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ASSESSMENT OF SEAWEED EXTRACTS AND LEVELS OF RDF ON QUALITY TRAITS OF TOMATO (*SOLANUM LYCOPERSICUM* L.) VAR. SAAHO.

Lalita Lal[1*], Vijay Bahadur[1] and Ram Bharose[2]
[1]Department of Horticulture, Naini Agricultural Institute, SHUATS, Prayagraj-211007, India
[2]Department of Soil Science and Agricultural Chemistry, Naini Agricultural Institute
SHUATS, Prayagraj-211007, India
*Corresponding author E-mail: lalitalal127@gmail.com
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ABSTRACT

The current study was carried out in the Rabi seasons of 2023–24 and 2024–25 at the Horticultural Research Farm, within the Department of Horticulture at Naini Agricultural Institute, Sam Higginbottom University of Agriculture, Technology and Sciences (SHUATS), located in Prayagraj, Uttar Pradesh. The experiment aimed to assess the influence of foliar application of seaweed-based biostimulants (*Kappaphycus* and *Sargassum*) at different concentrations in combination with recommended fertilizer levels on growth, yield, quality, and economics of tomato cultivation. The experiment was laid out in a Randomized Block Design (RBD) with 15 treatments replicated thrice. The treatment combinations included varying levels of RDF (50% and 100%) with foliar sprays of K SAP and S SAP at 2%, 4%, and 6% concentrations, along with controls. Observations were recorded on quality traits such as total soluble solids, lycopene content, chlorophyll content, ascorbic acid content, and shelf life were also evaluated. Among all treatments, T_{14} (100% RDF + 6% S SAP) showed the most promising results, recording the superior quality traits, longest shelf life. The study concludes that integrating seaweed extracts, particularly *Sargassum*-based formulations, with 100% RDF significantly improves tomato quality under Rabi conditions.
Keywords **:** RDF, Seaweed, Quality, Lycopene.

Introduction

Tomato (*Solanum lycopersicum* L.) is one of the most significant horticultural crops having diploid chromosome number of 2n=2x=24 (Fedorov, 1969), with a global production exceeding 138 million metric tonnes. Taxonomically, it belongs to the Solanaceae family, with *Solanum pimpinellifolium* recognized as its closest wild relative (Preedy and Watson, 2008), Tomato is a globally significant vegetable, ranking second in both production and consumption. In the United States, it is the second most consumed fresh vegetable, with an annual per capita intake of 6–7 kg (FAOSTAT, 2020). Tomatoes are renowned for their rich nutritional profile, offering an abundant source of essential vitamins, minerals, and bioactive compounds. They offer substantial quantities of vitamin C, pro-vitamin A, β-carotene, and folate, in addition to essential minerals like potassium. Additionally, they are rich in secondary metabolites, including lycopene, flavonoids, phytosterols, and polyphenols, which contribute to their health-promoting properties (Luthria *et al.,* 2006). India is home to approximately 700 species of marine algae, thriving in both intertidal and deep-water regions along its vast coastline. Of these, nearly 60 species hold significant commercial value. The main states known for seaweed production are Tamil Nadu, Gujarat, Maharashtra, Goa, Lakshadweep, Andhra Pradesh, and Karnataka. Additionally, the Andaman and Nicobar Islands, as well as parts of West Bengal and Odisha, also contribute to seaweed production (Tandel *et al.,* 2016). However, despite this rich diversity, only a limited number of species are currently utilized in agricultural practices. This underutilization highlights the need for greater exploration of seaweed-based biofertilizers and bio stimulants to enhance sustainable crop production.

