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Effect of Presoaking of *Solanum melongena* L. (Brinjal) Seed in *Laurencia obtusa* Seaweed extract on Germination and Growth Parameter

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Abstract

Solanum melongena L. (Eggplant) is one of the most important herbs among vegetable crops belongs to Solanaceae family. It is one of the horticultural vegetables that is widely distributed in Indonesia. This research aims to study the effect of *Laurencia obtusa* (Hudson) seaweed extract was evaluated on the seed germination and seedlings growth. The seeds were embedded in different concentration such as 0.2%, 0.5%, 0.7%, 1.0%, 1.5, 2.0% and control (without treatment) with different time period (0h, 1h, 2h, 3h, 4h, 5h, 6h, 12h and 24h) in this seaweed extract. After 10 days in laboratory condition some plant germination parameters like % germination, root length, shoot length, seedling length, seed vigour index, No. of lateral roots and after 100days in field trial experiment some growth parameters like no. of branches per plant, no. of leaves per plant, height of the plant, no. of flower per plant, no. of fruits per plant, weight of the fruit and leaf area were observed. The result of this research showed that the *Laurencia obtusa* seaweed extract significantly affected on germination and growth of *Solanum melongena* L. plant as well as Soil profile.

Key words: growth, germination, *Laurencia obtusa*, *Solanum melongena* L.

1. Introduction

Port Okha coast, which is known for its luxuriant growth of a diverse assemblage of seaweeds on Saurashtra coast, is found to have abundant quantities of seaweeds being drifted and washed ashore every year. Port Okha is located at 22°28' N latitude and 69°05' E longitude and is situated within the opening of Gulf of Kachchh, has a flat rocky intertidal belt, with many tide pools, gullies and crevices. The substratum is made of limestone rock. Seaweeds on the coast are harvested and utilized for a variety of purposes such as feed, fertilizer and as a source of raw material for industrial production of photochemicals of commercial importance (Kirkman and Kendrick 1997). Several studies have described the priming of seeds to enhance the germination rate and equal opportunity of growth thereby reducing the emergence time of many horticultural and agricultural crops (Basra et al., 2002; Lee & Kim, 1999; Brocklehurst & Dearman, 1983). Seed priming is a commercially used technique to hydrate the seed to a point where germination processes begin. Mainly the priming treatments imply imbibing the seed with limited quantities of water to allow the necessary hydration and improvement of metabolic processes of germination. In recent years, numerous species of red seaweeds were evaluated for the potential growth rates and dry weight yields. *Solanum melongena* L. (Eggplant) is one of the horticultural vegetables that is widely distributed in Indonesia. The fruit has a variety of colours, namely purple, green and white, among the varieties of brinjal plant (Shahid, Ahmad, Shah, Muhammad, Zainub and Jan, 2017). Eggplants are very rich in minerals, which are very beneficial for the immune system. Eggplants contain low calorie and high nutrient (Khaerunnisa, Hidayati, Sussanto, Setiawati and Suhartati, 2019). It can also be utilized as a medicine to reduce cholesterol in blood, and it is suitable as a diet to regulate hypertension. The fruits and their juices are effective diuretics. Roots are laxative, analgesic and cardio tonic. Presuming that the demand for this crop will increase, therefore, the production should be increased (Moch. Dawam Maghfoer Roedy Soelistyono and Herlina, 2014). This crop is one of the important Asian Vegetables grown in Indonesia. As such promising potentials, therefore, effort to improve its productivity should be emphasized. Brinjal is highly productive and usually finds its place as a poor man's crop. It is being consumed as a cooked vegetable in various ways.

