International Journal of Environment and Climate Change

Volume 13, Issue 11, Page 2010-2014, 2023; Article no.IJECC.107838
ISSN: 2581-8627
(Past name: British Journal of Environment & Climate Change, Past ISSN: 2231–4784)

Seaweed Extract's Effect on Carrot (*Daucus carota*. L) Growth. Super Kuroda

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Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

Article Information

DOI: 10.9734/IJECC/2023/v13i113359

Open Peer Review History:
This journal follows the Advanced Open Peer Review policy. Identity of the Reviewers, Editor(s) and additional Reviewers, peer review comments, different versions of the manuscript, comments of the editors, etc are available here: https://www.sdiarticle5.com/review-history/107838

Original Research Article

Received: 03/08/2023
Accepted: 11/10/2023
Published: 01/11/2023

ABSTRACT

A field experiment was conducted during *rabi* 2022 on carrot variety 'Super kuroda' in sandy loam soil at Horticultural Garden, Professor Jaya Shankar Telangana State Agriculture University, Rajendranagar, Hyderabad. To study the effect of seaweed extract on the growth parameters of carrots. The experiment was laid out in randomized block design (RBD) with eight treatments and

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replicated thrice. The treatments include various sources of biostimulants *viz*., Seaweed extract liquid, seaweed granules, vermicompost and vermiwash given as foliar application on three stages *viz.,* first spray on 2-3 leaves stage and thereafter at every 20 days interval and as soil application twice at the time of sowing as well as 30 DAS.The various growth parameters were recorded. The results revealed that on application of RDF + soil application of seaweed extract twice at the time of sowing and at 30 DAS + foliar spray thrice 2.5 ml l^{-1} of water significantly increased the growth parameters *viz.,* plant height, number of leaves per plant, chlorophyll content.

Keywords: Carrot; seaweed extract; plant height; number of leaves per plant; chlorophyll content.

1. INTRODUCTION

Plant biostimulants, or agricultural biostimulants, are a diverse group of substances that can find application in farming to improve crop productivity and the crop's ability to withstand biotic and abiotic stress. These biostimulants are typically derived from organic sources and contain bio-active compounds. Common components found in biostimulants include mineral elements, humic substances (HSs), vitamins, amino acids, chitin, chitosan, poly- and oligosaccharides, and seaweed extract [1]. In recent trends, seaweed has gained popularity. Seaweed extracts are important in sustainable agriculture because of their composition as it contains phytohormones such as auxins, gibberellins, cytokinins, and betaines [2] and it also contains inorganic compounds like nitrogen, phosphorous, potassium, calcium, iron, magnesium, zinc, sodium and sulphur (Rayorath et al*.*, 2009). Hence, it plays a crucial role in sustainable agriculture due to its biodegradable, non-polluting and non-hazardous nature for both humans and animals, and does not harm the environment [3].

The carrot, scientifically known as *Daucus carota*, belongs to umbellifarae family. It is the most popular and widely consumed vegetable worldwide. They are known for remarkable nutritional benefits and have a very low-fat index, making them included in dietary practices. Carrot is abundant in essential nutrients, including vitamin A, vitamin C, dietary fibers, minerals like calcium, iron, and amino acids. It has anti-carcinogenic properties Zaini et al [4]. Keeping the above points in view, the experiment was planned to study the effect of seaweed extract on the growth parameters of carrots.

2. MATERIALS AND METHODS

The experiment was conducted during *rabi* season 2022 in sandy loam soils at Horticultural Garden, Professor Jayashankar Telangana State Agriculture University, Rajendra Nagar, Hyderabad. The experiment was laid out in randomized block design comprising ~~of~~ eight treatments and replicated thrice T_1 - RDF, T_2 - RDF+ soil application of seaweed extract twice at the time of sowing and at 30 DAS, T_3 - RDF+ foliar spray of seaweed extract thrice 2.5 ml l^{-1} of water, T_4 - RDF+ soil application of seaweed extract twice at the time of sowing and ~~at~~ 30 DAS + foliar spray thrice 2.5 ml l^{-1} of water, T_5 - RDF+ vermicompost 5 t ha^{-1}, T_6 - RDF+ foliar spray of water three times, T_7 - RDF+ foliar spray of 10% of vermiwash, T_8 - Soil application of seaweed extract twice at the time of sowing and ~~at~~ 30 DAS + foliar spray of seaweed extract thrice 2.5 ml l^{-1} of water. Super kuroda variety was sown on November 3rd 2022 with a spacing of 30 cm x 5 cm. The RDF used was 50: 40: 50 kg ha^{-1} N, P_2O_5 and K_2O respectively. For the treatment, commercially available seaweed liquid "Sagarika" and granules "Sagarika Gold" were used and ~~are~~ manufactured by IFFCO. Spraying was done through a knapsack sprayer using 500 liters of water per hectare. Biometric observations were taken on tagged five representative plants selected randomly from each treatment of the net plot, and the mean values were presented.