Various formulations of seaweed, including Liquid Seaweed Fertilizer (LSF), granular, and powdered forms, are widely available in the market. Algal manure, either in its whole form or finely chopped powder, has demonstrated beneficial effects on cereals, pulses, and numerous flowering plants. Recently, liquid extracts obtained from seaweeds have become increasingly popular as foliar sprays for various crops, such as grasses, cereals, flowers, and vegetables. Foliar application of seaweed extract increases plant growth and significantly enhances yield in cereals, vegetables, fruit crops, and other horticultural species (Elansary *et al.,* 2016). This practice has become increasingly common in commercial agriculture due to its proven efficacy in boosting crop productivity (Khan *et al.,* 2009). *Sargassum wightii*, a brown seaweed, is recognized for its substantial nutrient composition, making it a valuable biofertilizer in agriculture. It contains 174.02 mg/g of nitrogen, 45.56 mg/g of phosphorus, and 72.83 mg/g of potassium, 17.13 mg/g of magnesium, 3.016 µg of copper and traces of auxin plant growth regulator (Divya *et al.,* 2015). This rich nutrient profile enhances soil fertility and promotes plant growth. When applied as a biofertilizer, *S. wightii* improves root development, boosts crop yield, and strengthens resistance against abiotic stress. Its organic nature makes it an eco-friendly alternative to synthetic fertilizers, offering a sustainable solution for enhancing agricultural productivity. *Kappaphycus alvarezi i*, a red seaweed, is highly valued for its rich mineral composition, making it a potential biofertilizer for enhancing soil fertility and crop productivity. It contains 5.47 mg/100 g of iron (Fe), 5.09 mg/100 g of zinc (Zn), and trace amounts of copper (Cu) (<0.55 mg/100 g). Additionally, it is a significant source of magnesium (639 mg/100 g), potassium (3877 mg/100 g), and sodium (3944 mg/100 g), making it effective in promoting plant growth and strengthening resistance against abiotic stress. Its nutrient profile also contains Indole acetic acid (23.36 mg), Gibberellin GA_3(127.87 mg) making it a sustainable alternative to synthetic fertilizers, contributing to eco-friendly agricultural practices (Dogra and Rakesh, 2012). Adding the suggested amount of fertilizer (RDF) with seaweed extracts derived from *Kappaphycus alvarezii* (K sap) and *Gracilaria edulis* (G sap) at a concentration of 10% notably improved the growth and yield of potatoes (Prajapati *et al.* 2016). The combined application of 10% G sap + RDF resulted in the highest tuber yield of 32.88 t/ha, followed closely by 10% K sap + RDF, which produced 31.30 t/ha. Both treatments outperformed the control, demonstrating the efficacy of seaweed extracts in boosting potato productivity.

Material and Methods

The current study was carried out at the Horticultural Research Farm within the Department of Horticulture at Naini Agricultural Institute, part of Sam Higginbottom University of Agriculture, Technology and Sciences (SHUATS), located in Prayagraj, Uttar Pradesh, during the Rabi seasons of 2023-24 and 2024-25. The distinguished university is strategically situated approximately 5 kilometres from Prayagraj City, along the Prayagraj–Rewa National Highway, offering convenient accessibility. In the present investigation the design used for analysis of variables was Randomized Block Design (RBD) comprising 3 replications comprising of foliar application of micronutrients total treatment combinations being fifteen. The treatments comprised T_0 (Control); T_1 (50 % RDF + Water Spray); T_2 (100 % RDF + Water Spray); T_3 (50% RDF + 2% K SAP); T_4 (50% RDF + 4% K SAP); T_5 (50% RDF + 6% K SAP); T_6 (50% RDF + 2% S SAP); T_7 (50% RDF + 4% S SAP); T_8 (50% RDF + 6% S SAP); T_9 (100% RDF + 2% K SAP); T_{10} (100% RDF + 4% K SAP); T_{11} (100% RDF + 6% K SAP); T_{12} (100% RDF + 2% S SAP); T_{13} (100% RDF + 4% S SAP) and T_{14} (100% RDF + 6% S SAP). Characters like TSS (°Brix), Total chlorophyll content (mg/100g fresh weight), Ascorbic acid (mg/100 gm), Lycopene content (mg/100gm), Acidity and Shelf life (days) for quality parameters. Analysis of Variance was worked out using Fisher and Yates (1967).

