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Effect of Growth Stimulants on Growth, Abscission and Productivity of Some Faba Bean Cultivars

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ABSTRACT

Two field experiments were conducted at the Experimental Farm, Faculty of Agriculture, Menoufia University, Shebin El-Kom, Egypt during2022/2023and 2023/2024 seasons to study the effect of foliar application with some growth stimulants on growth, chlorophyll content "Chl", flowering and abscission as well as yield and its components and seed protein% of some faba bean cultivars. Each experiment included 24 treatments which were the combination of 4 faba bean cultivars (Sakha4, Nubaria5, Giza843 and Mariout2) and 6 foliar application treatments of growth stimulants substances (control, yeast, fulvic acid, seaweed, effective micro-organisms"EM1"and salicylic acid). The results can be summarized as follows:

1- There are significant differences among the tested faba bean cultivars in their growth, flowering, abscission% and seed yield and quality in favor of Mariout2 for plant height, leaf area/plant, total dry weight/plant, no. of flowers/plant, and flowers and total abscission/plant%, as well as straw yield/ fed,Giza843 for total Chl, no. of setting pods/ plant, setting pod abscission%, no. of pods/plant and seed yield/plant as well as seed and biological yields/fed,Nubaria5 for no. of leaves/plant, no. and weight of seeds/pod and 100-seed weight and Sakha4 for harvest index and protein%.

2- Spraying plants with any tested growth stimulants caused a significant increase in all studied characters but reduced the abscissions% of flower, setting pods and their total/plant compared to the control treatment.

3- Spraying Giza843cv. with yeast (2.5g/L) was the most effective interaction treatments for increasing Chl. content, no. of pods/plant, seed yield either per plant or per fed. The highest values of plant height and total dry weight/plant were obtained when Mariout2cv.was sprayed with EM1 (2cm3/L). The lowest total abscission/ plant% was scored by Sakha4 cv. sprayed with yeast (2.5g/L).

KEYWORDS: *Vicia faba*, Cultivars, Growth stimulants, Flowering, Yield.

1. INTRODUCTION

Faba bean (*Vicia faba*, L.) is an important pulse crop valued for its nutritional benefits and role in sustainable agriculture. Faba bean seeds are characterized by high levels of protein (~25%–30%), and carbohydrate (~55-60%), appropriate level of minerals (magnesium, calcium, and iron) and vitamins (riboflavin, thiamine, and pyridoxine), and low level of fats (Martineau-Côté *et al.,* 2022). In Egypt, the cultivated area of faba bean was approximately 111527 feddans with an average productivity of 1.45 ton /fed according to Agricultural Statistics Bulletin (2023). Faba bean seed production in Egypt (about 161 thousand tons) is still limited and fails to face the local increasing consumption of the crop. To satisfy the national requirement of faba bean, either the area could be increased and/ or the high yielding cultivars should be grown as well as improved the productivity of such cultivars using some growth stimulant substances.

Varietal differences play a critical role in determining growth performance, yield potential, and quality traits. Significant variation existed among the various faba bean cultivars, attributed to genetic differences and their interactions with the environment. Varietal differences can be detected among faba bean genotypes in their growth (Sadak *et al.*, 2023), photosynthetic pigments (Attia, 2023), yield (Gomaa *et al.,* 2023), and nutritional composition (Zaki *et al.,* 2021). A significant contributor to the instability of faba bean seed yield is may be due to the high rate of flower and pod abscission, which ranged about 82-88% (Ibrahim *et al*., 2014) up to 84-91% (Ali *et al*., 2016). Nutrient availability and hormonal regulation are intricately linked in their effects on flower and pod abscission in faba bean. Managing nutrient levels effectively and understanding hormonal interactions can help minimize abscission and maximize yield of faba bean. The majority of previous researches aimed at increasing seed yield has concentrated on breeding new varieties, optimizing environmental conditions, and refining agricultural management techniques. Using organic and / or bioproducts in agricultural practices worldwide is required to increase in an effort to implement sustainable agriculture policies. Many growth stimulants such as yeast, EM1, seaweed, fulvic acid and salicylic acid have the capacity to augment plant productivity and/ or decrease the abscission % of flowers and pods/ faba bean plants by enhancing crop nutrition and/or functioning as phytohormones, yeast, seaweed, effective microorganisms (EM1), fulvic acid and salicylic acid. Applying such growth stimulants was found to be most attention for its potential to enhance plant growth and productivity of faba bean such as application of yeast (Al-Rubaiee, 2024), seaweed (Faiyad and Abd El-Azeiz, 2024), EM1 (Abd El-Ati, 2017), salicylic acid (Bughdady and Kenawey, 2021) and fulvic acid (Ismail and Fayed, 2020).

Therefore, the objective of this investigation is to study the response of some faba bean cultivars to foliar application of some growth stimulant substances in attempt to find a way to minimize flowers and pods abscission and maximize faba bean productivity.

2. MATERIALS AND METHODS

Two field experiment were conducted at the Experimental Farm, Faculty of Agriculture, Menoufia University, Shebin El-Kom, Egypt (latitude 30°52'58"N, longitude 31°02'58"E) during 2022/2023 and 2023/2024 seasons. These experiments were conducted to study the effect of foliar application with some growth stimulants on growth, flowering and abscission as well as yield and quality of some faba bean cultivars. Each experiment included twenty-four treatments which were the combination of four faba bean cultivars (Sakha 4, Nubaria 5, Giza 843 and Mariout 2) and six foliar application treatments of growth stimulants substances ,i.e. control (tap water), yeast (2.5 g/l), fulvic acid (1 g/l), seaweed (1 g/l), effective micro-organisms " EM1" (2 cm^3/L) and salicylic acid (1 g/L)

The characteristics of the tested growth stimulants are presented in Table (1). Yeast extract (*Saccharomyces cerevisiae*) was prepared from dry yeast (baker's yeast). Seaweed, i.e. brown algae (*Ascophyllum nodosum*) as a powder was applied as commercial substance namely "Acadian" manufactured by Acadian AagriTech, Canada. EM1 is a biological solution developed by

Table 1. The main properties of tested growth stimulants in the experiment.

Yeast		Seaweed		Fulvic acid		Salicylic acid		EM1	
Appearance	Soluble powder	Appearance	Brownish-Black powder	Appearance	Brown powder	Appearance	White to off-white powder	Appearance	Reddish brown solution
pH	6.5-7.0	pH	6.5-8.0	pH	4.00	pH	6.5	pH	3.2-3.8
Amino acids (mg /100g dry wt.)		Amino acids (%)		IUPAC Name	3,7,8-trihydroxy-3-methyl-10-oxo-1,4-dihydropyrano[4,3-b]chromene-9-carboxylic acid	IUPAC Name	2-Hydroxybenzoic acid	Formula	Liquid contains various strains of beneficial micro-organisms, i.e. lactic acid bacteria, photosynthetic bacteria, yeasts, fermenting fungi and actinomycetes.
Arginine	1.99	Arginine	0.22						
Histidine	2.63	Histidine	0.07						
Isoleucine	2.31	Isoleucine	0.26						
Leucine	3.09	leucine	0.38						
Lysine	2.95	Lysine	0.30	Chemical Formula	$C_{14}H_{12}O_8$	Chemical Formula	$C_7H_6O_3$		
Methionine	0.72	Methionine	0.11						
Phenyl alanine	2.01	Phenyl alanine	0.24	Molecular weight	308.24 g/mol	Molecular weight	138.12 g/mol		
Threonine	2.09	Threonine	0.25						
Tryptophan	0.45	Tryptophan	0.13	Solubility	In water and acidic	Solubility	In alcohol, ether, acetone and bowling water		
Valine	2.19	Valine	0.27	Elemental composition (%)					
Glutamic acid	2.00	Glutamic acid	0.71	C	40.1				
Serine	1.59	Serine	0.27	N	0.67				
Aspartic acid	1.33	Aspartic acid	0.53	H	3.57				
Cystine	0.23	Cystine	0.07	O	55.0				
Proline	1.53	Proline	0.25	S	0.66				
Tyrosine	1.49	Tyrosine	0.12						
Vitamins (mg /100g dry wt.)		Minerals							
Riboflavin	4.96	Nitrogen	0.5-2 %						
Thimain	2.71	Phosphorus	0.1-0.2 %						
Pyridoxine	2.90	Potassium	1.5- 2.5 %						
Insitol	0.26	Calcium	1-3 %						
Biotin	0.09	Magnesium	0.5-1 %						
Nicotinic acid	39.88	Sulfur	2-3 %						
Panthothenic acid	19.56	Iron	100-500 ppm						
Folic acid	4.36	Zinc	10-50 ppm						
Carbohydrates (mg /100g dry wt.)		Carbohydrates (%)							
Total carbohydrates	23.20	Alginic acid	18-27 %						
Glucose	13.33	Mannitol	3-8 %						
Hormones		Hormones							
Cytokinin, Auxin	Trace	Cytokinin, Auxin	Trace						
Minerals									
N, P, K, Mg, Ca, Si, S, Fe, Zn, Mn ...etc	Trace								

a Japanese Horticulturist, Japan. Fulvic acid and EM1 were obtained from outlets of Ministry of Agriculture and Land Reclamation, while salicylic acid from El-Gomhouria Company for Chemilab, Egypt. The tested growth stimulants were sprayed twice at 30 and 45 days after sowing (DAS). In each spray, the water volume used was 400 L water/fed. The tested treatments were arranged in a strip plot design with three replications. Faba bean cultivars were randomly distributed in the vertical strip plots, while stimulants were occupied in the horizontal strip plots. In each season, prior to sowing, soil samples were collected at depth 0-30 cm to estimate various physical and chemical properties of the experiment soil by the methods outlined by Jackson (1973), Chapman and Pratt (1978) and Page et al. (1982) as shown in Table (2).

