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Integrative Effect of Mineral Fertilizers and Seaweed Extract on Growth, Productivity, and Quality of Faba Bean Crop

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Abstract

An experiment was conducted in the field over two consecutive seasons (2021/2022 and 2022/2023) at the Experimental Farm of the Department of Agricultural Research and the Experimental Center of the Faculty of Agriculture, Benha University, Egypt to study the effect of foliar spray with seaweed extract and mineral fertilization treatments, i.e., The recommended from N P K (control),75 % of the recommended from N P K + Foliar spray of seaweed extract at 3 mg/L. , 50 % of the recommended from N P K + Foliar spray of seaweed extract at 3 mg/L. and Foliar spray of seaweed extract at 3 mg/L. on vegetative growth, yield, and yield components of Faba bean. The experiment was laid out in a Randomized Complete Block Design with three replicates. Faba bean plants treated with 75 % of the recommended from N P K + Foliar spray of seaweed extract at 3 mg/L. significantly gave the maximum Chlorophyll content, plant height, number of branches, Plant weight, Pod length, Weight of pods, Seed yield/plant, Harvest index, Weight of 100-seed, Biological yield/fed, Seed yield/fed, Seed nitrogen content, Seed protein yield, Seed phosphorus content and Seed potassium content and reduced Abscission in the flowers in both seasons. Based on the previous results, it could be concluded that growing promising Faba bean seeds (Giza 716 variety) treated by 75 % of the recommended amount from N P K + Foliar spray of seaweed extract at 3 mg/L treatment produced the maximum seed yield and its related traits.

Keywords: Faba bean, nitrogen, phosphorus, potassium, seaweed extract, seed yield.

Introduction

Faba bean (*Vicia faba* L.), a crop for the winter in the leguminosae family, has seeds with a protein content that is high of 23-37%, making it a cheaper source of protein than pricey animal protein. In addition to carbs, which can make up as much as 56% of most cultivars, they also contain minerals, vitamins, fiber, and other substances. **Alghamdi (2009).** Nitrogen (N) is the element most readily taken up by plants growing under normal conditions. For this reason, and because of its great mobility in soil, nitrogen is the most lacking nutrient for most crops worldwide. The N boosts leaf area and leaf area index, which could be attributable to a larger quantity and size of leaves. **McCullough *et al.*, (1994**) It enhances the green hue of the leaves and is a component of important cellular components, including amino acids that make up proteins, and nucleic acids. It also controls phosphorus, potassium, and other nutrients, enhancing the succulence of many crops. **Sedano-Castro *et al.*, (2011)**. Promotes photosynthesis because the N increases the amount of chlorophyll **Xu and Wang, 2023).** Phosphorus (P) is one of the many vital and essential elements for the life of plants.is one of the most vital and essential minerals for plant life. The unique properties of phosphate produce water-stable anhydrides and esters, which are necessary for the storage and transmission of energy in plant biochemical activities. The most common are (ADP and ATP). When a terminal phosphate separates from either ATP or ADP, energy is released. Phosphorylation is the mechanism by which phosphate molecules are transferred from energy-transforming systems to ATP as well as from ATP for energy-requiring procedures within plants. Some of the energy from photosynthesis is retained through a process called photophosphorylation, which phosphorylates ADP to create ATP. Oxidative phosphorylation is another activity that uses the energy generated during respiration. Phosphate bonds are significant linking groups in addition to their function in energy-transferring activities. Phospholipids, nucleic acids, nucleotides, coenzymes, and phosphoproteins all contain phosphate as a structural element. When it comes to membrane structure, phospholipids are crucial. **(Barker, and Pilbeam, 2006; Bakhsh *et al.* 2008 and Awaad *et al.* 2020)**. Numerous studies have demonstrated that the majority of the faba bean's vegetative development, yield elements, yield, and seed chemical attributes all significantly increased as phosphorus rates rose. However, there was a considerable drop in the height to the first pod, the number of days from planting to 90% physiological maturity, and the efficiency of

phosphorus consumption. Since it aids in photosynthesis and respiration, potassium (K) is a crucial ingredient for faba bean growth. One macro element that regulates stomata's opening and shutting is potassium. In biological processes, it carries produced nutrients and activates several vital enzymes, which boost leaf efficiency and product transfer and encourage cell division and elongation, particularly meristematic cells in emerging tops and leaf cells. Additionally, it is essential for the growth and reproduction stages of plants. (**Malvi, 2011; Taha *et al.*, 2016; Hasanuzzaman *et al.*, 2018; Awaad *et al.*, 2020 and Abo-Alhassan *et al.*, 2022)**. Seaweed extracts (SWE) are extensively used in agriculture for their ability to enhance plant growth and serve as nutrient supplements in both farming and horticulture. Beyond their rich content of nitrogen, phosphorus, and potassium, seaweed-based fertilizers are recommended because they also provide trace elements and bioactive compounds that mimic natural plant growth regulators. Due to their high levels of growth hormones such as auxins and gibberellins, along with essential vitamins, amino acids, micronutrients, and trace elements, seaweed extracts have recently gained popularity as effective liquid fertilizers. These extracts are beneficial as fertilizers across a wide range of crops. (**El-Gamal *et a.,l* 2020**). Seaweed extract, a vital source of organic matter and essential nutrients, also offers various growth regulators and amino acids that help reduce dependency on chemical fertilizers, ultimately improving both crop yield and quality. **(Al-Khaqani *et al.*, 2022).** Because it contains several growth regulators, amino acids, and mineral elements that influence the different functions of plants, it is one of the most significant sources of organic matter and nutrient elements. They play a crucial part in boosting the plant's early blooming and vegetative growth, which raises production. (**Elansary *et al.*, 2016 ; Begum *et al.*, 2018 Ali *et al.*, 2021).** The current study aims to investigate how faba bean vegetative development, yield components, and seed chemical properties are affected by foliar spray with seaweed extract, as well as by nitrogen, phosphorus, and potassium.

