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Some Observations on the effect of Seaweed Liquid Fertilizers on the Higher Plants

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Abstract

Effect of seaweed extracts as a liquid fertilizer (SLF) on the crop and fruit plants was studied. Different methods of utilizing seaweed extracts, such as soaking of the seeds, liquid feed to the plants and as a foliar spray were adopted. Among these methods foliar spray showed better results. The laboratory and nursery experiments showed that lower concentrations of SLF were effective in enhancing the rate of seed germination, better growth as well as higher and quicker yield. It is suggested that the use of SLF in agriculture and horticulture may yield promising results.

Introduction

Since long seaweeds have been used as manure for paddy and coconut plantations, for the simple reason that they contain many growth promoting hormones, trace elements and micro-nutrients (Challen and Hemingway, 1966). Beneficial effects from use of seaweed and seaweed extracts have been obtained on plants, crop yield, their seed germination, their resistance to fungal and insect attack (Brian, et al, 1973).

Foliar feeding with seaweed extract was first tried in 1814 but it has been tested successfully only recently (Povolny, 1971). The extracts derived completely or partly from seaweeds are now being used commercially in agriculture and horticulture (Blunden et al, 1968).

Recently in India, Bhosle et al, (1975) and Bukhari and Untawale, (1978) used higher concentrations of seaweed extracts to see the effect of soaking on growth *Phaseolus vulgaris*. The results obtained were quite encouraging with the lower concentrations of 10% extract. On the basis of these preliminary results, investigations were carried out with lower than 10% concentrations of different seaweed extracts.

The present investigation was carried out to determine the effect of marine algae from India as seaweed liquid fertilizer (SLF) on different crop and fruit plants and also the method to utilize liquid extract.

Materials and Methods

Seaweeds were hand picked from the intertidal area of the Goa coast. The collected seaweeds were washed with seawater to remove the adhering sand particles and impurities. They were then carried to the laboratory in polythene bags in an ice box. These seaweeds were again washed with fresh water. Maximum care was taken to remove epiphytes from the thallus.

Seaweed extracts were prepared as described by Challen and Hemingway (1966). This method was slightly modified for the sake of convenience during the field trials. The seaweeds were chopped into the fine fragments with the help of a mixer. One kilogram of chopped seaweed was boiled

with 2 litres of tap water for one hour to make it approximately one litre. The extract was then refrigerated for further use. The filtrate thus obtained was treated as 100% seaweed liquid fertilizer (SLF), from which different concentrations were prepared with tap water.

Hydrangia sp. Garden plant

Hydrangia plants were sprayed with different concentrations (1%, 5% and 10%) of *Spatoglossum asperum* extract. The spray was applied on every 6th day for 4 times. One set of the plants was treated as control with out spray. The leaf size of the sprayed and control plants was measured at the end of the experiment.

Green chillies (~~Solanum~~ *Solanum*)

Two plots of 3 m² area of green chillies were sprayed with 1% *Stoechospermum marginatum* extract on every 8th day for 6 times. The total yield and the length of the chillies were recorded (Table 1). One plot of similar size was treated as control.

Turnip (*Brassica napus*)

The seedlings of 5 cm height turnip plants were transplanted in the plots having an area of 3m². In all 6 plots were used. One of the plots was treated as control, to which no spray was applied and remaining five were sprayed with 1% *Stoechospermum marginatum*, *Dictyopteris australis*, *Padina tetrastrum*, *Spatoglossum asperum* and *Sargassum* sp. extract. About 4 litres of 1% SLF was sprayed to one plot on every 8th day for 3 times. First spray was applied on the 15th day after transplantation of the seedlings. Plants were harvested on the 39th day after transplantation. All the turnip plants from the respective plots were weighed and the number of leaves per plant, length and the breadth of the leaves for each plant was recorded.

Pineapple

One year old pineapple plants, before fruiting were sprayed with mixed seaweed extract (compound of SLF) of *Hypnea musciformis* 20%, *S. asperum*-20%, *S. marginatum*-20%, *Sargassum* sp. 20% *Caulerpa sertularioides* - 20%. The 1% compound SLF spray was applied on pineapple plot of 9m² area on every 8th day while another plot of 5m² area was treated as control. Both the plots were watered every day. The sprayed plants when matured were harvested 11 times, while of control 6 times. The weight of the fruit with the crown, diameter and length of the fruits were measured.

