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Effect of Method and Concentrations of Adding Dry Baker's Yeast Extract on the Growth and Yield of Green Fava Bean (*Vicia faba* L.)

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Abstract. At the Karmat Ali site of the Agricultural Research Station, which is part of the College of Agriculture / University of Basra, researchers tried growing green broad beans of the Loz de Otono variety under various conditions, including folious spraying, irrigation, and the effects of adding different concentrations of dry baker's yeast extract (10, 5, 0) g L^{-1}. A concentration of 10 g L^{-1} significantly outperformed the other concentrations in terms of total chlorophyll in the leaves, but the 5 g L^{-1} concentration significantly outperformed it in terms of increasing plant height, leaf number, and total chlorophyll content. Moreover, the interaction between the two factors significantly affected plant height, leaf number, and total chlorophyll content. Subjects covered include the growth of broad beans, the addition method, the yield, and baker's yeast extract.

Keywords. Vicia faba L., Dry baker's, Green fava bean.

1. Introduction

Broad bean (*Vicia faba* L.) is an important seed legume crop that belongs to the legume family Fabaceae and is a staple food for millions of people in Lower income countries because it contains a high percentage of protein ranging from 23 to 42% [1] and [2] in addition to its high content of carbohydrates, minerals, fibers and vitamins [3].

The cultivated area of broad bean crop in Iraq reached 251 hectares with an estimated productivity of 473 tons of seeds [4].

Yeast in bread One of the natural biofertilizers and biological stimulants that obviously improve the development and output of numerous crops is Saccharomyces cervisiae [5]. Cytokinins derived from this natural source boost cell division and differentiation as well as induce protein, nucleic acid synthesis and chlorophyll generation [6]. These are added two ways: either by foliar spray or by including them into the ground [7]. It also includes several major and minor nutrients and growth regulators (such as auxins and gibberellins), carbohydrates and vitamins—especially vitamin B [8]. It clearly and significantly helps to increase the efficacy of enzymes as well as the absorption of nutrients and others, therefore promoting vegetative development of the plant generally [9]. Yeast simultaneously strives to release CO_2, which is favorably reflected in higher photosynthetic total production [10].

Because it is a safe, effective, and environmentally friendly alternative to chemical fertilizers that has recently gained popularity, and because it promotes the growth of a wide variety of plant crops [11]. Using yeast as a harmless and all-natural growth stimulant for plants is currently a topic of intense research.

With that out of the way, the study's overarching goal is to learn how different methods of applying yeast extract—such as foliar spraying or irrigation—influence green bean growth and yield, and to establish the optimal concentrations of addition.

2. Materials and Methods

During the winter of 2024/2023, researchers from the College of Agriculture / University of Basra conducted an experiment at the Karmat Ali site of the Agricultural Research Station to see how adding dry baker's yeast extract affected the growth and harvest of green broad beans. The land was created by plowing, leveling, and dividing the area into three lines that were 16.20 meters long and had a 0.80 meter space between them.

The seeds of the Spanish broad beans variety were planted on 11/5/2023, and the line was divided into 6 experimental units with a length of 2.7 m. The seeds were planted in holes 30 cm apart. 3 seeds were placed in each hole and thinned after germination to one plant. All agricultural operations used in growing the crop, including weeding, irrigation, fertilization and pest control, were carried out on all experimental units.

The treatments were carried out by spraying dry baker's yeast extract one month after planting in two ways: ground addition (irrigation) and foliar spraying at three concentrations (10, 5, 0) g L^{-1} and three sprays with a two-week interval between each spray. It was carried out as a factorial experiment according to the randomized complete block design (RCBD) and with three replicates [12]. Plant height (cm), number of branches, number of leaves, number of pods, and total chlorophyll in the leaves were among the following observations recorded at the conclusion of the season 2024/2/15. The method described by (1976) Goodwin (1992) was used to estimate the chlorophyll pigment in the leaves: acetone 80% was extracted by spectrophotometer from random samples taken from five plants for each treatment and well washed with water and left to dry in the air. Then 5 g was taken from each sample and 10 ml of acetone 80% concentration was added to it and the tissue was crushed with a ceramic mortar and then the dye solution was isolated from the leaf tissue using Wathmann No. 1 filter paper. The process was repeated to extract the remaining pigments with another 10 ml of acetone (until the tissue whitened) then it was filtered, and the total volume of the filtrate was completed to 100 ml with acetone. Chlorophyll A pigment was measured at a wavelength of 663 nm and chlorophyll B was measured at a wavelength of 645 nm, while carotene pigment was measured at a wavelength of 480 nm. The percentage of each pigment was calculated as in the following equations:

$$\text{Chlorophyll A (mg } L^{-1}) = 12.7 \times 663)\ D) - 2.69 \times (645)\ D.$$

$$\text{Chlorophyll B (mg } L^{-1}) = 22.9 \times 645)\ D) - 4.68 \times (663)\ D.$$

$$\text{Total chlorophyll (mg } L^{-1}) = 20.2 \times 645)\ D) + 8.02 \times (663)\ D.$$

Where D represents the optical density reading of the extracted chlorophyll.

The unit (mg L^{-1}) was then converted to (mg 100 g^{-1}) from the following equation:

$$(mg.100\ g^{-1}) = [(mg.L^{-1}) / (1000\ ml)] \times 100/(sample\ weight\ (g))$$

The concentration of carotene in the floral discs was calculated using the following equation:

$$1000X = (E\ Y) / (e\ 100)$$

Where:
X = number of milligrams of carotene in one cm3 of the solution.
Y = volume of the final solution after dilution with acetone.
E = reading of the device at a wavelength of 480 nm.
e = carotene constant and equals 2300.
Carotene concentration was converted from mg L^{-1} to mg 100 g^{-1} sample weight, as in chlorophyll.
The results were analysed statistically according to the followed design and the differences of the causative means were determined according to the LSD test at a significant level of 0.05.

Table 1. Some chemical and physical properties of the study soil.

Character		Value	Unit
pH		7.7	
Ec		5.22	Decimens m-¹
Available P		38.3	$mg.kg^{-1}$
Total N		0.23	$mg.kg^{-1}$
Available K		101.20	$mg.kg^{-1}$
dissolved positive ions	Ca	16.5	$mmol.L^{-1}$
	Mg	11	
	Na	21.3	
dissolved negative ions	Carbonates	0.00	
	Bicarbonates	13.6	
	Sulfates	18.5	
	Chlorides	28.0	
Soil separators	Sand	593	$mg.kg^{-1}$
	Silt	271.5	
	Clay	135.5	
Texture		Sand loamy	

3. Results and Discussion

According to table (2), the plant height was significantly affected by the method of adding the baker's yeast extract, the concentrations used, and how they interacted with one another. For example, when compared to folious spraying, the method of adding the extract by irrigation resulted in a 21.72% increase in plant height.
Additionally, the addition concentrations had a significant impact, with a concentration of 5 g. L^{-1} significantly surpassing that of the comparator treatment. The corresponding rise rates were 10.69% and 7.92%, respectively.
Plants treated with an irrigation method and an extract concentration of 10 g. L^{-1} reached a maximum height of 51 cm, while plants treated with the extract alone resulted in a minimum height of 29 cm. This suggests that there is a strong interaction between the two components.

Table 2. Effect of the method and concentrations of adding dry baker's yeast extract and the interaction between them on the height of green broad bean plants.

Adding method	Yeast extract effect			Mean of adding methods
	0	5	10	
Spraying	41.67	41.33	29.00	37.33
Irrigation	36.33	49.00	51.00	45.44
Mean of extract	39.00	43.17	40.00	
L S D 0.05				
Adding method		Extract		Interaction
1.87		2.29		3.24

The results can be found in table (3), which displays the method, concentrations, and interaction between the dry baker's yeast extract and the total number of green fava bean leaves. The interaction between the two factors had a significant impact, but the addition method itself did not show a significant difference. The concentration of 5 g L^{-1} significantly outperformed the comparison treatment, while the concentration of 10 g L^{-1} reached (55.71 and 32.98%) respectively. Similarly, the concentration of 10 g L^{-1} outperformed the comparison treatment and had a 17.9% increase rate.
The same table results illustrated that the interaction between the two factors had a significant effect on this trait, as the addition method by irrigation and at a concentration of 10 g L^{-1} of the dry baker's yeast extract gave the largest number of leaves, reaching 41 leaves, while the lowest number of leaves was in plants sprayed with the extract and at a concentration of 10 g L^{-1} of the extract.

