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ANTI-INSECT PROPERTIES OF A POTENTIAL MARINE ALGAE *SARGASSUM WIGHTII* AGAINST *S. LITURA* (FAB.)

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Abstract

The present experiment was conducted to evaluate the insecticidal potential of a brown algal sea weed - *Sargassum wightii* on the leaf eating caterpillar, *Spodoptera litura* (Fabricius). Sea weed was collected from Rameswaram coastal ecosystem, Tamil Nadu and the laboratory experiments were conducted in the Department of Entomology, Faculty of Agriculture, Annamalai University, India during 2018 - 2019.The seaweed solvent extract's preparations were screened against homogenous population of *S. litura* (third instar larva) using contaminated food bio-assay technique with the following concentrations 0.1, 1, 3, 5, 7, 10 and 20 per cent. The highest larvicidal activity (60.00%) was observed after 72 hrs of treatment at the maximum concentration (20%) and least larval mortality were observed in 0.1 per cent concentration (6.66%). The highest pupal mortality and lowest adult emergence among the treatments were also recorded by 20 per cent concentration compared to both solvent and untreated control.

Key words : Brown algal seaweed, Larvicide, Mortality, *Spodoptera litura*.

Introduction

The tobacco cutworm *Spodoptera litura* Fab. as a cosmopolitan pest has been reported to attack more than 120 host plants including cultivated crops. The larval damage to the leaves have caused physiological instability in crops and reduced the yield thereby the farmers encountered hectic monetary loss. The wide host range, abundance and gregarious feeding nature of the larvae made them a major pest of crops and accountable to produce yield losses in short period of time (Ahmad *et al.*, 2013). Nowadays numerous organic chemical insecticides were used for the management of *S. litura* of which most of them have been reported to cause serious problems *viz*, development of insecticide resistant pests, environment pollution, toxicity to non-target beneficial organisms (predators, parasitoids) and bio-magnification etc. (Ahmad *et al.*, 2007; Saleem *et al.*, 2008). The problems due to insecticides paved way for finding alternatives wherein the naturally available flora and fauna in the ecosystem may fit appropriately to fulfill the void. The marine ecosystem with rich flora especially algae which are embeeded in the salt water for millions of years may have accumulated the secondary metabolites would be a better tool for the management insect pests in Agriculture.

The marine algae are reported possess dynamic biological activities like bactericidal, anti-viral, fungistatic, neamaticidal and insecticidal activity. Many researchers have proved that marine algae have the potential to strike against different pests (Bianco *et al.*, 2013; Xin Yu *et al.*, 2015; Ishii *et al.*, 2018; Kannan and Dharani Priya, 2019). In this context, a brown algal seaweed (*S. wightii*) has been investigated for its insecticidal and IGR activity against *S. litura* and the results were documented and presented.

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Materials and Methods

Seaweed Collection

The brown algal seaweed, *Sargassum wightii* was collected from deep sea regions of Rameshwaram coast, Tamil Nadu, India by hand picking and scuba diving. Collected algae were washed with seawater and then repeatedly washed with running tap water (three times) to remove salt, sand and epiphytes. Washed algae were shade dried for a fortnight and the dried seaweeds were

stored in room temperature under dry conditions (Kannan and Bharathkumar, 2016).

Mass culturing of Test insects (*Spodoptera litura* Fab.)

The *Spodoptera litura* Fab. egg masses were collected from groundnut field at U. Agaram village, Vridhachalam in Cuddalore district of Tamil Nadu. The collected egg masses were allowed to hatch and the neonates are reared on fresh castor leaves (*Ricinus communis* L.) until pupation. The pupating larvae were provided with sterilized soil in a plastic tray and allowed to pupate After pupation, they were placed inside the ovipositional cage (40 x 25 x 25 cm) and the emerged adult moths (five pairs) were fed with 10% honey solution as adult food and allowed them for mating and they were allowed to lay its eggs on Nerium twigs (in conical flask) kept inside ovipositional cage. After hatching, the neonates were fed with fresh tender castor leaves and were and were reared up to third instar and these uniform aged third instar larvae were used for bioassay experiment.

Preparation of solvent extract

The brown algal seaweeds were partially powdered, packed and loaded separately in Soxhlet apparatus (30g) and refluxed with 300ml of acetone for 24 hours continuously. The extracted solvent extract were transferred into 500ml beaker and evaporated on a hot plate. The final extract as stock solution was used for the experiments. The extracts were stored at -20°C (Kombiah and Sahayaraj, 2012).