Results and Discussion

Total soluble solids and Chlorophyll content

Among the treatments evaluated, T_{14} (100% RDF + 6% S SAP) demonstrated the highest total soluble solids [Table 1], recording 5.38°Brix in 2023–24, 5.20°Brix in 2024–25, and an average of 5.29°Brix. T_{11} (100% RDF + 6% K SAP) followed closely, yielding 5.11, 5.16 and 5.13°Brix during the same periods. Conversely, the control treatment (T_0) exhibited the lowest yields, with figures of 3.00°Brix, 3.00°Brix, and an average of 3.00°Brix. Among the treatments evaluated, T_{14} (100% RDF + 6% S SAP) demonstrated the highest chlorophyll content [Table 1] in fruits, recording 2.26mg in 2023–24, 5.20mg in 2024–25, and an average of 4.70mg. T_{11} (100% RDF + 6% K SAP) followed closely, yielding 1.88, 4.14 and 3.01mg during the same periods. Conversely, the control treatment (T_0) exhibited the lowest yields, with figures of 1.20mg, 1.80mg, and an average of 1.50mg. An analysis of the interaction effect over the two years revealed a relatively low magnitude, indicating minimal variation in treatment responses from year to

year. This limited interaction effect suggests that the performance rankings of the treatments were largely consistent across both seasons, leading to the conclusion that the interaction effect is statistically non-significant and practically negligible, thereby reinforcing the reliability and stability of the pooled analysis results.

The highest total soluble solids (TSS) in T_{14} (100% RDF + 6% S SAP) can be attributed to the presence of bioactive compounds in S SAP, such as cytokinins and amino acids, which enhance sugar accumulation, enzymatic activity, and nutrient uptake. This combination improves photosynthesis efficiency and assimilate translocation to developing fruits, resulting in elevated sugar concentration. When coupled with RDF, it ensures a balanced supply of nutrients, further boosting metabolic activity and fruit quality. T_{11} (100% RDF + 6% K SAP) also recorded high TSS due to potassium's vital role in carbohydrate metabolism and sugar transport. Both treatments outperformed others by improving physiological and biochemical processes, confirming the efficacy of integrating seaweed extracts with RDF in enhancing TSS and overall fruit quality in tomato. Kalariya *et al.* (2018) in okra demonstrated the enhancement of quality parameters like TSS, ascorbic acid content in fruits using a seaweed extracts along with RDF.

Ascorbic acid content and Lycopene content

Among the treatments evaluated, T_{14} (100% RDF + 6% S SAP) demonstrated the highest ascorbic acid content in fruits, recording 15.76mg in 2023–24, 15.82mg in 2024–25, and an average of 15.79mg. T_{11} (100% RDF + 6% K SAP) followed closely, yielding 14.32, 14.86 and 14.59mg during the same periods. Conversely, the control treatment (T_0) exhibited the lowest yields, with figures of 8.83mg, 9.76mg, and an average of 9.29mg [Table 1]. An analysis of the interaction effect over the two years revealed a relatively low magnitude, indicating minimal variation in treatment responses from year to year. This limited interaction effect suggests that the performance rankings of the treatments were largely consistent across both seasons, leading to the conclusion that the interaction effect is statistically non-significant and practically negligible, thereby reinforcing the reliability and stability of the pooled analysis results.

Among the treatments evaluated, T_{14} (100% RDF + 6% S SAP) demonstrated the highest lycopene content [Table 2] in fruits, recording 3.17mg in 2023–24, 3.48mg in 2024–25, and an average of 3.32mg. T_{11} (100% RDF + 6% K SAP) followed closely, yielding 3.00, 3.25 and 3.13mg during the same periods. Conversely, the control treatment (T_0) exhibited the lowest yields, with figures of 1.80mg, 1.55mg, and an average of 1.68mg. An analysis of the interaction effect over the two years revealed a relatively low magnitude, indicating minimal variation in treatment responses from year to year. This limited interaction effect suggests that the performance rankings of the treatments were largely consistent across both seasons, leading to the conclusion that the interaction effect is statistically non-significant and practically negligible, thereby reinforcing the reliability and stability of the pooled analysis results.