Material and Methods

A field experiment was carried out in the Farm of Agricultural Research and the Experimental Center of Faculty of Agriculture at Moshtohor, (Toukh Directorate, Kalyubia Governorate) Benha University Egypt, during the two successive winter seasons of 2021/2022 and 2022/2023. The objective of this investigation was to study the effect of nitrogen, phosphorus, potassium and Foliar spray of seaweed extract at 3 mg/L .on vegetative growth, yield, yield components, as well as some seeds chemical properties of (*Vicia faba*) Faba bean seeds, Giza 716 variety). The factors under study, (the recommended from N P K (control),75 % of the recommended from N P K + Foliar spray of seaweed extract at 3 mg/L. , 50 % of the recommended from N P K + Foliar spray of seaweed extract at 3 mg/L. and Foliar spray of seaweed extract at 3 mg/L) which arranged in Randomized Complete Block Design (RCBD) with three replicates. Phosphorus rates were added after ridging and before sowing in the form of calcium super phosphate (12.5 % P2O5) at rate of 200 kg P2O5/feddan in both growing seasons. Nitrogen fertilizer was applied at a rate of 15 kg N/fed in form of urea (46 % N) at one dose and applied side-dressed before the first irrigation in each season. Potassium fertilizer was added in the form of potassium sulfate (48% K2O) at rate of 50 kg K2O /feddan. The applied K fertilizer was added into two doses. The first dose was added before the first irrigation, and the second one was added after 35 days from the first dose. Seaweed extract contains minerals as (Fe, Zn, Cu, Mn and Mo), vitamins, enzymes, amino acids, sugars and plant hormones (auxins, cytokinins and gibberellins) were used. The recommended value of Seaweed extract was one 3 mg/L and was repeated three times as a foliar spray; the first at 40 days after sowing (DAS) and repeated with 15-day intervals during both seasons. Samples of soil were taken before sowing of faba bean to depth of 0-30 cm for mechanical and chemical properties analysis of the experimental soil were determined according to the methods of Association of Official Analytical Chemists described in (**A.O.A.C., 2005**) Soil analysis indicated clay texture with pH values of 7.97 and 7.86, organic matter content 1.66 and 1.61%, total N 0.31 and 0.28%, total P 0.21 and 0.18% and total K 0.71 and 0.73% in the first and second seasons, respectively. The preceding crop was corn in both seasons.

The Experimental plot area was 14.7 m2. Faba bean seeds were planted on 11th November in the first season 2021/2022 and 1th November in the second season 2022/2023.using standard plant population density of 80,000 plants /fed. Faba bean plants were harvested on the 21st and 10th of April in the first and the second seasons, respectively. All recommended cultural practices for growing faba bean, according to the Agricultural Research Center recommendations followed.

Characters studied:

A. Vegetative Growth characters

1- Chlorophyll content index (SPAD value) at 85 days after sowing, three plants in three different ridges were randomly selected, and chlorophyll content index (CCI) of upper, middle and lower leaves was measured by a Minolta Chlorophyll Meter SPAD-502 (MINOLTA CO., LTD. JAPAN).

At harvest, random sample of ten guarded plants from each sub- sub plots in the both seasons was taken to determine the following measurements:

2- Plant height (cm).
3- Height to 1st pod (cm).
4- Number of branches/plant.
5- Plant weight (g).
6- Shedding.

B. Yield and yield components:

1- Pod length (cm).
2- Number of pods/plant.
3- Weight of pods/plant (g).
4- Number of seed/plant.
5- Seed yield/plant (g).
6- Harvest index (%).
7- Weight of 100-seed (g).
8- Biological yield/fed (kg).
9- Seed yield/fed (kg).
10- Straw yield fed (kg).

C. **Seed chemical properties**:

1- Seed nitrogen content (%) according to the modified micro Kjeldahl method was determined according to the methods of the Association of Official Analytical Chemists described in **(A. O. A. C., 2005).**

2- Protein yield/fed (kg) = (seed yield kg x seed protein content)/100.
3- Seed phosphorus content (%).
4- Seed potassium content (%).

Phosphorus was determined colorimetrically and potassium was measured by flame photometer according to the methods described in **(A. O. A. C., 2005)**.