During this entire investigation no other manure or fertilizer was used for the plants grown in the experimental plots. All the experiments were undertaken at the NIO nursery, Goa.

In order to see the effect of seaweed extract on the sprayed pineapple plants in comparison with control, student 't' test was applied to weight, length and diameter data.

Results and Discussion

Species like *Ascomyllum nodosum*, *Laminaria digitata*, *Fucus serratus* and *Sargassum* sp. have been extensively used as a liquid fertilizer in other countries (Povolny, 1968, 69; Blunden, 1977).

Seaweed extract as a foliar spray was carried out on the preliminary basis on the ornamental plant and the green chillies. In the beginning only one seaweed species has been used to see the effect on growth, health of the leaves and the yield.

Hydrangia sp. - Garden plant

Hydrangia sp. was sprayed with different concentrations of *S. asperum* extract. It was observed that the leaves of the sprayed plants, with 1% and 5% extract showed healthy growth with bright green colour and substantial increase in the leaf size as compared to the control (Figure 1). Leaves probably absorb micronutrients present in the seaweed extract through the leaf and under natural sunlight conditions growth is enhanced (Blunden, et al, 1974).

Leaves sprayed with 10% extract did not show any significant effect which was probably due to the higher concentrations of growth hormones and mineral elements (Challen and Hemingway, 1966).

Green chillies (~~Solanum esculentum~~)

15 days old green chillie seedlings were sprayed with 1% *S. marginatum* extract for 6 times (Figure 2). The formation of the chillies started on the 7th day after the 1st spray. The total yield of the sprayed chillies was 6.3 kg within 40 days of the 1st spray, while in the control it was 0.636 kg. The mean length of the sprayed chillies was 14.39cm while that of control was 12.65 cm (Table 1). Increase in the yield is successfully related to growth hormones and micronutrients present in the extract (Boney, 1965; Blunden et al, 1974).

Turnip (*Brassica napus*)

Brassica napus (Turnip) were sprayed with the five species of Phaeophyta members - *S. asperum*, *D. australis*, *S. marginatum*, *P. tetrastrum* and *Sargassum* sp. After applications of the first spray, within 8 days plants showed formation of the bulbs which gradually increased in size at the end of the 3rd spray. In control, formation of the bulb was delayed and it was noticed on the 29th day after transplantation of the seedlings (Figure 2).

The total duration from transplantation to the harvest was only 39 days. During this period, the turnip crop was sprayed thrice. After the third spray it was observed that the turnip bulb started cracking. The growth of the control plant was found moderate (Figure 3).

Of all the five extracts, it was found (Table 2) that *S. marginatum* extract gave maximum growth and mean weight of the plant was 491.92g while minimum of 330.12 g was observed in *P. tetrastrum*. The girth of the bulb (diameter) was also found maximum (33 cm) in plants sprayed with *S. marginatum* extract, while in control it was 24cm. Mean length and breadth of the leaves was found to be maximum 38.75 cm and 18.75 cm respectively in plants sprayed with *S. asperum* while in control it was 31.33 cm and 14.96 cm respectively.

The effect of different seaweed extracts probably depends upon the concentrations of auxins, gibberellins and cytokinins present in the seaweeds. According to Mowat (1961) and William et al. (1978) presence of auxins and gibberellins in seaweed extract do not produce significant physiological response at lower concentrations. Hence it was considered that cytokinin is the only responsible hormone to produce significant biological effect in the plant. The effect of cytokinin was observed mainly on cell division, cell enlargement, delay in senescence and transport of the nutrients (Blunden, 1971). The effect of five different seaweeds used in the present experiment may be due to the large variations in cytokinin activities in different seaweeds.

The present investigations confirms that SLF increases the growth and yield of the turnip plants and that within a very short period the plant reaches a harvestable size. Turnip plants in the present investigation were harvested within a period of 39 days after transplantation, while ordinarily these plants require 60 to 75 days to grow to the harvestable size.

