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Influence of seaweed extract on growth, yield and quality of onion cv. Sukhsagar

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ABSTRACT

Entitled as "Influence of seaweed extract on growth, yield and quality of onion cv. Sukhsagar", a study was designed and well performed at HRS, Mondouri, BCKV, under NAZ of West Bengal, throughout November – March of two consecutive years (2020-2021 and 2021-2022). The exploration was set up in RBD accompanied with 10 treatments of 3 replications viz., (T_1- seed treatment with SWE (20%) @ 1ml l^{-1}, T_2 - seed treatment with SWE (20%) @ 1.5 ml l^{-1}, T_3 - seed treatment with SWE (20%) @ 2ml l^{-1}, T_4 -seed treatment + root dipping with SWE (20%) @ 1ml l^{-1} , T_5 - seed treatment + root dipping with SWE (20%) @ 1.5ml l^{-1} , T_6 - seed treatment + root dipping with SWE (20%) @ 2ml l^{-1}, T_7 - root dipping with SWE (20%) @ 1 ml l^{-1}, T_8 - root dipping with SWE (20%) @ 1.5 ml l^{-1}, T_9 - root dipping with SWE (20%) @ 2 ml $l^{-1}$and T_{10} - control (seed and root dipping in distilled water). The concentrated combination for the treatment were subjected to mean maximum plant height (63.40 cm), leaf length (61.70 cm), leaf width (3.35 cm), neck thickness (3.55 cm), no. of leaves plant^{-1} (5.80), bulb yield plot^{-1} (4.18 kg), projected bulb yield (16.93 t ha^{-1}), dry matter content (8.52 %), TSS (11.63º Brix), titratable acidity (0.42 mg 100^{-1}), ascorbic acid (8.01 mg 100^{-1}), total sugar (12.70 %) , reducing sugar (4.54 %), net profit (Rs. 201608 ha^{-1}) and B:C ratio (1.95:1) was evident underneath T_6 (seed treatment + root dipping with SWE (20%) @ 2ml l^{-1}).

Keywords: B: C ratio, growth, onion, quality, seaweed extract, yield

Onion (*Allium cepa* L.) owner of the epithet, 'The Queen of the Kitchen' (Selvaraj, 1976) is one of the most important commercial vegetables cum spices throughout the world. With all its commercial value, it is also remarkably marked for its nutritional value inherent, its unique taste, flavour, odour – which brought it both local as also international acclaim. The main nutrients in 100 g of raw onions are – moisture 86.60%, protein 1.20 g, carbohydrates 11.10 g, sugar 4.20 g, fibre 0.60 g, fat 0.10 g, energy 50 kcal, vitamin C 11 mg, B_9 64 mg, B_6 0.06 mg, potassium 276 mg, phosphorus 50 mg, calcium 50 g, iron 0.70 mg, thiamine 0.08 mg, niacin 0.40 mg and total folic acid 6 mg (Basak, 2004). Onion has several medicinal and therapeutic properties which is effective against diabetes, common cold, heart disease and osteoporosis (Vohra *et al.*, 1974). The most well-known seaweeds in the field of agricultural market are the brown seaweed, which includes species of the genera *Ascophyllum, Fucus and Laminaria*. The seaweed products are mostly found in solvent powder forms or liquid formulations prepared throughout multiple extraction process. Some types of extraction methods may include alkali, acid extraction or other technological methods (Bhattacharya *et al.*, 2015). Among others, one of the essential components of seaweed is polysaccharides and remarkably, it has 30% – 40% capacity of dry weight.

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These polysaccharides inherently include plant growth promoting components and also capable of protecting them from fungal and bacterial onslaughts. Besides, seaweed extract essences are prolific in phenolic compounds as also able to take on phytohormones, which directly hasten plant growth. Moreover, it holds the power of soil conditioning and has metal chelating properties. As seaweeds can make gel like network, also known as hydrogels – it is also capable to foster water capacity of plants. Keeping the above fact in view, the study on "Influence of seaweed extract on growth, yield and quality of onion cv. Sukhsagar" was undertaken in the New alluvial zone of West Bengal.