After harvest, the preceding crop (maize) in both seasons, the experimental land was prepared. The furrowing was done at a rate of 60 cm width for each furrow. The area of each experimental plot was 10.8 m^2 (3 m in length and 3.6 m in width) including six furrows. Faba bean seeds were inoculated before sowing immediately by specific Okadin bacteria included N- fixing bacteria (*Rhizobium leguminosarum*) at the rate of 300 g/fed. The seeds of tested cultivars and N-fixing bacteria were obtained from Agricultural Research Center, Giza, Egypt. Faba bean seeds were sown on 2nd and 3rd November in the first and second seasons, respectively on one ridge, in hills spacing of 20 cm. At 30 days after sowing (DAS),

Table 2. Physical and chemical properties of the experimental soil.

Properties		2022/2023	2023/2024
Texture class		Clay loam	Clay loam
Sand (%)		33.03	34.95
Silt (%)		28.60	28.60
Clay (%)		38.37	36.45
pH		7.63	7.78 (Slightly alkaline)
Organic matter %		1.75	1.79 (Low content)
EC (ds/m)		0.68	0.70 (Non-Saline Soil)
Macronutrients (ppm)	N	32.13	33.92 (Medium level)
	P	10.57	11.02 (Medium level)
	K	302.73	310.28 (High level)

faba bean plants were thinned to two plants /hill, producing 70000 plants/fed. Phosphate fertilizer (22.5 P2O5 kg/fed) as a form of calcium superphosphate (15 % P2O5) was added during soil preparation. Nitrogen fertilizer (15 kg N/fed) as a form of urea (46.5% N) and potassium fertilizer (24 kg K_2O /fed) as a form of potassium sulfate (48 % K_2O) were added to plants in one dose during the first irrigation (35 DAS). Other agricultural practices of growing faba bean plants were conducted as recommended.

2.1.Characters studied:

1- Growth characters and photosynthetic pigments:

Five guarded plants were taken at random from each experimental plot (at three samples, i.e. 60, 75 and 90 DAS) to estimate growth characters, i.e. plant height (cm), number (no.) of leaves/plant, leaf area/plant (cm^2) and total dry weight/plant as well as total Chl (SPAD value) determined in the upper fourth leaf ,using Chl meter SPAD–502 Plus (Minolta Co. Ltd., Osaka, Japan).

2- Production and abscission % of flowers and pods

At beginning of flowering period, five plants were marked at random in each experimental plot. No. of flowers and setting pods were recorded on the main stem and branches per each marked plant during the flowering period at three days intervals beginning the blooming of the first flower until the end of flowering period. Then, the following data were measured as follows:

1- No. of flowers/ plant
2- No. of setting pods (young pods)/ plant.
3- Flowers abscission / plant %:

$$\frac{\text{No. of flowers/ plant - No. of setting pods/ plant}}{\text{No. of flowers/ plant}} \times 100$$

4- Pods abscission / plant %:

$$\frac{\text{No. of setting pods/ plant - No. of pods at harvest/ plant}}{\text{No. of setting pods/ plant}} \times 100$$

5- Total abscission / plant %:

$$\frac{\text{No. of flowers/ plant - No. of pods at harvest/ plant}}{\text{No. of flowers/ plant}} \times 100$$

3- Yield and seed quality

At maturity, the plants of Sakha 4 and Giza 843 cultivars were harvested at 150 DAS, while Nubaria 5 and Mariout 2 cultivars were harvested at 160 DAS in both seasons. Samples of ten guarded plants were taken randomly to determine the yield components of plant, i.e. No. of pods/plant, No. of seeds/pod, 100-seed weight (g), seeds weight/ pod (g) and seed yield/ plant (g). However, seed, straw and biological yields of inner two furrows in each experimental plot were estimated and converted to kg/fed "fed = 4200 m^2", after then harvest index (%) was calculated. Protein in the dry seeds was calculated by multiplying N% by the factor of 6.25. The N% was determined using the micro Kjeldahl method as described by AOAC (2019).

2.2.Statistical analysis

Measurements data were statistically analyzed according to the methods described by Gomez and Gomez (1984). The statistical analysis was done using CoStat package program, version 6.45 (CoStat, 2017). The differences between the means of different treatments were tested using Duncan's multiple range test (Duncan, 1955) at 5% probability level. The mean values within each column, presented in the tables, followed by the same letter (s) are not significant at 5% level of probability.

3. RESULTS AND DISCUSSIONS

3.1. Growth characters and photosynthetic pigments

The growth characters (plant height, no. of leaves, leaf area and total dry weight/ plant) as well as chlorophyll content "Chl" of faba bean plant at three plant ages (60, 75 and 90 DAS) of the four tested faba bean cultivars (Table 3) as affected by foliar application of growth stimulants (Table 4) and their interaction (Figs 1-3) were studied in this part.

3.1.1. Mean performance of tested cultivars

There are significant differences among the four faba bean cultivars in all growth characters studied at different growth ages in both seasons as presented in Table (3). Mariout 2 cultivar "cv." recorded the taller plants and exhibited higher values of leaf area and total dry weight/ plant than that of the other cultivars. However, Nubaria 5 cv. had substantial increase in the no. of leaves/ plant compared to the rest cultivars. Reversely, the lowest values were recorded by Nubaria 5 cv. for plant height, and Sakha 4 cv. for each of no. and area of leaves as well as total dry weight/ plant.

Table 3. Mean values of growth characters and chlorophyll content for the tested faba bean cultivars at different plant ages during 2022/23 and 2023/24 seasons. (overall means of the tested growth stimulants).

Cultivars	2022/2023 season			2023/2024 season		
	60 DAS	75 DAS	90 DAS	60 DAS	75 DAS	90 DAS
			Plant height (cm)			
Sakha 4	59.08 ab	91.13 b	120.27 b	59.80 b	86.60 b	109.80 b
Nubaria 5	52.84 c	83.21 c	108.19 d	55.99 b	81.96 d	103.23 d
Giza 843	57.30 bc	89.11 bc	112.44 c	57.68 b	85.06 c	106.12 c
Mariout 2	62.78 a	100.42 a	124.86 a	64.53 a	93.30 a	120.78 a
			No. of leaves/plant			
Sakha 4	29.44 b	40.69 d	51.83 d	28.30 d	34.82 b	54.46 c
Nubaria 5	32.59 a	47.43 a	60.67 a	33.14 a	39.80 a	57.43 a
Giza 843	29.68 b	42.77 c	53.87 c	29.69 c	37.16 ab	54.89 c
Mariout 2	31.49 ab	45.43 b	58.10 b	32.05 b	38.76 ab	56.70 b
			Leaf area/plant (cm^2)			
Sakha 4	1356.72 c	2391.96 d	3842.95 c	1198.32 c	2376.97 b	3662.31 c
Nubaria 5	1545.24 ab	2922.72 b	4486.08 ab	1420.98 ab	2807.55 a	4467.70 a
Giza 843	1462.58 bc	2612.83 c	4241.48 b	1316.82 bc	2573.37 b	4088.79 b
Mariout 2	1628.51 a	3100.32 a	4772.34 a	1509.31 a	2922.09 a	4684.40 a
			Total dry weight/plant (g)			
Sakha 4	9.65 b	23.51 d	49.46 d	10.72 b	18.58 c	49.74 d
Nubaria 5	11.05 ab	26.24 b	52.24 b	12.21 ab	22.48 a	53.24 b
Giza 843	10.21 b	24.74 c	50.94 c	11.44 b	20.38 b	52.03 c
Mariout 2	12.33 a	28.38 a	54.49 a	13.33 a	23.21 a	57.83 a
			Total chlorophyll (SPAD value)			
Sakha 4	40.12 a	40.90 a	46.14 a	41.30 a	41.73 a	42.85 a
Nubaria 5	39.15 ab	40.19 b	42.30 b	40.20 b	40.75 b	41.50 b
Giza 843	40.34 a	41.36 a	46.53 a	41.82 a	42.56 a	43.41 a
Mariout 2	38.24 b	39.87 b	40.67 c	39.87 b	40.50 b	41.35 b

These results are fairly true, generally, in the three growth stages at both seasons. The differences among the tested faba bean cultivars obtained herein are related and due to their genetic background. The superiority of Mariout 2 cv. in the total dry weight/ plant may be attributed to the increase in its plant height and leaf area/ plant which caused an increase in dry matter accumulation. On the other hand, Giza 843 and Sakha 4 cvs were significantly superior in the total chl. followed by Nubaria 5 and Mariout 2 in a descending order without significant differences between them. It can be noticed also that all growth characters studied were gradually increased with advanced age from 60 up to 90 DAS in the four cultivars in both seasons. These results are in harmony with those obtained by other researchers who found variation among some faba bean cultivars in their growth habits, i.e. plant height (Eid *et al.,* 2017 and Sadak *et al.,* 2023), no. of leaves/ plant (Messiha *et al*., 2018 and Abdel-Baky *et al*., 2019), leaves area/ plant (Bakhoum *et al*., 2022 and Sulieman *et al*., 2023) and total dry weight/ plant (El-Hendawy *et al.,* 2013 and Abdelaal, 2023). Moreover, other investigators found that the total chl. content was found to be higher in Sakha 4 cv. as reported by El-Shafey *et al*. (2016) and Abdelaal (2023) as well as Giza 843 cv. as recorded by Saudy *et al*. (2020) and Elbatrawy *et al*. (2023).