Bioassay - Leaf disc method (Free choice)

The stock solution of crude extract (10%) was prepared by dissolving in solvents. The solvent extracts at different concentrations: 0.1, 1, 3, 5, 7, 10 and 20 per cent along with an absolute and solvent control were evaluated against third instar larvae of *S. litura* larva (homogenous population) using leaf dip bio-assay under free choice method. Surface sterilized Castor leaf discs (5cm dia.) were dipped in the solvent extract concentrations for ten minutes and shade dried. The treated leaves after drying were placed inside the Petri dishes (five leaf discs per petri plate) separately and provided with required moisture using wet filter paper. Four hours pre-starved third instar larva were introduced in each Petri plate according to the treatment schedule and allowed to feed on the treated leaves. The experiment was laid under completely randomized design with nine treatments under three replications. Data on larval mortality, pupation percentage, pupal malformation, adult emergence, and adult malformation were noticed and the means values were pooled and analyzed statistically.

Results and Discussion

Data on larval mortality and growth regulator activities instigated by the acetone solvent extract of *S. wightii* revealed that the larval mortality initiated at 24 hours of treatment wherein the highest mortality rate was demonstrated by the maximum concentration (200µl/ml) (40.00%) followed by 100µl/ml concentration (33.33%) compared to other treatments and control (Table 1). The mortality of *S. litura* lasted up to 72 hours and thereafter the alive larvae have transformed to pupal stage. There was a gradual increase in larval mortality with increase in concentration. The mortality rate at 48 and 72 hours after treatment the highest concentration demonstrated the maximum larval mortality (46.66 and 60.00 per cent mortality respectively) table 1 followed by 100 and 70 µl/ml concentration wherein among the seaweed treatments the lowest concentration recorded the least mortality rate when compared to both control (absolute and untreated) without larval death. The pupal transformation data observed during the experiment revealed that the maximum pupation (86.67%) was observed at the lowest concentration (0.1 µl/ml) and vice versa (40 per cent at 200µl/ml) (Table 2). The experiment was continued up to adult emergence and the observations on the influence of seaweed extracts on the tested insects demonstrated pupal malformation with the highest level

Table 1: Larvicidal action of acetone solvent extract of *Sargassum wightii* on *Spodoptera litura*.

Treatment Dose (%)	Larval mortality % after		
	24hrs	48hrs	72hrs
T_1 - *Sargassum wightii* (0.1µl/ml)	13.33^{ab}(18.13)	13.33^{ab}(18.13)	13.33^{bc}(18.13)
T_2 - *Sargassum wightii* (10µl/ml)	13.33^{ab}(18.13)	20^{ab}(22.36)	20^{b}(22.36)
T_3 - *Sargassum wightii* (30µl/ml)	13.33^{ab}(18.13)	26.66^{a}(30.78)	33.33^{ab}(35.01)
T_4 - *Sargassum wightii* (50µl/ml)	26.66^{a}(30.78)	26.66^{a}(30.78)	33.33^{ab}(35.01)
T_5 - *Sargassum wightii* (70µl/ml)	33.33^{a}(34.63)	33.33^{a}(34.63)	33.33^{ab}(35.01)
T_6 - *Sargassum wightii* (100µl/ml)	33.33^{a}(30.42)	46.66^{a}(42.70)	53.33^{a}(46.92)
T^7 - *Sargassum wightii* (200µl/ml)	40.00^{a}(38.85)	46.66^{a}(38.49)	60.00^{a}(51.14)
T_8 (Solvent control)	0.00^{b}(1.28)	0.00^{b}(1.28)	0.00^{c}(1.28)
T_9 (Absolute control)	0.00^{b}(1.28)	0.00^{b}(1.28)	0.00^{c}(1.28)
SED	12.20	12.65	9.60
CD(p=0.05)	25.64	26.59	20.17

Table 2: IGR activity of acetone solvent extract of *Sargassum wightii* on *Spodoptera litura*.