3. RESULTS AND DISCUSSION

3.1 Plant Height (cm)

All treatments had shown an impact on the plant height of the carrot, with gradual improvement observed as the days after sowing (DAS) increased. The effects of seaweed extract on carrot plant height at 30, 60, and ~~at~~ 90 DAS are summarized in Table 1.

At 30 DAS, no significant difference was noticed among the various treatments concerning the plant height. In contrast, a notable disparity in plant height was observed at 60 DAS. The highest plant height (18.43) was recorded with RDF + soil application of seaweed extract twice

at the time of sowing and 30 DAS + foliar spray thrice 2.5 ml l^{-1} of water. This treatment was statistically on par with RDF+ foliar spray of seaweed extract thrice 2.5 ml l^{-1} of water and RDF + soil application of seaweed extract at the time of sowing and at 30 DAS. The next most effective treatments *viz.,* RDF + foliar spray of 10% of vermiwash, RDF + vermicompost 5 t ha^{-1}, RDF alone and RDF + foliar spray of water three times. The lowest plant height (9.18) was soil application of seaweed extract twice at the time of sowing and 30 DAS + foliar spray thrice 2.5 ml l^{-1} of water.

Table 1. Impact of seaweed extract on plant height

Treatments	Plant height (cm)		
	30 DAS	60 DAS	90 DAS
T_1 - RDF	9.15	13.39	23.13
T_2 - RDF + soil application of seaweed extract at time of sowing and 30 DAS	9.39	17.70	24.55
T_3- RDF+ foliar spray of seaweed extract thrice 2.5 ml l^{-1} of water	9.35	17.77	24.63
T_4 - RDF + soil application of sea weed extract twice at time of sowing and 30 DAS + foliar spray thrice 2.5 ml l^{-1} of water	9.35	18.43	25.63
T_5 - RDF + vermicompost 5 t ha^{-1}	9.26	13.53	23.43
T_6 - RDF + foliar spray of water 3 times	9.10	13.08	22.82
T_7 - RDF + foliar spray of 10 % of vermiwash	9.26	14.73	23.69
T_8 - soil application of sea weed extract twice at time of sowing and 30 DAS + foliar spray thrice 2.5 ml l^{-1} of water	9.18	9.21	15.43
SEm±	0.07	0.31	0.43
CD (P = 0.05)	NS	1.0	1.3

Table 2. Impact of seaweed extract on number of leaves per plant in carrot

Treatments	Number of leaves		
	30 DAS	60 DAS	90 DAS
T_1 - RDF	3.67	7.67	10.33
T_2 - RDF + soil application of seaweed extract at time of sowing and 30 DAS	4.00	9.67	11.62
T_3- RDF+ foliar spray of seaweed extract thrice 2.5 ml l^{-1} of water	4.00	10.00	11.80
T_4 - RDF + soil application of sea weed extract twice at time of sowing and 30 DAS + foliar spray thrice 2.5 ml l^{-1} of water	4.00	10.67	12.11
T_5 - RDF + vermicompost 5 t ha^{-1}	3.66	8.33	10.67
T_6 - RDF + foliar spray of water 3 times	3.66	7.00	7.33
T_7 - RDF + foliar spray of 10 % of vermiwash	4.00	9.00	10.80
T_8 - soil application of sea weed extract twice at time of sowing and 30 DAS + foliar spray thrice 2.5 ml l^{-1} of water	3.45	4.49	6.46
SEm±	0.19	0.15	0.34
CD (P = 0.05)	NS	0.5	1.0

