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Herbicidal and Growth Promoter Activity of Three Saltmarsh Plants from Pulikat Coast

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Abstract: Three species of saltmarsh plants ((*Salicornia brachiata*, *Sesuvium portulacastrum*, *Suaeda maritima*) were screened for herbicidal and growth promoter activities using Lemna Bioassay. Two solvents, hexane and methanol were used for the preparation of crude extracts. Three concentrations (500, 100, and 50 ppm) and a control were tested in duplicates for the analysis. The results were obtained on the 3rd and 7th day of the experiment. Of the two solvents used, the methanol extract of all the three saltmarsh plants exhibited herbicidal activity and in the hexane extracts only Salicornia brachiata and Sesuvium portulacastrum at 500ppm concentration exhibited herbicidal activity. The hexane extract of Salicornia brachiate and Suaeda maritima showed growth promoter activity enhancing the growth of the Lemna plants.
Keywords: Herbicidal, Growth promoter, saltmarsh plants, Salicornia brachiata, Sesuvium portulacastrum, Suaeda maritima, Pulicat.

INTRODUCTION

The farmland of the world includes about 150,000,000 hectares or 10% of terra firma and there are more than 200 families (6000 species including the analogs) of weeds that damage agricultural production. Weeds reduce crop yield by competing for water, light, soil nutrients, space, and CO_2. Weeds also pose additional problems such as reducing crop quality by contaminating the commodity; interfering with harvest; serving as hosts for crop diseases. Before chemical herbicides appeared early in the 1950s, weeding was done by hand and by machinery requiring more than half the total hours of farming labour. Nowadays the appropriate application of herbicides has brought about a great reduction of labour and increase in crop yield to support the world population[1]. The oceans represent a virtually untapped resource for the discovery of novel chemicals with potential as pharmaceuticals, nutritional supplements, cosmetics, agrochemicals, molecular probes, enzymes and fine chemicals. Each of these classes of marine bioproducts has a potential multi-billion dollar market value[2-5]. Work regarding herbicidal activity relating to marine natural products is very limited. The major work carried out in this field was a collaborative study carried-out by Australian Institute of Marine Sciences and Department of Biochemistry and Molecular Biology, James Cook University, Australia. They have developed a

rapid thoroughput biomolecular screening for marine derived C4 plant specific herbicides[6]. Human survival vis-a-vis a continuous increase in agricultural productivity depends on the effective merging of classical breeding with modern plant biotechnology and the novel tools it provides. Screening for growth promoters for agriculture usage is important in the context of increasing agriculture production to meet the demand of ever increasing world population. In the present study while screening for herbicidal activity of salt marsh plants, their growth promoter activity was also studied.

MATERIALS AND METHODS

Description of Study Area

Pulicat lake is the second largest brackishwater lake in India and is located between13º26' and 13º43'N latitude and 80º03' and 80º18'E longitudes. The dried parts of the lagoon extend up to 13º 60' N latitude. It opens into the Bay of Bengal through the southeastern margin near the Pulicat town which is located 40 km north of Chennai city, Tamilnadu, India.

Extraction of saltmarsh plants

The salt marshes (Salicornia brachiata, Sesuvium portulacastrum, Suaeda maritima**)** were collected from Pulicat, the whole plant was washed thoroughly in running water to remove mud and sand. Then the plants were cut into small pieces and air-dried for 24 hours at room temperature before extraction with solvents. The samples were used for extraction using hexane and methanol separately. The extract were cold steeped overnight at 4^0C and filtered using Whatman No 1 filter paper. The filtrate was poured in previously weighed Petri plate and evaporated to dryness in rotary evaporator[7]. The dried crude extracts were used for herbicidal activity.

Lemna Assay

The glass vials were prepared for testing in duplicate, i.e., two vials per dose (500, 50, 5 ppm, control). 20 mg of compound was weighed and dissolved in 20 ml solvent (hexane and methanol). From each solvent extract, 1000, 100, and 10 ml solution were added to vials corresponding to 500, 50 and 5 ppm concentration. Then solvents were allowed to evaporate overnight. 2 ml of water was taken in each vial for all the doses and then single plants containing a rosette of three fronds were added. The vials were then placed in glass dish filled with about 2 cm water, and sealed with cling film to retain moisture inside the glass chamber. The dishes with vials were placed in a place with natural light for seven days. The appearance and number of fronds were recorded on the 3rd and 7th days. The data were analysed for percentage inhibition or growth promotion of the extracts on Lemna plants using the formulae:

$$\text{Growth inhibition (\%)} = \frac{Dc - Dt}{Dc} \times 100$$

$$\text{Growth promotion (\%)} = \frac{Dt - Dc}{Dc} \times 100$$

RESULTS

In the present study, the hexane extract of Salicornia brachiata decoloured the fronds of Lemna plant at the concentration of 1000 ppm on 3rd day, and it decayed the fronds of Lemna plant at the concentration of 1000 ppm on 7th day. The hexane extract of Sesuvium portulacastrum formed yellow dots on the fronds of lemna plant at a concentration of 100 ppm on 3rd day. And on the 7th day, the hexane extracts decayed the fronds of Lemna plant at the concentration of 1000 and 100 ppm. The hexane extract of Suaeda maritima decoloured the fronds of Lemna plant at the concentration of 1000, 100 ppm on 7th day. The hexane extract of Salicornia

brachiata showed growth promoter activity in Lemna plant at the concentration of 100 ppm. The hexane extract of Suaeda showed growth promoter activity in Lemna plant at the concentration of 50 ppm. (Tables 1 & 2).

Methanol extract of Salicornia brachiata decoloured the fronds of lemna plant at the concentration of 500,100 and 50 ppm on 3rd day and decayed the fronds of Lemna plants at the concentration of 500, 100, 50 ppm on 7th day. Methanol extract of Sesuvium portulacastrum decoloured the fronds of lemna plant at the concentration of 500,100 and 50 ppm on 3rd day and decayed the fronds of Lemna plants at the concentration of 500, 100 ppm on 7th day. Methanol extract of Suaeda maritima decoloured the fronds of lemna plant at the concentration of 500,100 and 50 ppm on 3rd day and decayed the fronds of Lemna plants at the concentration of 500, 100, 50 ppm on 7th day (Table 3).

Table 1. Percentage inhibition of hexane extract of saltmarsh plants

Hexane Extract (ppm)	**Salicornia brachiata**		**Sesuvium portulacastrum**		**Suaeda maritima**	
Period	3rd Day	7th Day	3rd Day	7th Day	3rd Day	7th Day
500	14.28%	57.14%	14.28%	57.14%	14.28%	14.28%
100	0	0	14.28%	57.14%	14.28%	14.28%
50	14.28%	14.28%	14.28%	14.28%	0	0
C	0	0	0	0	0	0

Table 2. Percentage Growth promoter of hexane extract of saltmarsh plants

Hexane Extract (ppm)	**Salicornia brachiata**		**Sesuvium portulacastrum**		**Suaeda maritima**	
Period	3rd Day	7th Day	3rd Day	7th Day	3rd Day	7th Day
500	0	0	0	0	0	0
100	16.28%	16.28%	0	0	0	0
50	0	0	0	0	16.28%	16.28%
C	0	0	0	0	0	0

Table 3. Percentage inhibition of methanol extract of saltmarsh plants

Methanol Extract (ppm)	**Salicornia brachiata**		**Sesuvium portulacastrum**		**Suaeda maritima**	
Period	3rd Day	7th Day	3rd Day	7th Day	3rd Day	7th Day
500	25%	62.5%	100%	100%	100%	100%
100	25%	62.5%	25%	62.5%	62.5%	100%
50	25%	100%	25%	62.5%	25%	100%
C	0	0	0	0	0	0

DISCUSSION

Lemna plants are miniature aquatic monocotyledonous plants, which are very sensitive to bioactive compounds. Lemna assay has been used to detect natural anti-tumor and phytotoxic compounds, and may be useful to detect new plant growth stimulants[8]. Works relating to screening and isolation of herbicidal compounds from marine sources is very limited. The shift towards marine natural products regarding herbicides is very recent. [6]Burnell et al. reported the development of rapid throughput biomolecular screening for marine derived C4 plant specific herbicides.

In the present study, the methanol extract of salt marsh (Salicornia brachiata, Sesuvium portulacastrum and Suaeda maritima) were found to have herbicidal activity against Lemna minor at concentration of 500 ppm on

the 7th day of the experiment. [9]Raja et al. observed that of the different solvents used like ethyl acetate, acetone and dichloromethane for the extraction of the winged oyster, Pteria chinensis, only the acetone extract exhibited activity. [10]Anand et al. isolated bacterial stains from the surface of sponges, seaweeds, crabs, ascidians and cephalopod eggs and reported that the bacterial broth extracts exhibited 90% inhibition against L. minor.

In the present study, the hexane extract of Salicornia brachiata showed growth promoter activity in Lemna plant at the concentration of 100 ppm. The hexane extract of Suaeda showed growth promoter activity in Lemna plant at the concentration of 50 ppm. Growth promotor activity of seaweeds have been widely studied and reported by many researchers. In recent years, the uses of natural seaweed products as substitutes to the conventional synthetic fertilizers have assumed importance (Crouch & Staden 1993).

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