



## Assessment of Biostimulatory Effect of Seaweed Extract in Improvement of Growth and Yield Characteristics in Two Spinach (*Spinacia oleracea* L) Cultivars

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### Article Info

**ISSN (online):** 3107-6602

**Impact Factor (RSIF):** 8.20

**Volume:** 02

**Issue:** 03

**Received:** 03-03-2026

**Accepted:** 02-04-2026

**Published:** 01-05-2026

**Page No:** 23-27

### Abstract

A field research was directed in one of vegetable fields of Horticulture Department / Agriculture faculty / University of Al-Qasim Green for reduction season 2023-2024, with aim of study was effect of seaweed extract on the growth and yield of spinach plants. experimentation included 2 factors: one of it was spraying seaweed extract at three levels (1.5, 3, 4.5) ML/L, and the other factor: the local and French variety (Virofly). Experiment was implemented according to a (R.C.B.D.) and means were compared using the (L.S.D.) test at the possibility level of 0.05.

The outcomes showed a significant increase, as the French variety of spinach V2 (8.22) leaf.plant<sup>-1</sup> was superior to the local variety V1 (7.11) leaf.plant<sup>-1</sup> in the number of leaves only, while the local variety V1 (27.11) cm.plant<sup>-1</sup> was superior to the French variety V2 (22.89) cm.plant<sup>-1</sup> in terms of plant height (cm.plant<sup>-1</sup>) and weight of the total wet yield (gm.m<sup>-2</sup>). The local variety V1 (398) gm.m<sup>-2</sup> gave the highest results compared to the French variety V2 (329 gm.m<sup>-2</sup>).

As the interaction results between variety and seaweed extracts showed, that was a significant increase in leaves number. We note that there were differences significant between treatments, like V2S2 action excelled and gave the highest value (9.67) compared to the treatment control V1S1, which provided (7.00), and the plant height recipe, as the comparison treatment V1S1 excelled (28.00) cm.plant<sup>-1</sup>, which provided the highest rate compared to V2S1 treatment. (21.33) cm.plant<sup>-1</sup> and treatment V2S3 (22.33) cm.plant<sup>-1</sup>, which presented a lowest result, and the recipe for total plant yield. We note from the table above a superiority significant of the control treatment V1S1, which gave a highest value (468) gm.m<sup>-2</sup> compared to V1S2 treatment, which offered the lowest rate (275) gm.m<sup>-2</sup> and the treatment. V2S1 (284) gm.m<sup>-2</sup> and treatment V2S3 (334) gm.m<sup>-2</sup>.

As for the dry matter and chlorophyll percentage, there are no differences significant between all treatments.

**DOI:** <https://doi.org/10.54660/IJASF.2026.2.3.23-27>

**Keywords:** Virofly, seaweed extracts, varieties of spinach, *Spinacea Oleracea* L

### 1. Introduction

Spinach *Spinacea Oleracea* L., is native to central and southwestern Asia. It goes to the *amaranthaceae* family [1]. It is thought that it was planted in Iran two thousand years ago and then moved to Africa, Europe, and North America, where its cultivation is currently widespread in all regions of the world with moderate climates [2]. China is considered the first producer of spinach in the world, followed by the United States of America, followed by Japan [3]. Spinach is considered a vegetable with high nutritional value. It is a very powerful antioxidant because it contains high levels of carotenoids (Zeaxanthin, Lutein, B-Carotene,

phenolic compounds, and flavonoids). It is low in calories, as every 100 grams of fresh spinach leaves gives 23 Kcal [4, 5, 6]. Due to the importance of the plant from a medical and nutritional perspective, it was necessary to improve the plant's quantitative and qualitative performance through various agricultural and nutritional processes, including spraying with an environmentally friendly natural extract such as seaweed extract, which is an important foundation of plant antioxidants and hormones that increase its ability to survive stressful situations and is useful for chelating elements [7]. Foliar spraying is a supplement to fertilization and is highly effective, especially when absorption determinants such as drought, freezing, salinity deposition, and injury are present. Roots with pathogens [8, 9].

Where seaweed extracts *Ascophyllum nodosum* was used. In this research, which is fortified with zinc and iron [10, 11], the extract contains macronutrients, some micronutrients, and plant growth hormones such as auxins and cytokinins, materials alike to hormones plant, and promoter's growth such organic and amino acids, enzymes and vitamins. It is known that all of these mentioned substances were complex in the compound's synthesis necessary for plants, such as RNA, DNA and proteins, and in all the important biological processes of the plant that contribute to growth of plant and development, like respiration and photosynthesis, it rises. division of Cell and elongation, and this is reproduced in an upturn in the vegetative plants growth characteristics, represented by an intensification in length stem, branches and leaves number and leaf area [12, 13, 14, 15]

The aim of this examination is to:

- Improving yield and growth, quantitatively and qualitatively, by two varieties of local spinach and French virofly when sprayed foliarly with seaweed extracts *Ascophyllum nodosum* L.

