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IMPACT OF FOLIAR APPLICATION OF SEAWEED EXTRACT ON GROWTH AND YIELD ATTRIBUTES OF POTATO (*SOLANUM TUBEROSUM* L.)

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ABSTRACT

A field experiment was conducted during the *Rabi* season of 2024–25 at the Experimental Field of Horticulture, College of Agriculture, RVSKVV, Gwalior (M.P.) to evaluate the "Impact of foliar application of seaweed extract on growth and yield attributes of potato (*Solanum tuberosum* L.). The results revealed that the foliar application of T_4 (Seaweed extract @4ml/L at 25 & 45 DAP + 100% RDF) resulted in significant increase of growth parameters *viz.* plant height (27.00, 52.33 and 65.67 cm), number of branches per plant (5.57, 11.97 and 16.63), leaf area per plant (2169.33, 5176.00 and 6089.333 cm^2) and new leaf emergence (24.33, 29.37 and 17.77%) of potato at before 1st application of seaweed extract, before 2nd application of seaweed extract and 20 days after 2nd application of seaweed extract, respectively. Further, foliar application of T_4 (Seaweed extract @4ml/L at 25 & 45 DAP+ 100 %RDF) resulted in significant higher yield *i.e.*, Stover yield (118.17q), Tuber yield (296.97q) and Biological yield (408.67 q), Dry matter of tuber (19.57%), Marketable potatoes (97.43%) and quality of tuber in size wise gradation in <25g, 25-75g and >75g) (6%, 42% and 52%, respectively) per hectare of potato were recorded in treatment T_4 (Seaweed extract @4ml/L at 25 & 45 DAP+ 100% RDF) which was found to best statically at par with the treatment T_7 (Seaweed extract @ 4ml/L at 30 & 50 DAP+100% RDF) and T_3 (Seaweed extract @3ml/L at 25 & 45 DAP + 100% RDF) at after harvest. Thus, application of foliar application of T_4 (Seaweed extract @ 4ml/L at 25 & 45 DAP + 100% RDF) outperformed the other foliar application of seaweed extract treatments and may be recommended for economical potato production.

Key words : Concentration, Growth, Potato, Seaweed extract, Yield attributes.

Introduction

Potato (*Solanum tuberosum* L.) popularly known as "King of Vegetables" is one of the main vegetable crops grown worldwide, which has also been considered as the poor man's friend. It is native of South America and introduced in India in 16th Century by Portuguese. In world scenario, potato is grown on an area of 19.30 mha^{-1} with production and productivity of 388.19 m tones and 20.11 t ha^{-1} respectively. In India, it is grown on an area of 1.84 million ha with production of 50.33 million tones and productivity of 27.31 t ha^{-1} (Anonymous, 2022-23). In India, Uttar Pradesh is the major potato producing State with 31.26% of production share, followed by West Bengal, Bihar, Gujarat and Madhya Pradesh with 23.29%, 13.22%, 7.43% and 6.20% share, respectively. However, with respect to Madhya Pradesh, potato is grown on an area of 0.61 million ha with production and productivity of 13.9 million tones and 22.7 t/ha (Anonymous, 2022-23).

Potato is major staple food crop after rice, wheat and maize and is rich source ofprotein,12 essential vitamins such as (vitamin C, thiamine and folic acid), minerals and superior dietary fiber, 20.6% carbohydrate, 2.1% protein, 0.3% fat, 1.1% crude fiber, 0.9% ash and a good amount

of essential amino acids like leucine, tryptophane and isoleucine etc. It is an excellent source of carbohydrates with low fat contents, which makes it a balance food.

Seaweed extracts exhibit growth motivating property on crop plants. Hence its formulation can be used as a bio-stimulant in agriculture. Biostimulant is defined as a 'material' other than fertilizer that promotes the growth and yield attribute property of the plants when applied in a small quantity during a crop cycle. The bio-stimulant present in seaweed extract increase the vegetative growth (10%), the leaf chlorophyll content (11%), the stomata density (6.5%), photosynthetic rate and the fruit production (27%) of the plant (Spinelli *et al*., 2010). Seaweed liquid fertilizer has been shown in the recent past to possess great potential as an organic bio- stimulant and this potential still remains to be exploited in Indian agriculture (Sujatha and Vijaya lakshmi, 2013).