3.1.2. Mean effect of growth substances:

Data presented in Table (4) indicated that all growth characters studied herein were significantly affected by foliar application of the tested growth stimulants substances along different growth ages in both seasons. It is obvious that foliar application of EM1 produced the highest significant values of plant height, no. of leaves and total dry weight/ plant followed by yeast and fulvic acid application without significant differences among them in most ages in the two seasons, whereas foliar application of seaweed and salicylic acid produced intermediate values of such traits. Moreover, the higher values of leaf area/ plant and total chl. were recorded when the plants were sprayed with yeast, EM1 and fulvic acid, in a descending order, without significant differences among them as compared with seaweed and salicylic acid that took the next rank in this respect. On the other hand, the untreated plants (control) produced the lowest significant values for all abovementioned growth characters studied. The superiority of EM1 treatment may be attributed to the active components in its formula where it contains a sugar-based medium (cane molasses) that provides a low pH value, as well as many specific microorganisms producing bioactive useful materials for plants such as hormones and growth stimulators that trigger cell division (Pszczółkowski *et al*., 2023). Also, the existence of nutrients, amino acids and hormones involved in the yeast caused a promoting effect on cell elongation and division (Ibrahim *et al*., 2023) as well as improving chl. contents, which leads to the increase in photosynthetic rate in the plants (Abou El-Yazied and Mady, 2011 and El-Shafey *et al*., 2016). These findings are similar to those obtained by other investigators who found that there are positive effect by foliar application of faba bean plants with some growth substances such as EM1 for plant height and total dry weight/ plant (Almumin and Matloob, 2024), and leaf area/ plant (Abd El-Ati, 2017), yeast for no. of leaves/ plant (Abd El-Sattar and Abdelhameed, 2024), dry weight/ plant and total chl. (Zaki *et al*., 2021), and fulvic acid for leaf area/ plant and chl. (Abdel-Baky *et al*., 2019) as well as seaweed for leaf area/ plant (Hamza and Abbas, 2020) as compared with the untreated faba bean plants.

3.1.3. Effect of the interaction

The interaction between the tested faba bean cultivars and the growth stimulants was found to be significant for plant height, total chl. and total dry weight/plant characters at 90 DAS in both growing seasons. On the other hand, the differences among interaction treatments did not reach the 5% significance level for the rest studied growth characters at all growth ages in the first and / or second seasons, indicating that the tested cultivars were similarly responded to different growth stimulants and each factor of them independently responded. Therefore, these data were excluded.

Table 4. Mean values of vegetative growth characters and chlorophyll content as affected by growth stimulants at different growth ages in 2022/23 and 2023/24 seasons. (overall means of the tested cultivars).

Stimulants	2022/2023 season			2023/2024 season		
	60 DAS	75 DAS	90 DAS	60 DAS	75 DAS	90 DAS
			Plant height (cm)			
Control	52.93 d	84.13 c	111.55 d	54.68 d	81.19 c	104.31 d
Yeast	60.23 a	93.48 ab	117.70 b	61.42 ab	88.84 ab	112.19 a
Fulvic acid	59.13 ab	92.18 ab	117.98 b	60.50 abc	87.84 ab	111.04 b
Seaweed	57.85 bc	91.07 ab	116.58 c	59.25 bc	86.64 b	109.84 c
EM1	61.02 a	95.18 a	119.08 a	62.70 a	90.12 a	113.31 a
Salicylic acid	56.83 c	89.77 b	115.73 c	58.44 c	85.76 b	109.21 c
			No. of leaves/plant			
Control	26.08 d	38.57 c	51.90 e	25.87 e	33.08 d	51.94 e
Yeast	32.77 ab	46.42 ab	57.15 b	33.11 ab	39.64 ab	57.57 b
Fulvic acid	31.67 bc	45.07 ab	56.60 c	31.85 bc	38.53 abc	56.70 c
Seaweed	30.73 bc	43.75 b	55.72 d	30.53cd	36.28 c	54.87 d
EM1	34.08 a	48.02 a	58.65 a	34.23 a	40.82 a	59.02 a
Salicylic acid	29.47 c	42.67 bc	56.68 c	29.18 d	37.46 bc	55.13 d
			Leaf area/plant (cm^2)			
Control	1202.23 d	2484.64 b	3773.48 c	1102.46 d	2263.22 c	3773.92 c
Yeast	1684.96 a	2938.94 a	4727.06 a	1557.31 a	3012.98 a	4591.78 a
Fulvic acid	1543.99 abc	2807.92 a	4416.02 ab	1416.21 abc	2745.73 ab	4282.75 ab
Seaweed	1497.69 bc	2745.79 a	4248.15 b	1353.64 bc	2619.53 bc	4033.07 bc
EM1	1622.74 ab	2874.51 a	4544.27 ab	1469.76 ab	2845.98 ab	4486.94 ab
Salicylic acid	1437.98 c	2689.96 ab	4305.30 b	1268.75 c	2532.52 bc	4186.33 abc
			Total dry weight/plant (g)			
Control	9.04 c	21.99 d	45.30 c	9.85 d	18.32 c	44.95 b
Yeast	11.82 a	27.69 ab	55.24 a	13.00 ab	22.69 a	57.38 a
Fulvic acid	11.09 ab	26.44 abc	52.01 b	12.35 abc	21.59 ab	53.61 a
Seaweed	10.61 b	24.70 cd	50.90 b	11.70 bc	21.01 ab	53.11 a
EM1	12.03 a	28.29 a	56.39 a	13.40 a	23.00 a	58.14 a
Salicylic acid	10.27 b	25.19 bc	50.85 b	11.27 c	20.35 bc	52.07 ab
			Total chlorophyll (SPAD value)			
Control	37.66 b	38.91 c	42.10 b	39.16 c	39.91 d	40.88 d
Yeast	40.50 a	41.98 a	45.17 a	41.90 a	42.61 a	43.30 a
Fulvic acid	39.86 a	40.83 abc	44.28 a	41.11 ab	41.70 abc	42.56 abc
Seaweed	39.47 a	40.36 abc	43.90 ab	40.70 b	41.12 bc	42.19 bc
EM1	40.21 a	41.55 ab	44.64 a	41.60 a	42.10 ab	42.89 ab
Salicylic acid	39.07 ab	39.87 bc	43.37 ab	40.31 b	40.89 cd	41.85 c

The data of the interaction for plant height at 90 DAS during both seasons are illustrated in Figure "Fig" (1). The highest significant values of plant height (128.87 and 124.67 cm) were obtained when Mariout 2 cultivar was sprayed with EM1, While, the lowest values (102.07 and 99.22 cm) were obtained by untreated plants of Nubaria 5 cultivar in the first and second seasons, respectively. In this respect, Hurtado *et al*. (2019) found that the plant height of some faba bean cultivars were increased when they were sprayed with EM1 at a rate of 100 ml/L compared to untreated plants. In addition, El-Shafey *et al*. (2016) recorded tallest plants of faba bean cultivars by foliar application of yeast at a rate of 10 g/L compared to untreated plants.

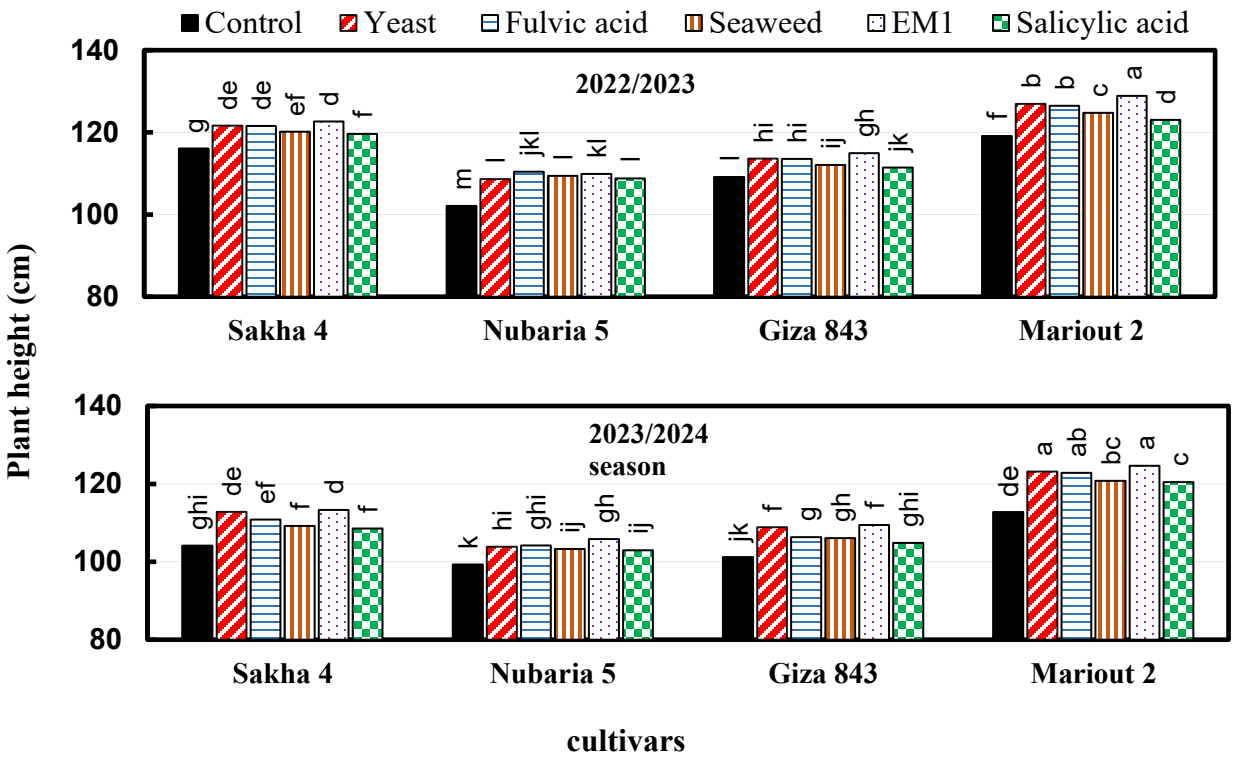

Figure 1. Effect of the interaction between faba bean cultivars and growth stimulants on plant height at 90 DAS during 2022/2023 and 2023/2024 seasons.

