International Journal of Botany Studies
www.botanyjournals.com
ISSN: 2455-541X
Received: 03-12-2021, Accepted: 19-12-2021, Published: 04-01-2022
Volume 7, Issue 1, 2022, Page No. 1-6

Effect of bio-primed green gram (*Vigna radiata* L.) seed in *corallina berteroi* seaweed liquid fertilizer on germination and seedling growth

Megha P Pandya*, Shailesh K Mehta
Department of Botany, Sir P.P Institute of Science, M.K Bhavnagar University, Bhavnagar, Gujarat, India

Abstract
In the present study the effect of *Corallina berteroi* Montagne seaweed liquid fertilizer was evaluated on the Green gram seed germination and seedlings growth. The seeds were primed 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 5 days some seed germination parameter like % germination, root length, shoot length, seedling length, seed vigour index, wet weight, dry weight, % moisture content, No. of lateral roots were observed. In this study, seeds primed with Corallina berteroi extracts at 1.0% & 1.5% enhanced germination parameters. After 60 days in field trial 0.2% concentration seaweed extract enhanced some growth parameter like No. of branches per plant, No. of leaves per plant, total height of the plant, No. of flower per plant, No. of pod per plant, No. of seed per pod, length of the pod and leaf area were observed. The objective of this study is to improve the seed germination, growth, yield as well as quality for better production and process.

Keywords: *corallina berteroi*, germination, growth, green gram

Introduction
Seaweeds are the eukaryotic organisms that live in salty water and recognized as a potential source of bioactive natural products. Seaweeds come in an amazing variety of beautiful shapes, colors and sizes and found in all of the world's oceans. Seaweeds have been used for several purposes especially for human consumption in many parts of the world. Seaweed can also serve as a source of minerals, vitamins, free amino acids and polyunsaturated fatty acids. Seaweed can be classified as red algae (Rhodophyta), brown algae (Phaeophyta) and green algae (Chlorophyta) depending on their nutrient and chemical composition. In recent years, numerous species of red seaweeds were evaluated for the potential growth rates and dry weight yields. Seaweed extracts as liquid fertilizers have come in market. Recent researches have proved that SLF (Seaweed Liquid Fertilizer) is better than other chemical fertilizers (Anantharaj and Venkatesalu, 2002). 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. The biopriming technique can also be carried out with macroalgae at low concentrations (parts per million) (Sharma *et al*., 2014). 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). The seaweeds when applied to plants as a foliar spray can increase the rate of cell division and elongation in those plants. The hormones also increase root growth when applied to the soil as a meal or when seaweed extract is used as a root dip. The seeds primed in liquid seaweed extract showed rapid germination and the resulting seedlings had increased root mass and stronger plant growth than seedlings from untreated seeds. They also had a higher survival rate. Seaweed foliar sprays promote faster, stronger stem and leaf growth and earlier blossoming and fruit set sprayed on leaves and flower buds (Smitte, 1991).

Material and Methods
The specimens of red seaweed *Corallina berteroi* Montagne were collected from Okha coast, Dwarka during February 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). The obtained filtrate was 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. Healthy green gram seed were collected in Vasundhara Agro Agency, Bhavnagar. Then seeds were bioprimed in particular and individual doses of seaweed liquid fertilizer and hydroprimed up to 0, 1, 2, 3, 4, 5, 6, 12, 24 hours at room temperature for better germination and early growth. After 5 days all the vegetative parameter like germination percentage, root length, shoot length, seedling length, seed viguor index, % Moisture content, No. of lateral roots was observed in sterilized 90- mm Petri dishes. All healthy and specific time selected green gram seed again bio- primed in each concentration of seaweed extract and sawing in enough space in each field. Water is sprinkle after sawing seed for maintaining the moisture content. Seaweed extract applied

by foliar method with different concentration with selected time duration. After 40 days, 50 days and 60 days measurement of growth parameter like No. of branches per plant, No. of leaves per plant, No. of flower per plant, No. of pod per plant, Total height of the plant (cm), No. of seed per pod, pod length (cm), Leaf area (cm2).