The highest lycopene content in tomato fruits under T_{14} (100% RDF + 6% S SAP) is due to the presence of bioactive compounds like cytokinins, gibberellins, and micronutrients in S SAP, which enhance carotenoid biosynthesis and delay senescence, allowing more time for lycopene accumulation. The synergistic effect with RDF ensures optimal nutrient availability, boosting photosynthesis and metabolic activity, thereby promoting pigment formation. T_{11} (100% RDF + 6% K SAP) followed, as potassium plays a key role in enzyme activation and assimilate transport, both crucial for lycopene synthesis. These treatments outperformed others by improving fruit ripening and biochemical pathways involved in pigment formation, indicating that the integration of seaweed extracts with RDF significantly enhances the nutritional and functional quality of tomatoes through increased lycopene concentration. Similar findings were concluded by Prajapati *et al.* (2016) and Layak *et al.* (2020) in tomato.

Acidity and Shelf life

Among the treatments evaluated, T_{14} (100% RDF + 6% S SAP) demonstrated the highest lycopene content in fruits [Table 2], recording 3.17mg in 2023–24, 3.48mg in 2024–25, and an average of 3.32mg. T_{11} (100% RDF + 6% K SAP) followed closely, yielding 3.00, 3.25 and 3.13mg during the same periods. Conversely, the control treatment (T_0) exhibited the lowest yields, with figures of 1.80mg, 1.55mg, and an average of 1.68mg. An analysis of the interaction effect over the two years revealed a relatively low magnitude, indicating minimal variation in treatment responses from year to year. This limited interaction effect suggests that the performance rankings of the treatments were largely consistent across both seasons, leading to the conclusion that the interaction effect is statistically non-significant and practically negligible, thereby reinforcing the reliability and stability of the pooled analysis results.

The highest lycopene content in tomato fruits under T_{14} (100% RDF + 6% S SAP) is due to the presence of bioactive compounds like cytokinins, gibberellins, and micronutrients in S SAP, which enhance carotenoid biosynthesis and delay senescence, allowing more time for lycopene accumulation. The synergistic effect with RDF ensures optimal nutrient availability, boosting photosynthesis and metabolic activity, thereby promoting pigment formation. T_{11} (100% RDF + 6% K SAP) followed, as potassium plays a key role in enzyme activation and assimilate transport, both crucial for lycopene synthesis. These treatments outperformed others by improving fruit ripening and biochemical pathways involved in pigment formation, indicating that the integration of seaweed extracts with RDF significantly enhances the nutritional and functional quality of tomatoes through increased lycopene concentration. Similar findings were concluded by Prajapati *et al.* (2016) and Layak *et al.* (2020) in tomato.

Among the treatments evaluated, T_{14} (100% RDF + 6% S SAP) demonstrated the highest shelf life in fruits [Table 3], recording 18.33days in 2023–24, 18.00days in 2024–25, and an average of 18.17days. T_{11} (100% RDF + 6% K SAP) followed closely, yielding 17.00, 17.00 and 17.00days during the same periods. Conversely, the control treatment (T_0) exhibited the lowest yields, with figures of 9.33days, 9.67days, and an average of 9.50days. An analysis of the interaction effect over the two years revealed a relatively low magnitude, indicating minimal variation in treatment responses from year to year. This limited interaction effect suggests that the performance rankings of the treatments were largely consistent across both seasons, leading to the conclusion that the interaction effect is statistically non-significant and practically negligible, thereby reinforcing the reliability and stability of the pooled analysis results.