The interaction effect between the two tested factors illustrated in Fig (2) showed that the tested faba bean cultivars varied in their response to growth stimulants for total chl. (SPAD value) at 90 DAS in both seasons. Plants of Giza 843 cultivar produced the highest values in the total chl., especially when they were sprayed with yeast (47.94 and 44.45) in the first and second seasons, respectively. On the other hand, the lowest significant values of total chl. were obtained by untreated plants of Mariout 2 and Nubaria 5 cultivars in both seasons.

The interaction effect on total dry weight / plant illustrated in Fig (3) indicated that the heaviest total dry weight of plant (61.25 and 62.23 g) was registered by spraying Mariout 2 plants with EM1 in the first and second seasons, respectively. However, the lowest values of total dry weight/plant were obtained by the untreated plants of Giza 843 (44.13 g) in the first season and Sakha 4 (42.36 g) in the second season. This increase observed herein by such interaction treatment (Mariout 2 X EM1) may be due to the increases in plant height and different plant organs as shown in Tables (3 and 4).

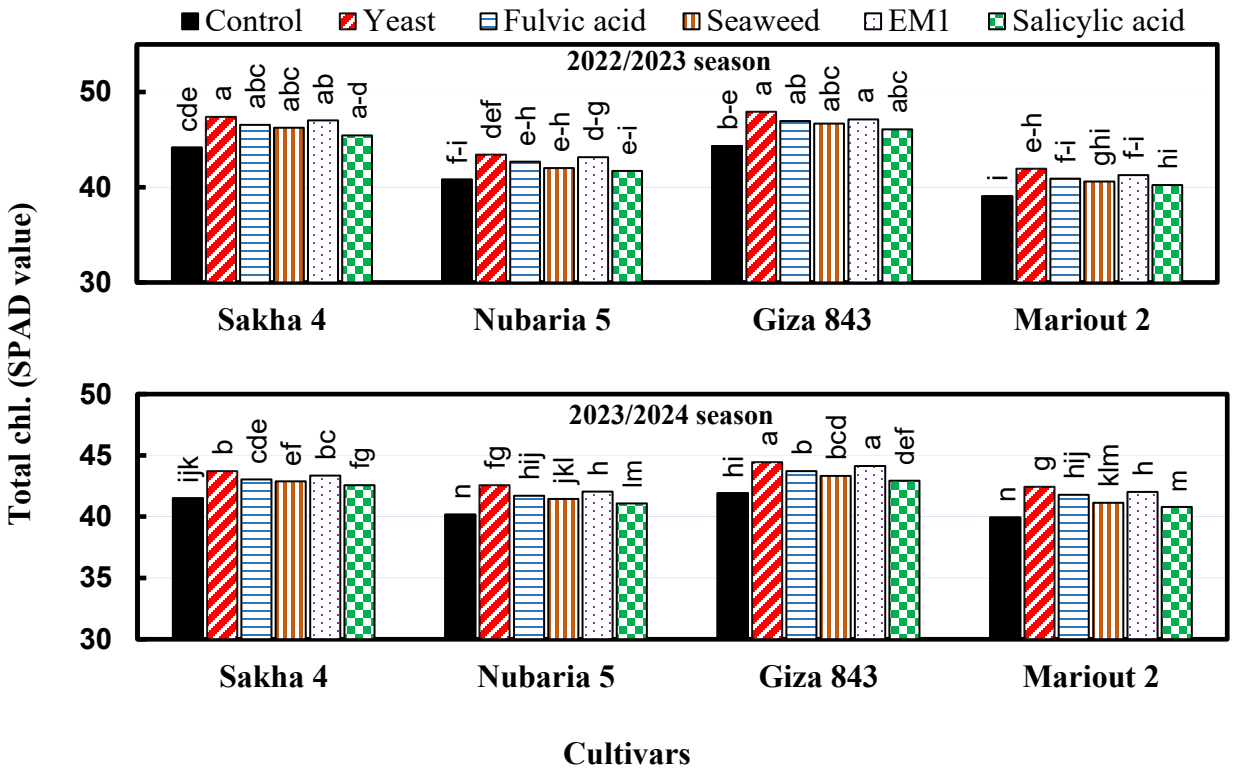

Figure 2. Effect of the interaction between faba bean cultivars and growth stimulants on total chl. at 90 DAS during 2022/2023 and 2023/2024 seasons.

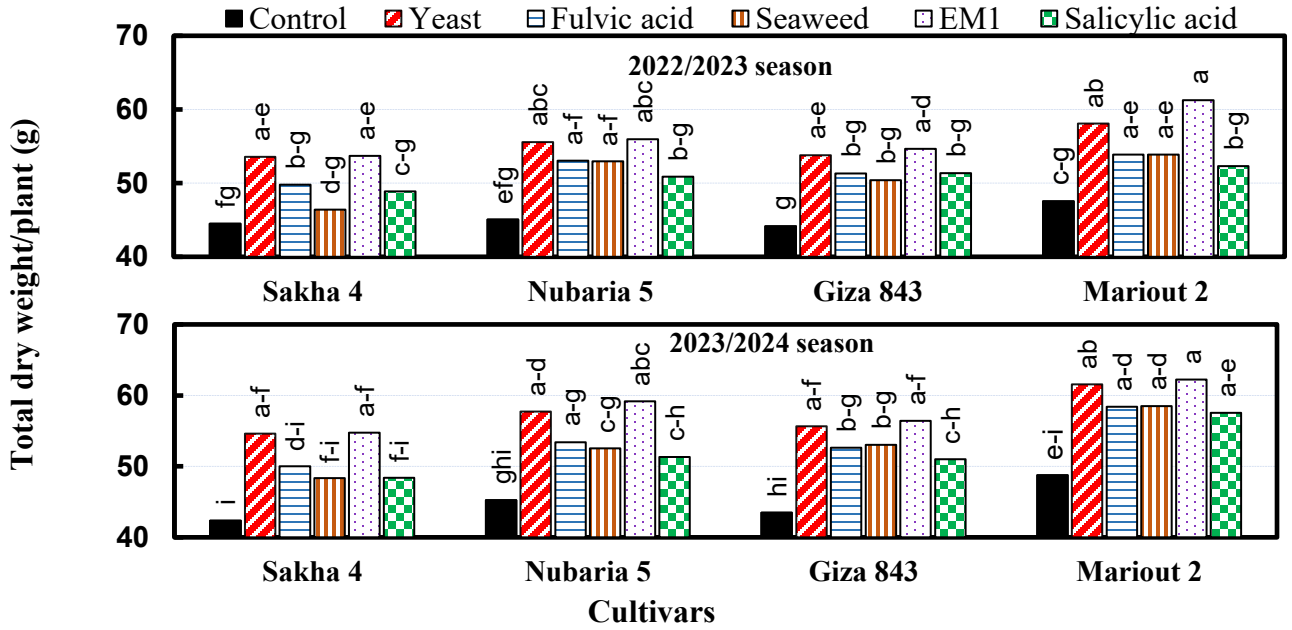

Figure 3. Effect of the interaction between faba bean cultivars and growth stimulants on total dry weight /plant at 90 DAS during 2022/2023 and 2023/2024 seasons.

3.2.Production and abscission of flowers and pods

3.2.1. Mean performance of tested cultivars

Significant differences in total no. of flowers and setting pods/ plant were detected among the tested faba bean cultivars (Table 5). Giza 843 and Mariout 2 cvs. produced the highest significant values of no. of flowers/plant without significant differences between them, as well as Giza 843 cv for no. of setting pods in both seasons. On the other hand, Sakha 4 and Nubaria 5 cvs produced the lowest ones in both seasons. Giza 843 cultivar exhibited increases in total no. of flowers over Sakha 4 cv. by 23.26%, and in total setting pods by 46.20% over Nubaria 5 cv, as an average of both seasons. In this concern, Abdellatif *et al*. (2012) and Ibrahim *et al*. (2014) found variation among faba bean cultivars in the no. of flowers and setting pods/plant.

Concerning abscission %, it can be noticed that Sakha 4 and Giza 843 cvs. afforded lower flowers abscission %, while Mariout 2 cv. recorded the highest flowers abscission % in both seasons. On the other hand, the highest setting pods abscission % was recorded by Giza 843 cv. compared to other tested cultivars in both seasons. Moreover, it can be noticed that Sakha 4 cv recorded the lowest value of total abscission %, while Mariout 2 cv. registered the highest value in the two growing seasons. In this concern, Ali *et al*. (2016) found that total abscission % was lower in Sakha 4 cv. than other some tested faba bean cultivars. However, the differences among the tested faba bean cultivars may be due to the differences among them in their Chl content (Attia, 2023) and endogenous hormones (El-Shafey *et al*., 2016). In this concern, it can be concluded that Sakha 4 cv which had the highest values of Chl content produced the lowest abscission % and the adversely behavior was done by Mariout 2 cv as shown previously in Table (3). Other investigators found a relationship between the decrease in the Chl content and increasing of flower abscission (Saifuddin *et al*. 2010), and reduction in pod setting (Amoanimaa-Dede *et al*., 2022).

Table 5. Mean values of production and abscission of flowers and pods/ plant for the tested faba bean cultivars during 2022/23 and 2023/24 seasons. (overall means of the tested growth stimulants).