Statistical analysis:

The analysis of variance was carried out according to the procedure described by **Gomez and Gomez (1984).** Data were statistically analyzed according to using the MSTAT-C Statistical Software Package **(Freed, 1991).** Where the F-test showed significant differences among means L. S. D. test at 0.05 level was used to compare between means.

Results and Discussion:

Data in **Table 1** indicated that In the Fertilization levels for both seasons, showed significant increments in most vegetative growth Characters of faba bean under study, plant height (cm), Plant weight (g)/plant, number of branches/ plant, while height to st 1 pod (cm) was significantly decreased by using 75 % of the recommended from N P K + Foliar spray of seaweed extract at 3 mg/L. , while Foliar spray of seaweed extract at 3 mg/L. had the lowest values on plant height (cm), Plant weight (g)/plant, number of branches/ plant, and while height to st 1 pod (cm) was significantly increased. It seemed that the application of phosphorus enhanced meristematic activity, cell division, and enlargement, which encouraged growth and increased plant height. Many investigators came out with similar results as **Abbas *et al.*, (2012); Adak and Kibritci (2016) and Mam Rasul (2018).** The increase in vegetative growth of faba bean with the application of nitrogen, potassium, and phosphorus may be due to the synergetic role of macro elements in improving directly or indirectly photosynthesis, vital processes in plant such as respiration, protein synthesis, reproduction phase, biochemical and physiological activities. Many investigators came out with similar results as **Taha *et al.*, (2016) ; Rasul (2018) and Tsige *et al.*, (2022).** The treatment with the seaweed extract led to an increase in the vegetative growth and the reason for this is that the marine algae extract contains the necessary nutrients for the plant, as it contains the major nutrients NPK in addition to containing plant hormones such as auxins, gibberellins and cytokinins, which when sprayed on plants stimulate root and shoot growth by increasing the efficiency of the photosynthesis process. This will eventually lead to an increase plant vigor and stem diameter **Al-Zubaidy (2023).**

Table 1. Effect of mineral N, P,K and Foliar spray of seaweed extract on plant height (cm), Plant weight (g)/plant, number of branches/ plant and height to st 1 pod (cm) of faba bean, combined data across 2021/2022 and 2022/2023 seasons.

Treatment		Plant Height		Plant weight		No / of branches/plant		height to st 1 pod	
		2021/22	2022/23	2021/22	2022/23	2021/22	2022/23	2021/22	2022/23
Fertilization	F1	107.729	102.950	103.768	99.072	4.852	4.625	23.572	24.166
	F2	115.200	112.432	108.669	106.780	5.114	4.941	22.681	23.275
	F3	110.417	106.212	105.986	101.575	5.031	4.743	23.164	23.642
	F4	99.364	95.432	92.833	91.636	3.717	3.450	26.223	26.656
	Mean	**108.177**	**104.257**	**102.814**	**99.766**	**4.678**	**4.440**	**23.910**	**24.435**
	L .S. D	**5.349**	**5.252**	**7.387**	**7.932**	**0.7029**	**0.7104**	**2.033**	**1.863**

Where, F1= The recommended from N P K (control), **F2=** 75 % of the recommended from N P K + Foliar spray of seaweed extract, **F3 =** 50 % of the recommended from N P K + Foliar spray of seaweed extract , **F4=** Foliar spray of seaweed extract.

Results in **Table 2** indicated that For In the Fertilization levels for both seasons, showed significant increase in vegetative growth Characters under study, that chlorophyll content index, number of pod/ plant and pod length (cm), by using 75 % of the recommended from N P K + Foliar spray of

seaweed extract , while Abscission was significantly decreased by using 75 % of the recommended from N P K + Foliar spray of seaweed extract at 3 mg/L. , while Foliar spray of seaweed extract at 3 mg/L. had the lowest values on chlorophyll content index, number of pod/ plant and pod length (cm) and, Abscission(flower drop) was significantly increased with Foliar spray of seaweed extract. The significant increase of chlorophyll content index may be attributed to the physiological role of each seaweed extract, nitrogen, phosphorus, and potassium. Since, polyamines are implicated in a variety of plant functions, including photosynthesis and stomatal conductance, enzyme activation and maintenance, cell division and differentiation and photo morphogenesis. These results are in agreement with those obtained by **Jarecki *et al.* (2016) and Yasmin *et al.* (2020).** Phosphorus can positively influence faba bean plants by reducing abscission, influencing both the initiation and regulation of flower and fruit drop, and accumulation in petioles, specifically at the point where the petiole attaches to the stem (the abscission zone), is believed to directly influence the mechanism of abscission. **Zhang *etal,*. (2010).** Potassium is a crucial nutrient for plants, impacting both abscission and flowering through its roles in nutrient transport, enzyme activation, cellular processes, and stress response. Adequate potassium levels are essential for proper flower development, fruit set, and preventing premature abscission. **Wang (2007) and Hasanuzzaman *etal,*. (2018).** Seaweed extract can positively influence faba bean plants by reducing abscission (premature flower and pod drop). This is achieved through several mechanisms, including the presence of growth hormones like auxins, cytokinins, and gibberellins in the extract, which promote cell division and elongation, strengthening the plant and its ability to hold onto developing pods. Additionally, seaweed extract enhances nutrient uptake and stress tolerance, potentially mitigating factors that can lead to abscission, such as nutrient deficiencies **Aliko *etal,*. (2017) and Mukherjee and Patel (2020).** The increase in No. of pods/plant with increase in N, P,K and Foliar spray of seaweed extract fertilization rates may be to that encouraged vegetative growth of faba bean plants as well as No. of flowers/plant, sitting of flowers and pods. Many investigators obtained similar results as **Negasa *et al.* (2019) and Al-Zubaidy (2023).**