Results

Germination and growth parameters of green gram seedling

Green gram seed showed 80% germination in the control and 86.66% in the 1.0% seaweed liquid fertilizer treated seeds. A minimum of 77.77% germination was observed at 0.5% seaweed liquid fertilizer when compared to all other concentrations of treatment (Table 1). It was found that the treated seeds showed higher percentage of germination than control seeds. The results on % germination, root length, shoot length, seedling length, seed vigour index, wet weight, dry weight, No. of lateral roots in green gram are presented in Table 2 to 8. A maximum seedling length (33cm) and seed vigour index (3300) was found in 1.5% (12h) and minimum in 0.5% (2h) concentration of seaweed extract. In control plant seedling length (14cm) and seed vigour index (1400) value lesser than other concentration.

Percent moisture content was highest in 2.0% (5h) and lower in 0.2% (3h) concentration of seaweed extract. The results of growth parameter are presented in Table 9 to 12. A maximum height of the plant and leaf area were observed in 0.2% concentration in seaweed extract.

There increments were more than 88.88% and 74.28% respectively, when compared to control. The no. of branches increased in 1.5% concentration and decreased in 2.0% concentration in seaweed extract.

Table 1: Effect of *corallina berteroi* liquid fertilizer on germination of *Vigna radiata* L.

Concentrations (%)	Germination (%)
Control	**80.00**
0.2	84.44
0.5	77.77
0.7	82.22
1.0	86.66
1.5	84.44
2.0	84.44

Table 2: Effect of *Corallina berteroi* liquid fertilizer (0.2%) on *Vigna radiata* L.

Time Period	Germination % (GP)	Root length (radicle length) (cm)	Shoot length(cm)	Seedling length (cm)	Seed Vigour Index (SVI)	Wet weight(g)	Dry weight(g)	% Moisture content	No. of lateral roots
0h	80	9.2±0.1	11.5±0.1	20.7±0.1	1656±35.04	0.49±0.01	0.20±0.01	59.18	31
1h	60	8.2±0.1	16.8±0.1	25.0±0.1	1500±15.23	0.58±0.01	0.26±0.01	55.17	17
2h	100	5.6±0.1	16.0±0.1	21.6±0.1	2160±17.20	0.50±0.01	0.23±0.01	54.00	18
3h	100	12.8±0.2	18.2±0.1	31.0±0.1	3100±14.20	0.40±0.01	0.23±0.02	42.50	26
4h	100	11.2±0.1	14.0±0.2	25.2±0.2	2520±17.16	0.32±0.01	0.12±0.01	62.50	30
5h	100	7.8±0.1	23.2±0.1	31.0±0.1	3100±25.12	0.34±0.02	0.14±0.01	58.82	20
6h	60	6.5±0.1	6.5±0.1	13.0±0.1	780±8.04	0.27±0.02	0.10±0.02	62.96	10
12h	80	9.2±0.2	22.4±0.1	31.6±0.1	2528±14.02	0.33±0.01	0.12±0.01	63.63	21
24h	80	7.9±0.1	15.2±0.1	23.1±0.1	1848±16.21	0.23±0.01	0.09±0.01	60.86	13

(Results=Mean ±std)

Table 3: Effect of *Corallina berteroi* liquid fertilizer (0.5%) on *Vigna radiata* L.

Time Period	Germination % (GP)	Root length (radicle length) (cm)	Shoot length(cm)	Seedling length (cm)	Seed Vigour Index (SVI)	Wet weight(g)	Dry weight(g)	% Moisture content	No. of Lateral roots
0h	60	6.5±0.1	6.5±0.1	13.0±0.1	780±5.12	0.22±0.01	0.10±0.01	54.54	10
1h	80	5.6±0.1	11.1±0.1	16.7±0.1	1336±15.23	0.32±0.01	0.12±0.01	62.50	15
2h	100	9.2±0.2	16.8±0.1	26.0±0.1	2600±26.21	0.57±0.01	0.26±0.01	54.38	17
3h	60	3.5±0.1	12.2±0.1	15.7±0.2	942±8.14	0.45±0.02	0.22±0.01	51.11	14
4h	100	8.8±0.1	18.1±0.1	26.9±0.1	2690±31.24	0.33±0.01	0.14±0.01	57.57	20
5h	60	6.5±0.1	6.5±0.2	13.0±0.1	780±5.12	0.24±0.01	0.11±0.01	54.16	10
6h	100	6.0±0.1	12.1±0.1	18.1±0.1	1810±25.23	0.18±0.02	0.09±0.01	50.00	16
12h	40	7.8±0.2	18.7±0.1	26.5±0.2	1060±14.12	0.57±0.1	0.24±0.01	57.89	18
24h	100	2.8±0.1	11.6±0.1	14.4±0.1	1440±12.17	0.54±0.2	0.23±0.01	57.40	16

(Results=Mean ±std)

Table 4: Effect of *Corallina berteroi* liquid fertilizer (0.7%) on *Vigna radiata* L.

