



**EFFECT OF FOLIAR APPLICATION WITH SALICYLIC
ACID AND YEAST EXTRACT ON PRODUCTION AND
QUALITY OF TWO FABA BEAN (*Vicia faba*, L.)
VARIETIES**

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ABSTRACT

Two field Experiments were conducted at the Agricultural Experimental Farm of Al-Azhar Univ. at Assiut, during 2012/2013 and 2013/2014 seasons to study the effect of foliar application with salicylic acid [0 (control), 200 and 400 ppm] and yeast extract [0 (control), 5 and 10 ml/L] on production and quality of two varieties of faba bean (Misr1, and Giza-843). The obtained results showed that faba bean varieties exhibited significant differences in 100-seed weight; seed yield and straw yield/fed. and seeds protein percentage in both seasons, except seed yield/plant in the first season only. On other hand number of branches/plant, number of pods/plant and seeds phosphorus percentage did not detect significant differences in both seasons. Increasing the concentration of salicylic acid applications from 0.0to 400 ppm caused significant and gradual increases in all traits under study in both seasons. Applications of yeast extract induced significant increases in all studied characters, i.e. number of branches and pods/plant, seed yield/plant, 100-seed weight as well as seed and straw yields/fed. Also, such treatment increased phosphorus and protein percentages of faba bean seeds. The interaction between varieties and salicylic acid exerted a significant influence on 100- seed weight and seed yield / fad. in both seasons and number of branches / plant and seed yield /plant in the first season and phosphorus percentage in the second season. While, the interaction between varieties and yeast extract exhibited a significant effect on seed yield

/plant and 100- seed weight in both seasons and number of pods /plant in the first season only. Moreover, the interaction between salicylic acid and yeast extract possessed a significant influence on number of branches / plant, number of pods/plant, seed yield/plant, and 100-seed weight, seed yield/fed. and seed protein percentage in both seasons. Also, the second order interaction exerted a significant effect on seed yield /plant in both seasons and 100- seed weight in the first season, only. In general, the highest value of seed yield/ fed. and quality was obtained from Misr-1 variety with 400 ppm salicylic acid and 10 ml/L yeast extract under Assiut conditions.

INTRODUCTION

Faba bean (*Vicia faba, L.*) is one of the principal winter food legumes in Egypt. The importance of its seeds lies chiefly to its high protein content with high calories and nutritive value since it contains about 24% proteins and a source of carbohydrates. The total production in Egypt is still below the demand. To meet the national requirement of this crop could be achieved via expansion in devoted area with planting high yielding cultivars of good agricultural practices. Bakheit *et al.* (2001) showed that plant height; seed yield and 100-seed weight were significantly affected by faba bean cultivars (Giza-2, Giza-402, Giza-429 and Giza-674). While number of branches and pods/plant and straw yield/fed. were not affected by cultivars. Khalil *et al.* (2004) indicated that Misr-1 cultivar surpassed Giza-40 cultivar in number of pods/plant, weight of seeds/plant, weight of 100-seeds (gm), seed yield (ard./fed.), straw yield (ton/fed.) and seed protein percentage. However, seed phosphorus percentage did not significantly affected in both seasons. Sharaan *et al.*

(2004) indicated that the tested faba bean cultivars (Giza-2, Giza-429, Giza-843 and Misr-1) showed significant differences for all of the studied characters (seed yield /plant, seed index, seed yield /fed. and seed protein percentage). Ahmed and El-Abagy (2007) showed that faba bean cultivars were significantly differed in number of branches/plant, number of pods /plant, seed yield/plant, seed yield/fed. straw yield/ fed. and seed protein%. El-Banna *et al.* (2009) found significant differences between the two faba bean cultivars in number of branches/plant, number of pods/plant, seed yield /plant, seed yield /fed. straw yield/fed. and seed protein content in both seasons. Ragab *et al.* (2010) reported significant differences among the three faba cultivars (Nubaria-1, Giza-716 and Sakha-1) in seed yield (kg/fed.) and weight of 100-seeds.