2. Materials and Methods

2.1 Seaweed collection and preparation of extract

The specimens of red seaweed *Laurencia obtusa* (Hudson) were collected from Okha coast, Dwarka during January 2021. The collected seaweed was washed with seawater initially to remove macroscopic epiphytes and sand particles and finally with fresh water to removal of extra salts on the surface. They were shade dry for five days followed by oven dry at 60ºC for 6h. Then the materials were hand crushed and made as coarse powder using a mixer grinder. These fine powder 10g was weighed and add 100ml distilled water. The mixture was incubated for One day (24h) then centrifuge in 5000rpm for 15mins. Thereafter, the extract was filtered through What-man No. 1 filter paper (Bhosle et al. 1975). This obtained filtrate considered as 100%. Six different concentrations of solutions such as 0.2%, 0.5%, 0.7%, 1.0%, 1.5% and 2.0% were prepared using this 100% extract and were used for the study.

2.2 Collection of Seeds

The seeds of *Solanum melongena* L. (Variety: GAOB-2) were collected from Vegetable Scientific research center, Anand Agriculture University, Anand, Gujarat during 2020-2021.

2.3 Seed Soaking & Germination

The seeds surface was sterilized with 0.1% $HgCl_2$ up to 1-2 minutes and washed help of distilled water. Seeds was presoaked with different concentration seaweed extract of *Laurencia obtusa* such as 0.2%, 0.5%, 0.7%, 1.0%, 1.5%, 2.0% and control (without treatment) in different time period such as 0h, 1h, 2h, 3h, 4h, 5h, 6h, 12h and 24h at room temperature for better germination and early growth. After 10 days all the vegetative parameter like percent germination, root length, shoot length, total seedling length, seed vigour index, no. of lateral roots was observed in 90mm sterilized petridish. After 100 days in field trial some growth parameters like no. of branches per plant, no. of leaves per plant, height of the plant, no. of flower per plant, no. of fruits per plant, weight of the fruit and leaf area were observed.

2.4 Preparation of Soil Sample

Take 500g farm soil and put the *Laurencia obtusa* seaweed powder according to concentration i.e., 0.2g, 0.5g, 0.7g, 1.0g, 1.5g, 2.0g, and Control (without any treatment) in twice time. The primary and Secondary Macro elements find out in this sample and this experiment is carried out in Excel Industries.

2.5 Data analysis

The experimental design used in 3 replications. Data obtained were analyzed using MS-excel program.

3. Results and Discussion

Table 1: Effect of *Laurencia obtusa* Seaweed extract 0.2% on *Solanum melongena* L.

Time Period	Germination % (GP)	Root length (cm)	Shoot length(cm)	Seedling length (cm)	Seed Vigour Index (SVI)	No. of Lateral roots
0h	100	6.9±0.1	5.7±0.1	12.6±0.2	1260±22.15	3.33
1h	100	7.3±0.1	4.5±0.1	11.8±0.1	1180±20.14	6.33
2h	100	5.1±0.1	4.3±0.1	9.4±0.1	940±6.24	----
3h	100	6.1±0.1	7.2±0.1	13.3±0.1	1330±13.14	2.66
4h	80	4.6±0.1	3.1±0.1	7.7±0.1	616±4.21	3.33
5h	100	7.2±0.1	5.3±0.1	12.5±0.2	1250±22.48	5.33
6h	100	5.1±0.1	3.5±0.1	8.6±0.1	860±6.54	3.66
12h	80	5.8±0.1	4.0±0.1	9.8±0.1	784±5.74	3.66
24h	100	6.2±0.1	5.2±0.1	11.4±0.1	1140±24.16	3.33

(Result= Mean ±std)

Table 2: Effect of *Laurencia obtusa* Seaweed extract 0.5% on *Solanum melongena* L.