Table 2. Effect of mineral N, P,K and Foliar spray of seaweed extract on SPAD, Abscission, number of pod/ plant and pod length (cm) of faba bean, combined data across 2021/2022 and 2022/2023 seasons.

Treatment		SPAD		Shedding		No of pod		pod length(cm)	
		2021/22	2022/23	2021/22	2022/23	2021/22	2022/23	2021/22	2022/23
Fertilization	F1	35.42	34.42	89.32	90.01	12.45	10.88	10.74	10.09
	F2	39.86	38.85	87.81	88.64	14.60	12.82	11.47	10.66
	F3	38.71	37.71	88.26	89.03	13.14	11.33	11.19	10.37
	F4	30.88	29.88	92.45	93.12	10.81	9.05	9.74	8.99
	Mean	**36.22**	**35.21**	**89.46**	**90.20**	**12.75**	**11.02**	**10.78**	**10.03**
	L .S. D	**3.43**	**3.43**	**0.93**	**0.82**	**1.94**	**1.22**	**1.12**	**1.12**

Where, F1= The recommended from N P K (control) , **F2=** 75 % of the recommended from N P K + Foliar spray of seaweed extract, **F3** = 50 % of the recommended from N P K + Foliar spray of seaweed extract , **F4=** Foliar spray of seaweed extract.

Data in **Table 3** indicated that In the Fertilization levels for both seasons, showed significant increase in yield attributes Characters under study, that 100- seed /weight(g), Weight of pods/plant (g), number of seeds/plant and seed yield/plant(g) by using 75 % of the recommended from N P K + Foliar spray of seaweed extract at 3 mg/L. , while Foliar spray of seaweed extract at 3 mg/L. had the lowest values on 100- seed /weight(g), Weight of pods/plant (g),number of seeds/plant and seed yield/plant(g). The increase in 100-seed weight, Weight of pods/plant (g),number of seeds/plant and seed yield/plant(g) with the increase in nitrogen, phosphorus, potassium and seaweed extract application may be due For they plays a vital role in several physiological processes via photosynthesis, respiration, energy storage, cell division/enlargement and a good seed filling. These results are in agreement with those obtained by **Abd AlKader *et al.* (2017) ; Hamza and Abbas (2020) ; Getu *et al.* (2020) and Mohamed (2022).** This shows how crucial proper fertilization is in enhancing Seed yield/plant (g), with specific formulations with superior results. Such obtained increase in seed yield/plant is mainly due to the increase in plant weight, No. of pods/plant, No. of seeds/plant, harvest index, and 100-seed weight resulting from increasing nitrogen, phosphorus, potassium, and seaweed extract fertilizer. These results are in agreement with those obtained by **Salah El Din *et al.*, (2008) ;Abbas *et al.*, (2012); Hashemabadi (2013) ; Adak and Kibritci(2016) ; Taha *et al.*, (2016) ; Barlóg *et al.*, (2019) ; Hamza and Abbas (2020) and Tsige *et al.*, (2022).**

Table 3. Effect of mineral N, P,K and Foliar spray of seaweed extract on 100- seed /weight(g), Weight of pods/plant (g),number of seeds/plant and seed yield/plant(g) of faba bean, combined data across 2021/2022 and 2022/2023 seasons.

Treatment		100- seed /weight(g)		Weight of pods/plant (g)		No of seeds/plant		seed yield/plant(g)	
		2021/22	2022/23	2021/22	2022/23	2021/22	2022/23	2021/22	2022/23
Fertilization	F1	86.43	83.85	41.28	35.62	40.51	35.63	35.26	30.17
	F2	87.50	85.47	50.44	44.36	49.30	44.17	43.51	38.14
	F3	86.94	84.89	44.24	37.88	43.21	37.45	37.85	32.08
	F4	82.70	81.96	31.22	25.38	30.41	25.42	25.31	20.99
	Mean	85.89	84.04	41.80	35.81	40.86	35.67	35.48	30.35
	L .S. D	**1.45**	**1.82**	**4.49**	**5.13**	**4.63**	**5.45**	**4.11**	**4.81**

Where, F1= The recommended from N P K (control), **F2=** 75 % of the recommended from N P K + Foliar spray of seaweed extract, **F3 =** 50 % of the recommended from N P K + Foliar spray of seaweed extract, **F4=** Foliar spray of seaweed extract at 3 mg/L.