Salicylic acid plays an important role in the regulation of plant growth and development. Ion uptake and transport, photosynthetic rate, membrane permeability and transpiration. Enhancing effect of SA on photosynthetic capacity can be

attributed to its stimulatory effects on activity and pigment contents. Khafaga *et al.* (2009) found that the application of salicylic acid on faba bean plants caused significant (Khan *et al.*, 2003) increase on number of pods/plant, 100 seed weight and seed yield/fed. Ismaeil, Faten and Abd El-All (2011) showed that salicylic acid at (100 ppm) significantly increased the number of branches /plant, seed yield /plant, and weight of 100-seeds, seed yield /fed., Also foliar application of salicylic acid at 100 ppm increased number and weight of pods/plant, seed yield/plant, seed index and seed crude protein of faba bean. Abdel-Monaim (2013) indicated that salicylic acid significantly increased growth parameters (No. of branches /plant) and yield components (No. of pods and seeds /plant, weight of 100 seeds and total yield /feddan and protein content in both seasons. Orabi, Salwa *et al.* (2013) found that foliar spraying of salicylic acid significantly increased seed protein and yield criteria (Pod weight, seed weight, and 100-seed weight) of faba bean. Sadak, Mervat *et al.* (2013) indicated that applications of salicylic acid caused increases in branches number/plant. However, salicylic acid increased seed yield and its components (number and dry weight of pods/plant, seeds weight/plant and seed index) as well as seed biochemical constituent (protein content). Abd El-Hakim (2014) indicated that the investigated legumes are rich and good sources of crude protein content. Number of dry pods per plant, 100-seed weight and dry

seeds yield of the three studied crops (common bean, pea and broad bean) were significantly affected by using the antioxidant treatments (salicylic acid). Jasim and Muhsen (2014) showed that the highest salicylic acid levels (0.5 and 1 mM/L) gave the highest number of pods /plant, 100-seed weight, seed yield /plant and protein percentage of mung bean. Mohamed *et al.* (2014) indicated that the application of salicylic acid at (100 ppm) was the most effective in increasing all yield and its parameters of faba bean (number of pods / plant, pods weight / plant (g), seeds weight / plant (g) and 100- seed weight (g)) compared with control treatment.

Many studies indicated that yeast is a natural source of cytokinins and has stimulatory effects on bean plants (Amer, 2004). Moreover, yeast extract was suggested to participate in a beneficial role during vegetative and reproductive growth stages through improving flower formation and their set in some plants due to its high auxin and cytokinin content and enhancement carbohydrate accumulation (Barnett *et al.*, 1990). Elwakil *et al.* (2009) found that yeast application on faba bean plants significantly increased plant growth parameters including plant height, number of branches and pods /plant and pods weight/plant. Khalil, Soha and Ismael (2010) indicated that yeast application on lupinus plants showed insignificant increase in number of pods and seeds/plant and 100 seeds weight in both seasons. Whereas, such treatment showed significant increase

in crude protein concentrations. Al-Tawaha (2011) found that the application of yeast extract on soybean plants significantly increased seed yield per plant. Abdo, Fatma *et al.* (2012) revealed that foliar spray with active yeast extract significantly decreased number of branches /plant and all studied yield characters (number of pods and seeds/plant, specific seed weight and seed yield/plant) of soybean 'Giza 35'. Mahmoud, Asmaa (2013) indicated that yeast extracts improved the previously mentioned parameters and gave the highest values with using the highest level of yeast extracts (2%). Abido and Seadh (2014) pointed that foliar spraying of yeast extract significantly increased number of branches per plant, number of pods per plant, 100-seeds weight, seed yield per plant, seed yield per feddan and seed protein percentage in both growing seasons. Mohamed *et al.* (2014) found that the application of yeast increased faba bean yield and its parameters (number of pods / plant, pods weight / plant (g), seeds weight / plant (g) and 100- seed weight (g)). The objective of the present work is to study the response of two-faba bean varieties Misr-1 and Giza-843 to application at three levels of salicylic acid and yeast extract under Assiut Governorate conditions.