MATERIALS AND METHODS

The present extensive investigation was carried out during November – March in two consecutive years (2020-2021 and 2021-2022) at Horticultural Research Station, Mondouri, Bidhan Chandra Krishi Viswavidyalaya, Nadia, West Bengal under New Alluvial Zone situated at 9.75 meters above mean sea level having latitude 23.5^0N and longitude 89^0 E. The soil of the field is a well-drained clay loam with a pH of 6.8.and an excellent water-holding capacity. 0-5 cm layer of the top soil is having 55% sand, 28.6 % silt and 16.40 % clay. The experiment was set up in Randomized Block Design with three replications comprising 10 treatments *viz.*,T_1 - seed treatment with SWE (20%) @ 1ml l^{-1}, T_2 - seed treatment with SWE (20%) @ 1.5 ml l^{-1}, T_3 - seed treatment with SWE (20%) @ 2ml l^{-1}, T_4 - seed treatment + seedling-root dipping with SWE (20%) @ 1ml l^{-1} , T_5 - seed treatment + seedling-root dipping with SWE (20%) @ 1.5 ml l^{-1} , T_6 –seed treatment + seedling-root dipping with SWE (20%) @ 2ml l^{-1}, T_7 – only seedling-root dipping with SWE (20%) @ 1 ml l^{-1}, T_8 –only seedling-root dipping with SWE (20%) @ 1.5 ml l^{-1}, T_9 - only seedling-root dipping with SWE (20%) @ 2 ml l^{-1} and T_{10} - control (both seed and seedling- root dipping in distilled water). Seed sowing was done on 10^{th} of November each year in the nursery bed. For getting a better moisturized seed bed as well as to get control over weed and to accelerate germination, the beds were covered with banana leaves. Healthy rooted saplings of 4 weeks age were transplanted in the main field during morning hours on 15^{th} of December each year. 1.6 m x 1.5 m investigating plot was divided into 30 plots, each with a 30 cm wide ridge surrounding them. Irrigation channels of 50 cm width were also constructed. A number of two hundred forty saplings were transplanted at a spacing of 10x10 cm in each plot. Organics like well rotten Farm Yard Manure (FYM 5 t ha^{-1}) and vermicompost (VC 2.5 t ha^{-1}) were applied by broadcasting and mixed thoroughly with the soil 10 days before final bed preparation. While preparing plots required step of practices were abided by. Five plants were marked at early growth stage on each plot for making observations on plant height (cm), leaf length (cm), leaf width (cm), neck thickness (cm) and number of leaves $plant^{-1}$ at 30, 60 and 90 days after transplanting. At mature stage, when the top of the plants were drooping just above the bulb but the leaves are still green, the bulbs were harvested. Equatorial diameter of bulb (cm), bulb weight $plant^{-1}$ (g), bulb yield (kg $plot^{-1}$) and projected bulb yield (t ha^{-1}) were recorded. Some selected bulbs were kept in the departmental laboratory of Plantation, Spices, Medicinal and Aromatic crops, Faculty of Horticulture for taking records on dry matter content (%){Dry weight (%) =A/B X 100, Where, A = sample weight of cured onion bulb (g), B = weight of the sample after drying (g)},TSS (^{o}Brix)(Nieuwhof, 1973), titratable acidity (mg 100 g^{-1}), ascorbic acid (mg 100 g^{-1}){Ascorbic acid (mg 100g^{-1})= (burette reading × dye factor × volume made up)/(Volume of sample taken for estimation × weight of sample)×100} (Rangana, S. 1977; Li *et al.*,2007), total sugar (%), {Total sugar (%)= (Factor × Volume made up)/(Burette reading × Weight of sample)×100=(0.02 x 100 x 100)/(Burette reading×10)×100=20/(Burette reading)}, reducing sugar (%) {Reducing sugar (%) = (Factor × Volume made up)/(Burette reading × Weight of sample)×100= (0.02×100×100)/(Burettereading×10)×100=20/(Burette reading) (Nelson, 1944; Somogyi, 1945). The benefit :cost (B:C) ratio { B.C ratio = (Net income (Rs. ha^{-1})/(Total cost of cultivation (Rs.ha^{-1})} was determined by splitting the production cost by the net return. Based on established protocols, statistical analysis was carried out on pooled data (Gomez and Gomez, 1984).