Results in **Table 4** indicated that In the Fertilization levels for both seasons, showed significant increase in yield attributes Characters under study, that Harvest index (%), seed yield (kg /fed), Straw yield (kg/fed) and biological yield (kg/fed)by using 75 % of the recommended from N P K + Foliar spray of seaweed extract at 3 mg/L. , while Foliar spray of seaweed extract at 3 mg/L. had the lowest values on Harvest index (%), seed yield (kg /fed), Straw yield (kg/fed) and biological yield (kg/fed). This points to the importance of appropriate fertilization in enhancing harvest index (%), with specific formulations superior results. The increases in harvest index (%) with increase in nitrogen, phosphorus, potassium and seaweed extract fertilization rates may be attributed to the increase in seed yield/plant of faba bean plant. Many investigators obtained similar results as **Abdalla *et al.*,(2015) ;Shakori and Sharifi (2016) ;Alemayehu and Shumi (2018) ; Ozaktan and Doymaz (2022) ;Tsige *et al.*, (2022). and Al-Zubaidy(2023).**

Table 4. Effect of mineral N, P,K and Foliar spray of seaweed extract on Harvest index (%), seed yield (kg /fed), Straw yield (kg/fed) and biological yield(kg/fed) of faba bean, combined data across 2021/2022 and 2022/2023 seasons.

Trait		Harvest index (%)		seed yield(kg /fed)		Straw yield (kg/fed)		biological yield(kg/fed)	
Treatment		2021/22	2022/23	2021/22	2022/23	2021/22	2022/23	2021/22	2022/23
Fertilization	F1	33.89	30.04	1115.169	937.09	2108.85	2098.23	3224.02	3035.33
	F2	39.76	35.11	1446.52	1228.87	2151.29	2151.42	3597.82	3380.29
	F3	35.45	31.21	1245.94	1028.41	2207.63	2204.37	3453.57	3232.79
	F4	27.13	22.67	632.54	511.52	1644.97	1707.59	2277.51	2219.12
	Mean	34.06	29.76	1110.04	926.47	2028.18	2040.40	3138.23	2966.88
	L .S. D	**5.01**	**3.92**	**138.50**	**178.00**	**356.60**	**266.20**	**383.70**	**347.20**

Where, F1= The recommended from N P K (control) , **F2=** 75 % of the recommended from N P K + Foliar spray of seaweed extract, **F3 =** 50 % of the recommended from N P K + Foliar spray of seaweed extract , **F4=** Foliar spray of seaweed extract at 3 mg/L.

This shows how crucial proper fertilization is in enhancing Seed yield, with specific formulations producing superior results. The significant improvement in seed yield/fed due to required nitrogen, phosphorus, potassium, and seaweed extract fertilization rates can further be evidenced by the fact that there was positive and significant correlation existed between seed yield/fed and seed yield attributes i.e., No. of pods/plant, No. of seeds/plant, seed yield/plant, harvest index and 100-seed weight. Many investigators obtained similar results as **Mam Rasul (2018); Kandil *et al.* (2019); Getu *et al.* (2020) and Yasmin *et al.* (2020).** It could be concluded that the increase in seaweed application, which agreed with the studies made by **Hamza and Abbas (2020) and Al-Zubaidy (2023)** on bean plants. They showed that seaweed extract did not act simply as a fertilizer, but as some kind of bio-stimulant. They suggested that seaweed extract could have increase yield in at least two ways. The first, it might have increase the source capacity of the leaves, thus increasing the supply of assimilates available for bean filling. This might by increasing leaf area and photosynthetic rates. Second, the seaweed extract might increase bean weight by enhancing the sink potential of the fruit for assimilates, thus increasing cotyledon cell number and final seed mass.

Data in **Table 5** indicated that In the Fertilization levels for both seasons, showed

significant increase in seed chemical, that Seed N content (%), Seed protein yield (kg/fed), Seed P content (%), and Seed K content (%) by using 75 % of the recommended from N P K + Foliar spray of seaweed extract at 3 mg/L., while Foliar spray of seaweed extract at 3 mg/L. had the lowest values on Seed N content (%), Seed protein yield (kg/fed), Seed P content (%), and Seed K content (%).It could be concluded that the increase in nitrogen, phosphorus, potassium and seaweed extract fertilization rates the addition of high level of P fertilizer (30 kg P fed^{-1}.) Combined with the high level of potassium (10 kg fed^{-1}.) caused the highest percentage of N, P and K contents as well as uptake in the faba bean seeds. These results are in agreement with those obtained by **Shakori and Sharifi (2016); El-Sobky and Yasin (2017) ;Awaad *et al.* (2020)and Yasmin *et al.* (2020).** The increase in protein yield/fed with increasing nitrogen, phosphorus, potassium and seaweed extract fertilization ratesmay be due increases of seed yield/fed and seed crude protein content of faba bean. Many investigators obtained similar results as **Torres-Olivar *et al,*. (2014) ; Ghazi (2017) ;El-Kholy *et al.* (2019) and Tsige *et al,*. (2022).** This shows how crucial proper fertilization is in enhancing Seed phosphorus content (%), with specific formulations superior results. The increase in Seed phosphorus content due to increasing nitrogen, phosphorus, potassium and seaweed extract rates can enhance the uptake of various nutrients, including phosphorus, by faba bean plants. This is likely due to the presence of compounds that promote root development and nutrient transport within the plant. These results are in agreement with those obtained by **Alemayehu and Shumi, (2018). Al-Taey *et al.* (2018) and Abd Alqader *et al.* (2020) .** This shows how crucial proper fertilization is in enhancing Seed potassium content (%), with specific formulations superior results. The effects of nitrogen, phosphorus, and potassium are often interconnected. Optimal nitrogen and phosphorus levels can create a better environment for potassium uptake and translocation, leading to higher seed potassium content. These results are in agreement with those obtained by **Al-Taey *et al.* (2018) ; Abd Alqader *et al.* (2020) ; Mughunth *et al.*, (2024) and Raheem *et al.* (2024).**