Yeast extract rates were sprayed three times during the growth period (30, 45 and 60 days after sowing). Salicylic acid spraying was conducted three times; first one was after 25 days from planting and then every 15 days

for the second and third spray. Spraying was applied in early morning. All treatments were applied triple as foliar spray on plants using hand operated compressed air sprayer at the rate of 10 liter/plot.

The experimental design was randomized completed blocks in split-split plot arrangement with three replications. Faba bean varieties were assigned to the main plots, salicylic acids were distributed randomly in the sub plots and yeast extract were allocated to the sub-sub plots. The experimental unit comprised five ridge, each 3.5m long and 0.6 m wide (10.5 m² in area = 1/400 /fad.). Seeds in a population of 140 thousand plants/fad. were sown on the two sides of ridges, in hills 20 cm apart and thinned to two plants/hill. Seed were sown on October 25th and 22nd in 2012/2013 and 2013/2014 seasons, respectively. The preceding summer crop was maize in both seasons. All other practices were uniformly applied as recommended for faba bean production in the region. The mechanical and chemical analyses of the experimental site are presented in Table (2)

MATERIALS AND METHODS

Two field Experiments were conducted at the Agricultural Experimental Farm of Al-Azhar Univ. at Assiut, during 2012/2013 and 2013/2014 seasons to study the effect of salicylic acid and yeast extract on production and quality of two faba bean (*Vicia faba* L.) varieties under

Assiut Governorate conditions. Each experiment included 18 treatments which were the combinations of two faba bean varieties, three levels of salicylic acid and yeast extract.

A- Faba bean varieties:

- 1- Misr-1.
- 2- Giza-843.

B- Salicylic acid levels:

- 1- Control (without addition).
- 2- 200 ppm.
- 3- 400 ppm.

C- Yeast extract levels:

- 1- Control (without addition).
- 2- 5 ml/L.
- 3- 10 ml/L.

Yeast extract was prepared from brewer's yeast (*Saccharomyces cerevisiae*), dissolved in water followed by adding sugar at a ratio of 1: 1 and kept 24 hours in a warm place for reproduction according to the Table (1): Chemical analysis of yeast extract.

methods of Morsi *et al* (2008). Chemical analysis of yeast extract according to Mahmoud (2001) is presented in Table (1).

Studied characters:-

A- Yield and yield components:

At harvest, samples of 10 plants were chosen randomly from the inner ridges and the following characters were recorded:

- 1- Number of branches / plant.
- 2- Number of pods / plant.
- 3- Seed yield /plant (gm).
- 4- 100- seed weight (gm):
- 5- Seed yield (ard./fed.) (ard. = 155 kg).
- 6- Straw yield (ton/fed.). Seed and straw yields were recorded on the basis of all plants/ plot. The recorded values were used to estimate the corresponding values per fed.

Amino acids mg/100g dry weight		Vitamins and carbohydrates mg/100g dry weight	
Arginine	1.99	Vit.B1	2.23
V	2.63	Vit.B2	1.33
Isoleucine	2.31	Vit.B6	1.25
leucine	3.09	Vit B12	0.15
Lysine	2.95	Thimain	2.71
Methionine	0.72	Riboflavin	4.96
Phenyl alanine	2.01	Insitol	0.26
Threonine	2.09	Biotin	0.09
Tryptophan	0.45	Nicotinic acid	39.88
Valine	2.19	Panthothenic acid	19.56
Glutamic acid	2.00	P amino benzoic acid	9.23
Serine	1.59	Folic acid	4.36
Aspartic acid	1.33	Pyridoxine	2.90
Cystine	0.23	Total carbohydrates	23.20
Proline	1.53	Glucose	13.33
Tyrosine	1.49		

Table (2): The mechanical and chemical analysis of soil field experiments

Mechanical analysis	2012/2013	2013/2014	Chemical analysis	2012/2013	2013/2014
Sand (%)	24.80	25.50	Organic matter (%)	0.98	1.01
Silt (%)	38.90	39.50	Available N (ppm)	74.40	76.50
Clay (%)	36.30	35.00	Available P(ppm)	9.60	10.56
Soil texture	Clay loam	Available K (ppm)	355.15	363.25	
		pH (s.p. 65)	7.73	7.99	
		E.C. (ds. m ⁻¹)	1.16	1.17	
		Total CaCO ₃ (%)	2.86	2.61	

B- Chemical analysis:

At harvesting, seed samples were ground and kept for chemical analysis.

