
P-ISSN: 2349-8234
JPP 2019; 8(5): 1376-1378
Received: 07-07-2019
Accepted: 09-08-2019

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Effect of green algal sea weed - *Chaetomorpha antennina* (Bory de Saint-Vincent) Kutzing's acetone extract on the growth and development of tobacco caterpillar, *Spodoptera litura* (Noctuidae: Lepidoptera)

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Abstract

Investigations on the green algal seaweed *Chaetomorpha antennina* (Bory de Saint-Vincent) Kützing for their insecticidal and inhibition effect on *Spodoptera litura* Fabricius were conducted under laboratory conditions in Department of Entomology. Experimental results on the larvicidal action of acetone extract exhibited no effect up to 24 hours of treatment. *C. antennina* acetone extract @ 10 per cent concentration demonstrated the highest larval mortality in all the periods of observation and a gradual increase in mortality was observed up to 7th day (66.67%). Even though the larval mortality was gradual among the treatments, pupation was at variable level among the treatments and the pupal to adult conversion was comparatively lower in all the treatments. Adult emergence data exhibited pupal: adult conversion ratio of 1:0.54 *C. antennina* 10 per cent treatment whereas in control and solvent control the ratio was 1:0.92.

Keywords: Pest management, sea weed, *Chaetomorpha antennina* - *Spodoptera litura*

Introduction

Marine algae were widely spread throughout the inter tidal and deep water regions of Indian coastline and accounted for an approximate population of 841 species (Dhargalkar and Neelam, 2005) and have been shown to have bactericidal (Cordeiro *et al*., 2006) [3]; fungicidal (Rajesh *et al*., 2011) [10] and insecticidal activities (Sahayaraj and Mary Jeeva, 2012) [14]. *Chaetomorpha antennina* (Bory de Saint-Vincent) Kützing is a common and widespread green algae, characterized by unbranched filaments. The inhibitory substances biosynthesized by the seaweeds were noted as early as in 1917 (Harder and Oppermann, 1953) [6]. Management of *S. litura* with an array of insecticides during the bygone three decades produced numerous detrimental effects *viz*., resistance, resurgence, residues, health hazards, global warming, green house effect etc. (Dhaliwal and Arora, 1996) [4]. These conditions pave way for the scientists and researchers to find alternatives. Among different alternatives, seaweeds offer a novel approach to pest management (Sahayaraj and Kalidas, 2011) [13]. The present study deals with the bio efficacy of acetone extract of *Chaetomorpha antennina* on the larva of *S. litura.*

Materials and methods

Seaweeds belonging to chlorphyta, green algae *Chaetomorpha antennina* (Bory de Saint-Vincent) Kutzing was collected in different seasons from the intertidal and submerged rocky substratum in the beach of Puducherry, India and identified in Centre for Advanced Studies in Marine Biology (located at Parangipettai), Faculty of Marine Biology, Annamalai University. The seaweeds collected by hand picking method was immediately washed in fresh seawater and carefully washed thoroughly three times with the tap water to remove the excess salt, sand and epiphytes (Sahayaraj and Mary Jeeva, 2012) [14]. To drain off the water, the algae were wiped with a blotting sheet and air-dried under shade (Kombiah and Sahayaraj, 2012 [7]. *Spodoptera litura* was mass cultured using the natural diet castor leaves under laboratory conditions in sterilized plastic buckets and the required stage of the insects was obtained from the culture.

Preparation of seaweed acetone extracts

Partially powdered seaweed - *C. antennina* was packed in Soxhlet apparatus and refluxed with acetone for 12 hours continuously. Extracted solvent was evaporated and dried in desiccator under vacuum. The final extract was elucidated with acetone and used for the experiments.

The extract was stored at -20 ^{0}C (Kombiah and Sahayaraj 2012) [7]. Prepared *C. antennina* acetone extracts was treated to the uniform aged third instar larva as per the following treatments *viz*., 0.1, 0.3, 1, 3, 5, 7, 10, solvent control and untreated control.

In all the experiments the leaf dip method was used. Castor leaf discs (5cm dia) were dipped for 10 minutes in the corresponding treatments in petri plates and they were shade dried and placed in petri plates. Uniformly aged *S. litura* larvae (III instar) were used in all the experiments In each petri plates, five leaf discs were kept and five pre-weighed 6 hours starved larvae were allowed in to the treated leaf discs in the petri plates. To compare the performance of solvent effect on the larva, a solvent control was maintained along with an absolute control also. The treatments were replicated thrice with five larvae per replication under completely randomized block design. Data on the mortality of larva was recorded every 24 hours up to 7th day of treatment (up to pupation). Larval weight data was recorded on 1st, 3rd, 5th and 7th day of treatment and per cent pupation and adult emergence was also noticed. Data and observations were taken on malformation of pupa and adults was ascertained and documented and analysed statistically.

Results and discussion

Effect of *C. antennina* acetone extract against *Spodoptera litura*

Laboratory experiments conducted to find out the larvicidal action of acetone extract of seaweed *C. antennina* against third instar larvae of *S. litura* revealed no effect up to 24 hours of treatment. From 48 hours onwards, the data clearly indicated an increased larvicidal activity and at the 7th day with maximum mortality of 73.33 per cent was exhibited by 10 per cent concentration followed by T_6, T_5, T_3 which were 53.33, 46.67, 46.67 per cent in *C. antennina* treatments respectively. In the same period, in solvent control (T8) and control treatment (T9) the observed mortality was 26.67 and 13.33 per cent respectively (Table 1).