RESULTS AND DISCUSSION

Growth Parameters

Dwelling on the outcome, acquired from the exploration of vegetative parameters, Table-1 showcases mean maximum average plant height (38.70 cm, 60.90 cm and 63.40 cm), leaf length (36.40 cm, 58.70 cm and 61.70 cm), leaf width (2.50 cm, 3.20 cm and 3.35 cm), neck thickness (2.80 cm, 3.35 cm and 3.55 cm) and number of leaves $plant^{-1}$ (4.50, 5.00 and 5.80) recorded from treatment T_6 (seed treatment + seedling-root dipping with SWE (20%) @ 2 ml l^{-1}) at 30, 60 and 90 DAT respectively. However, in all the vegetative parameters, T_{10} (control – both seed and seedling-root dipping in distilled water) scored the mean minimum average plant height (31.80 cm, 53.30 cm and 57.00 cm), leaf length (25.20 cm, 47.00 cm and 51.00 cm), leaf width (1.50 cm, 1.95 cm and 2.25 cm), neck thickness (2.20 cm, 2.20

cm and 2.45 cm) and number of leaves plant^{-1} (3.60, 3.90 and 4.00) at 30, 60 and 90 DAT respectively. Seed treatment of onion as well as seedlings-root dipping with SWE 20% @ 2 ml l^{-1} of water significantly increased plant height, leaf length, width, neck thickness and number of leaves plant^{-1} in all stages of crop growth. These might be due to enough flow of photosynthates leading to remarkable growth and liveliness. Similar results were received by Danesh *et al*. (2012) and Pramanik *et al*. (2013). The seaweed extract apparently affects the metabolic activity of leaves, resulting in encouragement of the cell division hence enhanced the number of leaves plant^{-1}. And the same was observed in onion, attained by Shafeek *et al.* (2015).

Yield parameters

On consideration of yield and yield attributing parameters, Table-2 significantly revealed that the maximum mean values of equatorial diameter of bulb (5.35 cm), bulb weight plant^{-1} (73.71 g), bulb yield (4.18 kg plot^{-1}) and projected bulb yield (16.93 t ha^{-1}) was associated with T_6 (seed treatment + seedling-root dipping with SWE (20%) @ 2 ml l^{-1}), while minimum mean values of equatorial diameter of bulb (4.18 cm), bulb weight plant^{-1} (41.68), bulb yield (1.85 kg plot^{-1}) and projected bulb yield (10.09 t ha^{-1}) were found in T_{10} (control plots- seed and seedling-root dipping in distilled water). Significant enhancement in root growth and bulb size through seed treatment of onion and seedling-root dipping in SWE 20% @ 2 ml l^{-1} of water along with proper simultaneous nutritional supply may be due to the enhancement in yield attributes like equatorial diameter of bulb, bulb weight plant^{-1}, bulb yield and projected bulb yield. Koyama *et al*. (2012) opined that using *Ascophyllum nodosum* speeds up the plant's vegetative growth, which is the early stage of crop growth that is followed by its reproductive growth which are very much verisimilitude to the findings of Patel *et al*. (2000) in fennel, and Abbbas *et al*. (2020) and Szczepanek *et al*. (2017) in onion.

Quality parameters

With respect to qualitative parameters (Table-3), maximum average values of dry matter content (8.52%), TSS (11.63º Brix), ascorbic acid (8.01mg 100 g^{-1}), total sugar (12.70%) and reducing sugar (4.54%) could be noticed after T_6 (seed treatment + seedling-root dipping with SWE 20% @ 2 ml l^{-1}), excepting titratable acidity for which it was T_8 followed by T_6. Overall, significant enhancement over control was noticed for almost all the parameters after all sorts of treatment, exception could be noticed for ascorbic acid and total sugar content. Significantly least amount of those parameters were 4.56 %, 9.30º Brix, 0.16 mg 100 g^{-1}, 3.12 mg 100 g^{-1}, 6.67% and 3.71% respectively, which were accompanied with control plot. It is important to note that no significant change could be regarded among the treatments excepting T_6 and T_4 for ascorbic acid, and excepting T_6, T_4 and T_5 for total sugar content. The progress in total dry matter up to harvest may be due to the influence of ingredients of seaweed extract *i.e.*, nitrogen and potassium as they are prime substances to enrich the onion bulb's dry content. SWE applied provenly increased the nutritional contents of onion as it preserves glycine, betaine, a component of SWE, may cause by improving phenolic compound synthesis (Karjalainen *et al.*, 2002), which has also a co-relation to TSS (Abdel-Mawgoud *et al.*, 2010). The present findings are in conformity with the results of Mikulewicz *et al*. (2019) and Abdul-Ameer and Almousawy (2019) in onion.