Pineapple

On the basis of above results a compound SLF was prepared to see the cumulative effect of 5 different seaweeds on the pineapple plants. Four phaeophyta species and one chlorophyta species were used to prepare compound SLF. The spray was applied 10 times on every 8th day. Mean weight of the pineapple fruit along with the crown in control was 1.88 kg while in sprayed plant it was 2.2 kg (Table 3). The sprayed fruits were larger in size than the control (Figure 4). The maximum weight of the sprayed pineapple was 3.1 kg while in control it was 2.5 kg. The increase in growth may have been due to the effect of cytokinin activities of the compound SLF (Blunden, 1971). Statistical analysis were carried out to examine the effectiveness of SLF on sprayed pineapple plants in comparison with control pineapple plants. Student, t test was applied to weight, length and diameter data. The mean values along with the t values are represented in Table 4. It can be seen from the values that the values are highly significant at 1% level of significance. This indicates that there is a significant effect of SLF on growth of sprayed pineapples.

In all experiments sprayed plants did not show any insect or pest attack while on the control plants insect attack was observed. Probably SLF acts as insecticide (Stephenson, 1966).

On the basis of these encouraging results, it is suggested that seaweed extracts, to promote growth of crop and fruit plants, should be further studied, particularly on horticultural plants. Further work is in progress to determine the nature of the active compounds in these seaweed extracts.

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Table - 1 - Effect of 1% *Stoechospermum marginatum* extract on green chillies

Sl. No.	Date of harvest	Control				Sprayed with extract			
		No. of chillies	Total wt. of the chillies kg.	Mean wt. per chillie g.	Mean length of the chillie cm.	No. of chillies	Total wt. of the chillies kg.	Mean wt. per chillie g.	Mean length of the chillie cm.
1.	10/3/80	37	0.120	3.24	14.44	71	0.293	4.08	15.09
2.	15/3/80	39	0.086	2.20	14.05	430	1.090	2.53	15.07
3.	22/3/80	50	0.165	1.30	12.20	900	2.250	2.50	14.87
4.	31/3/80	28	0.065	2.32	12.18	635	1.823	2.87	13.68
5.	9/4/80	130	0.200	1.53	10.40	450	0.890	1.97	12.66
	Total	284	0.636	10.59	63.27	2486	6.343	13.95	71.97
	Mean		0.127	2.11	12.65		1.585	2.79	14.39

Table 2 - Effect of different seaweed extracts on *Brassica napus* (turnip) plants

Sl. No.	Liquid extracts of the species used	No. of plants	Mean of the total wt. of the plant	g.	Circumference of the bulbs	Measurement of the leaves		
						No. of leaves per plant	Mean length of the leaves	Mean breadth
					cm.		cm.	cm.
1.	Control	59	277.62		24.0	15	31.33	14.96
2.	<i>Stoechospermum marginatum</i>	91	491.92		33.0	13	37.93	18.25
3.	<i>Dictyopteris australis</i>	96	389.34		28.0	13	35.84	18.06
4.	<i>Spatoglossum asperum</i>	85	390.82		30.0	13	38.75	18.95
5.	<i>Sargassum</i> sp.	76	356.18		30.0	14	29.97	15.64
6.	<i>Padina tetraströmatica</i>	77	330.12		31.0	15	32.27	17.78

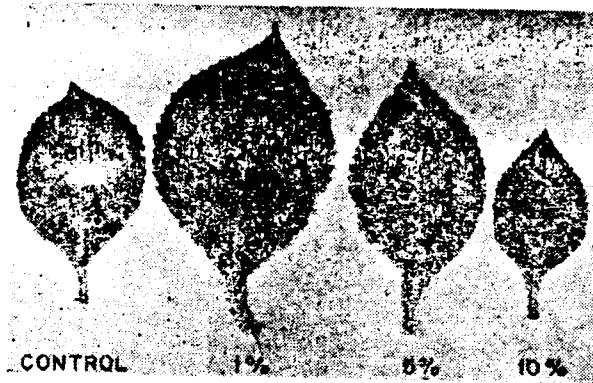
Table 3 - Effect of mixed seaweed extracts (compound SLF) on the growth of *Pineapple*.