Time Period	Germination % (GP)	Root length (radicle length) (cm)	Shoot length(cm)	Seedling length (cm)	Seed Vigour Index (SVI)	Wet weight(g)	Dry weight(g)	% Moisture content	No. of Lateral roots
0h	80	3.0±0.1	5.1±0.2	8.1±0.1	648±5.12	0.23±0.01	0.10±0.01	56.52	7
1h	60	6.5±0.1	6.5±0.1	13.0±0.1	780±6.12	0.25±0.01	0.11±0.01	56.00	10
2h	80	4.4±0.1	18.0±0.1	22.4±0.1	1792±17.25	0.45±0.01	0.23±0.01	48.88	14
3h	80	6.3±0.1	14.0±0.1	20.3±0.2	1624±23.14	0.45±0.01	0.22±0.01	51.11	15
4h	80	14.2±0.2	16.5±0.1	30.7±0.1	2456±23.10	0.46±0.02	0.24±0.01	47.82	37
5h	80	9.4±0.1	15.6±0.1	25.0±0.1	2000±26.10	0.34±0.01	0.16±0.01	52.94	22
6h	100	8.3±0.1	20.3±0.2	28.6±0.1	2860±28.14	0.48±0.01	0.25±0.02	47.91	20
12h	100	7.7±0.1	11.5±0.2	19.2±0.1	1920±26.14	0.44±0.02	0.21±0.01	52.27	19
24h	80	5.2±0.1	12.6±0.1	17.8±0.1	1424±25.10	0.32±0.02	0.14±0.01	56.25	9

(Results=Mean ±std)

Table 5: Effect of *Corallina berteroi* liquid fertilizer (1.0%) on *Vigna radiata* L.

Time Period	Germination % (GP)	Root length (radicle length) (cm)	Shoot length(cm)	Seedling length (cm)	Seed Vigour Index (SVI)	Wet weight(g)	Dry weight(g)	% Moisture content	No. of lateral roots
0h	60	6.5±0.1	6.5±0.1	13.0±0.1	780±5.61	0.22±0.01	0.10±0.01	54.54	10
1h	100	4.6±0.1	11.0±0.1	15.6±0.1	1560±15.23	0.26±0.01	0.12±0.01	53.84	16
2h	100	10.8±0.1	20.2±0.1	31.0±0.2	3100±23.24	0.47±0.01	0.23±0.01	51.06	28
3h	100	8.4±0.2	12.6±0.1	21.0±0.1	2100±14.10	0.39±0.02	0.16±0.02	58.97	20
4h	80	7.4±0.1	16.6±0.1	24.0±0.1	1920±22.10	0.21±0.01	0.09±0.01	57.14	17
5h	80	9.2±0.1	20.2±0.1	29.4±0.2	2352±24.13	0.33±0.01	0.14±0.02	57.57	25
6h	80	8.7±0.1	22.6±0.1	31.3±0.1	2504±13.14	0.48±0.02	0.23±0.01	52.08	13
12h	100	8.4±0.2	18.2±0.1	26.6±0.1	2660±16.12	0.44±0.01	0.21±0.01	52.27	12
24h	80	4.8±0.1	8.2±0.1	13.0±0.2	1040±14.12	0.31±0.02	0.14±0.02	54.83	12

(Results=Mean ±std)

Table 6: Effect of *Corallina berteroi* liquid fertilizer (1.5%) on *Vigna radiata* L.

