



Utilization of seaweed extract to enhance growth and biochemical parameters of *Raphanus sativus* var. *Pusa chetki*

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ABSTRACT

In the present study, investigations were made on efficacy of pre-treatment of *Raphanus sativus* var. *pusa chetki* seeds with different concentrations of brown seaweed (*Zonaria*) extract on germination at different incubation periods, growth and biochemical parameters by laboratory bioassay and pot culture experiments (saline soil). The maximum germination percentage (100%) was recorded at lower concentration (0.5%) with 12 and 24 hours of incubation and was reduced in 10% to 60% and 20% at 12 hours and 24 hours respectively. In pot culture experiment, liquid extract of *Zonaria* (2%) enhanced the root length, shoot length, root diameter, leaf area, fresh weight and dry weight by 30%, 63%, 227%, 86%, 65% and 91% respectively in comparison with control. The biochemical parameters such as protein, carbohydrates and vitamin C also enhanced in the plants treated with 2% extract than the control and other concentrations. The results of the present study showed that seaweed extract can be used as a pre sowing treatment for better growth and yield of vegetable crops.

Introduction

Agriculture is the mainstay of Indian economy and has the power to change the economic and social status of the country. Green revolution technologies have shown path to developing countries for self-sufficiency in food but for sustainable agricultural production, "resource degrading" chemical agriculture has been shifting to "resource protective" organic agriculture. In Tamil Nadu, people realizing the benefits of organic farming, many farmers have started converting their farming techniques to organic way. Radish (*Raphanus sativus* var. *pusa chetki*) belongs to the Family Brassicaceae. It is a popular root vegetable in both tropical and temperate regions. Large scale production of radish in field is more common in India. It is grown for its young tender tuberous root which is a good source of vitamin C and minerals like calcium, potassium and phosphorus. It has refreshing and diuretic properties. Being a short duration and quick growing crop, the root growth should be rapid and uninterrupted. Hence, for the production of good quality of radish, optimum nutrition through organic and bio fertilizers are essential for sustainable production. Organic farming can provide quality food without adversely affecting the soil health and the environment. It is a matter of giving back

nature what was taken away from it. Seaweeds are one of the most important marine renewable resources of the world. The use of seaweeds as manure is important in the present day world as the seaweed fertilizers are often found to be more successful than the chemical fertilizers (Bokil *et al.*, 1972). The utilization of seaweed as manure is a common practice in coastal areas throughout the world. Two main forms in which the seaweeds are at present used in agriculture and horticulture in many countries are as seaweed meal and liquid extract. Liquid fertilizer obtained from seaweed is more effective than seaweed meal because it is already broken down (Stephenson, 1974). Thoothukudi is a coastal area harbouring a wide variety of seaweeds with maximum potential in Hare Island. In the present investigation, the effect of liquid extract of brown seaweed *Zonaria* was tested on the tuber crop *Raphanus sativus* var. *Pusa chetki* to find out its effect on seed germination, early growth of seedlings and its biochemical parameters under laboratory bioassay and in pot culture studies.

Materials and Methods

The brown seaweed *Zonaria* was collected from Hare

Island, Thoothukudi. The collected seaweed was initially washed with tap water to remove sand, dust and finally washed with fresh water to remove adhering dust particles.

Preparation of seaweed liquid extract

The seaweeds were chopped and cooked in a pressure cooker for 1 hour. The cooked seaweed was weighed 0.5g, 1g, 2g, 5g and 10g using electrical balance and was soaked overnight in 100 ml distilled water. The extracts were filtered through Whatman No. 2 filter paper to separate suspended particles. The filtrate obtained was used for study as 0.5%, 1%, 2%, 5% and 10% concentration of the seaweed liquid extract.

Laboratory bioassay

Seeds of *Raphanus sativus* var. *Pusa chetki* were sterilized with 0.1% Mercuric chloride and washed several times with distilled water. The seeds were incubated in different concentrations of seaweed extract (0.5%, 1%, 2%, 5% and 10%) for 12 hours and 24 hours durations. The seeds of control were soaked in distilled water. For each treatment, 10 seeds were placed in a sterilized petriplates on Whatman No. 2 filter paper and 5 ml of aqueous extract were added on the first day. Controls were treated with same amount of distilled water. Equal volume of extract and distilled water was added once in 3 days. The germination and growth characteristics namely root length and shoot length (average of triplicates) were recorded at the end of 10- day.

Pot studies

Experimental setup has been carried out in small earthen pots with coastal saline soil of pH 8.68. The seeds incubated in different concentrations for 12 hours were sown in pots. The effect of seaweed extract on growth parameters like shoot length, root length, root diameter, leaf area, fresh weight and dry weight were studied on 40- day. Shoot and root were also taken for the analysis of biochemical parameters like protein (Lowry *et al.*, 1951), carbohydrates (Dubois, 1956) and vitamin C (Baker and Frank, 1986). The values are expressed in mg/g fresh weight.

