



Article

Comparing the Influence of Yeast Extract and Ascorbic Acid on Improving Faba Bean (*Vicia Faba L.*) Growth, Yield, and Quality Traits

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Abstract: A pot experiment was carried out to compare the effects of yeast extract (0, 3, and 6 g.l-1) and ascorbic acid (0, 50, and 100 mg. l-1) and their interaction on the growth, yield, and quality traits of faba bean (*Vicia faba L.*) plants, In the growing season of 2021–2022. A completely Randomized Design (CRD) was used to experiment with three replications. A probability level of 0.05 was used when comparing averages using the Least Significant Difference (LSD) test. According to the results, the yeast extract treatment (3 g.l-1) had a highly significant effect on some growth and yield traits except shoot fresh weight, chlorophyll content, pods length, the weight of 100 seeds, and carbohydrates %, where yeast extract treatment (6g.l-1) showed the highest value. Also, ascorbic acid (50mg.l-1) showed better results for some characteristics except plant height, leaf area, shoot fresh weight, number of pods, and chlorophyll content, whereas ascorbic acid (100 mg. l-1) treatment showed the highest value. Based on the results the yeast extract (3g.l-1) with ascorbic acid (50 mg.l-1) treatment showed the highest values with a plant height (50.40 cm), number of branches (5.67), leaf area (8.92cm²), shoot fresh weight (17.32), shoot dry weight (5.93), chlorophyll content (42.23), number of pods (4.33), pods length (13.33), pod weight (16.38), number of seed (4.33), weight of 100 seeds (70.97), nitrogen (4.35%), phosphorus (0.85%), potassium (4.85%), and protein (27.16%). while (6g.l-1 and 50mg. l-1) treatment gave the highest percentage of carbohydrates (58.03%). The lowest values for all of the parameters were obtained by the control treatment.

Keyword: faba bean, yeast extract, ascorbic acid, growth, yield, quality traits.

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1. Introduction

Faba bean (*Vicia faba L.*) plant is one of the major food crops and an essential source of protein for human and animal feeding [1,2]. Its green or dry seeds include high levels of protein and essential amino acids like arginine and lysine, as well as carbohydrates, vitamins, and minerals that are beneficial for health and help form strong bones [3]. It is one of the four most important crops of legumes in the world, after pea, chickpea, and lentil [4]. About 58% of faba bean seeds are comprised of carbohydrates, 26% are proteins, 2% are fat, and a small amount of vitamins (B1, B2, B3, B6, B9, C, and K) and minerals (calcium, copper, iron, manganese, magnesium, potassium, selenium, sodium, and zinc) [5]. Recent research has focused on the use of biological fertilizers to improve the production of

various vegetables and to use them in a way that is safe, healthy, and pollution-free [6]. One of the biological enhancers and natural biofertilizers that improves the growth and production of many crops is yeast (*Saccharomyces cerevisiae* L.) [7]. As it contains amino acids, plant hormones, carbohydrates, nitrogen, phosphorus, potassium, magnesium, calcium, carbon, and other minerals, it acts as a source of nutrition for plants [8]. yeast is one of the best sources of high-quality protein, particularly the essential amino acids, essential minerals, and trace elements including Ca, Co, and Fe, The best source of B-complex vitamins, amino acids, and bio-constituents, such as cytokinins, is yeast extract [9]. It stimulates the synthesis of proteins and nucleic acids as well as cell division, expansion, and chlorophyll synthesis [10,11]. Foliar spraying with yeast extract may increase some plants' growth, flowering, total yield, and pod quality[12,13,9]. also improving pea plant vegetative growth, leaves satisfying photosynthesis pigments, free amino acids, carbohydrates, and cytokinins, pod yield and quality, as well as nutritive value by increasing the levels of yeast extract in spraying solution from 1% to 3% [14]. Additionally, [9]noted that the maximum production and quality of green pods in the pea plant were related to the highest concentration of yeast extracts (2%). Ascorbic acid (AsA) was used as a source of antioxidants to protect plants from photo-oxidation [15] and for its roles in the synthesis of ethylene, gibberellin, and anthocyanins [16]. It is responsible for many processes, including photosynthesis, the development of cell walls, cell expansion, and the biosynthesis of gibberellins, anthocyanins, and hydroxyl proline [17-19].

Therefore, this research aimed to compare how yeast extract and ascorbic acid affected the production of the best faba bean growth, yield, and quality traits.