Table 5. Effect of mineral N, P,K and Foliar spray of seaweed extract on Seed N content (%), Seed protein yield (kg/fed), Seed P content (%), and Seed K content (%) of faba bean, combined data across 2021/2022 and 2022/2023 seasons.

Treatment		Seed N content (%)		Seed protein yield (kg/fed)		Seed P content (%)		Seed K content (%)	
		2021/22	2022/23	2021/22	2022/23	2021/22	2022/23	2021/22	2022/23
Fertilization	F1	3.93	3.67	286.59	230.85	0.60	0.59	1.56	1.18
	F2	4.21	3.96	394.66	309.77	0.67	0.66	1.67	1.29
	F3	4.08	3.82	330.67	252.92	0.58	0.56	1.50	1.11
	F4	2.89	2.65	120.02	88.80	0.44	0.41	1.03	0.65
	Mean	3.78	3.53	282.98	220.59	0.57	0.56	1.44	1.06
	L .S. D	0.36	0.36	37.41	43.89	0.026	0.026	0.045	0.037

Where, F1= The recommended from N P K (control) , **F2=** 75 % of the recommended from N P K + Foliar spray of seaweed extract, **F3 =** 50 % of the recommended from N P K + Foliar spray of seaweed extract , **F4=** Foliar spray of seaweed extract at 3 mg/L.

Conclusion

Generally, it can be concluded that using 75 % of the recommended from N P K + foliar spray of seaweed extract at 3 mg/L could reduce abscission of flowers and improve the productivity of the faba bean crop under the prevailing environmental conditions of Toukh Directorate, Kalyubia Governorate, Egypt.

References

A. O. A. C. (2005). Official Methods of Analysis of the Association of Official Analytical Chemists. Published by A.O.A.C. 16th Ed., Washington, D.C., U. S. A.

Abbas, E. E.; M. M. El-Metwally and M. R. A. Mohamed (2012). Response of some faba bean cultivars to different levels of phosphorus fertilizer with inoculation by phosphorus solubilizing fungi. J. Plant Prod., Mansoura Univ., 3 (9): 2479-2494.

Abd AlKader, E. Y.; S. Sh. El-Tabbakh; A. I. Nawar and H. M. Ibrahim (2017). Effect of phosphatic and potassium fertilization rates on some faba bean cultivars. J. Adv. Agric. Res. (Fac. Agric. Saba Basha), 22 (2): 188-207.

Abdalla, A. A., El Naim, A. M., Ahmed, M. F., & Taha, M. B. (2015). Biological yield and harvest index of faba bean (Vicia faba L.) as affected by different agro-ecological environments. *World journal of agricultural research*, *3*(2), 78-82.

Abo-Alhassan, A. M., HASSANEIN, A. E. H. M., ABD EL-AZIZ, M. A. A., & Abou Tahoun, A. M. (2022). Effect of phosphorus and potassium fertilization on drought tolerance of broad bean (Vicia faba L.). *Scientific Journal of Agricultural Sciences*, *4*(1), 114-124.

Adak, M. S. and M. Kibritci (2016). Effect of nitrogen and phosphorus levels on nodulation and yield components in faba bean (*Vicia faba* L.). Legume Res., 39 (6): 991-994

Alemayehu, D. and D. Shumi (2018). Response of faba bean (*Vicia faba* L.) to phosphorus nutrient application in bore Highlands, Guji Zone, Southern Ethiopia. Agri. Res. & Tech. Open Access J. 17 (4): 107-114.

Alghamdi, S. S. (2009). Chemical composition of faba bean (Vicia faba L.) genotypes under various water regimes. *Pakistan Journal of Nutrition*, *8*(4), 477-482.

Ali, O., Ramsubhag, A., & Jayaraman, J. (2021). Biostimulant properties of seaweed extracts in plants: Implications towards sustainable crop production. *Plants*, *10*(3), 531.

Aliko, A. A., Manga, A. A., Zakari, S. M., Haruna, H., Tafinta, I. Y., & Umar, M. (2017). comparative effect of aqueous seaweed extract and ibaon fruit shedding in watermelon and okra.