The enhanced longevity of tomato fruits in T_{14} (100% RDF + 6% S SAP) can be ascribed to the bioactive components present in S SAP, including antioxidants, cytokinins, and micronutrients, which collectively inhibit senescence, lower respiration rates, and fortify cell walls essential elements in prolonging post-harvest viability. When combined with RDF, this treatment improves nutrient absorption and physiological equilibrium, thereby promoting better structural integrity and minimizing spoilage. Similarly, T_{11} (100% RDF + 6% K SAP) demonstrated an increased shelf life, attributed to potassium's crucial function in sustaining osmotic balance and enzyme activity, which aids in delaying ripening and mitigating degradation. Both treatments outperformed others by enhancing fruit firmness and metabolic stability, underscoring the efficacy of integrating seaweed extracts with RDF to enhance the storage potential and marketability of tomato fruits. Selvakumari *et al.* (2013) came up with similar findings in tomato.

Conclusions

The present study demonstrated that the integration of seaweed-based biostimulants with 100% Recommended Dose of Fertilizers (RDF) significantly enhanced quality, shelf life of tomato cultivation. Among the 15 treatments evaluated, T_{14} (100% RDF + 6% S SAP) consistently recorded the highest total soluble solids (5.29 °Brix), chlorophyll content (4.70 mg), ascorbic acid (15.79 mg), lycopene content (3.32 mg), and shelf life (18.17 days). T_{11} (100% RDF + 6% K SAP) closely followed across all parameters. The superior performance of T_{14} can be attributed to the synergistic effects of bioactive compounds in sulphur-based seaweed extract (S SAP), including cytokinins, auxins, gibberellins, amino acids, and micronutrients that enhanced nutrient uptake, delayed senescence, and improved physiological and biochemical functions. From a quality perspective, these treatments also significantly enhanced TSS, lycopene, and ascorbic acid content, key markers of nutritional value. Furthermore, they extended fruit shelf life, thereby improving marketability.

Table 1: Assessment on effect of Seaweed Extracts and levels of RDF for TSS, chlorophyll content and ascorbic acid of tomato.

Treatment Details		Total soluble solids (°Brix)			Chlorophyll content (mg)			Ascorbic acid content (mg)		
		2023-24	2024-25	Pooled Mean	2023-24	2024-25	Pooled Mean	2023-24	2024-25	Pooled Mean
T_0	Control	3.00	3.00	3.00	1.20	1.80	1.50	8.83	9.76	9.29
T_1	50 % RDF + Water Spray	3.76	4.00	3.88	1.51	2.51	2.01	10.50	11.24	10.87
T_2	100 % RDF + Water Spray	4.20	3.46	3.83	1.60	3.16	2.38	11.98	12.69	12.33
T_3	50% RDF + 2% K SAP	3.69	3.46	3.57	1.44	3.35	2.39	12.65	12.49	12.57
T_4	50% RDF + 4% K SAP	3.93	4.12	4.02	1.50	2.89	2.19	11.98	11.64	11.81
T_5	50% RDF + 6% K SAP	3.38	4.37	3.88	1.29	3.18	2.23	12.75	12.94	12.85
T_6	50% RDF + 2% S SAP	3.58	4.76	4.17	1.30	2.96	2.13	11.67	11.70	11.68
T_7	50% RDF + 4% S SAP	3.94	4.85	4.40	1.29	3.00	2.14	11.11	10.59	10.85