Time Period	Germination % (GP)	Root length (radicle length) (cm)	Shoot length(cm)	Seedling length (cm)	Seed Vigour Index (SVI)	Wet weight(g)	Dry weight(g)	% Moisture content	No. of Lateral roots
0h	60	6.6±0.1	7.4±0.1	14.0±0.1	840±5.12	0.39±0.01	0.16±0.01	58.97	15
1h	80	8.3±0.1	9.6±0.2	17.9±0.1	1432±13.24	0.29±0.01	0.14±0.01	51.72	26
2h	100	6.2±0.1	13.2±0.1	19.4±0.2	1940±16.25	0.29±0.01	0.15±0.02	48.27	17
3h	60	6.8±0.1	14.7±0.2	21.5±0.1	1290±15.48	0.36±0.02	0.13±0.02	63.88	17
4h	100	8.1±0.1	16.4±0.1	24.5±0.2	2450±21.20	0.39±0.01	0.17±0.01	56.41	18
5h	100	6.6±0.2	7.2±0.1	13.8±0.1	1380±19.32	0.38±0.01	0.16±0.01	57.89	18
6h	60	6.5±0.1	6.5±0.1	13.0±0.1	780±6.14	0.22±0.02	0.08±0.01	63.63	10
12h	100	10.8±0.1	22.2±0.1	33.0±0.1	3300±30.14	0.66±0.01	0.34±0.01	48.48	25
24h	100	4.5±0.1	8.0±0.1	12.5±0.1	1250±14.23	0.32±0.01	0.14±0.01	56.25	14

(Results=Mean ±std)

Table 7: Effect of *Corallina berteroi* liquid fertilizer (2.0%) on *Vigna radiata* L.

Time Period	Germination % (GP)	Root length (radicle length) (cm)	Shoot length(cm)	Seedling length (cm)	Seed Vigour Index (SVI)	Wet weight(g)	Dry weight(g)	% Moisture content	No. of Lateral roots
0h	60	6.5±0.1	6.5±0.1	13.0±0.1	780±5.20	0.23±0.01	0.10±0.01	56.52	10
1h	60	6.5±0.1	6.5±0.1	13.0±0.1	780±5.32	0.21±0.01	0.09±0.01	57.14	10
2h	100	6.0±0.2	15.5±0.1	21.5±0.2	2150±16.23	0.57±0.01	0.26±0.01	54.38	16
3h	80	11.7±0.1	18.6±0.1	30.3±0.1	2424±25.31	0.39±0.02	0.17±0.02	56.41	32
4h	80	6.0±0.1	15.2±0.2	21.2±0.2	1696±23.17	0.34±0.01	0.15±0.01	55.88	12
5h	100	6.4±0.1	20.4±0.2	26.8±0.1	2680±24.13	0.39±0.01	0.17±0.02	56.41	22
6h	100	8.6±0.2	18.4±0.1	27.0±0.1	2700±30.16	0.65±0.02	0.32±0.01	50.76	13
12h	80	2.5±0.1	8.0±0.1	10.5±0.1	840±6.12	0.44±0.01	0.21±0.01	52.27	8
24h	100	5.7±0.1	12.5±0.1	18.2±0.1	1820±31.21	0.36±0.01	0.14±0.01	61.11	10

(Results=Mean ± std)

Table 8: Control plant of *Vigna radiata* L.

Time Period	Germination % (GP)	Root length (radicle length) (cm)	Shoot length(cm)	Seedling length (cm)	Seed Vigour Index (SVI)	Wet weight(g)	Dry weight(g)	% Moisture content	No. of Lateral roots
0h	70	5.7±0.1	6.8±0.1	12.5±0.1	875±2.31	0.27±0.01	0.1±0.01	62.96	7
1h	80	4.2±0.1	2.8±0.1	7.0±0.1	560±5.21	0.1±0.01	0.04±00.2	60.0	10
2h	100	5.8±0.2	8.2±0.2	14.0±0.1	1400±32.10	0.3±0.02	0.01±0.1	96.66	17
3h	90	4.1±0.2	5.2±0.1	9.3±0.2	837±4.11	0.27±0.01	0.1±0.01	62.96	8
4h	90	5.4±0.1	6.6±0.1	12.0±0.1	1080±25.56	0.24±0.02	0.1±0.01	58.33	18
5h	60	6.2±0.1	4.0±0.2	10.2±0.1	612±6.10	0.09±0.02	0.006±0.001	93.33	15
6h	80	5.6±0.2	2.4±0.2	8.0±0.2	640±7.12	0.2±0.01	0.08±0.01	60.0	11
12h	90	4.6±0.1	5.0±0.2	9.6±0.2	864±9.12	0.17±0.01	0.09±0.01	47.05	9
24h	60	5.2±0.1	2.4±0.1	7.6±0.1	456±5.14	0.16±0.01	0.06±0.01	62.5	7

