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# Insecticidal activity of brown and red seaweed extracts against cowpea bean aphid, *Aphis craccivora* Koch

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**Abstract**
The marine algae, popularly known as seaweeds are one of the most important marine resources of the world. The insecticidal activity of seaweed extracts *viz*., brown seaweed, *Sargassum tenerrimum* and red seaweed, *Gracilaria corticata* were evaluated against *Aphis craccivora* adults on cowpea. *Sargassum tenerrimum* and *Gracilaria corticata* methanolic extracts showed insecticidal activity against *Aphis craccivora* at the same concentrations tested (0.1, 0.2, 0.4, 0.8 and 1.6% for both the extracts). Both the seaweed extracts caused more than 60% mortality against *Aphis craccivora* at higher concentration. Hence, these seaweed extracts will be an alternative botanical pesticide in the development of IPM module for the management of aphids.

**Keywords:** Seaweeds, methanolic extract, insecticidal activity, cowpea bean aphid

## Introduction
Cowpea, *Vigna unguiculata* (L.) is an important crop for food and nutritional security, notably in sub-saharan Africa and around the world, because of its nutritional value and capacity to endure drought and heat. It's rich in protein (28%) and minerals including magnesium and calcium (Gerrano *et al*., 2019) [7], as well as vitamins A and B6. It is an important staple food for millions of people in the arid and semi-arid tropics (Quin, 1997; Asiwe, 2009) [12, 5].
In India, 23.13 million tonnes of cowpea were produced during the year 2016–2017 (Anonymous, 2019) [2]. Although the area under cowpea production in the country is increasing, there are many constraints associated with cowpea production with substantial yield loss. However, among the biotic stresses, aphids impedes cowpea growth, development and production (Souleymane *et al*., 2013) [18]. It causes 20-40% yield loss (Choudhary *et al*., 2017) [6].
The widespread and indiscriminate application of synthetic chemical pesticides to combat this pest has resulted in ecological imbalances, in addition to their destructive effects on other living things, including humans. Hence, there is an urgent need for developing methods and materials with eco-friendly standards (Rajappan *et al*., 2000) [13].
In the search for pesticide alternatives, seaweeds fit into the strategy, with many seaweeds containing a variety of bioactive chemicals with varied biological functions (Tuney, 2006) [20]. Seaweeds are known for their insecticidal activities (Sahayaraj and Mary Jeeva, 2012) [15]. Various studies on seaweed extracts have proven that they could be used to manage several agricultural pests such as aphids (Argadoña *et al*., 2000) [3], bugs (Sahayaraj and Kalidas, 2011; Asha *et al*., 2012; Sahayaraj and Jeeva, 2012) [16, 4, 15], moths (Argadoña *et al*., 2000; Abbasy *et al*., 2014) [3, 1] and weevils (Manilal *et al*., 2011; Ishii *et al*., 2017) [11, 10]. Therefore, over the last few years, the utilization of seaweeds has gained attention due to eco-friendly approaches for the management of insect pests (Sahayaraj *et al*., 2012) [4]. The objective of the study was to assess the insecticidal activity of *Sargassum tenerrimum* and *Gracilaria corticata* methanolic extracts for the control of cowpea bean aphid, *Aphis craccivora* Koch.

## Materials and Methods
The seaweeds, *Sargassum tenerrimum* (brown seaweed) and *Gracilaria corticata* (red seaweed) were collected from Mandapam, Ramanathapuram district coasts of Tamil Nadu, India. The collected leaves were washed three times with fresh water and once with distilled water to remove salts and micro algae. Then, the leaves were shade dried for 2 weeks continuously and dried seaweeds were partially powdered using a domestic blender and willey

mill. The powdered seaweeds (30g) were extracted with 300ml of methanol solvent in Soxhlet apparatus (temperature ranging from 55-60 °C) for 12 hours. These extracts were filtered and concentrated by evaporation in a rotary vacuum evaporator at 40 °C. Both the crude extracts were stored at -20 °C until further use (Sahayaraj and Kalidas 2011; González-Castro *et al*., 2019) [16, 8].

Adult aphids were collected from the infested plants (*Vigna unguiculata*) in the field (AC&RI, Madurai). The collected insects were maintained in screened cages under natural environmental conditions. Then, the reared insects were used for subsequent studies.

Five stock concentrations (0.1, 0.2, 0.4, 0.8 and 1.6%) methanolic extracts of *Sargassum tenerrimum*, *Gracilaria corticata* and Azadiractin 1% EC as treated check were used for the insect bio-assay. Surface sterilized cowpea leaf discs were dipped in the different concentrations of methanolic extracts for 10 minutes and shade dried. After that, the leaves were placed inside the Petri plate and provided with wet filter paper to maintain turgidity. For each treatment, twenty aphids were placed in a Petri plate containing the dipped leaf and replicated thrice. Mortality was recorded at 24, 48 and 72 hours after treatment (Gowthish and Kannan, 2019) [9].

The ratio of dead insects to the total number of insects after 72 hours was used to compute percent mortality. If no movement was visible after several seconds of touching with a probe under a magnifying glass, the insects were declared as dead. After arc sine transformation, the data from the studies were statistically analysed by one factor CRD using the computer-based application SPSS software (Tukey, 1977) [19].