## Materials and Methods

2.1 A experiment was lead at season (2023-2024) in agricultural fields of the Horticulture Department / Agriculture faculty / Al-Qasim Green University located at the University of Babylon / Al-Hillah City / Babylon Governorate to revision the seaweed extract effect on the yield and growth of two diversities of spinach as a according to (RCBD) in three replicates, where each replicate contains six treatments, where the first factor, the variety, was distributed. with two levels and the second factor with three levels of seaweed extracts and was matched using the (LSD) test on 5% level [16]

### The Type

- local variety, symbolized by V1
- French variety virofly, symbolized by V2 spraying with seaweed extract *Ascophyllum nodosum* L.
- The comparison treatment is according to the fertilizer

recommendation at a 1.5 ml/liter concentration of and is represented by S1

- Add algae extract at a absorption (twice the comparison) of 3 ml/liter, symbolized by S2
- Adding algae extract at a concentration (twice the comparison) 4.5 ml/liter, symbolized by S3.

The land was plowed, smoothed, and divided into panels with dimensions of 1 m \* 1 m per panel, and manure was added to all panels, then we planted the seeds on 11/11/2023.

They were distributed in lines within the panels, and the panels were watered immediately after sowing, then watered twice a week at the beginning of germination, then according to the needs of the plant and the environmental conditions of the field, after which hoeing and weeding operations were carried out for the entire field and from time to time.

The extract of seaweed was scattered for the first time when seedlings reached the stage of four leaf, then every two weeks, three sprays during the vegetative growth stage until the plant was ready for mowing and marketing.

### Studied attributes

- Height of Plant (cm.plant<sup>-1</sup>)  
The plants heights was restrained using a ruler, start from soil surface to top of plant, then plant height average for each treatment was extracted.
  - Leaves Number (plant.leaf<sup>-1</sup>)  
The total leaves number for all plant was calculated from five plants taken, and their average was occupied to compute the number of leaves for each plant.
  - Number of total plant leaves = (plants per fifth of the total number of leaves)/(experimental unit number of plants).
  - Vegetative yield per unit area (gm.m<sup>-2</sup>)  
The plants were mowed on 1/11/2024 by cutting the plants at the level of the soil surface from each experimental unit, then they were weighed immediately after harvest with a two-stage field scale (HR-200) of Japanese origin.
  - Dry matter percentage %  
The dry matter percentage was premeditated after completely drying samples and weighing them, then applying the equation according to [17]
  - Percentage of dry matter = (dry leaf weight)/(wet leaf weight) \* 100.
  - Chlorophyll percentage (Spad)  
The total chlorophyll percentage in leaves spinach was estimated using Spad by taking five separate leaves from each plant and then taking the average.
- 2.5 for physicochemical properties following the protocols outlined by [18]. The properties soil are concise in Table 1.

**Table 1:** Characteristics Soil for the Experiment

Soil Characteristic	Unit	Value
Ece.	DS/ m	4.3
pH	---	7.6
Organic matter	%	1.5
Available N	Ppm	43.7
Available P		7.2
Available K		125.2
Sand	gm/ kg soil	55%
Silt		25%
Clay		12%
Texture		Sandy loam soil

**Results:**

A table showing the seaweed and variety extract effect on the leaves number (leaf<sup>-1</sup> .plant), Height Plant (cm), chlorophyll

percentage, total yield (gm.m<sup>-2</sup>) and dry matter percentage (%).

**Table 2:** showing the seaweed and variety extract effect on the leaves number (leaf<sup>-1</sup> .plant), Height Plant (cm), chlorophyll percentage, total yield (gm.m<sup>-2</sup>) and dry matter percentage (%).

dry matter percentage (%)	total yield (gm.m <sup>-2</sup> )	chlorophyll percentage (Spad)	plant height (cm)	the umber of leaves (leaf.plant <sup>-1</sup> )	effect of the variety(V)
8.04	398	45.7	27.11	7.11	V1
10.34	329	45.8	22.89	8.22	V2
2.84	57.3	6.74	3.038	0.99	LSD 0.05%
					seaweed extract (S)
8.54	376	45.9	24.67	7.00	S1
10.39	322	48.0	25.83	8.83	S2
8.63	392	43.5	24.50	7.83	S3
3.48	70.2	8.25	3.72	1.22	LSD 0.05%
					Interference effect V*S
7.48	468	43.7	28.00	7.00	V1S1
9.27	275	50.2	26.67	6.67	V1S2
7.37	450	43.0	26.67	7.67	V1S3
9.61	284	48.1	21.33	7.00	V2S1
11.52	369	45.8	25.00	9.67	V2S2
9.89	334	43.5	22.33	8.00	V2S3
4.92	99.2	11.67	5.26	1.72	LSD 0.05%

**Effect of variety V**

From the table above, it was shown that the French variety of spinach V2 was superior to the local variety V1 in the number of leaves only, while the local variety V1 was superior to the French variety V2 in the physical characteristics of height plant (cm) and the total wet yield weight (gm.m<sup>-2</sup>), where the local variety V1 gave the highest results compared to the French variety V2.