Sl. No.	Date of harvest	Control			Sprayed Plants						
		No. of plants	Total wt. of plant kg.	Mean wt. of plant kg.	Mean circum-ference of the fruit cm.	Mean length of the fruit cm.	No. of plants	Total wt. of plants kg.	Mean wt. of plants kg.	Mean circum-ference of the fruit cm.	Mean length of the fruit cm.
1.	28/5/80	—	—	—	—	—	3	8.00	2.67	41.23	23.0
2.	5/6/80	—	—	—	—	—	1	3.10	3.10	46.00	31.50
3.	12/6/80	—	—	—	—	—	2	4.72	2.36	42.10	24.00
4.	16/6/80	2	5.15	2.57	42.25	23.70	10	24.43	2.44	42.16	23.23
5.	19/6/80	3	—	—	—	—	3	7.60	2.53	43.17	23.83
6.	21/6/80	2	3.90	1.95	39.25	18.50	3	7.20	2.40	42.17	23.67
7.	24/6/80	2	3.60	1.80	36.50	19.80	3	5.95	1.98	38.93	20.77
8.	27/6/80	—	—	—	—	—	2	3.60	1.80	39.75	20.10
9.	28/6/80	1	1.92	1.92	38.00	19.20	2	3.24	1.62	36.85	19.45
10.	30/6/80	2	3.00	1.50	34.35	14.60	3	6.00	2.00	39.27	20.07
11.	2/7/80	4	6.20	1.55	37.25	18.12	2	2.70	1.35	36.50	18.50
	Mean			1.88	37.93	18.98			2.20	40.74	22.56

Table 4 — Showing mean values and t values.

	Control		Sprayed		t — test
	Weight	Length	Weight	Length	
	1.81	37.86	2.24	40.95	15.92
	18.83	18.83	22.39	22.39	17.36
					20.00
t = 2.69, P < 0.01, n = 45					

Figure 1



Effect of different concentrations of *Spatoglossum asperum* extract on the ornamental plant *Hydrangia* sp.

Figure 2

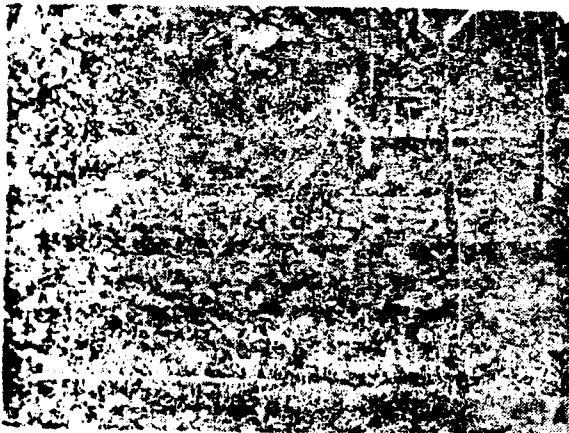
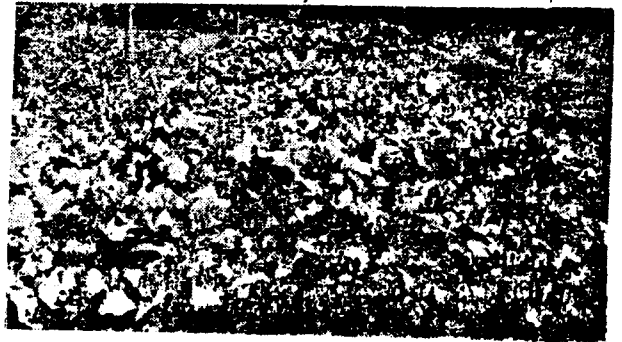
A - Plot showing transplanted *Turnip* seedlings.B - Plot showing healthy growth of the *Turnip* seedling after the spray.

Figure 3

A - Control *Turnip* plantB - Turnip plant sprayed with *Stoechospermum marginatum*



C - Turnip plant sprayed with *Padina tetrastromatica*.

Figure 4



Control and sprayed (1%) compound SLF Pineapple fruits.