(Results=Mean ± std)

Table 9: Effect of *Corallina berteroi* liquid fertilizer on *Vigna radiata* L. (After 40 days)

Concentration	No. of branches per plant	No. of leaves per plant	Height of the plant (cm)	No. of flower per plant	No. of pod per plant	No. of seed per pod	Length of the pod (cm)	Leaf area (cm2)
0.2% (3h)	5	14	23	1	2	----	1	17.5
0.5% (2h)	3	11	13	----	----	----	----	10
0.7% (6h)	4	11	15	----	----	----	----	10.5
1.0% (2h)	4	11	15	----	----	----	----	6.0
1.5% (12h)	5	11	20	1	2	----	3.8	15
2.0% (5h)	4	11	19	1	----	----	----	10

(Results=Mean)

Table 10: Effect of *Corallina berteroi* liquid fertilizer on *Vigna radiata* L. (After 50 days)

Concentration	No. of branches per plant	No. of leaves per plant	Height of the plant (cm)	No. of flower per plant	No. of pod per plant	No. of seed per pod	Length of the pod (cm)	Leaf area (cm2)
0.2%	6	16	23	----	3	----	7	17.5
0.5%	6	14	16	----	1	----	8	10
0.7%	5	10	18	----	2	----	4.7	10.5
1.0%	4	11	15	----	----	----	----	6.0
1.5%	6	14	21	----	3	----	7	15
2.0%	4	11	19	----	1	----	5.8	10

(Results=Mean)

Table 11: Effect of *Corallina berteroi* liquid fertilizer on *Vigna radiata* L. (After 60 days)

Concentration	No. of branches per plant	No. of leaves per plant	Height of the plant (cm)	No. of flower per plant	No. of pod per plant	No. of seed per pod	Length of the pod (cm)	Leaf area (cm2)
0.2%	7	17	27	----	4	7	7	17.5
0.5%	6	14	17	2	2	11	8	10
0.7%	6	14	17	----	2	1	2	10.5
1.0%	6	11	16	1	1	10	8	6.0
1.5%	8	15	23	----	5	4	5.2	15
2.0%	5	11	19	----	3	5	5.8	10

(Results=Mean)

Table 12: Control plant of *Vigna radiata* L.

Days	No. of branches per plant	No. of leaves per plant	Height of the plant (cm)	No. of flower per plant	No. of pod per plant	No. of seed per pod	Length of the pod (cm)	Leaf area (cm2)
40	5	14	15	----	----	----	----	12.5
50	5	17	24	----	----	----	----	12.5
60	7	15	24	2	3	5	7	13.0

(Results=Mean)