Table 3. Effect of the method and concentrations of adding dry baker's yeast extract and the interaction between them on the number of leaves.

Adding method	Yeast extract effect			Mean of adding methods
	0	5	10	
Spraying	26.33	51.00	20.67	32.67
Irrigation	26.33	31.00	41.00	32.78
Mean of extract	26.33	41.00	30.83	
		L S D 0.05		
Adding method		Extract		Interaction
NS		2.56		3.63

Table (4) indicated that the method and concentrations of adding dry baker's yeast extract have significantly affected the number of lateral branches of green fava beans plants, while the interaction between them did not significantly affect this trait, as the irrigation method was significantly superior and increased by 20%, and the addition concentration of 10.5 g L^{-1} had a significant effect in increasing the number of branches by (53.98, 50.30)%, respectively, compared to the comparison treatment, and the two concentrations did not show a significant difference.

Table 4. Effect of the method and concentrations of adding dry baker's yeast extract and the interaction between them on the number of branches.

Adding method	Yeast extract effect			Mean of adding methods
	0	5	10	
Spraying	1.40	2.20	2.40	2.00
Irrigation	1.86	2.83	2.51	2.40
Mean of extract	1.63	2.51	2.45	
		L S D 0.05		
Adding method		Extract		Interaction
0.37		0.46		NS

Table (5) showed the effect of the method of addition and concentrations of dry baker's yeast extract and the interaction between them on the total chlorophyll content of leaves, if both factors and the interaction between them affected this trait, as the irrigation method was significantly superior and by an increase rate of 14.59% compared to foliar spraying, and the addition concentration of 10 g. L^{-1} led to a significant superiority compared to the comparison treatment and the concentration of 5 g. L^{-1} and by an increase rate of (8.56, 15.41)%, respectively.

Table 5. Effect of the method and concentrations of addition of dry baker's yeast extract and the interaction between them in estimating the percentage of total chlorophyll.

Adding method	Yeast extract effect			Mean of adding methods
	0	5	10	
Spraying	7.26	5.40	6.46	6.37
Irrigation	7.22	6.81	7.86	7.30
Mean of extract	7.24	6.81	7.86	
		L S D 0.05		
Adding method		Extract		Interaction
0.30		0.37		0.52

The results of table (6) indicated that the method and concentrations of adding dry baker's yeast extract and the interaction between them did not significantly affect the number of pods of green fava beans.

Table 6. Effect of the method and concentrations of adding dry baker's yeast extract and the interaction between them on the number of pods.

Adding method	Yeast extract effect			Mean of adding methods
	0	5	10	
Spraying	3.67	4.33	4.00	4.00
Irrigation	4.33	4.67	5.00	4.67
Mean of extract	4.00	4.50	4.50	
		L S D 0.05		
Adding method		Extract		Interaction
NS		NS		NS

The superiority of the irrigation method in most of the characteristics compared to foliar spraying may be due to the role of the irrigation method in improving the acidity of the soil, which stimulated the roots of plants to absorb the necessary nutrients for plants and its role in increasing the efficiency of the photosynthesis process and thus increasing the vegetative growth indicators of the green fava bean plant. As for the moral superiority of the concentration of adding baker's yeast *Saccharomyces cerevisiae*, which is a single-celled eukaryotic organism that contains many important nutrients for the plant and leads to improving the characteristics of vegetative growth, this is due to its containing nitrogen, which enters into the composition of amino acids, which are the basic building blocks of proteins and enzymes, which control most of the important vital reactions that occur inside the plant. Nitrogen also entered the composition of nucleic acids DNA, RNA, which are necessary for cell division and in the arrangement of cytokinin that work to increase the activity of the apical meristem, cell division, elongation and increased growth (Day, 1990). These results are consistent with [5].

Conclusion

This study results that to achieve ideal growth of green fava beans plants grown under Basra conditions, which concluded that this plant growth would be in best condition when bio-fertilized using dry baker's yeast by irrigation at a concentration of 5 g L^{-1} and at a rate of three times during the season, and the period between each spray would be two weeks.

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