2. Materials and Methods

The effects of yeast extract and ascorbic acid on the growth, yield, and quality traits of faba bean plants were investigated in a pot experiment in the growing season of 2021–2022. *Vicia faba* L. cv. We used local seeds that we obtained from a local market. Each plastic pot containing three kilograms of peat moss and soil mixture (1:1) was seeded with five seeds. The experiment included two factors the first was yeast extract (0, 3, and 6 g.l⁻¹), and The second factor was ascorbic acid (AsA) (0, 50, and 100 mg.l⁻¹). Yeast extract and ascorbic acid were sprayed twice: the first time after 20 days from the planting date and the second time after 15 days. Spraying began in the early morning. A completely Randomized Design (CRD) was used to experiment with three replications. After 75 days, the experimental characteristics have been studied: plant growth traits, which include: plant height (cm), the number of branches per plant, leaf area (cm²), shoot fresh weight (g), shoot dry weight (g), total chlorophyll content (SPAD) it was calculated by using Spad Meter -502, Konica Minolta), pods from each replicate were collected at harvest time (120 days), and some yield parameters, including a number of pods/plant, length of pods (cm), pod weight (g), number of seeds per pods, and weight of 100 seeds (g), Additionally, the dry seed was used to determine the percentage of nitrogen by Micro-Kjeldahl method[20]. A spectrophotometer was used to measure phosphorus [21]. Potassium was determined using a flame photometer [22]; seed protein concentration was calculated by (N% × 6.25). According to the method described by [23] total carbohydrates were calculated. A probability level of 0.05 was used when comparing averages using the Least Significant Difference (LSD) test [24].

3. Results

3.1. Vegetative Growth Characters

3.1.1. Effect of Yeast Extract

Results from Table 1 show that yeast spraying at 3 g.l⁻¹ was superior and had significant effects on plant height, branch number, and leaf area. which reached (48.76 cm, 5.11 plant⁻¹, and 7.87 cm²) respectively. While 6 g.l⁻¹ treatment had the highest efficacy in shoot fresh weight, shoot dry weight, and chlorophyll content which reached (16.38 g, 4.82 g, and 40.61 SPAD) respectively.

Table 1. Effect of yeast extract and ascorbic acid at the different concentrations on vegetative growth characteristics of Faba Bean plants.

Ascorbic Acid (Mg.L ⁻¹)	Yeast Extract (G.L ⁻¹)	Plant Height (Cm)	No. Branche s/Plant	Leaf Area (Cm ²)	Shoot		Chlorophyll Content)Spad(
					Fresh Weight (G)	Dry Weight (G)	
0	0	41.97	3.33	5.66	13.97	2.97	32.37
	3	46.30	4.33	5.91	14.45	3.39	36.42
	6	47.33	4.67	6.27	15.29	3.81	39.25
Mean		45.20	4.11	5.95	14.57	3.39	36.01
50	0	46.50	5.00	6.93	15.07	3.52	36.41
	3	50.40	5.67	8.92	17.32	5.93	42.23
	6	48.73	5.33	8.35	16.89	5.53	41.50
Mean		48.54	5.33	8.07	16.43	4.99	40.05
100	0	48.13	4.67	7.68	16.26	4.13	40.96
	3	49.57	5.33	8.77	16.92	4.92	41.14
	6	48.53	4.67	8.70	16.96	5.11	41.09
Mean		48.74	4.89	8.38	16.71	4.72	41.06
Average	0	45.53	4.33	6.76	15.10	3.54	36.57
	3	48.76	5.11	7.87	16.23	4.75	39.93
	6	48.20	4.89	7.77	16.38	4.82	40.61

LSD 0.05	ascorbic acid	0.59	0.54	0.07	0.09	0.05	0.65
	Yeast	0.59	0.54	0.07	0.09	0.05	0.65
	Interaction	1.02	NS	0.12	0.15	0.19	1.12

3.1.2. Effect of Ascorbic Acid

According to the data in Table 1 ascorbic acid at 50 mg.l⁻¹ produced the best treatment for, branch number, and shoot dry weight which reached (5.33 per plant and 4.99 g) respectively. While 100 mg.l⁻¹ treatment showed the highest value in plant height, leaf area, shoot fresh weight, and chlorophyll content which reached (48.73 cm, 8.38 cm², 16.71 g, and 41.05 SPAD) respectively.