Results

Studies made on the effect of seaweed extract obtained from brown seaweed *Zonaria* on germination and early growth of seedlings under laboratory bioassay and in pot studies on radish (*Raphanus sativus* var. *Pusa chetki*) revealed the following observations.

Laboratory bioassay

Seed germination and early growth

The seeds that were soaked for 12 hours duration in lower concentration (0.5%) showed 100% germination compared with the seeds soaked in 10% concentration (60% and 20% in 12 hours and 24 hours respectively). Similarly, the length of radicle and plumule was higher in seeds soaked in 1% extract with 12 hours of incubation (13.1 cm and 12.28 cm respectively). A decrease in germination percentage, length of radicle and plumule was recorded at high concentration 10% in both 12 hours and 24 hours of incubation (Table-1).

Pot studies

In the pot culture studies, plants treated with different concentrations of seaweed extract viz., 0.5%, 1%, 2%, 5% and 10% showed that seaweed extract enhanced the growth of plants compared to control. Root length, shoot length, root diameter, leaf area, fresh weight and dry weight increased up to 2%, but at high concentration i.e., at 5% and 10% they were slightly reduced. The maximum root length, shoot length, leaf area, root diameter, fresh weight and dry weight were 17.4 cm, 24.3 cm, 25.5 cm, 2.6 cm, 12.2 g and 5.3 g respectively (Table-2).

Biochemical parameters

The biochemical parameters recorded on total protein, total carbohydrate and vitamin C content of the leaves and roots revealed the following. The concentration of total protein increased with the concentration of the extract increased but at higher concentration, the amount of protein decreased. The plants received 2% seaweed extract contained more protein in root (72 mg/g FW) and in shoot (69 mg/g FW). In case of carbohydrates in root and shoot, the maximum value was recorded in plants treated with 2% extract; 4.7 mg/g FW

Table-1. Effect of *Zonaria* extract on the seedling growth of *Raphanus sativus*

Parameters	Duration of soaking	Concentration of the extract					
		Control	0.5%	1%	2%	5%	10%
Germination percentage	12 hours	80	100	90	80	60	50
	24 hours	70	100	80	70	40	20
Length of radicle	12 hours	8.5	7.7	13.1	8.8	4.4	1.7
	24 hours	6.9	9.2	8.8	11.7	4.2	1.8
Length of the plumule	12 hours	7.7	9.7	12.3	10.4	8.4	3.7
	24 hours	8.9	11.9	10.9	7.8	4.0	3.6

Table-2. Effect of *Zonaria* extract on growth of *Raphanus sativus*

Parameters	Concentration of the extract					
	Control	0.5%	1%	2%	5%	10%
Root length (cm)	13.4	15.8	16.7	17.4	16.4	14.7
Shoot length (cm)	14.9	21.7	23.1	24.3	22.5	19.1
Leaf area (cm ²)	7.8	21.4	23.6	25.5	23.9	20.2
Root diameter (cm)	1.4	2.1	2.4	2.6	1.9	1.4
Fresh weight (g)	7.4	8.2	10.8	12.2	9.5	8.4
Dry weight (g)	2.2	3.2	4.1	5.3	3.1	2.8

and 4.4 mg/g FW respectively, whereas the control had 3.6 mg/g FW and 3.9 mg/g FW in root and shoot respectively. The accumulation of vitamin C was higher in plants treated with 2% *Zonaria* extract than the control (Fig. 1 and Fig. 2).

Discussion

Use of seaweed fertilizer to enhance the growth

characteristics of terrestrial plants is fast and becoming an accepting practice. The result presented in the study clearly shows the efficacy of *Zonaria* in promoting seed germination, growth and biochemical composition in tuber crop *Raphanus sativus*. The higher germination and growth were recorded at lower concentrations of *Zonaria* extract with 12 hours incubation than 24 hours. The results obtained in present study agree with the findings of Ashok Kumar *et al.* (2012) that the incubation of *Vigna radiata* seeds in lower concentrations of *Sargassum wightii* extract for short duration was more effective than the long duration and higher concentrations. Extracts obtained from *Spatoglossum asperum*, *Ulva lactuca* and *Enteromorpha intestinalis* have shown enhancement of seed germination and growth of the seedlings of black gram, ground nut and maize. Dilute seaweed extracts were more effective than concentrated extracts (Bukhari and Untawale, 1978). Anantharaj and Venkatesalu (2001) reported that low concentrations of aqueous extracts of *Caulerpa racemosa* and

