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Role of seaweed extract application on physiological planting value of rice (*Oryza sativa* L.)

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Abstract
Seaweed extract have been used for several decades to enhance plant growth and productivity and the use of seaweed formulations as a bio stimulants in crop is well established. Seaweed extracts was applied as a seed treatment to enhance the seed quality. Knowing the quality of rice seed will enable one to decide the appropriate practices that could help to maintain or improve the performance of seed lots. The seeds of rice cv. ADT 36 were imposed with priming treatment with seaweed extract of two species *viz*., *Gracilaria carticata* and *Sargassum wightii* at different concentration for 20 hours along with control and the seeds were evaluated for the seed quality under laboratory condition. From the results, it was concluded that seeds treated with 1% of *Sargassam wightii* seaweed extract recorded higher values for the initial seed qualities *viz.*, germination percentage (91%), speed of germination (34.69), root length (28.78 cm), shoot length (13.52 cm), seedling fresh weight (2.57 g), seedling dry weight (0.28 g), vigour index I (3849.30) and vigour index II (25.48) and the lower values were recorded by the untreated seeds. Hence, rice seeds primed with 1% *Sargassam wightii* seaweed extract could be recommended for priming seed treatment for improving the planting value of seed.

Keywords: rice, seed priming, seaweed, sargassum wightii, seed quality

Introduction
Seed priming is an effective technology to enhance rapid and uniform emergence and to achieve high vigour, leading to better stand establishment and yield. It is a simple and low cost hydration technique in which seeds are partially hydrated to a point where pre-germination metabolic activities start without actual germination, and then re-dried until close to the original dry weight. Seed priming is a common practice followed to enhance seed performance with respect to rate and uniformity of germination (De Lespinay *et al.*, 2010) [3]. Priming enhanced seed performance activities which are related to the repair and the buildup of nucleic acid, enhanced synthesis of protein, repair of membranes and improves antioxidant system (Hsu *et al.*, 2003) [6].

Seaweeds are the macroscopic marine algae found attached to the bottom in relatively shallow coastal water. The use of marine macro algae as fertilizer in crop production has a long tradition in coastal areas all over the world. In India, large quantity of macroscopic marine algae has been utilized directly as manure or in the form of compost by coastal people (Thivy, 1960) [17]. Seaweed extract have been used for several decades to enhance plant growth and productivity and the use of seaweed formulations as a bio stimulants in crop is well established (Khan, 2009) [8].

In agriculture and horticulture, application of seaweed extracts has proved beneficial for the growth and yield with better germination (Abetz and young 1983) [2], improved plant vigour and yield (Ferreira and Lourens, 2002) [4]. Seaweed extracts are applied to crop as seed treatment (Gopalakrishnan and Binumol, 2016) [5]. With this background, study was undertaken to evaluate the effect of seaweed extract application on seed quality in rice cv. ADT 36.

Materials and Methods
Genetically pure and physically pure seeds of rice cv. ADT 36 were obtained from Tamil Nadu Rice Research Institute (TRRI), Aduthurai, which formed the basic material for the study, were imposed with the following priming treatment. The seeds were soaked in seaweed extract of different concentration *viz.* 0.4%, 0.6%, 0.8%, 1.0% at room temperature@ 1:1 ratio for 20 hrs and dried back to original moisture content.

Preparation of Seaweed Liquid Fertilizer
The seaweed was washed with tap water to remove salts and it was finally washed with distilled water. The seaweed was then shade dried for four days duration followed by oven drying at 60 °C for 5 hours. The dried sample was grounded with blender to get fine powder and was stored for future use. Seaweed liquid fertilizers were prepared by boiling method. In boiling method, seaweed powder of 10 g was mixed with 100 ml of distilled water and it was then heated for 1 hour at 100 ºC. Then the contents were filtered through the filter paper. The collected filtrate was stored in refrigerator (0-20 ºC). The obtained filtrate was considered as stock solution with 100% pure extract.

Treatment details
T_0 – Control
T_1 –*Gracilaria corticata*@0.4% soaking for 20 Hours
T_2 –*Gracilaria corticata*@0.6% soaking for 20 Hours
T_3 –*Gracilaria corticata*@0.8% soaking for 20 Hours
T_4 –*Gracilaria corticata*@1% soaking for20 Hours
T_5 –*Sargassam wightii* @0.4 %soaking for 20 Hours
T_6 – *Sargassam wightii* @0.6 % soaking for 20 Hours
T_7 – *Sargassam wightii* @0.8 % soaking for 20 Hours
T_8 – *Sargassam wightii* @1 %soaking for20 Hours

The randomly selected sample of seeds from each treatment was evaluated for their seed quality characters such as Germination per cent (ISTA Rules, 2013) [7], Root Length (cm), Shoot Length (cm), Dry matter production (mg/10 seedlings), Vigour index I (Abdul-Baki and Anderson, 1973) [1], Vigour index II(Abdul-Baki and Anderson, 1973) [1] and Vigour index III (Abdul-Baki and Anderson,1973) [1]. The data was analyzed statistically adopting the procedure described by Panse and Sukhatme (1985) [9]. Wherever necessary, the percentage values were transformed to angular (arc sine) values, before carrying out the statistical analysis. The critical difference (CD) was worked out of 5 per cent (P = 0.05) level.