3.1.3. Effect of the interaction between yeast extract with ascorbic acid

According to Table 1, spraying 3 g.l⁻¹ of yeast and 50 mg.l⁻¹ of ascorbic acid had the best effects on plant height, branch number, leaf area, shoot fresh weight, shoot dry weight, and chlorophyll content which reached (50.40 cm, 5.67 per plant, 8.92cm², 17.32 g, 5.93 g, and 42.23 SPAD) respectively. While the control treatment gave the lowest values for all the growth indicators.

3.2. Yield and Quality

3.2.1. Effect of Yeast Extract

As shown in Table 2, spraying yeast extract at 3 g.l⁻¹ enhanced the number of pods, pod weight, and number of seeds per pod which reached (6.22, 16.18, and 3.89) respectively compared with control ones. While 6 g.l⁻¹ treatment showed the highest value in length of pods and weight of 100 seeds which reached (12.59 cm, and 70.60 g) respectively. However, compared to the treated treatment (control), the application of yeast extract increased significantly.

Table 2. Effect of yeast extract and ascorbic acid at different concentrations on yield characters of Faba Bean plants.

Ascorbic Acid (Mg.L ⁻¹)	Yeast Extract (G.L ⁻¹)	Pod			No. Of Seeds/Pod	100 Seed Weight (G)
		No. Per Plant	Length (Cm)	Weight (G)		
0	0	4.67	10.91	15.33	2.33	61.34
	3	5.67	11.77	15.90	3.33	66.28
	6	6.33	12.40	15.99	3.33	68.98
Mean		5.56	11.69	15.74	3.00	65.53
	0	5.00	11.80	15.91	3.33	66.62

50	3	6.67	13.33	16.38	4.33	70.97
	6	5.67	12.63	16.20	3.66	72.65
Mean		5.78	12.59	16.16	3.77	70.08
100	0	5.67	12.00	15.91	4.00	68.90
	3	6.33	12.60	16.27	4.00	70.03
	6	5.67	12.73	16.01	3.33	70.17
	Mean	5.89	12.44	16.06	3.78	69.70
Average	0	5.11	11.57	15.72	3.22	65.62
	3	6.22	12.57	16.18	3.89	69.09
	6	5.89	12.59	16.07	3.44	70.60
Lsd 0.05	Yeast	Ns	0.26	0.05	0.50	0.78
	Asa	0.54	0.26	0.05	0.05	0.78
	Interaction	0.93	0.45	0.09	0.87	1.36

3.2.2. Effect of Ascorbic Acid

Foliar ascorbic acid at 50 mg.l⁻¹ (Table 2) significantly greater average pod length, pod weight, number of seeds, and weight of 100 seeds which reached (12.59, 16.16, 3.78, and 70.08) respectively compared with no treated (control). In the same direction, 100 mg.l⁻¹ of ascorbic acid did not significantly enhance the number of pods/plants in comparison to control treatments.

3.2.3. Effect of the Interaction Between Yeast Extract with Ascorbic Acid

Table (2) shows the increased effects of spraying 3 g.l⁻¹ yeast and 50 mg.l⁻¹ ascorbic acid on the number of pods/plant, length of pods, pod weight, and number of seeds/ pod, which reached (6.67, 13.33, 16.38, and 4.33) respectively. While 6 g.l⁻¹ yeast and 50 mg.l⁻¹ ascorbic acid showed the highest value in weight of 100 seeds (72.65).

3.3. Seeds Chemical Content

3.3.1. Effect of Yeast Extract

The data presented in Table 3 indicate that spraying yeast extract had significant effects, The highest values of nitrogen, phosphorus, potassium, and protein were recorded by using yeast extract at a rate of 3 g.l⁻¹, which reached (4.14%, 0.85%, 4.85% and 27.16%) respectively and carbohydrates by using yeast extract at a rate of 6 g.l⁻¹ which reached (58.03%)compared to no treated (control).

Table 3. Effect of yeast extract and ascorbic acid at different concentrations on chemical constituents of Faba Bean seeds.