Cultivars	No./plant			Abscission/ plant (%)		
	Flowers	Setting pods	Pods at harvest	Flowers	Setting pods	Total
			2022/2023			
Sakha 4	123.97 b	49.33 b	19.48 b	60.21 b	60.51 ab	84.28 c
Nubaria 5	126.86 b	38.90 c	17.28 d	69.33 a	55.59 b	86.38 b
Giza 843	150.61 a	60.35 a	21.22 a	59.93 b	64.84 a	85.91 b
Mariout 2	151.35 a	45.28 bc	18.34 c	70.08 a	59.48 ab	87.88 a
			2023/2024			
Sakha 4	128.03 c	51.46 b	23.29 b	59.81 c	54.73 b	81.81 c
Nubaria 5	139.75 b	46.54 c	20.44 d	66.70 b	56.07 b	85.37 ab
Giza 843	160.08 a	63.88 a	24.93 a	60.10 c	60.97 a	84.42 b
Mariout 2	161.90 a	47.40 c	21.57 c	70.72 a	54.50 b	86.68 a

3.2.2. Mean effect of growth stimulants

Data in Table (6) showed that that the foliar application of all growth stimulants significantly increased the total no. of flowers and setting pods/plant compared to the control treatment. Foliar application of EM1 and yeast resulted in substantial increase in the total no. of flowers/ plant and setting pods /plant, respectively compared to the other growth stimulants without significant differences among them, mostly, in both seasons. Other investigators found increasing in the no. of flowers/ plant by foliar application of yeast (Muhammad *et al*., 2020) and salicylic acid (Abdelaal, 2015) as well as improving in the no. of setting pods/plant by foliar application of seaweed

Table 6. Mean values of production and abscission of flowers and pods of faba bean as affected by growth stimulants during 2022/23 and 2023/24 seasons. (overall means of the tested cultivars).

Stimulants	No./plant			Abscission/ plant (%)		
	Flowers	Setting pods	Pods at harvest	Flowers	Setting pods	Total
			2022/2023			
Control	130.90 b	43.65 b	16.21 d	66.66 a	62.86 a	87.62 a
Yeast	134.65 ab	51.06 a	20.19 a	62.08 b	60.46 a	85.00 b
Fulvic acid	137.46 ab	47.79 ab	19.55 b	65.23 ab	59.09 a	85.78 b
Seaweed	139.31 ab	49.06 a	19.72 ab	64.78 ab	59.81 a	85.85 ab
EM1	145.04 a	50.69 a	19.96 ab	65.05 ab	60.62 a	86.24 ab
Salicylic acid	141.83 a	48.54 ab	18.86 c	65.52 ab	61.15 a	86.70 ab
			2023/2024			
Control	132.52 c	44.23 d	17.27 e	66.62 a	60.96 a	86.97 a
Yeast	148.25 ab	58.31 a	25.25 a	60.67 c	56.70 ab	82.97 b
Fulvic acid	146.19 b	51.98 c	23.58 bc	64.44 b	54.65 b	83.87 b
Seaweed	152.65 ab	54.46 b	22.77 cd	64.32 b	58.19 ab	85.09 ab
EM1	156.15 a	52.96 bc	23.83 b	66.08 a	55.00 b	84.74 b
Salicylic acid	148.90 ab	51.98 c	22.67 d	65.09 ab	56.39 ab	84.78 b

(Abdel-Aziz, 2018) compared to the untreated faba bean plants. The data in Table (6) indicated also that foliar application of all tested stimulants decreased the flowers, setting pods and total abscission %/ plant compared to untreated plants. Application of yeast and fulvic acid produced the lowest abscission/ plant % of such these traits without significant differences among most tested growth stimulants in this respect. On the other hand, the highest values of the total abscission/ plant % were recorded by the untreated plants. Therefore, it could be concluded that there is a negative relationship between abscission % and foliar application of growth stimulants, especially yeast and fulvic acid which seemed to be the most effective and useful treatments for decreasing the total abscission/plant. Similar results were obtained by Abido and Seadh (2014) who reported that the total abscission in faba bean plants could be decreased by foliar application of yeast compared to the untreated plants.

3.2.3. Effect of the interaction

Total abscission % trait was significantly responded to the interaction between faba bean cultivars and growth stimulants during both growing seasons as graphically illustrated in Fig (5). However, total no. of flowers and setting pods/plant as well as flowers and setting pods abscission % showed insignificant response to such interaction during both seasons.

Data in Fig (5) revealed that total abscission %/ plant increased when the plants of the four tested cultivars were not treated with any growth stimulant in both seasons. Untreated plants of Mariout 2 cv. registered the highest total abscission % (88.91 and 88.53%) in the first and second seasons, respectively. However, the lowest total abscission % occurred in the four tested cultivars were obtained when the plants were treated with yeast, especially with of Sakha 4 cv. (82.51 and 80.24%) followed by Giza 843 cv. (84.87 and 82.88%) in the first and second seasons, respectively.

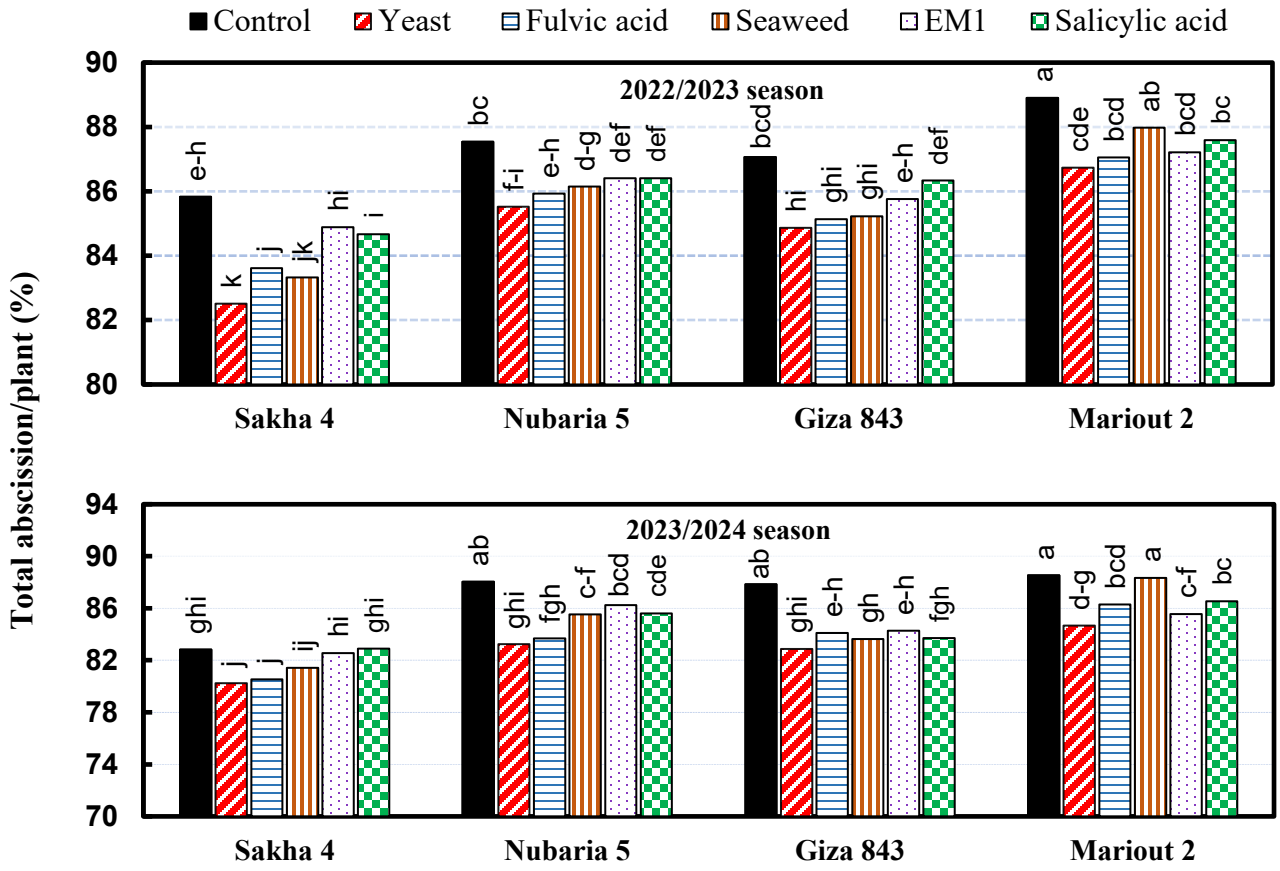

Figure 5. Effect of the interaction between faba bean cultivars and growth stimulants on total abscission /plant (%) during 2022/2023 and 2023/2024 seasons.

3.3.Yield and seed quality

Mean performances for yield and its components characters (no. of pods/plant, no. of seeds/pod, 100-seed weight, seed weight/ pod, seed yield/ plant, seed yield/ fed, straw yield/ fed, biological yield/fed and harvest index) and seed quality (protein %) were studied for the tested faba bean cultivars (Table 7) as affected by foliar application of growth stimulants (Table 8) and their interaction (Fig 6-8) in the two growing seasons.

3.3.1. Mean performance of tested cultivars

It is evident that there is a considerable amount of variation among the tested cultivars in their yield and its components in both seasons. Generally, it can be found that Giza 843 cv was the most superior, while, Nubaria 5 cv. was the most inferior in the no. of pods/ plant in both seasons. As an average of the two seasons, Giza 843 cultivar produced no. of pods amounted to 7.99, 16.65 and 22.38 % more than Sakha 4, Mariout 2 and Nubaria 5 cvs, respectively. The superiority of Giza 843 cultivar in the no. of pods/plant could be attributed to greater no. of flowers and setting pods production and/or decreases in the setting pods abscission percentage during flowering and poding period (Table 5). In this concern, other investigators found significant variation among some faba bean cultivars in their no. of pods/plant in favors of Giza 843 cv. as reported by Wafa and Heakel (2022) and Elbatrawy *et al.* (2023) as well as Sakha 4 cv (El-Shafey *et al*., 2019 and Abdelaal, 2023).

Since seed weight/pod is a function of no. of seeds/pod and 100-seed weight, Nubaria 5 cv.

Table 7. Mean values of yield and its components as well as seed quality for the tested faba bean cultivars during 2022/23 and 2023/24 seasons. (overall means of the tested growth stimulants).