Seaweeds are rich source of growth promoting substances such as IAA, kinetin, zeatin and gibberellins, auxins and cytokinin's, macro and micro elements, amino acids, vitamins and beneficial results from their use in crop plants like early seed germination and establishment, improved crop performance and yield, elevated resistance to biotic and abiotic stress has been reported.). The use of seaweed extracts also recorded significant increases in the percentages of nitrogen, total soluble solids and protein content of potato tubers (Sarhan, 2011, Haider *et al*., 2012 and Ahmed *et al*., 2018).

Materials and Methods

A field experiment entitled "Impact of foliar application of seaweed extract on growth and yield attributes of potato (*Solanum tuberosum* L.)" was conducted during the Rabi season of 2024–25 at Research Farm, Department of Horticulture, College of Agriculture, Gwalior (Madhya Pradesh), under the administrative control of Rajmata Vijayaraje Scindia Krishi Vishwa Vidyalaya (RVSKVV), Gwalior. The experiment was laid out in randomized block design (RBD) involving seven treatments pattern with three replications. The different concentration of foliar application of seaweed extract along with RDF *viz*., T_1 (Control 100% RDF), T_2 (Seaweed extract @ 2ml/L at 25 & 45 DAP +100% RDF), T_3(Seaweed extract @ 3ml/L at 25 & 45 DAP +100% RDF), T_4 (Seaweed extract @ 4ml/L at 25 & 45 DAP +100% RDF), T_5 (Seaweed extract @ 2ml/L at 30 & 50 DAP+ 100% RDF), T_6 (Seaweed extract @ 3ml/L at 30 & 50 DAP + 100% RDF), T_7 (Seaweed extract @4ml/L at 30 & 50 DAP + 100% RDF), which was replicated thrice. The potato variety "Kufri Chipsona-1" was sown at a row-to- row spacing of 60 cm and plant-to-plant spacing of 20 cm. Seaweed extract was used as foliar application at different concentration as 2ml/L, 3ml/L and 4ml/L and at 25, 30, 45 and 50 days after planting. Prepared solutions of Seaweed extract was used as per requirement of treatment along with recommended dose of fertilizer in potato. For data collection, five healthy and uniform plants were randomly selected and tagged from the net plot area of each replication, excluding border rows to eliminate any edge effects. These tagged plants were used to record observations related to growth parameters such as Plant height (cm), Number of branches per plant, Inter-nodal distance (cm), Leaf area (cm^2) and new leaf emergence at before 1st application, before 2nd application, 20 days after 2nd application and yield parameters as dry matter (%), stover yield (q/ha), tuber yield (q/ha) and biological yield (q/ha). All data were statistically analyzed using appropriate methods to evaluate the significance of variations among the treatment-wise.

Results and Discussion

Growth parameters

A significant effect of foliar application of seaweed extract was observed on the growth parameters of potato. The data on the effect of foliar application of seaweed extract on the growth parameters *i.e.*, plant height (cm), number of branches per plant, leaf area per plant (cm^2) and new leaf emergence (%) were recorded at before and after foliar application is presented in Tables 1 and 2. The maximum values of growth parameters *i.e.*, plant height (27.00, 52.33 and 65.67 cm), number of branches per plant (5.57, 11.97 and 16.63), leaf area per plant (2169.33, 5176.00 and 6089.333 cm^2) and new leaf emergence (24.33, 29.37 and 17.77 %) of potato were recorded in treatment T_4 (Seaweed extract @4ml/L at 25 & 45 DAP+ 100% RDF), which was found to best statically at par with the treatment T_7 (Seaweed extract @ 4ml/L at 30 & 50 DAP+100% RDF) and T_3 (Seaweed extract @3ml/L at 25 & 45 DAP + 100 %RDF) at before 1st application of seaweed extract, before 2nd application of seaweed extract and 20 days after 2nd application of seaweed extract, respectively. This is due to better uptake and translocation of plant nutrients to growing plants. The maximum values of all the growth parameters in these treatments might be due to the more nutrient availability and nutrition to the crops which enhanced vegetative growth of potato which facilitated the crop to make optimum use of available underground and above ground resources. The pre found effect of foliar application of seaweed extract on potato crop, (before 1st application of seaweed extract, before 2nd application of seaweed extract and 20 days after 2nd application of seaweed

Table 1 : Impact of foliar application of seaweed extract on crop growth parameters analysis.