Among the seaweed acetone extract concentrations, pupation was minimum in the 10 percent concentration (26.67%) and maximum in T4 and T2 (73.33 %) in *C. antennina* treatments which were on par with each other, whereas in the same period the maximum pupation was noticed in control (86.67%). Adult emergence data showed significant difference among the treatments, where the lowest emergence (13.33%) was exhibited by T_7. The pupal to adult conversion was maximum in control (80%) (Table 1). Previous studies have shown evidences that botanicals exhibit feeding deterrent activity against *S. litura* (Morimoto *et al.*, 2002 and Sahayaraj, 2011) [9, 12-13]. Rathi and Gopalakrishnan (2005) [11] reported the toxic effects of *Synedrella nodiflora's* methanol extracts against *S. litura*.

Thakur *et al.* (2004) [15] concluded that methanol extract obtained from the sea cucumber body wall is an excellent source for insecticidal activity and further studies related to chemical isolation of active principles from these extracts are warranted also confirming mosquito larvicidal activity of sea cucumber extracts due to presents of saponins. This may due to the growth inhibition substance present in the sea weeds and it needed in-depth research.

Growth and development of *S. litura* larva was hindered by the solvent extracts, but observing the data on larval weight, statistical non significance could not displayed any treatment effects. Interestingly pupal to adult conversion was comparatively lower. Adult emergence data on the acetone extract effect of *C. antennina* (10%) exhibited pupal: adult conversion ratio of 1:0.54 whereas in control and solvent control the ratio was 1:0.92 and 1:0.55 respectively. The adult conversion ratio was higher in control compared to all the treatments and solvent control (Table 2).

Asha *et al.* (2012) [2] stated that the methanol extract of *Ulva fasciata* and *Ulva lactuca* caused highest nymphal mortality against *D. cingulatus*. Ahmed *et al.* (2011) [1] stated that the larvicidal effect of *Jania* may be due to bioactive phytoconstituents such as carotenoids. Based on these reports, it was evidenced that the green algal seaweed *C. antennina* has the potential to become a botanical insecticide and may be included in future IPM programmes.

Table 1: *Chaetomorpha antennina* acetone extracts' effect on larva, pupa and adult of *Spodoptera litura*

Treatments	Per cent mortality of larvae after							Pupation %	Adult Emergence %	Pupal : Adult conversion ratio
	1st day	2nd day	3rd day	4th day	5th day	6th day	7th day			
T_1 – *C. antennina* 0.1%	0^{b} (1.28)	0.00^{e} (1.28)	0.00^{e} (1.28)	6.67^{d} (9.70)	13.33^{d} (18.13)	26.67^{d} (30.78)	33.33^{b} (34.63)	66.67^{b} (55.36)	33.33^{b} (35.01)	1 : 0.50
T_2 -- *C. antennina* 1%	0^{b} (1.28)	13.33^{c} (18.13)	13.33^{c} (18.13)	20.00^{b} (26.56)	26.67^{b} (30.788)	26.67^{c} (30.78)	26.67^{c} (30.78)	73.33^{a} (59.21)	26.67^{b} (30.78)	1 : 0.36
T_3 - *C. antennina* 3%	0^{b} (1.28)	6.67^{d} (9.70)	6.67^{d} (9.70)	6.67^{d} (9.70)	26.67^{b} (30.78)	40.00^{a} (38.85)	46.67^{b} (43.07)	53.33^{b} (46.92)	26.67^{b} (30.78)	1 : 0.50
T_4 - *C. antennina* 5%	0^{b} (1.28)	0.00^{e} (1.28)	6.67^{d} (9.70)	13.33^{c} (18.13)	20.00^{c} (26.56)	26.67^{b} (30.78)	26.67^{c} (30.78)	73.33^{a} (59.21)	26.67^{b} (30.78)	1 : 0.36
T_5 - *C. antennina*	0^{b} (1.28)	20.00^{b} (26.56)	20.00^{b} (26.56)	33.33^{a} (35.01)	40.00^{a} (39.23)	46.67^{a} (43.07)	46.67^{b} (43.07)	53.33^{b} (46.92)	20.00^{b} (26.56)	1 : 0.36
T_6 - *C. antennina* 7%	0^{b} (1.28)	33.33^{a} (35.01)	40.00^{a} (39.23)	40.00^{a} (39.23)	46.67^{a} (43.07)	46.67 ^{a} (43.07)	53.33^{a} (46.92)	46.67^{c} (43.07)	13.33^{c} (18.13)	1 : 0.28
T_7 - *C. antennina* 10%	0^{b} (1.28)	40.00^{a} (39.23)	46.67^{a} (43.07)	53.33^{a} (46.92)	60.00^{a} (50.77)	66.67^{a} (54.99)	73.33^{a} (59.21)	26.67^{d} (30.78)	13.33^{c} (18.13)	1 : 0.50
T_8 – Solvent control	0^{b} (1.28)	0.00^{e} (1.28)	0.00^{e} (1.28)	13.33^{c} (18.13)	13.33^{d} (18.13)	20.00^{d} (26.56)	26.67^{c} (30.78)	73.33^{a} (59.21)	40.00^{b} (38.85)	1 : 0.54
T_9 - Control	0^{b} (1.28)	0.00^{e} (1.28)	0.00^{e} (1.28)	0.00^{e} (1.28)	6.67^{e} (9.70)	6.67^{e} (9.70)	13.33^{d} (18.13)	86.67^{a} (71.86)	80.00^{a} (67.64)	1 : 0.92
SEd	3.9731	5.9609	7.1164	8.3899	7.6528	7.0044	7.4805	7.4805	9.2698	
CD (=0.5)	8.3472	12.5236	14.9511	17.6267	16.0783	14.7160	15.7161	15.7161	19.4754	

Each value is an average of three replicates; figures enclosed in parentheses are arc sine transformed values; means followed by a common alphabet are not significantly different at 5% level by LSD

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