Cultivars	No. of pods/plant	No. of seeds/pod	100-seed weight (g)	Seed weight/ pod (g)	Seed yield/ plant (g)	Seed yield/ fed (kg)	Straw yield/ fed (kg)	Biological yield/ fed (kg)	Harvest index (%)	Protein (%)
					2022/2023					
Sakha 4	19.48 b	3.47 b	93.31 b	3.25 ab	50.77 b	2402.88 b	2761.88 b	5164.76 bc	46.52 a	29.54 a
Nubaria 5	17.28 d	3.82 a	93.99 a	3.54 a	43.12 c	2226.61 c	3010.33 a	5236.94 b	42.52 b	29.09 ab
Giza 843	21.22 a	3.55 b	85.55 c	3.13 ab	53.23 a	2570.62 a	2963.55 a	5534.17 a	46.45 a	29.29 a
Mariout 2	18.34 c	3.66 ab	80.59 d	3.10 b	40.94 d	2046.34 d	3055.15 a	5101.49 c	40.11 c	28.82 b
					2023/2024					
Sakha 4	23.29 b	3.54 b	92.34 b	3.31 ab	56.16 b	2693.92 b	2931.85 c	5625.77 c	47.89 a	29.50 a
Nubaria 5	20.44 d	3.87 a	98.03 a	3.70 a	53.14 c	2509.70 c	3480.89 b	5990.59 b	41.89 c	28.89 b
Giza 843	24.93 a	3.66 ab	90.36 c	3.23 b	60.76 a	2930.14 a	3367.48 b	6297.62 a	46.53 b	29.16 ab
Mariout 2	21.57 c	3.72 ab	91.45 bc	3.39 ab	48.14 d	2382.74 d	3897.70 a	6280.44 a	37.94 d	28.35 c

Table 8. Mean values of yield and its components as well as seed quality of faba bean as affected by growth stimulants during 2022/23 and 2023/24 seasons. (overall means of the tested cultivars).

Stimulants	No. of pods/plant	No. of seeds/pod	100-seed weight (g)	Seed weight/ pod (g)	Seed yield / plant (g)	Seed yield/ fed (kg)	Straw yield/ fed (kg)	Biological yield/ fed (kg)	Harvest index (%)	Protein (%)
					2022/2023					
Control	16.21 d	3.47 b	86.38 c	2.98 c	42.16 f	2025.65 e	2637.66 b	4663.31 d	43.44 bc	28.53 c
Yeast	20.19 a	3.71 a	90.77 a	3.53 a	51.63 a	2492.51 a	2999.84 a	5492.36 a	45.38 a	29.80 a
Fulvic acid	19.55 b	3.68 ab	87.58 b	3.25 b	47.42 c	2365.40 c	3020.62 a	5386.03 b	43.92 b	28.89 bc
Seaweed	19.72 ab	3.62 ab	87.64 b	3.18 b	45.94 d	2305.11 d	2974.69 a	5279.80 c	43.66 bc	29.50 ab
EM1	19.96 ab	3.67 ab	90.67 a	3.41 a	49.76 b	2412.15 b	3038.65 a	5450.81 a	44.25 b	29.30 ab
Salicylic acid	18.86 c	3.60 ab	87.11 b	3.17 b	45.19 e	2268.85 d	3014.92 a	5283.77 c	42.94 c	29.09 abc
					2023/2024					
Control	17.27 e	3.49 c	88.75 c	2.96 b	48.29 f	2380.55 c	3113.89 d	5494.44 c	43.33 a	28.12 d
Yeast	25.25 a	3.83 a	94.98 a	3.64 a	59.44 a	2864.44 a	3584.00 a	6448.44 a	44.42 a	29.86 a
Fulvic acid	23.58 bc	3.66 b	93.73 ab	3.56 a	55.25 c	2600.33 b	3449.78 b	6050.11 b	42.98 a	28.58 cd
Seaweed	22.77 cd	3.72 b	94.34 ab	3.41 a	54.05 d	2596.00 b	3403.89 bc	5999.89 b	43.27 a	29.30 b
EM1	23.83 b	3.74 ab	93.14 b	3.50 a	57.25 b	2761.66 a	3623.00 a	6384.67 a	43.25 a	29.09 bc
Salicylic acid	22.67 d	3.74 ab	93.34 b	3.38 a	53.02 e	2571.77 b	3342.33 c	5914.11 b	43.49 a	28.89 bc

having higher no. of seeds/pod and heavier 100-seed weight and consequently had heavier seeds weight/pod than the other tested cultivars. The differences among the tested cultivars might be attributed to the variation among them in the vegetative growth characters and sink capacity. In this respect, other researchers found variation among some faba bean cultivars in their no. of seeds/pod (Gomaa *et al*., 2023 and Ebaid *et al*., 2024), 100-seed weight (Tarek *et al*., 2020, Abo-Elwafa *et al*., 2022 and Anwar et al., 2025) and seed weight/pod (Messiha *et al*., 2018).

Seed yield either per plant or per fed were significantly differences among the tested faba bean cultivars in the two seasons. It is obvious that Giza 843 cv. significantly surpassed the other cultivars, i.e. Sakha 4, Nubaria 5 and Mariout 2 cvs. in seed yield/ plant by 6.25, 18.89 and 28.12 % as well as in seed yield/ fed by 7.87, 16.10 and 24.30 %, respectively, as an average in both seasons. The superiority of Giza 843 cv. in seed productivity/ fed occurred herein was logic, may be owing to the increase in its total chl, no. of pods/ plant, seed weight/ plant and its components (no. of seeds/ pod and 100-seed weight) as well as the decrease in the abscission % of flowers and pods as previously discussed. In this connection, other investigators found variation among some faba bean cultivars in favour of Giza 843 cv. (El-Hendawy *et al.,* 2013 and Elbatrawy *et al*., 2023) or Sakha 4 cv. (Abdel-Baky *et al*., 2019 and Abdelaal, 2023) for seed yield per plant and per fed.

Reversely, it can be noted that Mariout 2 cv. was higher in straw yield/ fed than the other tested cultivars, in spite of it was lower in seed yield/ fed, indicating that the straw yield took opposite trend to seed yield/ fed in such cultivar. However, Giza 843 cv. had the maximum values of biological yield/ fed compared to the other cultivars in both seasons. The increase in straw yield/ fed for Mariout 2 cv. could be due to the increases in its plant height as well as total dry weight/ plant in growth phase as previously discussed in Table (4), while the superiority of Giza 843 cv. in biological yield/ fed might be attributed to its higher in seed yield/ fed as shown in Table (7). Similar results were obtained by Gomaa *et al*. (2023) and Ebaid *et al.* (2024) who found also high variation among some faba bean cultivars in their straw and biological yields/ fed.

Significant differences could be detected among the four tested cultivars in their harvest index in both seasons. Sakha 4 cv. had the highest values of harvest index followed by Giza 843 cv. as compared with the other cultivars, while Mariout 2 cv. recorded the lowest one in both seasons. This means that the translocation or retranslocation of photoassimilates from non-seed plant tissues to the seed was much higher in Sakha 4 and Giza 843 plants than the rest cultivars. Badawy *et al*. (2023) and Ebaid *et al*. (2024) found also differences among some faba bean cultivars in their harvest index.

The values of crude protein % in the seeds showed that significant differences were detected among the tested faba bean cultivars in both seasons. Sakha 4 cv. surpassed the other cultivars in protein % followed by Giza 843 cv without significant differences between them, while Mariout 2 cv. gave the lowest seed protein % in both seasons. The increase in seed protein content associated with such cultivars might be attributed to the superiority of their capability in transporting metabolites from the vegetative organs to storage centers in the seeds and this led to the appreciable increase in protein content. Other investigators found variation among some faba bean cultivars in their protein % in favor of Sakha 4 cv. (Abdel-Baky *et al*., 2019 and El-Shafey *et al*., 2019) and Giza 843 cv. (Elbatrawy *et al*., 2023 and Sadak *et al*., 2023) compared to other tested cultivars.

3.3.2. Mean effect of growth stimulants

Significant differences in no. of pods/plant and seeds/pod due to different stimulants application (Table 8). It can be seen that foliar application of all tested stimulants caused an increase in the no. of pods/plant more than untreated plants in both seasons. The increase in this respect amounted to 35.38, 30.56, 28.57, 26.75 and 23.81% by application of yeast, EM1, fulvic acid, seaweed and salicylic acid, respectively more than the untreated plants, as an average of both seasons. This increase occurred herein by foliar application of stimulants may be due to the pronounced increase in growth performance and Chl content (Table 4), which might provide more

green area and consequently marked more assimilates supply for pods and seeds production and decreasing the abscission % of flower and pods/ plant (Table 6). Other investigators confirmed our results where they found that foliar application of faba bean plants with some growth stimulants such as yeast (El-Kamar, 2020), EM1 (Al-Tamimi and Lahmood, 2019), fulvic acid (Abdel-Baky *et al*., 2019) seaweed (Bashanday *et al*., 2024) and salicylic acid (Bughdady and Kenawey, 2021) caused an abundance in the no. of pods/ plant. Also, no. of seeds/ pod were increased with application of yeast (Huthily *et al*., 2020), EM1 (Abd El-Ati, 2017), fulvic acid (Ismail and Fayed, 2020), seaweed (Ghosh *et al*., 2020) and salicylic acid (Rasheed, 2018) as compared with the untreated plants.

The results cleared that foliar application of any tested growth stimulants produced heavier 100-seed weight and seed weight/ pod than the untreated plants in both seasons. The plants treated with yeast and EM1 produced the greatest values of the two traits without significant differences between them in the first season. However, the differences between all tested growth stimulants, mostly for such two traits, did not reach the significance level in the second season. In this respect, many investigations found enhancing in pod weight of faba bean plant by application of yeast at a rate of 6 ml/L (Hamza *et al*., 2020), fulvic acid at a rate of 1 g/L (Ismail and Fayed, 2020) and salicylic acid at a rate of 0.7 mM (Aldesuquy, 2015) compared to untreated plants.