Treat. Number	New leaf emergence			Plant height (cm)		
	Before 1st App.	Before 2nd App.	After 2nd App. 20 days	Before 1st App.	Before 2nd App.	After 2nd App. 20 days
T_1	17.10	20.13	12.27	21.87	41.67	55.33
T_2	20.93	23.00	15.13	24.83	46.00	61.67
T_3	22.00	26.03	16.27	25.97	49.67	63.67
T_4	24.33	29.37	17.77	27.00	52.33	65.67
T_5	19.47	21.97	14.87	23.57	44.67	59.67
T_6	21.67	24.07	15.67	25.17	47.67	62.33
T_7	23.30	27.77	17.30	26.07	50.67	64.33
SE(m)	**0.701**	**0.900**	**0.779**	**1.227**	**1.217**	**1.596**
CD(p-0.05)	**2.184**	**2.805**	**2.427**	**N/A**	**3.792**	**4.973**

Table 2 : Impact of foliar application of seaweed extract on crop growth and development.

Treat. Number	No. of branch			Leaf area (cm^2)		
	Before 1st App.	Before 2nd App.	After 2nd App. 20 days	Before 1st App.	Before 2nd App.	After 2nd App. 20 days
T_1	3.93	9.80	11.13	1556.67	4386.67	5283.333
T_2	4.70	12.03	14.70	1930.33	4867.00	5803.667
T_3	4.97	13.40	15.40	2100.67	5015.00	5948.333
T_4	5.57	11.97	16.63	2169.33	5176.00	6089.333
T_5	4.37	12.50	13.83	1803.67	4703.67	5570.333
T_6	4.87	12.97	15.07	2026.00	4949.33	5829.333
T_7	5.13	13.67	16.00	2141.67	5104.00	5990.667
SE(m)	**0.191**	**0.554**	**0.461**	**36.204**	**69.97**	**65.717**
CD(p-0.05)	**0.594**	**1.725**	**1.437**	**112.79**	**217.98**	**204.73**

extract, and at harvest) was observed on higher vegetative growth and increase in nutrient uptake Rathod *et al*. (2009), Thirumaran *et al.* (2009), Sridhar and Rengasamy (2010), Issa *et al.* (2019) and Garai *et al.* (2021).

Yield attributes

Stover yield (q), Tuber yield (q) and biological yield (q) per hectare

The yield was significantly influenced by the effect of foliar application of seaweed extract. The data on the effect of foliar application of seaweed extract on the Stover yield (q), Tuber yield (q) and biological yield (q) per hectare were recorded at harvest is presented in Table 3. The maximum Stover yield (118.17q), Tuber yield (296.97q) and biological yield (408.67 q) per hectare were recorded in treatment T_4 (Seaweed extract @4ml/L at 25 & 45 DAP + 100% RDF), which was found to be statistically at par with the treatment T_7 (Seaweed extract @4ml/L at 30 & 50 DAP+ 100% RDF) and T_4 (Seaweed extract @4ml/L at 25 & 45 DAP + 100% RDF). The minimum tuber yield per hectare of potato was recorded in treatment T_1 (Control 100% RDF). It may probably be due to the fact that more availability nutrients at crucial growth stages under this treatment ultimately improved all yield attributes besides increased rate of N, P, K and micro nutrients absorption cumulatively helped the crop plants to produce more surface area for high photosynthetic rate as well as maximum translocation of photosynthesis from source to sink, subsequently resulted in improvement of all yield attributes. Because of synergistic effect among the yield attributes, they benefited each other. These findings are in accordance with those of Rathore *et al.* (2009), Boghdady *et al*. (2016), Garai *et al.* (2021), Banjare *et al*. (2022) and Karak *et al.* (2023).