Al-Khaqani, T. S., Al-Salami, H. J., & Al-Khuzae, Z. H. T. (2022). Effect of foliar spray with SWE algae tecamin on some growth and yield indicators of two Vicia faba L. cultivars. *Int. J. Agricult. Stat. Sci. Vol*, *18*(1), 1391-1394.

Al-Taey, D. K., Alazawi, S. S., Al-Shareefi, M. J., & Al-Tawaha, A. (2018). Effect of saline water, NPK and organic fertilizers on soil properties and growth, antioxidant enzymes in leaves and yield of lettuce (Lactuca sativa var. Parris Island). *Research on Crops*, *19*(3), 441-449.

Al-Zubaidy, N. W. Q. (2023, December). Effect of Organic Fertilizer and Seaweed Extract in Growth and Yield Broad bean Vicia faba L. In *IOP Conference Series: Earth and Environmental Science* (Vol. 1262, No. 4, p. 042022). IOP Publishing.

Awaad, M. S., Shazly, M. E., & Deshesh, T. H. M. A. (2020). Effect of Potassium Humate and Phosphorus Fertilization on Faba Bean Plants of Yield and Its Content of Nutrients. *Menoufia Journal of Soil Science*, *5*(7), 161-171.

Bakhsh, A.; R. Khan; A. R. Gurmani; M. S. Khan; M. S. Nawaz and F. Haq; A. Farid (2008). Residual/direct of phosphorus application on wheat and rice yield under rice-wheat system. Gomal Univ. J. Res., 24, 29-35.

Barker, A.V. and D. J. Pilbeam (2006). Handbook of plant nutrition. Taylor & Francis Group, Boca Raton London New York.

Barłóg, P., Grzebisz, W., & Łukowiak, R. (2019). The effect of potassium and sulfur fertilization on seed quality of faba bean (Vicia faba L.). *Agronomy*, *9*(4), 209.

Begum, M., Bordoloi, B. C., Singha, D. D., & Ojha, N. J. (2018). Role of seaweed extract on growth, yield and quality of some agricultural crops: A review. *Agricultural Reviews*, *39*(4), 321-326.

Elansary, H. O., Skalicka-Woźniak, K., & 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.

El-Gamal, A. D., Ismail, M. A., Amin, M. A., & Sayed, A. M. (2020). Comparative studies between seaweeds and commercial algae in alleviation of harmful effects of drought stress of faba bean (vicia faba l.) plants. *Plant Prot*, *5*, 57-72.

El-Kholy, A. S. M.; R. M. A. Aly; A. Y. A. El-Bana and M. A. T. Yasin (2019). Yield of faba bean (*Vicia faba*, L.) as influenced by planting density, humic acid rate and phosphorus fertilization level under drip irrigation system in sandy soils. Zagazig J. Agric. Res., 46 (6A): 1-11.

El-Sobky, E. E. A. and M. A. T. Yasin (2017). Phosphorus and micronutrients fertilization impact on faba bean productivity (*Vicia faba* L.). Zagazig J. Agric. Res., 44 (3): 853-863.

Freed, R. D. (1991). MSTATC Microcomputer Statistical Program. Michigan State University, East Lansing, Michigan, USA.

Getu, A.; K. Gashu; Y. Mengie; B. Agumas; A. Abewa and A. Alemayehu (2020). Optimization of P and K fertilizer recommendation for faba bean in Ethiopia: the case for Sekela District. World Sci. News, 142: 169-179.

Ghazi, D. A. (2017). Maximizing efficiency of rock phosphate as a source of P-Fertilization for faba bean (*Vicia faba* L.) plant. J. Soil Sci. and Agric. Eng., Mansoura Univ., 8 (12): 741-747.

Gomez, K. A. and A. A. Gomez (1984). Statistical procedures for agricultural research. 2nd, (ed). John Wiley and Sons, NY, U.S.A.

Hamza, M. A., & Abbas, A. H. (2020). Effect of spraying with seaweed extract and licorice extract in the growth and yield traits of broad bean (Vicia faba L.). *Plant Archives (09725210)*, *20*(1).

Hasanuzzaman, M., Bhuyan, M. B., Nahar, K., Hossain, M. S., Mahmud, J. A., Hossen, M. S., ... & Fujita, M. (2018). Potassium: a vital regulator of plant responses and tolerance to abiotic stresses. *Agronomy*, *8*(3), 31.

Hashemabadi, D. (2013). Phosphorus fertilizers effect on the yield and yield components of faba bean (*Vicia faba* L.). Annals Biol. Res., 4 (2): 181-184.

Jarecki, W., Buczek, J., & Bobrecka-Jamro, D. (2016). Effect of foliar fertilization on the chlorophyll content in leaves and the chemical composition of faba bean seeds (Vicia faba L.(Partim)). *Journal of Elementology*, *21*(4).

Kandil, A. A.; A. E. Sharief and A. S. A. Mahmoud (2019). Influence of phosphorus fertilization levels on productivity of some broad bean cultivars. Int. J. Adv. Res. Biol. Sci., 6 (7): 124-131.