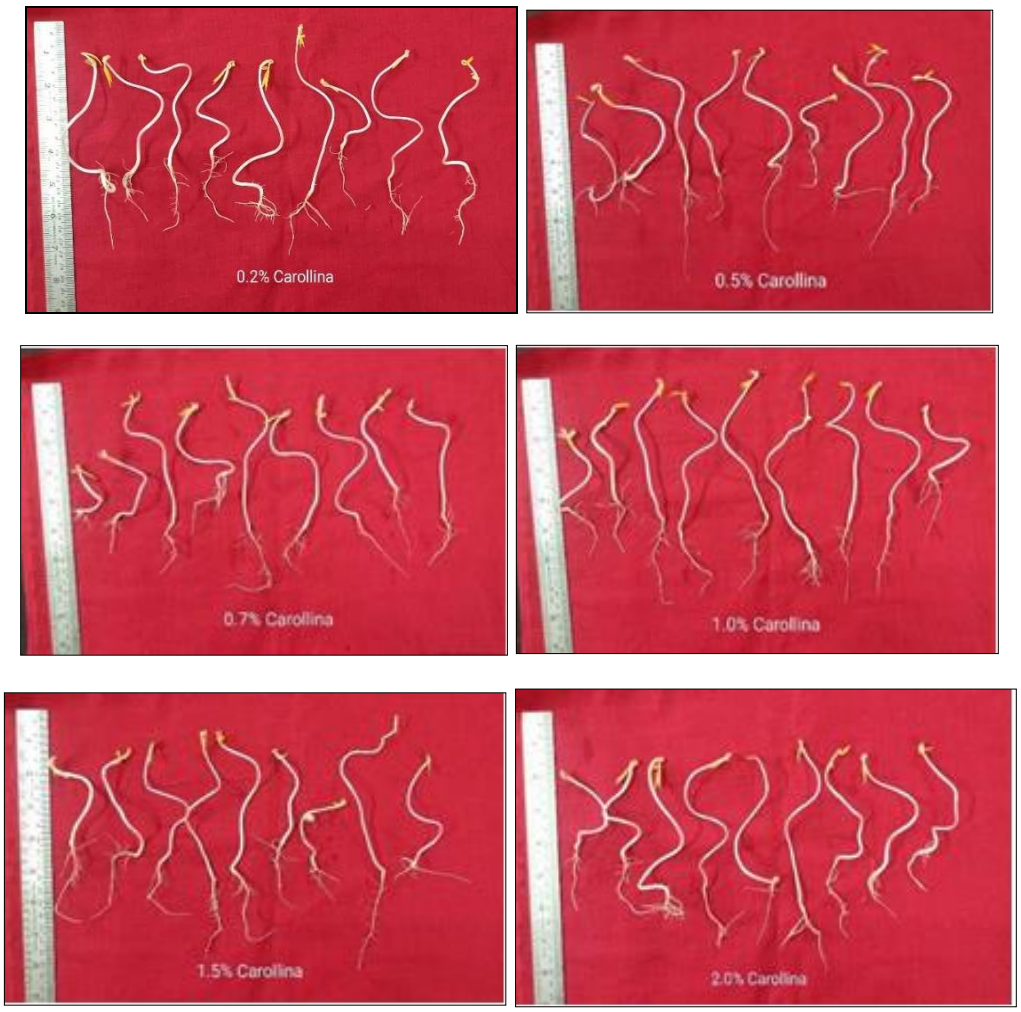

Fig 1: Effect of seed treatment with different concentration and different time period of *Corallina berteroi* SLF on the seedling growth of *Vigna radiata* L.

Control *Corallina berteroi* treated plants with different concentration

Fig 2: The growth of *Vigna radiata* at 50 days

Discussion

The present study highlights the efficiency of SLF obtained from the red seaweed *Carollina berteroi*. The *Vigna radiata* L. seeds soaked with higher concentrations of the seaweed biostimulant showed higher rates of germination, while the lower concentrations of the extracts inhibited the germination. The value of seaweed as fertilizer is not from the nitroger, phosphorous, potash and organic matter but from trace elements and metabolites similar to plants growth regulators (Booth, 1969). The green gram seeds bio primed with higher concentrations of the seaweed extracts showed higher rates of germination while the lower concentration of the extract inhibited the germination. Similar results were recorded in Cajanus cajan red gram (Kumar, Mohan, Murugeswari and Muthusamy, 1993), Oryza sativa (Kumar, 2009) and Vigna mungo (Ganapathy, Balamurugan, thinakaran and Sivakumar, 2013). Reported that the presence of plant growth regulators, trace elements, vitamins and macronutrients in the seaweed liquid fertilizer enhance the growth of root length and shoot length of Vigna mungo (Challen and Hemingway, 1965). Additionally, it is known that higher concentrations of (1.0%) the Ulva lactuca liquid extract can inhibit the germination of mung bean (Castellanos- Barriga, 2017). Seaweed liquid fertilizer was found superior than chemical fertilizer because of the presence of high level of organic matter (Aitken and Senn, 1965).

Conclusion

In this study, it is concluded that Seaweed Liquid Fertilizer prepared from the red seaweed *Carollina berteroi* Montagne can be applied to the important crop plant *Vigna radiata* L. showed better results in all aspects of germination, growth. The results of this research suggest that biopriming seeds of green gram with the seaweed extracts obtained in Carollina berteroi at 0.2% enhance the percentage and seedling rate emergence and faster root and shoot growth. In lower concentration found the better result in seed germination, and higher concentration found the better result in plant growth in field trial. The possibility of the existence of minerals and polysaccharides in algal extracts auxin-like activity is high and could be responsible for the effects on growth parameters. Further studies are needed to understand the mechanism involved in such growth stimulation caused by seaweed extracts.