Table 3. Impact of seaweed extract on chlorophyll content of carrot leaves

Treatments	Chlorophyll content (SPAD)		
	30 DAS	60 DAS	90 DAS
T_1 - RDF	3.67	7.67	10.33
T_2 - RDF + soil application of seaweed extract at time of sowing and 30 DAS	4.00	9.67	11.62
T_3- RDF+ foliar spray of seaweed extract thrice 2.5 ml l^{-1} of water	4.00	10.00	11.80
T_4 - RDF + soil application of sea weed extract twice at time of sowing and 30 DAS + foliar spray thrice 2.5 ml l^{-1} of water	4.00	10.67	12.11
T_5 - RDF + vermicompost 5 t ha^{-1}	3.66	8.33	10.67
T_6 - RDF + foliar spray of water 3 times	3.66	7.00	7.33
T_7 - RDF + foliar spray of 10 % of vermiwash	4.00	9.00	10.80
T_8 - soil application of sea weed extract twice at time of sowing and 30 DAS + foliar spray thrice 2.5 ml l^{-1} of water	3.45	4.49	6.46
SEm±	0.19	0.15	0.34
CD (P = 0.05)	NS	0.5	1.0

Similarly, at 90 DAS, the treatment that led to the highest plant height (25.63) was RDF + soil application of seaweed extract twice at the time of sowing and 30 DAS + foliar spray thrice 2.5 ml l^{-1} of water. This was statistically similar to RDF+ foliar spray of seaweed extract thrice 2.5 ml l^{-1} of water (24.63) and RDF + soil application of seaweed extract at the time of sowing and 30 DAS (24.55). The lowest plant height was observed in the treatment soil application of seaweed extract twice at the time of sowing and 30 DAS + foliar spray thrice 2.5 ml l^{-1} of water (15.43).

The increase in plant height can be attributed ~~due~~ to the provision of essential primary, secondary, and trace nutrients through the application of seaweed extract, similar to the results by Lee [5].

3.2 Number of Leaves per Plant

Much like the observation for plant height 30 days after sowing (DAS), there were no significant differences in the number of leaves per plant when seaweed extract was applied.

However, at 60 and 90 DAS, there was an increase in the number of leaves per plant. The highest number of leaves was observed in the treatment RDF + soil application of seaweed extract twice at the time of sowing and 30 DAS + foliar spray thrice 2.5 ml l^{-1} of water. This was statistically similar to the treatments RDF+ foliar spray of seaweed extract thrice 2.5 ml l^{-1} of water and RDF + soil application of seaweed extract at the time of sowing and 30 DAS. the treatment RDF + foliar spray of 10% vermiwash, RDF + vermicompost 5 t ha^{-1}, RDF alone, and RDF + foliar spray of water three times showed comparable results. Conversely, the lowest number of leaves per plant was observed in soil application of seaweed extract twice at the time of sowing and 30 DAS + foliar spray of seaweed extract thrice at 2.5 ml l^{-1} of water.

The increase in the number of leaves may be ascribed to the presence of micro and macronutrients and phytohormones in seaweed extract. These findings align with Mooney and Vastaden [6] and Blunden [7].

3.3 Chlorophyll Content (SPAD)

Initially, at 30 DAS there were no discernible difference observed among the treatments with respect to chlorophyll content at 30 DAS. However, at 60 and 90 DAS, a significant impact of seaweed extract was noticed. The highest chlorophyll content was observed in T4 RDF + soil application of seaweed extract twice at the time of sowing and 30 DAS + foliar spray thrice 2.5 ml l^{-1} of water. Treatments with RDF+ foliar spray of seaweed extract thrice 2.5 ml l^{-1} of water and RDF + soil application of seaweed extract at the time of sowing and 30 DAS were statistically on par with RDF + soil application of seaweed extract twice at the time of sowing and 30 DAS + foliar spray thrice 2.5 ml l^{-1} of water. The next best treatments were RDF+ foliar spray of seaweed extract thrice 2.5 ml l^{-1} of water and RDF + soil application of seaweed extract at the time of sowing and 30 DAS. The treatment RDF + foliar spray of 10% vermiwash, RDF + vermicompost 5 t ha^{-1}, RDF alone, and RDF + foliar spray of water three times. The treatment of lowest chlorophyll content was observed through oil application of seaweed extract twice at the time of sowing and 30 DAS + foliar spray of seaweed extract thrice at 2.5 ml l^{-1} of water.

The significant increase in chlorophyll content can be attributed to an elevated production of chloroplasts, a reduction in the breakdown of chlorophyll, and a delayed aging process in plants. This was observed in studies conducted by Jannin et al. [8]. Furthermore, cytokinin, a plant hormone, is protective in preserving chloroplasts (as demonstrated by Zavaleta-Mancera et al., [9]) and promoting chloroplast division Okazaki et al. [10].

4. CONCLUSION

Results of the experiment revealed that the application of RDF + soil application of seaweed extract twice at the time of sowing and 30 DAS + foliar spray thrice 2.5 ml l^{-1} of water improves the plant growth parameters of the carrot. Hence, it could be recommended to the farmers.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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