As for the chlorophyll characteristics and dry matter percentage (%) there are no significant differences between the two varieties.

**The effect of seaweed extract S**

We notice from above table that there were no differences significant between the first level of spraying with algae extract S1, the second level S2, and the third level S3 in all characteristics (leaves number leaf.plant<sup>-1</sup>, height plant cm.plant<sup>-1</sup>, chlorophyll percentage, total yield in gm.m<sup>-2</sup>, percentage of dry matter%).

**Interference effect V\*S**

From the table above, regarding the number of papers, we notice that there were differences significant between treatments, like V2S2 excelled and gave the highest value (9.67) related

to the comparison V1S1, which gave (7.00), V1S2, which gave the lowest results (6.67), V2S3 which gave (7.67), and V2S1 (7.00), while there are no significant differences. Between transaction V2S2 (9.67) and transaction V2S3 (8.00).

As for the plant height characteristic, we note from the table the treatment superiority V1S1 (28.00), which provided highest value, compared to treatment V2S1 (21.33) and treatment V2S3 (22.33), which presented lowest domino effect, while there are no differences significant between V1S1 treatment (28.00) and the rest of the treatments.

As for the characteristic of chlorophyll in plants, we note in table above that there are no differences significant between all treatments.

Characteristic of total plant yield. We notice from the table above a significant superiority V1S1 comparison treatment, which provided highest rate (468), compared to the treatment V1S2, which gave the lowest value (275), the treatment V2S1 (284), and the treatment V2S3 (334), while there are no differences significant between the control treatment V1S1, which gave the highest value (468), and the two treatments. V1S3 and V2S2. As for the percentage of dry matter of spinach, the table above showed that there are no differences significant between treatments.

## Discussion

From the table above, we notice that the French variety V2 is superior to the local variety V1 in the number of leaves. This may be due to the difference in genetic composition between them. It is also noted that a significant increase in effect of the communication between the variety and spraying with seaweed extract V\*S on some characteristics such as the number of leaves, growth, total yield of spinach plants, and plant height. The reason may be owing to containing macro elements in extract, some minor nutrients, and hormones of plant growth such as auxins, cytokinins, and plant hormone-like substances. And growth promoters, as organic and enzymes, vitamins, and amino acids. It is known that all of these mentioned substances are involved in amalgamation of necessary compounds for the plant, such as RNA, proteins and DNA in all the important vital processes of the plant that contribute to growth and development of plant, such as respiration and photosynthesis, which grows cell elongation and division, and that is reflected in the increase in growth vegetative characteristics of plant, which is represented by an rise in stem length, of branches and leaves number, and leaf area (12), (13), (14), (15). The significant intensification in the vegetative growth characteristics, especially the soft crop (which is economically important), might be payable to seaweed extracts content on some growth regulators, polyamines, and acids. Amino that improves the nutritional and physiological condition of the plant<sup>[19]</sup>, These hormones interact with the hormones present in the plant to perform their physiological action, causing an increase in cell division in the plant, in addition to their work in increasing the strength of root growth, which in turn tips to rise in the capability to nutrients absorb, which is reflected in an increase in the products of photosynthesis. This is reinforced by the presence of cytokinins in the algae extract, which helps in transfer of nutrients as of roots and directs them towards growth vegetative, including the leave<sup>[20]</sup>.

The effect of the interaction was greater because the seaweed extracts contains auxins, which ought to an role effective in growing cell division and expansion, which indications to a larger size of vegetative and thus an rise in wet weight, number of leaves, and plant height<sup>[21]</sup>.

## Conclusions:

- The intervention treatment of local variety v1s1 and seaweed extracts according to the fertilizer recommendation at a concentration of 1.5 ml/liter gave a positive effect on the total yield and plant height.
- The second factor (seaweed extracts) alone, at all three levels, had no significant effect.
- Increasing the concentration of seaweed extracts above 3 ml/L managed to a undesirable effect.

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#### **How to Cite This Article**

Al-Mousawi ZJM. Assessment of biostimulatory effect of seaweed extract in improvement of growth and yield characteristics in two spinach (*Spinacia oleracea* L) cultivars. *International Journal of Agriculture Sustainable Farming*. 2026;2(3):23-27. doi:10.54660/IJASF.2026.2.3.23-27.

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