T_8	50% RDF + 6% S SAP	4.02	4.92	4.47	1.45	3.00	2.22	10.89	10.93	10.91
T_9	100% RDF + 2% K SAP	4.33	4.66	4.49	1.30	3.42	2.36	12.98	13.29	13.14
T_{10}	100% RDF + 4% K SAP	4.40	5.08	4.74	1.51	3.46	2.49	13.79	14.21	14.00
T_{11}	100% RDF + 6% K SAP	5.11	5.16	5.13	1.88	4.14	3.01	14.32	14.86	14.59
T_{12}	100% RDF + 2% S SAP	4.29	4.56	4.42	1.36	3.35	2.35	13.87	13.68	13.77
T_{13}	100% RDF + 4% S SAP	4.36	4.78	4.57	1.52	3.68	2.60	13.08	12.72	12.90
T_{14}	100% RDF + 6% S SAP	5.38	5.20	5.29	2.26	4.70	3.48	15.76	15.82	15.79
SE. m (±)		**0.21**	**0.20**	**0.15**	**0.08**	**0.20**	**0.10**	**0.20**	**0.26**	**0.18**
$CD_{0.05}$		**0.62**	**0.59**	**0.43**	**0.23**	**0.57**	**0.30**	**0.57**	**0.76**	**0.53**
CV.%		**9.04**	**7.96**	**6.01**	**9.20**	**10.48**	**7.65**	**2.76**	**3.63**	**2.52**

Table 2: Assessment on effect of Seaweed Extracts and levels of RDF for Lycopene content(mg), Acidity, and Shelf life of tomato.

Treatment Details		Lycopene content (mg)			Acidity (%)			Shelf life at 32 °C (days)		
		2023-24	2024-25	Pooled Mean	2023-24	2024-25	Pooled Mean	2023-24	2024-25	Pooled Mean
T_0	Control	1.80	1.55	1.68	0.21	0.26	0.24	9.33	9.67	9.50
T_1	50 % RDF + Water Spray	2.23	2.22	2.22	0.36	0.36	0.36	10.67	12.33	11.50
T_2	100 % RDF + Water Spray	2.69	2.72	2.71	0.45	0.46	0.46	13.00	14.67	13.83
T_3	50% RDF + 2% K SAP	2.54	2.61	2.57	0.30	0.36	0.33	12.00	12.67	12.33
T_4	50% RDF + 4% K SAP	2.83	2.59	2.71	0.40	0.42	0.41	13.33	12.33	12.83
T_5	50% RDF + 6% K SAP	2.61	2.72	2.67	0.41	0.48	0.45	13.33	15.33	14.33
T_6	50% RDF + 2% S SAP	2.65	2.60	2.62	0.44	0.48	0.46	12.67	15.33	14.00
T_7	50% RDF + 4% S SAP	2.65	2.88	2.77	0.43	0.43	0.43	12.33	13.33	12.83
T_8	50% RDF + 6% S SAP	2.20	2.68	2.44	0.45	0.54	0.50	13.67	14.67	14.17
T_9	100% RDF + 2% K SAP	2.46	2.66	2.56	0.46	0.47	0.46	15.67	14.00	14.83
T_{10}	100% RDF + 4% K SAP	2.50	2.70	2.60	0.40	0.47	0.44	15.00	12.33	13.67
T_{11}	100% RDF + 6% K SAP	3.00	3.25	3.13	0.58	0.65	0.61	17.00	17.00	17.00
T_{12}	100% RDF + 2% S SAP	2.76	2.69	2.73	0.49	0.56	0.53	15.00	12.00	13.50
T_{13}	100% RDF + 4% S SAP	4.35	4.50	4.42	0.51	0.58	0.55	14.00	10.67	12.33
T_{14}	100% RDF + 6% S SAP	3.17	3.48	3.32	0.55	0.68	0.62	18.33	18.00	18.17
SE. m (±)		**0.09**	**0.16**	**0.10**	**0.02**	**0.02**	**0.02**	**0.73**	**1.22**	**0.73**
$CD_{0.05}$		**0.25**	**0.46**	**0.30**	**0.06**	**0.06**	**0.05**	**2.11**	**3.52**	**2.11**
CV.%		**5.51**	**9.95**	**6.60**	**7.83**	**8.05**	**6.00**	**9.19**	**15.45**	**9.26**

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Conflict of interest

The authors declare that they have no conflict of interest.