Result and Discussion

Seaweed treatment of crops has grown in popularity and lead to development of large numbers of processed seaweed products. Powdered or liquid extracts and concentrates employed as seed treatment, root dips and foliar spray. Seaweed extracts are known to enhance seed germination and plant growth. Method of fertilizer application plays a vital role in achieving higher yield of crops, where root dipping and foliar application of mineral nutrients, offers a quicker method of supplying nutrients to higher plants than methods involving soil application.

From the laboratory analysis, seeds treated with 1% of *Sargassam wightii* seaweed extract recorded higher values for the initial seed qualities *viz.*, germination percentage (91%), speed of germination (34.69), root length (28.78 cm), shoot length (13.52 cm), seedling fresh weight (2.57 g), seedling dry weight (0.28 g), vigour index I (3849.30), vigour index II (25.48) andvigour index III (2618.98) and the lower values were recorded by the untreated seeds.

Increase in germination indices *viz.*, germination percentage of 10.98% and speed of germination of 19.74% over the control by T_8 may be due to the increase in exogenous availability of growth hormones *viz.*, GA_3, IAA and IBA through seaweed extract priming migrates into the seeds, thereby increases the synthesis of hydrolytic enzymes. These enzymes are required for the digestion of storage endospermic starch to release energy, absence of which hastens the germination process. Hence, the priming induced enhancement in germination related metabolic activities. The macro and micro nutrients, vitamins and amino acid present in seaweed extract causes the enrichment effect on seed for early and speed in germination. (Ramarajan *et al.*, 2012) [12].

Seeds treated with 1% of *Sargassam wightii* seaweed extract recorded higher values for morphological characters like shoot length, root length, fresh weight and dry weight of seedling over the control. There was an increase of 3.26%, 22.41%, 15.66% and 9.30% over control respectively may be due to the presence of growth promoting hormones, cytokinins, trace elements, etc in seaweeds claimed to be the important compounds for cell size, cell division and cell elongation enhancement effect and especially GA_3 in seaweed extract causes faster release of energy for growing seedling and auxins and cytokinins plays a major role in root and shoot development which showed overall increment in seedling length and biomass production. The similar findings were reported by Ramamoorthy and Sujatha, 2007 in black gram and Sathya *et al.,* 2010 [14] in red gram. Seaweed derived fertilizer helps to enhance the seedling growth and development (Sasirekha *et al.,* 2016).

Improvement of 44.47% in seedling vigour index I, 48.23% in seedling vigour index II and 36.75% in seedling vigour index III was registered by T_8 over control. Seedling growth in terms of root and shoot has been regarded as a good index to measure the vigour of seeds (Abdul–Baki and Anderson, 1973) [1]. The increased seedling growth may be due to the presence of phenyl acetic acid (PAA) and other closely related compounds in seaweed extract (Taylor and Wilkinson, 1977) [16]. It may also due to the fertilizering effect of seaweed extract which enhances the seedling growth by inducing root proliferation, shoot elongation and biomass accumulation in developing seedlings. Similar findings were reported by Sujatha *et al.* (2013) [15] in sesame; Paul and Shri Devi (2014) [10] in cumbu and Thomas *et al.* (2015) [18] in green gram.

Table 1: Effect of seed treatment with seaweed extract of on seed quality of rice cv. ADT 36

Treatment	Germination percentage (%)	Speed of germination	Root length (cm)	Shoot length (cm)	Seedling Fresh weight (g per 10 seedlings)	Seedling Dry weight (g per 10 seedlings)	Vigour index I	Vigour index II	Vigour index III
T_o	81 (63.58)	27.84	20.45	10.49	1.74	0.17	2506.94	13.77	1656.45
T_1	82 (63.94)	28.00	21.65	10.89	1.80	0.18	2668.28	14.76	1775.3
T_2	82 (63.42)	29.04	22.67	11.21	1.94	0.19	2778.16	15.58	1858.94
T_3	83 (65.21)	31.32	23.02	12.24	2.24	0.20	2926.58	16.6	1910.66
T_4	89 (70.44)	34.41	27.75	13.38	2.53	0.27	3660.57	24.03	2469.75
T_5	86 (66.51)	30.24	25.56	13.00	2.44	0.25	3316.16	21.5	2198.16
T_6	88 (70.36)	33.49	24.47	11.74	2.38	0.26	3186.48	22.88	2153.26
T_7	87 (67.96)	33.98	26.89	12.54	2.41	0.24	3430.41	20.88	2339.43
T_8	91 (72.04)	34.69	28.78	13.52	2.57	0.28	3849.3	25.48	2618.98
MEAN	86 (67.12)	31.45	24.58	12.11	2.23	0.22	3146.98	19.49	2109.00
S. Ed	0.2098 (0.1630)	0.7363	0.8670	0.4219	0.0633	0.0139	11.9876	0.0780	43.0877
CD(P=0.05)	0.6045 (0.3560)	1.5463	1.734	0.8861	0.1329	0.0291	23.97	0.156	86.1753

(Figures in parenthesis indicate arcsine transformed values)

Conclusion

Rice seeds primed with 1% of *Sargassam wightii* seaweed extract recorded higher values for the initial seed quality parameters *viz.*, germination percentage (91%), speed of germination (34.69), root length (28.78 cm), shoot length (13.52 cm), seedling fresh weight (2.57 g), seedling dry weight (0.28 g), vigour index I (3849.30), Vigour index II (25.48) and vigour index III (2618.98) and the lower values were recorded by the untreated seeds. Seaweed extracts used as a priming agent could be proven beneficial for enhancing seed quality and seed yield.

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