Economics

Table-4 brings out maximum net return of Rs. 2,01,608 ha^{-1} was recorded with the treatment of T_6 . The highest benefit cost ratio of 1.95:1 was also recorded with T_6. Hence, it may be recommended that the economic return and profitability of the crop can be enhanced by the application with seed treatment + seedling-root dipping with SWE 20% @ 2 ml l^{-1}.

Table 1: Influence of seaweed extract on growth parameters of onion cv. Sukhsagar (Pooled)

Treatments	Plant height (cm) Days after transplanting			Leaf length (cm) Days after transplanting			Leaf width (cm) Days after transplanting			Neck thickness (cm) Days after transplanting			No. of leaves plant^{-1} Days after transplanting		
	30	**60**	**90**	**30**	**60**	**90**	**30**	**60**	**90**	**30**	**60**	**90**	**30**	**60**	**90**
T_1	32.00	54.40	57.00	29.30	51.40	54.05	1.65	2.40	2.95	2.30	2.65	3.05	4.00	4.30	4.50
T_2	34.30	56.00	58.70	30.20	52.40	54.85	1.70	2.60	2.90	2.60	2.65	3.00	3.90	4.10	4.30
T_3	34.80	56.40	59.30	29.40	53.60	57.40	1.65	2.40	2.75	2.70	2.75	2.90	3.80	4.10	4.30
T_4	36.60	57.20	60.10	33.00	54.60	57.95	1.85	2.80	3.10	2.75	2.85	3.20	4.20	4.30	4.70
T_5	35.60	56.80	59.80	32.60	54.20	57.40	1.80	2.70	3.00	2.70	2.80	3.15	4.15	4.30	4.60
T_6	**38.70**	**60.90**	**63.40**	**36.40**	**58.70**	**61.70**	**2.50**	**3.20**	**3.35**	**2.80**	**3.35**	**3.55**	**4.50**	**5.00**	**5.80**
T_7	34.20	55.80	58.80	32.20	53.60	56.40	1.80	2.15	2.30	2.50	2.55	2.50	4.00	4.30	4.30
T_8	33.00	56.00	60.00	30.50	53.40	56.30	1.70	2.50	2.80	2.65	2.80	3.00	4.00	4.30	4.50
T_9	33.50	57.00	59.80	31.30	54.20	56.10	1.65	2.55	2.75	2.60	2.75	2.90	3.90	4.10	4.10
T_{10}	31.80	53.30	57.00	25.20	47.00	51.00	1.50	1.95	2.25	2.20	2.20	2.45	3.60	3.90	4.00
S. Em(±)	**0.70**	**0.69**	**0.39**	**1.01**	**0.55**	**0.59**	**0.08**	**0.07**	**0.05**	**0.17**	**0.07**	**0.04**	**0.08**	**0.06**	**0.11**
LSD (0.05)	**2.08**	**2.07**	**1.18**	**3.023**	**1.66**	**1.76**	**0.23**	**0.20**	**0.15**	**0.19**	**0.20**	**0.12**	**0.23**	**0.19**	**0.32**

Table 2: Influence of seaweed extract on yield parameters of onion cv. Sukhsagar (Pooled)

Treatments	Equatorial diameter of bulb (cm)	Bulb weight plant^{-1} (g)	Bulb yield (kg plot^{-1})	Projected bulb yield (t ha^{-1})
T_1	4.50	58.55	3.13	14.63
T_2	4.75	48.47	2.75	13.29
T_3	4.51	61.43	3.20	14.87
T_4	4.92	70.08	3.60	15.90
T_5	4.79	59.83	3.33	15.40
T_6	**5.35**	**73.71**	**4.18**	**16.93**
T_7	4.79	59.27	3.10	14.52
T_8	4.48	57.05	3.28	15.16
T_9	4.48	51.89	2.20	11.34
T_{10}	4.18	41.68	1.85	10.09
S. Em (±)	**0.08**	**1.85**	**0.12**	**0.19**
LSD (0.05)	**0.25**	**5.55**	**0.36**	**0.56**