Time Period	Germination % (GP)	Root length (cm)	Shoot length(cm)	Seedling length (cm)	Seed Vigour Index (SVI)	No. of Lateral roots
0h	100	7.5±0.1	6.0±0.1	13.5±0.1	1350±16.10	3.33
1h	100	7.5±0.1	5.2±0.1	12.7±0.1	1270±25.18	9.33
2h	100	6.5±0.1	4.6±0.2	11.1±0.2	1110±17.06	----
3h	100	8.3±0.2	5.6±0.1	13.9±0.2	1390±24.13	4.33
4h	100	4.5±0.1	3.1±0.1	7.6±0.1	760±6.14	1.66
5h	100	6.6±0.1	5.0±0.1	11.6±0.1	1160±18.04	3.66
6h	100	6.0±0.1	4.4±0.2	10.4±0.1	1040±23.14	1.66
12h	90	4.0±0.2	2.5±0.1	6.5±0.1	585±7.14	3.33
24h	100	4.2±0.1	3.6±0.1	7.8±0.1	780±6.15	1.33

(Result= Mean ±std)

Table 3: Effect of *Laurencia obtusa* Seaweed extract 0.7% on *Solanum melongena* L.

Time Period	Germination % (GP)	Root length (cm)	Shoot length(cm)	Seedling length (cm)	Seed Vigour Index (SVI)	No. of Lateral roots
0h	100	6.7±0.1	5.5±0.1	12.2±0.1	1220±15.20	4.33
1h	100	5.5±0.1	4.6±0.1	10.1±0.1	1010±24.10	----
2h	100	5.3±0.1	2.5±0.1	7.8±0.2	780±3.15	6.33
3h	100	5.6±0.2	4.2±0.1	9.8±0.2	980±6.74	1.66
4h	100	4.1±0.1	4.3±0.1	8.4±0.1	840±6.12	3.66
5h	100	7.2±0.1	5.5±0.2	12.7±0.1	1270±22.10	2.33
6h	100	4.8±0.2	3.7±0.1	8.5±0.1	850±4.18	----
12h	100	6.5±0.1	2.6±0.1	9.1±0.1	910±6.18	7.00
24h	90	4.6±0.1	4.7±0.1	9.3±0.1	837±4.16	3.66

(Result= Mean ±std)

Table 4: Effect of *Laurencia obtusa* Seaweed extract 1.0% on *Solanum melongena* L.

Time Period	Germination % (GP)	Root length (cm)	Shoot length(cm)	Seedling length (cm)	Seed Vigour Index (SVI)	No. of Lateral roots
0h	100	7.6±0.1	5.7±0.1	13.3±0.1	1330±16.20	----
1h	100	5.5±0.1	3.8±0.1	9.3±0.2	930±6.24	4.33
2h	100	6.4±0.1	4.3±0.1	10.7±0.2	1070±18.10	3.66
3h	100	3.3±0.1	2.0±0.1	5.3±0.1	530±5.10	3.33
4h	90	4.2±0.1	2.6±0.1	6.8±0.1	612±3.01	2.66
5h	100	8.0±0.1	6.3±0.1	14.3±0.1	1430±23.16	1.66
6h	100	4.1±0.1	6.2±0.1	10.3±0.1	1030±22.18	----
12h	100	5.2±0.2	4.7±0.2	9.9±0.1	990±6.14	2.33
24h	100	5.6±0.1	3.9±0.1	9.5±0.1	950±4.19	7.33

(Result= Mean ±std)

Table 5: Effect of *Laurencia obtusa* Seaweed extract 1.5% on *Solanum melongena* L.

Time Period	Germination % (GP)	Root length (cm)	Shoot length(cm)	Seedling length (cm)	Seed Vigour Index (SVI)	No. of Lateral roots
0h	100	7.7±0.1	5.5±0.1	13.2±0.1	1320±22.18	4.33
1h	100	4.0±0.1	2.9±0.2	6.9±0.1	690±5.14	3.66
2h	100	5.2±0.1	5.4±0.1	10.6±0.1	1060±26.38	6.33
3h	100	3.8±0.1	3.5±0.1	7.3±0.1	730±4.16	4.33
4h	100	4.6±0.1	4.5±0.1	9.1±0.2	910±5.18	1.66
5h	90	4.6±0.1	5.7±0.1	10.3±0.1	927±6.10	----
6h	100	6.1±0.1	6.1±0.1	12.2±0.1	1220±14.25	6.00
12h	100	6.8±0.1	5.0±0.1	11.8±0.1	1180±18.47	4.33
24h	100	5.4±0.1	4.0±0.1	9.4±0.1	940±4.36	5.00

(Result= Mean ±std)

Table 6: Effect of *Laurencia obtusa* Seaweed extract 2.0% on *Solanum melongena* L.