Malvi, U. R. (2011). Interaction of micronutrients with major nutrients with special reference to potassium. *Karnataka Journal of Agricultural Sciences*, *24*(1).

Mam Rasul, G. A. (2018). Effect of level combinations of nitrogen and phosphorus fertilizers on growth and yield of faba bean (*Vicia faba* L.) in a calcareous soil from Sulaimani province. J. Zankoy Sulaimani, 20 (1): 81-88.

McCullough, D. E., Aguilera, A., & Tollenaar, M. (1994). N uptake, N partitioning, and photosynthetic N-use efficiency of an old and a new maize hybrid. *Canadian Journal of Plant Science*, *74*(3), 479-484.

Mohamed, E. (2022). Effect of organic and inorganic fertilizers on yield of broad bean plant grown on West Delta region. *Al-Azhar Journal of Agricultural Research*, *47*(2), 121-132.

Mughunth, R. J., Velmurugan, S., Mohanalakshmi, M., & Vanitha, K. (2024). A review of seaweed extract's potential as a biostimulant to enhance growth and mitigate stress in horticulture crops. *Scientia Horticulturae*, *334*, 113312.

Mukherjee, A., & Patel, J. S. (2020). Seaweed extract: biostimulator of plant defense and plant productivity. *International Journal of Environmental Science and Technology*, *17*(1), 553-558.

Negasa, G.; B. Bedadi and T. Abera (2019). Influence of phosphorus fertilizer rates on yield and yield components of faba bean (*Vicia faba* L.) varieties in Lemu Bilbilo District of Arsi Zone, Southeastern Ethiopia. Int. J. Plant & Soil Sci., 28 (3): 1-11.

Ozaktan, H., & Doymaz, A. (2022). Mineral composition and technological and morphological performance of beans as influenced by organic seaweed-extracted fertilizers applied in different growth stages. *Journal of Food Composition and Analysis*, *114*, 104741.

Raheem, A. H., Taha, A. A., & Ashraa Kalee, H. H. H. (2024). Phosphate fertilizers effects on the growth and yield traits of faba bean (Vicia faba L.). *Sabrao Journal of Breeding and Genetics*, *56*(3), 1324-1333.

Rasul, G. A. M. (2018). Effect of level combinations of nitrogen and phosphorus fertilizers on growth and yield of faba bean (Vicia faba L.) in a calcareous soil from Sulaimani province. *J Homepage*, *20*(1), 81-8.

Salah El Din, R. A., Elbakry, A. A., Ghazi, S. M., & Abdel Hamid, O. M. (2008). Effect of seaweed extract on the growth and yield of faba bean (Vicia faba l.). *Egyptian Journal of Phycology*, *9*(1), 25-38.

Sedano-Castro, G., González-Hernández, V. A., Saucedo-Veloz, C., Soto-Hernández, M., Sandoval-Villa, M., & Carrillo-Salazar, J. A. (2011). Yield and Quality of Zucchini Fruits on High Doses of N and K. *Terra Latinoamericana*, *29*(2), 133-142.

Shakori, S. and P. Sharifi (2016). Effect of phosphate biofertilizer and chemical phosphorus on growth and yield of *Vicia faba* L. Electronic J. Biol., S (1): 47-52.

Taha, A., Omar, M., & Khedr, H. (2016). Effect of different sources and levels of potassium on growth, yield and chemical composition of faba bean plants. *Journal of Soil Sciences and Agricultural Engineering*, *7*(3), 243-248.

Torres-Olivar, V., Villegas-Torres, O. G., Domínguez-Patiño, M. L., Sotelo-Nava, H., Rodríguez-Martínez, A., Melgoza-Alemán, R. M., ... & Alia-Tejacal, I. (2014). Role of nitrogen and nutrients in crop nutrition. *Journal of Agricultural Science and Technology. B*, *4*(1B), 29.

Tsige, B. A., Dechassa, N., Tana, T., Laekemariam, F., & Alemayehu, Y. (2022). Effect of mineral nitrogen, phosphorus, and potassium fertilizers on the productivity of faba bean (Vicia faba L.) in acidic soils of Wolaita Zone, Southern Ethiopia. *International Journal of Agronomy*, *2022*(1), 2232961.

Wang, Y. T. (2007). Potassium nutrition affects Phalaenopsis growth and flowering. *HortScience*, *42*(7), 1563-1567.

Xu, P., & Wang, E. (2023). Diversity and regulation of symbiotic nitrogen fixation in plants. *Current Biology*, *33*(11), R543-R559.

Yasmin, W., Paul, S. K., & Anwar, M. P. (2020). Growth, yield and quality of faba bean (Vicia faba L.) in response to sowing date and phosphorus fertilization. *Archives of Agriculture and Environmental Science*, *5*(1), 11-17.

Zhang, D., Liu, C., Cheng, H., Kan, G., Cui, S., Meng, Q., ... & Yu, D. (2010). Quantitative trait loci associated with soybean tolerance to low phosphorus stress based on flower and pod shedding. *Plant Breeding*, *129*(3), 243-249.