With regard to seed yield per plant and per fed, foliar application of all tested growth stimulants caused a significant increase in the two traits as compared with the untreated plants (control treatment). It can be noticed that foliar application of yeast found to be the most effective treatment in increasing seed yield either per plant or per fed in both seasons. The increase due to yeast application amounted to 22.46 and 23.09 % for seed yield/ plant and 23.05 and 20.33 % for seed yield/fed more than the untreated plants in the first and second seasons, respectively, as an average of both seasons. Moreover, application of other growth stimulants took the next significant rank and produced intermediate values in both seasons. The increase in seed yield/fed resulting from foliar application of the tested stimulants may be consequent to increase in seed yield/plant and its components (no. of pods/ plant and seed weight/ pod) as previously discussed. Similar results were recorded by many investigators who found that seed yield/ faba bean plant was increased when the plants were sprayed by some growth substances such as yeast (Ehtaiwesh and Abuiflayjah, 2024), EM1 (Abd El-Ati, 2017), fulvic acid (Abdel-Baky *et al*., 2019), seaweed (Hamza and Abbas, 2020) and salicylic acid (Abdelaal, 2015). Other researchers found that foliar application of such growth substances increased seed yield/ unit area as reported by El-Mehy *et al*., (2022) by yeast, El-Hadidy and Abd El-Ati (2014) by EM1, Ismail and Fayed (2020) by fulvic acid, Faiyad and Abd El-Azeiz (2024) by seaweed and Bughdady and Kenawey (2021) by salicylic acid compared to the untreated faba bean plants.

In addition, straw and biological yields/ fed were significantly increased by foliar application of all tested growth stimulants as comparison with the untreated plants in the two seasons. The highest significant values of straw yield/ fed (3330.83 kg/ fed) and biological yield/ fed (5970.40 kg/ fed) were obtained when the plants were sprayed with EM1 and yeast, respectively, as an average of the two seasons. Nextly, fulvic acid, seaweed and salicylic acid, in a descending order, produced lower values of such two traits than EM1 and yeast generally in both seasons. Moreover, foliar application of yeast recorded the highest significant values of harvest index compared to the other growth stimulants in the first season, while there are no significant differences among all tested growth stimulants on harvest index in the second season. The superiority of straw and biological yields/ fed by yeast or EM1 application may be due to the increase of the growth characters as well as seed yield/ fed which occurred by the application of such substances as previously discussed. Similar results were obtained by other investigators who reported that straw and biological yields/unit area of faba bean plant was increased by yeast (Abido and Seadh, 2014) and EM1 (Abd El-Ati, 2017) compared to untreated plants.

Spraying faba bean plants with all tested growth stimulants caused generally increase in the

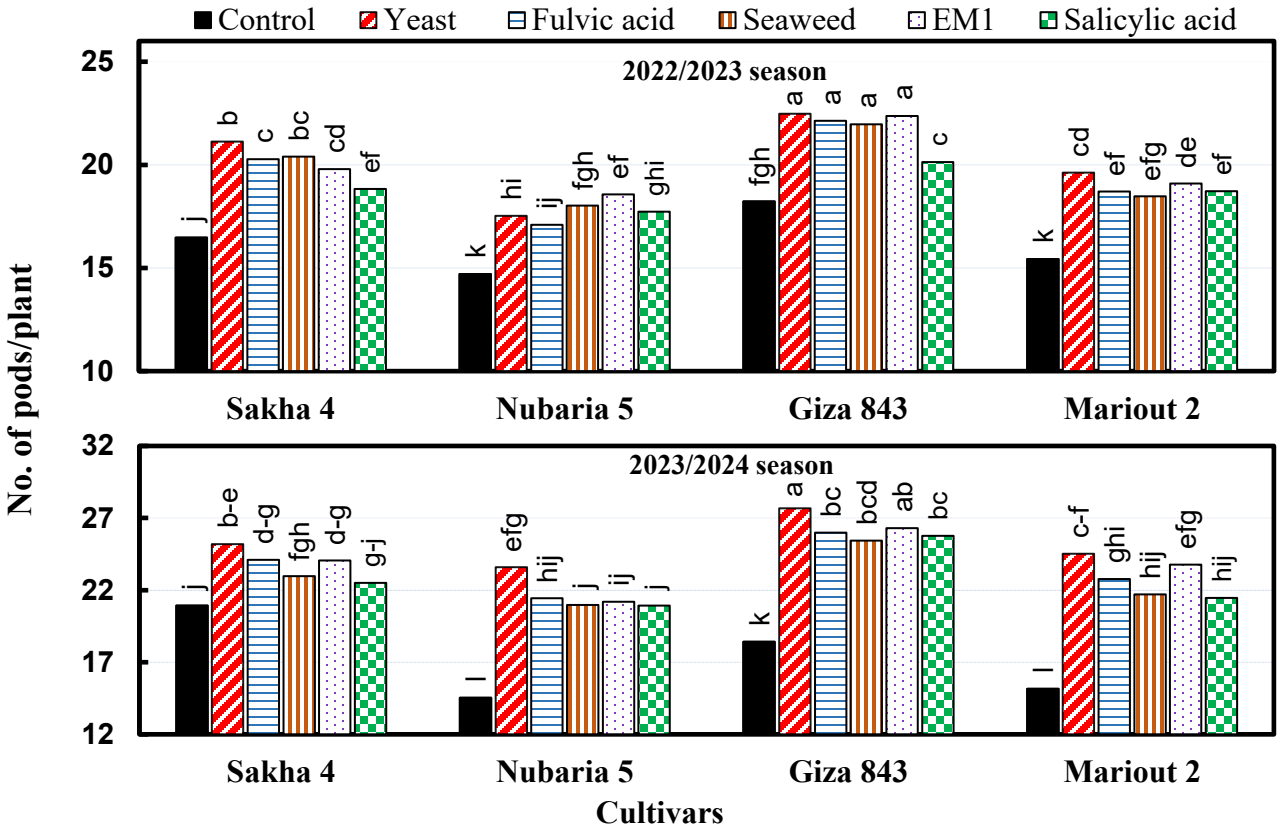

Figure 6. Effect of the interaction between faba bean cultivars and growth stimulants on no. of pods/plants during 2022/2023 and 2023/2024 seasons.

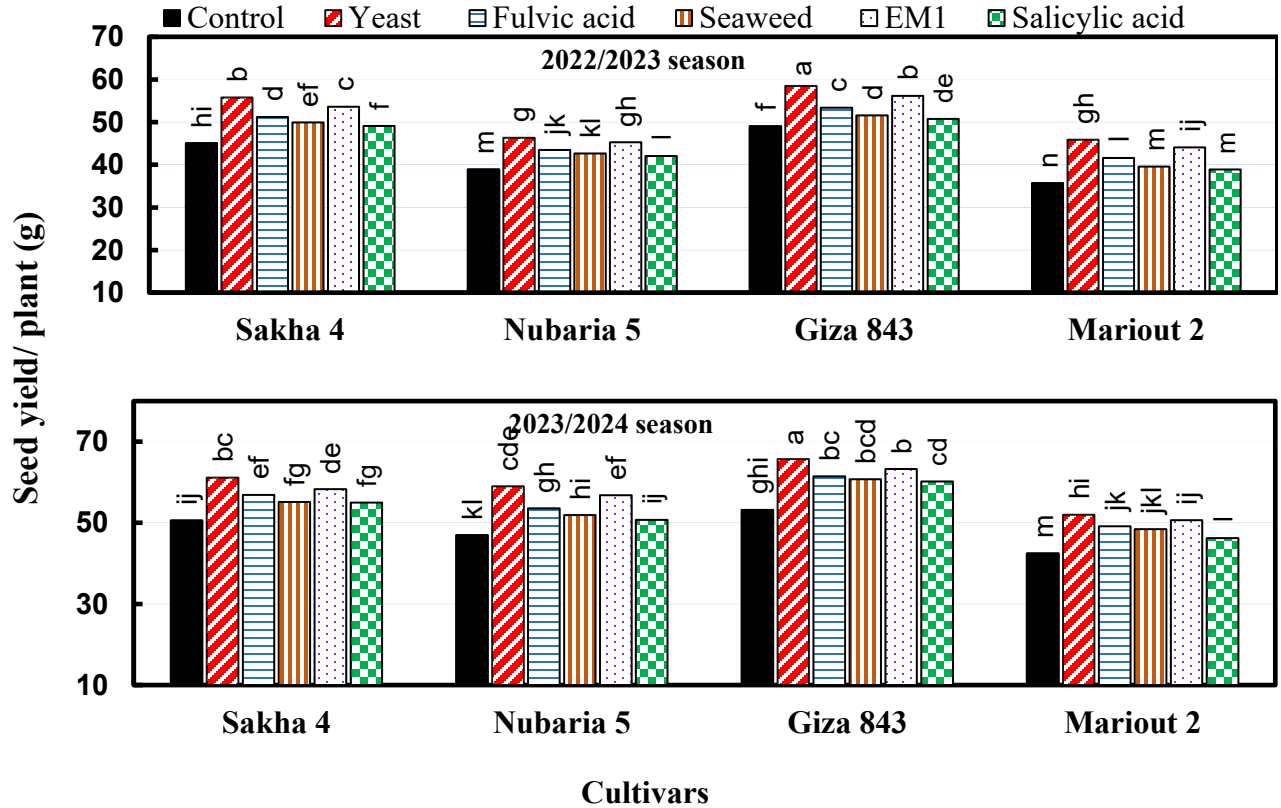

Figure 7. Effect of the interaction between faba bean cultivars and growth stimulants on seed yield/plant (g) during 2022/2023 and 2023/2024 seasons.