## Results and Discussion

The methanolic extracts of *Sargassum tenerrimum* and *Gracilaria corticata* were used against aphid, the mortality rate was gradually increased from lower concentration to higher concentration (21.67, 28.33, 40.00, 50.00 and 68.33% mortality for 0.1, 0.2, 0.4, 0.8 and 1.6% concentrations respectively) (Table 1) and (18.33, 25.00, 36.67, 41.67, 65.00% mortality for same concentrations respectively) (Table 2). Sahayaraj and Mary jeeva, (2012) [15] reported that the *Sargassum tenerrimum* extracts and column chromatographic fractions altered life traits of *Dysdercus cingulatus*. However, our study revealed that *Sargassum tenerrimum* and *Gracilaria corticata* methanolic extracts caused more than 60% mortality of *Aphis craccivora* at 72 hrs after the exposure. Similarly, *Osmundae pinnatifida* showed insecticidal activity against five different insects *viz*., *Callosobruchus analis*, *Sitophilus oryzae*, *Tribolium castaneum*, *Rhyzopertha dominica* and *Trogoderma granarium* (Rizvi and Shameel, 2003) [14]. In addition, *Aphis fabae* was also controlled by *Plocamium cartilagineum* (Argandona *et al*., 2000) [3].

**Table 1:** Insecticidal activity of *Sargassum tenerrimum* methanolic extract against Cowpea bean aphid, *Aphis craccivora*

| Treatment (Concentration) % | Mortality (Insecticidal activity) *Sargassum tenerrimum* (Methanol) | | |
|---|---|---|---|
| | 24 HAT | 48 HAT | 72 HAT |
| T1(0.1) | 1.7±0.58 (5.05)$^{cd}$ | 6.67±0.58 (7.72)$^{e}$ | 21.67±0.58 (12.69)$^{e}$ |
| T2(0.2) | 5.0±1.00 (6.73)$^{bcd}$ | 16.67±0.58(11.27)$^{d}$ | 28.33±0.58 (14.37)$^{e}$ |
| T3(0.4) | 8.3±0.58 (8.41)$^{bc}$ | 25.00±1.00(13.53)$^{cd}$ | 40.00±1.00 (16.93)$^{d}$ |
| T4(0.8) | 15.0±1.00 (10.71)$^{ab}$ | 30.00±1.00 (14.74)$^{bc}$ | 50.00±1.00 (18.89)$^{c}$ |
| T5(1.6) | 21.7±1.15 (12.64)$^{a}$ | 38.33±0.58 (16.60)$^{ab}$ | 68.33±0.58 (22.11)$^{b}$ |
| T6 (TC) | 30.0±1.00 (14.74)$^{a}$ | 46.67±1.15 (18.26)$^{a}$ | 91.67±0.58 (25.72)$^{a}$ |
| T7(SC) | 0.0±0.00 (4.05)$^{d}$ | 0.00±0.00(4.05)$^{f}$ | 0.00±0.00 (4.05)$^{f}$ |
| T8© | 0.0±0.00 (4.05)$^{d}$ | 0.00±0.00(4.05)$^{f}$ | 0.00±0.00 (4.05)$^{f}$ |
| S.Ed | 1.199 | 0.750 | 0.532 |
| P- value (0.05%) | 0.00** | 0.00** | 0.00** |

*Mean values of three replications are represented as mean; In a column, the mean followed by the same letter are not significantly different from each other, HAT – Hours After Treatment, Tukey ($p \leq 0.05$).

**Table 2:** Insecticidal activity of *Gracilaria corticata* methanolic extract against Cowpea bean aphid, *Aphis craccivora*

| Treatment (Concentration) % | Mortality (Insecticidal activity) *Gracilaria corticata* (Methanol) | | |
|---|---|---|---|
| | 24 HAT | 48 HAT | 72 HAT |
| T1(0.1) | 1.7±0.58 (5.05)$^{de}$ | 6.67±0.58 (7.72)$^{d}$ | 18.33±0.58 (11.76)$^{d}$ |
| T2(0.2) | 6.7±0.58 (7.72)$^{cd}$ | 15.00±1.00 (10.71)$^{cd}$ | 25.00±1.00 (13.53)$^{d}$ |
| T3(0.4) | 10.0±1.00 (8.97)$^{bc}$ | 23.33±1.15(13.09)$^{bc}$ | 36.67±0.58 (16.25)$^{c}$ |
| T4(0.8) | 15.0±1.00(10.71)$^{bc}$ | 28.33±1.53 (14.30)$^{b}$ | 41.67±1.15 (17.27)$^{c}$ |
| T5(1.6) | 18.3±0.58(11.76)$^{ab}$ | 35.00±1.00 (15.87)$^{ab}$ | 65.00±1.00 (21.55)$^{b}$ |
| T6 (TC) | 30.0±1.00 (14.74)$^{a}$ | 46.67±1.15 (18.26)$^{a}$ | 90.00±1.00 (25.47)$^{a}$ |
| T7(SC) | 0.0±0.00 (4.05)$^{e}$ | 0.00±0.00 (4.05)$^{e}$ | 0.00±0.00 (4.05)$^{e}$ |
| T8© | 0.0±0.00 (4.05)$^{e}$ | 0.00±0.00 (4.05)$^{e}$ | 0.00±0.00 (4.05)$^{e}$ |
| S.Ed | 1.01977 | 0.99892 | 0.66778 |
| P- value (0.05%) | 0.00** | 0.00** | 0.00** |

*Mean values of three replications are represented as mean; In a column, the mean followed by the same letter are not significantly different from each other, HAT – Hours After Treatment, Tukey ($p \leq 0.05$).

## Conclusion

The study was concluded that the methanolic extracts of brown algal seaweed *Sargassum tenerrimum* and red algal seaweed *Gracilaria corticata* could be used as a substitute to available botanicals. This marine seaweed can be used to manage sucking pests such as *Aphis craccivora* as an eco-friendly pest management component.

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