Dry matter content of tubers (%)

The perusal of data presented in Table 3, revealed that dry matter content of tubers (%) after harvesting of the crop registered non-significant variations through the foliar application of seaweed extract on potato crop. The maximum dry matter content of tubers (19.57%) was recorded in treatment T_4 (Seaweed extract @4ml/L at 25 & 45 DAP + 100% RDF) which was found to be

Table 3 : Impact of foliar application of seaweed extract on yield attributes at harvest.

Treat. Number	Dry matter (%)	Stover yield (Q/ha)	Tuber yield (Q/ha)	Biological Yield (Q/ha)
T_1	17.50	93.33	223.97	281.33
T_2	18.57	109.70	256.90	351.67
T_3	19.03	116.67	280.60	373.67
T_4	19.57	118.17	296.97	408.67
T_5	18.13	100.67	248.23	344.67
T_6	18.80	110.67	269.17	360.00
T_7	19.27	117.27	290.93	386.33
SE(m)	**0.268**	**0.527**	**1.014**	**4.869**
CD(p-0.05)	**0.834**	**1.642**	**3.158**	**15.165**

Table 4 : Impact of foliar application of seaweed extract on tuber quality.

Treat. no.	Marketable tuber (%)	Size wise gradation of tuber (Q/ha)		
		< 25 g	25-75 g	>75 g
T_1	91.97	10%	47%	42%
T_2	95.17	6%	43%	51%
T_3	96.07	6%	42%	52%
T_4	97.43	6%	42%	52%
T_5	94.73	6%	42%	52%
T_6	95.57	6%	41%	52%
T_7	96.40	7%	42%	51%
SE(m)	**0.554**	**0.527**	**3.273**	**2.751**
CD(p-0.05)	**1.724**	**1.642**	**10.196**	**8.570**

statistically at par with the treatment T_7 (Seaweed extract @4ml/L at 30 & 50 DAP + 100% RDF) and T_4 (Seaweed extract @3ml/L at 25 & 45 DAP + 100% RDF). The minimum dry matter content of potato was recorded in treatment T_1 (Control 100% RDF). The increase in total dry matter accumulation plant^{-1} may be due to profound effect of seaweed extract which supply all types of nutrients, result into higher vegetative growth, increase in better uptake and translocation of plant nutrients in growing plants. These results were conformity with Jothinayagi and Anbazhagan (2009), Sivasangari Ramya *et al.* (2010) and Sujatha and Vijayalakshmi (2013).

Marketable potatoes (%) and quality of tuber (size wise gradation)

The perusal of data presented in Table 4, revealed Marketable potatoes (%) and quality of tuber (size wise gradation in <25g, 25-75g and >75g) after harvesting of the crop registered non-significant variations through the foliar application of seaweed extract on potato crop. The maximum Marketable potatoes (97.43%) and quality of tuber (g) (6%, 42% and 52%, respectively) were recorded in treatment T_4 (Seaweed extract @4ml/L at 25 & 45 DAP + 100% RDF), which was found to be statistically at par with the treatment T_7 (Seaweed extract @3ml/L at 30 & 50 DAP+ 100% RDF) and T_4 (Seaweed extract @4ml/L at 25 & 45 DAP + 100% RDF). The minimum dry matter content of potato was recorded in treatment T_1 (Control 100% RDF). These findings are in accordance with those of Garai *et al.* (2021) Banjare *et al.* (2022) and Karak *et al.* (2023).

Conclusion

Seaweed products are popularly used by farmers of vegetables. In the present study, foliar application of seaweed extract has found effective in improving overall vegetative growth of crop like plant height, number of branches, leaf area and new leaf emergence. These growth parameters had resulted into better stover yield, tuber yield and biological yield. Use of foliar applications of seaweed extract has also resulted in formation of bigger size potatoes (>75 g) in all treatments. Results of the present study indicated that 4 ml/l application of seaweed extract twice at 25 DAP and 45 DAP have found to be best. If we delay the application (30 DAP and 50 DAP) of the product overall productivity is best at the dose of 4 ml per liter of Seaweed extract. These are first season results; further studies would be required to confirm the observations.

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