References

Divya K., Mary, R. N. and Padal, S. B. (2015). Effect of seaweed liquid fertilizer of *Sargassum wightii* on germination, growth and productivity of brinjal. *International Journal of Advance Research in Sciences, Engineering and Technology,* **2**(10), 868– 871.

Dogra, B. S. and Rakesh, K. M. (2012). Effect of seaweed extract on growth and yield of onion. *International Journal of Farm Science,* **2**(1), 59-64.

Elansary, H. O., Skalicka-Wozniak, K. and King, I. W. (2016). Enhancing stress growth traits as well as phytochemical and antioxidant contents of Spiraea and Pittosporum under seaweed extract treatments. *Plant Physiology and Biochemistry,* **105**, 310–320

FAOSTAT (2017). Food and Agricultural Organization statistical accords. FAOStat, core production (2016). Available online: http://faostat.fao.org/site/340/default.aspx

FAOSTAT (2020). www.fao.org/faostat/en/data/CC. Food Supply- Horticultural Crops Primary Equivalent.*Visited on 15/03/2025.*

Fedorov, A. A. (1969). Chromosome Number of Flowering Plants. *Academy of Sciences of USSR. Moscow.* 926 pp.

Fisher, R.A. and Yates, F. (1967). "The Design of Experiments: Statistical Principles for Practical Applications." New York: Hafner Publishing Company.

Kalariya, V. D., Bhanderi, D. R., Patel, N. K., & Vaghashiya, J. M. (2018). Effect of foliar application of micronutrients, novel organic liquid fertilizer, and seaweed extract on yield of okra (*Abelmoschus esculentus* L. Moench). *International Journal of Chemical Studies*, **6**(3), 1834-1836.

Khan, W., Rayirath, U.P., Subramanian, S., Jithesh, M.N., Rayorath, P., Hodges, D.M., Critchley, A.T., Raigie, J.S., Norrie, J., Prithiviraj, B (2009). Seaweed extracts as bio-

stimulants of plant growth and development. *Journal of Plant Growth Regulators*, **28**(4), 386-399.

Kharbyngar, B., & Singh, D. (2019). Influence of seaweed extract, organic, and inorganic fertilizers on growth and yield of cauliflower (*Brassica oleracea* var. *botrytis*) cv. Pant Sugra. *Journal of Pharmacognosy and Phytochemistry*, **8**(4), 2088-2090.

Layak, J., Das, A., Ghosh, A., Marak, M. R., Krishnappa, R., Ramkrushna, G. I., Panwar, A. S., & Devi, S. (2020). Evaluation of seaweed saps on performance of tomato (*Lycopersicon esculentum*) under organic production system. *Innovative Farming*, **3**(4), 185-191.

Luthria, D. L., Sudarsan, M., Krizek and D. T. (2006). Content of total phenolics and phenolic acids in tomato (*Lycopersicon esculentum* Mill.) fruits as influenced by cultivar and solar UV radiation. *Journal of Food Composition and Analysis,* **19**, 232.

Prajapati, A., Patel, C. K., Singh, N., Jain, S. K., Chongtham, S. K., Maheshwari, M. N., Patel, C. R. and Patel, R. N. (2016). Evaluation of seaweed extract on growth and yield of potato. *Environment & Ecology,* **34**(2), 605-608.

Preedy, V. R., and Watson, R. R. (2008). Tomatoes and tomato products: Nutritional, medicinal and therapeutic properties. *Boca Raton: CRC Press*. pp-242-256.

Selvakumari, P., Venkatesan, K., Jeyakumar, P., & Pugalendhi, L. (2013). Response to seaweed extract on growth and yield of tomato (*Solanum lycopersicum* L.) hybrid COTH 2. *Madras Agricultural Journal,* **100**(1-3), 163-166.

Tandel, K. V., Joshi, N. H., Tandel, G. M., Patel, M. R. and Tandel J. T. (2016). Seaweed Cultivation in India, a New Opportunity of Revenue Generation. *Advances in Life Sciences,* **5**(7), 2487-2491.