(T_1 - seed treatment with SWE 20% @ 1 ml l^{-1}, T_2 - seed treatment with SWE 20% @ 1.5 ml l^{-1}, T_3 - seed treatment with SWE 20% @ 2 ml l^{-1}, T_4 -seed treatment + seedling-root dipping with SWE 20% @ 1 ml l^{-1} , T_5 - seed treatment + seedling-root dipping with SWE 20% @ 1.5 ml l^{-1} , T_6 - seed treatment + seedling-root dipping with SWE 20% @ 2 ml l^{-1}, T_7 – only seedling-root dipping with SWE 20% @ 1 ml l^{-1}, T_8 –only seedling- root dipping with SWE 20% @ 1.5 ml l^{-1}, T_9 - only seedling-root dipping with SWE 20% @ 2 ml l^{-1} and T_{10} - control (seed and seedling-root dipping in distilled water).

Table 3: Influence of seaweed extract on quality parameters of onion cv. Sukhsagar (Pooled)

Treatments	Dry matter content (%)	TSS (ºBrix)	Titratable acidity (mg 100 g^{-1})	Ascorbic acid (mg 100 g^{-1})	Total sugar (%)	Reducing sugar (%)
T_1	6.04	10.10	0.32	3.12	7.29	4.17
T_2	6.25	10.80	0.19	3.12	7.01	4.12
T_3	6.35	9.80	0.29	4.01	6.93	4.09
T_4	8.09	11.23	0.38	6.23	8.25	4.23
T_5	6.89	11.15	0.35	4.50	8.17	4.18
T_6	**8.52**	**11.63**	0.42	**8.01**	**12.70**	**4.54**
T_7	6.25	10.75	0.29	3.12	7.29	3.71
T_8	5.17	10.43	**0.48**	4.45	7.29	4.04
T_9	6.66	10.30	0.32	3.12	7.74	4.10
T_{10}	4.56	9.30	0.16	3.12	6.67	3.71
S. Em (±)	**0.29**	**0.18**	**0.01**	**0.46**	**0.31**	**0.06**
LSD (0.05)	**0.88**	**0.53**	**0.02**	**1.39**	**0.94**	**0.17**

Table 4: Influence of seaweed extract on benefit cost ratio of onion

Treatments	Bulb yield (t ha^{-1})	Gross return (Rs ha^{-1})	Cost of production (Rs ha^{-1})	Net return (Rs ha^{-1})	B:C ratio
T_1	14.63	2,63,340	1,00,432	1,62,908	1.62:1
T_2	13.29	2,39,220	1,00,882	1,38,338	1.37:1
T_3	14.87	2,67,660	1,01,332	1,66,268	1.64:1
T_4	15.90	2,86,200	1,01,332	1,84,868	1.82:1
T_5	15.40	2,77,200	1,02,232	1,74,968	1.71:1
T_6	**16.93**	**3,04,740**	**1,03,132**	**2,01,608**	**1.95:1**
T_7	14.52	2,61,360	1,00,432	1,60,928	1.60:1
T_8	15.16	2,72,880	1,00,882	1,71,398	1.69:1
T_9	11.34	2,04,120	1,01,332	1,02,778	1.01:1
T_{10}	10.09	1,81,620	99,532	82,088	0.82:1

Notes: (Rate of inputs like FYM @ Rs. 7000 t^{-1}, VC @ Rs. 7000 t^{-1}, onion seed @ Rs 2000 kg^{-1}, labor wages @ Rs. 328 $m.u^{-1}$, total cost of irrigation, intercultural operation and plant protection measures Rs. 28,472, cost of total seaweed application @ Rs. 16,200 and total cost of harvesting Rs. 4920, onion bulbs were sold in market @ Rs. 18 kg^{-1}.)

CONCLUSION

Considering the above experiment, it may be concluded that yield of onion crop can be enhanced by onion seed treatment + seedling root dipping with SWE (20%) @ 2 ml l^{-1}. Nonetheless, the study could be conducted for a minimum of two to three years in order to validate these results.

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