Time Period	Germination % (GP)	Root length (cm)	Shoot length(cm)	Seedling length (cm)	Seed Vigour Index (SVI)	No. of Lateral roots
0h	100	4.8±0.1	4.8±0.1	9.6±0.1	960±3.12	2.66
1h	100	5.5±0.1	3.6±0.2	9.1±0.1	910±3.14	3.66
2h	70	4.0±0.1	3.9±0.2	7.9±0.2	553±2.18	----
3h	100	5.8±0.1	5.3±0.1	11.1±0.1	1110±20.14	2.33
4h	100	5.0±0.1	4.0±0.1	9.0±0.1	900±6.19	2.66
5h	100	5.3±0.2	5.7±0.1	11.0±0.1	1100±15.04	----
6h	80	5.1±0.1	5.6±0.1	10.7±0.2	856±4.36	1.66
12h	80	5.0±0.1	3.2±0.1	8.2±0.1	656±2.17	1.33
24h	100	8.0±0.1	4.9±0.1	12.9±0.1	1290±14.10	3.00

(Result= Mean ±std)

Table 7: Control plant of *Solanum melongena* L.

Time Period	Germination % (GP)	Root length (radicle length) (cm)	Shoot length(cm)	Seedling length (cm)	Seed Vigour Index (SVI)	No. of Lateral roots
0h	80	6.9±0.2	6.2±0.1	13.1±0.1	1048±23.63	----
1h	100	6.6±0.1	6.4±0.1	13.0±0.1	1300±21.15	4.33
2h	100	7.2±0.1	5.8±0.1	13.0±0.1	1300±18.23	----
3h	90	4.3±0.1	5.3±0.2	9.6±0.2	864±6.24	4.66
4h	100	7.0±0.1	5.5±0.1	12.5±0.1	1250±16.24	2.33
5h	90	7.3±0.2	5.5±0.1	12.8±0.1	1152±23.10	3.33
6h	100	6.5±0.1	5.7±0.2	12.2±0.2	1220±19.24	3.00
12h	70	5.6±0.2	4.6±0.1	9.2±0.2	644±5.10	5.00
24h	80	7.1±0.1	5.7±0.1	12.8±0.2	1024±17.36	10.33

(Result= Mean ±std)

Table 8: Effect of *Laurencia obtusa* seaweed extracts on *Solanum melongena* L. Growth Parameters (After 100 days)

Concentration	No. of branches per plant	No. of leaves per plant	Height of the plant (cm)	No. of flower per plant	No. of fruits per plant	Weight of the fruit	Leaf area (cm^2)
Control	5.33	22.00	61.2	3.33	2.33	26.1	73.1
0.2% (3h)	4.33	20.0	60.0	4.33	2.66	36.7	72.5
0.5% (3h)	5.66	18..66	62.8	2.66	1.66	41.8	74.9
0.7% (5h)	5.33	17.0	62.4	3.66	3.33	34.5	69.2
1.0% (5h)	4.33	19.0	60.7	5.0	2.0	37.4	68.4
1.5% (0h)	4.66	15.33	61.4	4.33	2.66	34.0	73.9
2.0% (24h)	5.66	17.66	62.1	3.66	1.66	48.7	71.6

(Result= Mean)