Acknowledgment

I am very thankful to my Guide & Head, Dr. Shailesh Mehta, Botany Department, Sir P. P. Institute of Science, Maharaja Krishnakumarsinhji Bhavnagar University, Bhavnagar, Gujarat for moral support and providing necessary facilities to carry out this work. I am also thankful Education Department, Gujarat state for providing SHODH (ScHeme of Developing High quality research) scholarship for financial assistance.

References

1. Mishra P, Dash D. Rejuvenation of Biofertiliser for Sustainable Agriculture Economic Development (SAED), Consilience: The Journal of Sustainable Development,2014:11:41-61.
2. Anantharaj M, Venkatesalu V. Effect of seaweed liquid fertilizer on Vigna calajung. Seaweed Res. Utiln,2001:23:33-39.
3. Sridhar S, Rengasamy R. Effect of seaweed liquid fertilizer on growth, pigment concentration and yield of Amaranthus roxburghinus and Amaranthus tricolor under field trial. IJCR,2011:3(7):131-134.
4. Asir Selin Kumar. Influence of seagrass Syringodium isoetifolium extract on germination and growth of Oryza sativa. J. Ecotoxicol. Environ. Onit,2009:19(2):157-162.
5. Ramamoorthy K, Sujatha K, Sivasubramanian K. Utilization of seaweed extracts for enhancing yield in black gram, Vigna mungo L. Hepper. Seaweed Res. Utiln,2007:29(1,2):97-100.
6. Sathya B Indu H, Seenivasan R. Geetha S. Influence of seaweed liquid fertilizer on the growth and biochemical composition of legume crop, Cajanus cajan (L.) Mill sp, Journal of Phytology,2005:2:5
7. Christobel GJ. Effect of seaweed (Sargassum weightii L.) on the germination and growth of green gram (Phaseolus aureus, L.) J Basic Appl Biol,2008:2(1):105-108.
8. Sylvia S, Baluswami M, Vijaya Parthasarathy MD, Krishnamurthy V. Effect of liquid seaweed fertilizers extracted from Gracilaria edulis (Gmel.) Silva, Sargassum wightii Greville and Ulva lactuca Linn. On the growth and yield of Abelmoschus esculentus (L) Moench. Indian Hydrobiol,2005:7:69-88.
9. Studies on Effect of Seaweed Extract on Crop Plants and Microbes. International Journal of Chem Tech Research,2014:6(9):4235-4240.
10. Patel RV, Pandaya KY, Jasrai RT, Brahmbhatt N. Effect of hydro priming and biopriming on seed germination of Brinjal and Tomato seed. Research Journal of Agriculture and Forestry

Sciences,2007:5(6):1-14.
11. Lingakumar K, Jeyaprakash R, Manimuthu C, Haribaskar A. Gracilaria edulis an effective alternative source as a growth regulator for legume crops. Seaweed Res. Utiln,2002:24(1):117-123.
12. Thirumal Thangam R, Maria Victorial Rani S, Peter Marian M. Effect of seaweed liquid fertilizers on the growth and biochemical constituents of Cyamopsis tetragonoloba (L.) Taub. Seaweed Res. Utiln,2003:25(1,2):99-103.
13. Sasikumar KT, Govindan, Anuradha C. Effect of seaweed liquid fertilizer of Dictyota dichotoma on growth and yield of Abelmoschus esculentus L., Eur J Exp Biol,2011:1:223-227.
14. Sekaram RN, Thangaraju, Rengasamy R. Effect of seaweed liquid fertilizer from Ulva lactuca L. on Vigna unguiculata L., Phykos,1995:34:49-53.
15. Rajkumar Immanuel S, Subramanian SK. Effect of fresh extracts seaweed liquid fertilizer some cereals and millets. Seaweed Research and Utilization,1999:20(21):91-94.
16. Khan W, Rayirath UP, Subramanian S, Jithesh MN, Rayorath P, Hodges DM *et al*. Seaweed extracts as Biostimulants of plant growth and development. J Plant Growth Regul,2009:28:386-399.
17. Zodape ST, Mukherjee S, Reddy MP, Chaudhary DR. Effect of Kappaphycus alvarezii (Doty) Doty ex Silva. extract on grain quality, yield and some yield components of wheat (Triticum aestivum L.), Int JPlant Prod,2009:3:97-101.
18. Wilczek CA, Ng T. The promotion of seed germination in table beet by an aqueous seaweed extract. Hort. Sci,1982:17:629-630.