Treatment Dose (%)	Pupation %	Pupal malformation %	Adult emergence %	Pupal to adult conversion ratio
T_1 - *Sargassum wightii* (0.1µl/ml)	86.67^{ab} (71.86)	13.33	73.33^{b} (59.21)	1:0.84
T_2 - *Sargassum wightii* (10µl/ml)	80.00^{b} (67.64)	13.33	66.66^{b} (54.99)	1:0.83
T_3 - *Sargassum wightii* (30µl/ml)	66.67^{bc} (54.99)	13.33	53.33^{bc} (46.92)	1:0.79
T_4 - *Sargassum wightii* (50µl/ml)	66.67^{bc} (54.99)	13.33	53.33^{bc} (46.92)	1:0.79
T_5 - *Sargassum wightii* (70µl/ml)	66.67^{bc} (54.99)	13.33	53.33^{bc} (46.92)	1:0.79
T_6 - *Sargassum wightii* (100µl/ml)	46.67^{c} (43.07)	13.33	33.33^{cd} (30.42)	1:0.71
T_7 - *Sargassum wightii* (200µl/ml)	40.00^{c} (38.85)	26.66	13.33^{d} (13.93)	1:0.33
T_8 - (Solvent control)	100.00^{a} (88.72)	0.00	100^{a} (88.72)	1:1.00
T_9 - (Absolute control)	100.00^{a} (88.72)	0.00	100^{a} (88.72)	1:1.00
SED	9.60	9.93	10.14	
CD(p=0.05)	20.17	20.86	21.32	

of 26.67 per cent in highest concentration whereas in all other treatments similar level of value (13.33%) was noticed wherein no pupal malformation was registered in both control (Table 2). The remaining pupae other than malformed have emerged out as adults wherein the highest influence was noticed in the 200µl/ml treated insects with the least emergence (13.33%) whereas in the lowest dosage the highest level of emergence was noticed (73.33%) in compared to both control wherein all the insects were successfully emerged out as adults. Considering the treatment effect on tested insects it was obvious that in control the pupal to adult conversion ratio was 1:1.00 whereas in seaweed treatments *i.e.*, @ 200µl/ml the ratio was 1:0.33 and higest (1:0.84) at lowest dosage (10µl/ml) (Table 2).

The present investigation informed that the acetone extract of *S.wightii* at different concentrations have influenced the growth and development of insect such as larval death, pupal mortality, pupal malformation and adult mortality as compared to untreated control. These findings are in close proximity to the results observed from the investigations of following researchers and their views are disclosed as given below. Soto and Martin (2003) reported the insecticidal activity of a Brown algae (Dictyotaceae) against tomato pinworm, *Tuta absoluta* owed to the presence of new diterpene dictyo crenulol. Similar studies by Kannan and Bharthkumar (2016) with the Chaetomorpha antennina also demonstrated larvicidal and insect growth regulator activity at higher concentration against S. litura. Further, Anandhan and Sornakumari (2011) revealed the larvicidal efficiency of methanol extract of *Gracillaria crassa* and *Hypnea valentia* against *Aedes aegypti*; *Lobophora variegate* against *A. aegypti* and *Culex quinquefasciatus* (Manilal *et al.*, 2011) and brown seaweed *Ascophyllum nodosum* against thrips and Persean mite colonies in Avocado

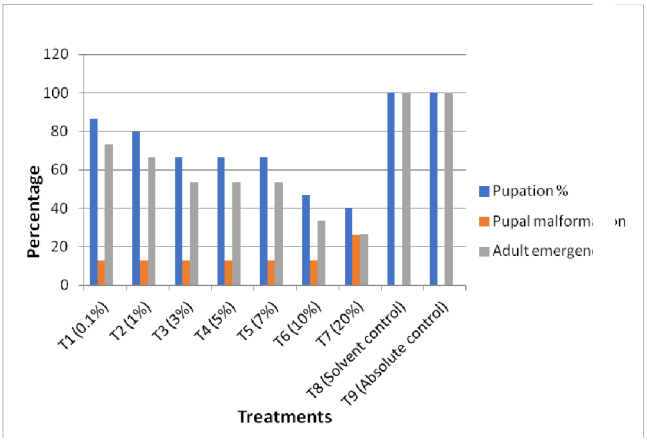

Fig. 1: Effect of *S.wightii* Acetone solvent extract on the pupation percentage adult emergence of *S. litura*.

(Holden and Ross, 2014).

The present study showed that the brown marine algae *Sargassum wightii*'s solvent extract possessed anti-insect property which needs to be investigated in depth for their biogenic molecules and to study their mode of action against crop pests for future biopesticide development.

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