Table 9: Soil Analysis

Soil Detail	P^H	EC (ds/m)	Organic carbon (%)	Available N (Kg/ha)	Available P_2O_5 (Kg/ha)	Available K_2O	Available Sulphur (ppm)	Ca (%)	Mg (%)
Control	8.11	0.138	0.49	176.44	8.34	179.56	52.27	0.73	0.23
***Laurencia obtusa* 0.2%**	8.04	0.246	0.87	168.20	5.26	217.16	43.63	0.74	0.27
***Laurencia obtusa* 0.5%**	8.02	0.242	0.83	163.84	5.20	210.20	42.68	0.70	0.24
***Laurencia obtusa* 0.7%**	8.07	0.248	0.89	165.25	5.34	218.46	44.61	0.75	0.25
***Laurencia obtusa* 1.0%**	8.01	0.240	0.76	158.32	5.14	219.34	45.89	0.68	0.27
***Laurencia obtusa* 1.5%**	8.04	0.247	0.79	159.36	5.17	220.96	46.10	0.69	0.29
***Laurencia obtusa* 2.0%**	8.03	0.246	0.77	156.47	5.15	217.23	44.89	0.67	0.28

Table 10: Effect of *Laurencia obtusa* seaweed extracts on Soil water Holding Capacity

Name	Water Holding Capacity
Control	44.40
Laurencia obtusa (0.2%)	58.39
Laurencia obtusa (0.5%)	50.23
Laurencia obtusa (0.7%)	52.40
Laurencia obtusa (1.0%)	55.27
Laurencia obtusa (1.5%)	56.94
Laurencia obtusa (2.0%)	52.11

The study showed that the treatment of *Laurencia obtusa* seaweed extract significantly affected the parameters including % germination, radicle length, shoot length and seed vigour index, no. of leaves per plant, height of the plant, no. of fruits per plant, weight of the fruit. This is because using seaweed extract given to brinjal plants have sufficient. In other words, unsufficient nutrients can disrupt the metabolic process, and that affect plant growth and development (Vijayanand, Ramya, and Rathinavel, 2014). *Solanum melongena* L. showed 80% germination (average %) in the control and 98.88% in the 0.5, 0.7, 1.0, and 1.5% seaweed extract treated seeds. Optimal growth can be achieved if all nutrients are at a balanced level, meaning that there is no one nutrient that is a limiting factor. A minimum of 92.22% germination was observed at 2.0% seaweed extract when compared to all other concentrations of treatment (Table 1 to 7). As a result, nutrient content in seaweed extract cause vegetative growth in eggplant better than control treatment (Kocira, Swieca, Kocira, Zlotek and Jakubezyk, 2018). The maximum seedling length of 14.03cm was recorded when the

plants applied with 1.0% of Seaweed extract in 5h time duration (Table 4), and minimum seedling length was recorded in 0.7% (12.7cm) of Seaweed extract in 5h time period (Table 3). A maximum seed vigour index of 1430 (5h) in 1.0% seaweed extract applied in this plant. In field trial experiments proved that the higher concentration is increase the weight of the fruits. But the lower concentration is beneficial for height of the plants. The seaweed fertilizer that has been used as additional nutrients and as biostimulants or organic fertilizers to increase plant growth and yield (Halpern, Bar-Tal, Ofek, Minz, Muller and Yermiyahu, 2015), because they contain plant growth regulators. Growth regulators contained in seaweed play a role in the physiology of plants, such as growth, division, and cell differentials, and protein synthesis. Plants can absorb nutrients, including growth regulators from all surfaces of plant cells (Sanderson, Jameson and Zabkiewicz, 1987). Plant growth and development are influenced by the application of fertilizers and the availability of nutrients in the soil (Bai, Christi and Kala, 2011). In Soil analysis increase the *Laurencia obtusa* concentration all the parameters are fluctuated. So, in this case *Laurencia obtusa* seaweed extract is significantly affected the soil structure. Using seaweed extract as fertilizer could be a solution to improve the growth and yield of many crops (Singh and Gupta, 2011), including *Solanum melongena* L. plant.

4. Conclusion

The results obtained in this experiment showed that pre-soaking experiment of seed with selected seaweed extract improve and increase seed germination and plant growth of Brinjal plant. Based on the results of the study above, it can be concluded that the use of *Laurencia obtusa* seaweed extract significantly affected *Solanum melongena* L. plant growth and yield compared to control treatment. Also Seaweed extract increase the soil nutrients and improve the soil structure.

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