Ascorbic Acid (Mg.L ⁻¹)	Yeast Extract (G.L ⁻¹)	N (%)	P (%)	K (%)	Protein (%)	Carbohydrate (%)
0	0	3.57	0.70	3.51	22.31	49.23
	3	3.83	0.79	3.60	23.92	51.87
	6	3.80	0.78	3.64	23.77	54.91
	Mean	3.73	0.76	3.58	23.33	52.00
50	0	3.95	0.81	3.97	24.68	52.76
	3	4.35	0.85	4.85	27.16	56.48
	6	4.22	0.82	4.27	26.39	58.03
	Mean	4.17	0.83	4.36	26.08	55.75
100	0	3.71	0.80	4.31	23.21	54.48
	3	4.24	0.82	4.47	26.48	55.20
	6	4.12	0.79	4.18	25.77	54.89
	Mean	4.02	0.80	4.32	25.15	54.86
Average	0	3.74	0.77	3.93	23.40	52.16
	3	4.14	0.82	4.31	25.85	54.51
	6	4.05	0.80	4.03	24.31	55.94
	Mean	4.02	0.80	4.32	25.15	54.86
LSD 0.05	Yeast	0.05	0.01	0.04	0.35	1.04
	AsA	0.05	0.01	0.04	0.35	1.04
	Interaction	0.09	0.02	0.06	0.60	1.81
	Mean	0.05	0.01	0.04	0.35	1.04

3.3.2. Effect of Ascorbic Acid

As shown in Table 3 spraying ascorbic acid significantly increased the percentage of nitrogen, phosphorus, potassium, protein, and carbohydrates, the highest values were recorded by using ascorbic acid at a rate of 50 mg.l⁻¹, which reached (4.14%, 0.83%, 4.36%, 26.08%, and 55.75%)respectively as compared with control plants.

3.3.3. Effect of the Interaction Between Yeast Extract with Ascorbic Acid

The results in Table 3 showed the superior effects of spraying 3 g.l⁻¹ of yeast and 50 mg.l⁻¹ of ascorbic acid on the percentage of nitrogen, phosphorus, potassium, and protein which reached (4.35%, 0.85%, 4.85%, and 27.16%)respectively. While 6 g.l⁻¹ of yeast and

50 mg.l⁻¹ of ascorbic acid treatment showed the highest value in the percentage of carbohydrates which reached (58.03%). The lowest values for all the parameters were obtained by the control treatment.

4. Discussion

Yeast's natural supply of cytokinins, which promote cell division and differentiation as well as the synthesis of protein, nucleic acid, and chlorophyll, may have an enhancing effect [10,11,25,26]. Additionally, it contains chemicals that stimulate and regulate growth, including auxins, and gibberellins. Also, it contains various nutrients, a higher percentage of proteins, and higher values of vitamins, especially B, which cause an increase in the physiological processes inside the plant [27,28]. Thus, as photosynthesis rates increase, more carbohydrates are produced and distributed to various plant components, including stems, branches, and seeds [29]. Additionally, the importance of vitamins and amino acids to stimulate metabolic processes and their effects in activating photosynthesis through the release of CO₂ from treated plants [30,31]. In addition to the nutrients and amino acids that were immediately absorbed by leaves, yeast extract also contained a variety of growth stimulants and the precursor to IAA (tryptophan), which triggered physiological processes, led to the growth of root systems, and increased water and nutrient absorption [32]. These chemicals are essential for transferring photosynthesis' byproducts to the vegetative regions. Therefore, when the faba bean was sprayed with yeast extract, vegetative growth characteristics, seeds weight, and yield increased. Similar results on bean plants have been reported by [33-35].

The role of ascorbic acid in biological processes as a co-factor to several enzymes, such as hydroxylase enzymes which play a part in the creation of plant growth regulators that control growth, such as gibberellins, ethylene, and abscisic acid, may affect encouraging these traits [36]. At the same time, This result may be caused by AsA's role in increased leaf area and chlorophyll content (Table 1), which was reflected in an increase in the rate of biosynthesis and its products [37,38]. In addition, ascorbic acid regulates the respiration, cell division, and stimulation of the biosynthesis of amino acids. In addition, according to [39], it plays a role in protein conversion and participates in both enzymatic and non-enzymatic cellular processes. These results were in agreement with the findings reported by [40, 41].

5. Conclusion

When exogenous spraying with yeast extract and ascorbic acid, the faba bean plant's growth, yield, and quality attributes significantly increased. Particularly at 3 g.l⁻¹ of yeast and 50 mg.l⁻¹ of ascorbic acid, the interaction between yeast extract and ascorbic acid created a high rate for the features under study.

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