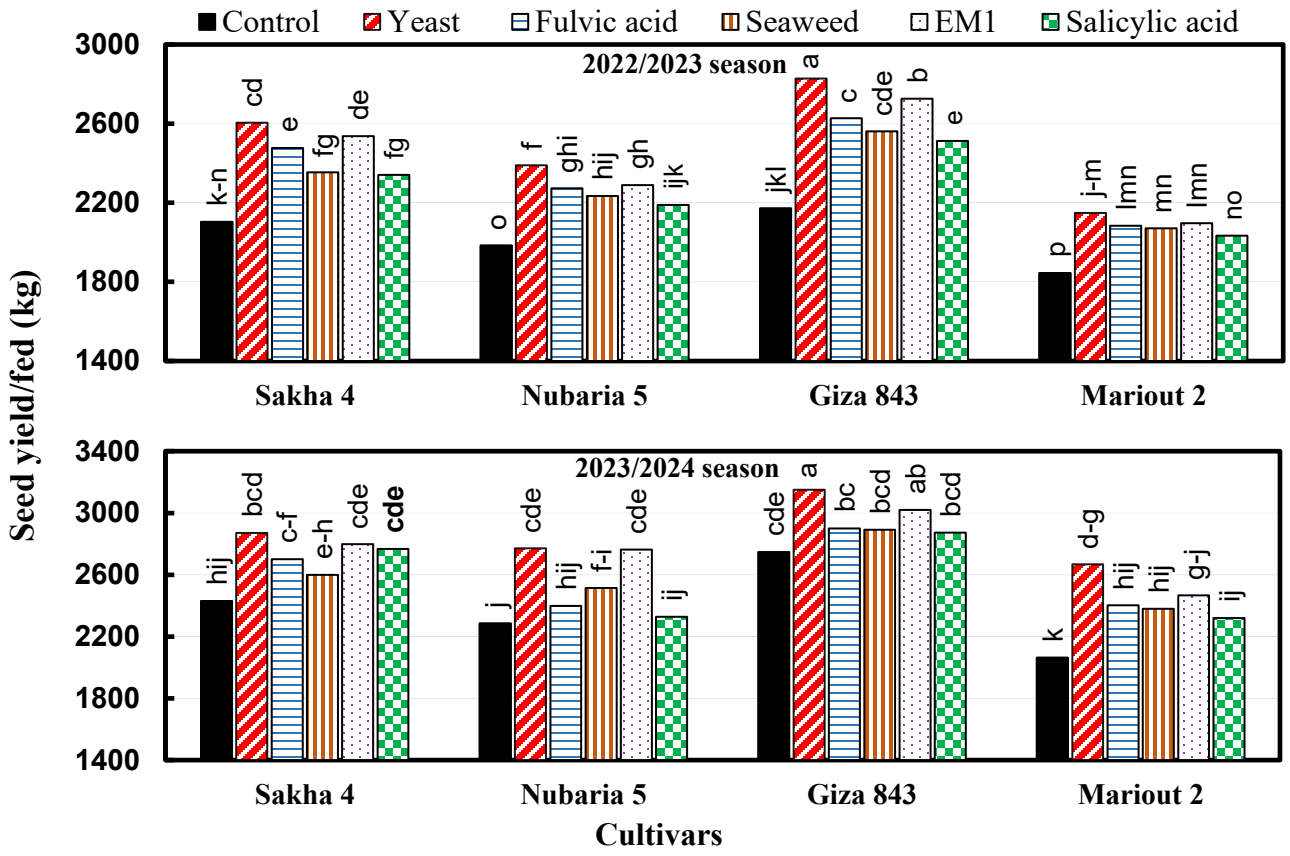

Figure 8. Effect of the interaction between faba bean cultivars and growth stimulants on seed yield/fed (kg) during 2022/2023 and 2023/2024 seasons.

seed protein % as compared with the control treatment. Moreover, foliar application of yeast caused a pronounced increase in protein % compared to the other tested growth stimulants in both seasons. These increases may be attributed to the composition of such stimulant which includes essential amino acids as previously showed in Table (1), which are the basis for protein synthesis. In this concern, several researchers affirmed the role of growth stimulants for increasing protein in faba bean seeds such as yeast at a rate of 2 g/L (Zaki *et al*., 2021), seaweed at a rate of 6 ml/L (Sulieman *et al*., 2023) and EM1 at a rate of 300 ml/10 m^2 area (Al-Tamimi and Lahmood, 2019) compared to untreated plants.

3.3.3. Effect of the interaction

The differences among interaction treatments reach the 5% significance level for no. of pods/plant, seed yield/plant and seed yield/fed in the both growing seasons. However, the differences did not reach the significance level for the rest of studied yield and seed quality characters in the first and / or second seasons. Therefore, the data were excluded.

It is clear from the data illustrated in Fig (6) that all tested faba bean cultivars were produced their highest values of no. of pods/plant when they were treated with yeast in both seasons. Giza 843 cv. plants treated with yeast was more effective interaction treatment for increasing no. of pods/plant, which produced the highest values, while the lowest values were recorded by the untreated plants of Nubaria 5 cv. in both seasons. The increase in no. of pods observed herein by the best interaction treatment was logic owing to of the increases in total Chl and no. of setting pods as previously discussed. This finding seems to be in confirmation with that obtained by Abido and Seadh (2014) who found that the no. of pods / faba

bean plant was increased when Sakha 1 cv. were treated with 50 ml/L yeast compared to other combination treatments.

It is interesting to note that the most pronounced interaction between cultivars and tested growth stimulants for increasing seed yield/plant (Fig 7) and seed yield/fed (Fig 8) was happened when the plants of all tested cultivars were sprayed with yeast in both seasons. Plants of Giza 843 cv. treated with yeast produced the highest seed yield/plant (58.50 and 65.70 g) and seed yield/fed (2827.81 and 3150.22 kg) in the first and second seasons, respectively. These results may be due to the superiority of such interaction treatment in promoting the photosynthetic pigments which led to an encouragement the pod formation owning to increasing the plant capacity in building metabolites and this in turn increased seed yield/plant as well as consequently seed yield/fed. On the other hand, the lowest significant values of seed yield/plant (35.63 and 42.47 g) and seed yield/fed (1845.15 and 2062.22 kg/fed) were obtained when the plants of Mariout 2 were untreated with any stimulants in both seasons. Therefore, it can be concluded that Giza 843 cv. plants sprayed with yeast is necessary for maximizing the seed yield /fed. Similar results were obtained by El-Shafey *et al*. (2016) who found that faba bean cv. Sakha 4 produced the highest values of seed yield/plant and fed when their plants were sprayed with yeast at a rate of 10 g/L.

4. CONCLUSION

Foliar application of Giza 843 cv. with yeast at a rate of 2.5 g/L was found to be the most effective treatments for maximizing seed yield/ fed (2989.02 kg/ fed) compared to the untreated plants of such cultivar (2458.74 Kg/ fed) as an average of both seasons under the environmental conditions of this study.

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الملخص العربي

تأثير منشطات النمو علي نمو وتساقط وانتاجية بعض أصناف الفول البلدى

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أجريت تجربتان حقليتان بمزرعة كلية الزراعة جامعة المنوفية بشبين الكوم بمصر خلال موسمي ٢٠٢٢/٢٠٢٣ و ٢٠٢٣/٢٠٢٤ لدراسة تأثير الرش الورقي بستة منشطات نمو :كنترول، خميرة(٢.٥جم/لتر)، حمض الفولفيك (١جم/لتر)،طحالب بحرية (١جم/لتر)، EM1(٢ سم٣/لتر) وحمض الساليسيليك(١جم/لتر) على صفات النمو ، محتوى الكلوروفيل، التزهير ونسبة التساقط والمحصول ومكوناته ونسبة البروتين في البذور لاربعة أصناف من الفول البلدي (سخا ٤، نوبارية ٥، جيزة ٨٤٣ ومريوط ٢) وقد تم الرش مرتين عند ٣٠و٤٥ يوم من الزراعة. ويمكن تلخيص أهم النتائج على النحو التالي:

١ –تفوق الصنف مريوط ٢ تفوقا معنوياً في ارتفاع النبات، مساحة الأوراق/نبات، الوزن الجاف الكلي/نبات، عدد الأزهار/نبات، النسبة المئوية لتساقط الأزهار والتساقط الكلي/نبات وكذلك محصول القش/فدان، والصنف جيزة ٨٤٣ في محتوى الكلوروفيل الكلي وعدد القرون العاقدة علي النبات ونسبة التساقط فيها وعدد القرون/نبات ومحصول البذور/نبات ومحصول البذور والبيولوجي/فدان، والصنف نوبارية ٥ في عدد الأوراق/نبات وعدد ووزن البذور/قرن ووزن ١٠٠بذرة، والصنف سخا ٤ في دليل الحصاد والنسبة المئوية للبروتين.

٢ –أدى رش نباتات الفول البلدى بأي من منشطات النمو المختبرة إلى زيادة معنوية في جميع الصفات المدروسة ، بينما الي انخفاض في نسبة تساقط الأزهار والقرون العاقدة والتساقط الكلي للنبات مقارنة بمعاملة الكنترول.

٣– تم الحصول علي أعلي القيم لصفات محتوى الكلوروفيل، وعدد القرون/نبات، ومحصول البذور للنبات أو للفدان عند رش نباتات الصنف جيزة ٨٤٣ بالخميرة (بمعدل ٢.٥جم/لتر) ، بينما تم الحصول على أعلى القيم لارتفاع النبات والوزن الجاف الكلي/نبات عند رش نباتات الصنف مريوط ٢ بمركب EM1 (بمعدل ٢سم٣/لتر) هذا وقد ادى رش نباتات الصنف سخا ٤ بالخميرة (بمعدل ٢.٥جم/لتر) الي تسجيل أقل نسبة تساقط كلي/نبات مقارنة بباقي المعاملات الاخري.