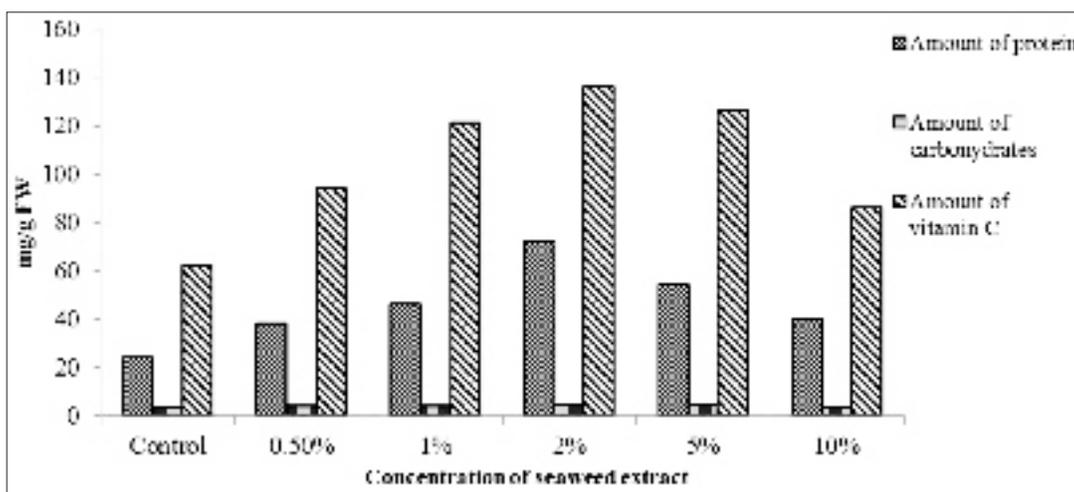


Fig. 1. Effect of seaweed extract on total protein, total carbohydrates and vitamin C content in root of *Raphanus sativus*

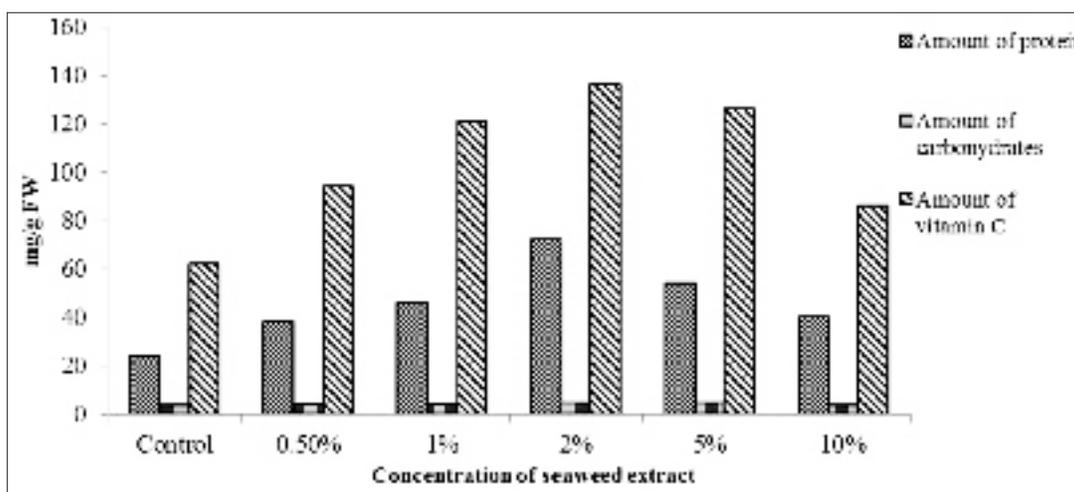


Fig. 2. Effect of seaweed extract on total protein, total carbohydrates and vitamin C content in shoot of *Raphanus sativus*

Gracilaria edulis on *Vigna catajung* showed that the promoted the seedling growth, fresh and dry weight. The accumulation of protein, carbohydrates and vitamin C was higher in plants treated with 2% aqueous extract than the higher concentrations 5% and 10%. Similar results were obtained by El-Sheekh and El-Saied (1999) with the lower concentration of three green seaweeds namely *Cladophora dalmatica*, *Enteromorpha intestinalis* and *Ulva lactuca* and red seaweed *Pterocladia pinnata* on the protein content and soluble sugars in leaves of *Vicia faba*. The experimental findings of present study clearly showed that in radish, soaking duration of seeds and also different concentrations of seaweed extract had the potential to enhance seed germination, growth and biochemical components. Though simple and cost effective, it is capable of improving farmers income and is recommended for adoption by farmers and small scale gardeners.

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