1- Protein percentage:-

Total nitrogen content in seeds was estimated by using microkjeldahl method as described by A.O.A.C (1980) and percentage of protein was calculated by multiplying the nitrogen percentage by 6.25.

2- Phosphorus percentage:-

Total phosphorus was determined in the seed digests colorimetrically using the spectrophotometer according to the method described by Chapman and Pratt (1961).

Statistical analysis:-

Data were statistically analyzed according to Gomez and Gomez (1984) using the computer MSTAT-C statistical analysis package by Freed *et al.* (1989). The least significant differences (LSD) test at probability level of 0.05 was manually calculated to compare the differences among treatments means.

RESULTS AND DISCUSSION

A- Yield and yield components:-

1- Number of branches/plant.

It is quite clear from presented results in Table (3) that the differences between the two studied varieties in number of branches/plant were not significant in 2012/2013 and 2013/2014 seasons. Similar results were obtained by Bakheit *et al.* (2001).

The presented results in Table (3) reveal that increasing levels of salicylic acid increased significantly number of branches/plant in both seasons. The highest values 3.85 and 4.26 were obtained when salicylic acid was applied at a level of 400 ppm in the first and second seasons, respectively. The increase in number of branches of faba bean in response to salicylic acid could be attributed to the role of salicylic acid in the regulation of plant growth and improving the nutrient uptake from the soil and subsequently increasing the plant growth of increasing the photosynthetic rate, and these aspects encourage dry matter accumulation and increase number of branches. These results are in harmony with those obtained by Ismaeil, Faten and

Abd El-All (2011) and Abdel-Monaim (2013) who reported that number of branches / plant increased by increasing salicylic acid levels.

The application of yeast extract to faba bean plants exerted a significant influence on number of branches/plant in the first and the second seasons. In general, number of branches/plant were increased gradually with increasing yeast extract levels from 0.0 to 10 ml/L in both seasons. These results may be due to the ability of yeast extract to produce growth regulator substance i.e., cytokinones (CKs). This growth substance may play an important role in plant growth through promoting photosynthesis, translocation and accumulation of dry matter within different plant organs.

2- Number of pods/plant.

Results in Table (4) show that the two studied varieties did not significantly differ in number of pods/plant in both seasons. These results are in agreement with those obtained by Bakheit *et al.* (2001).

It is clear from the results shown in Table (4) that applied salicylic acid levels had a significant effect on this trait in 2012/2013 and 2013/2014 seasons. The highest values of pod number (15.72 and 15.80) were obtained when salicylic acid was applied at the higher level of 400 ppm in the first and the second seasons, respectively. This may be due to the

role of salicylic acid in increasing the vegetative growth of faba bean via enhancing photosynthesis process. Furthermore, salicylic acid might have encouraged faba bean growth and caused the significant increase in number of pods / plant. The important role of salicylic acid for number of pods in legumes had been found by different investigators i.e., Khafaga *et al.* (2009), Ismaeil, Faten and Abd El-All (2011), Abdel-Monaim (2013), Sadak, Mervat *et al.* (2013), Jasim and Muhsen (2014) and Mohamed *et al.* (2014) who reported that number of pods/plant was increased by increasing salicylic acid levels.

These results are in agreement with those obtained by Elwakil *et al.* (2009), Abdo, Fatma *et al.* (2012) and Abido and Seadh (2014).

The presented results show that number of branches/plant was significantly affected by the interaction of varieties x salicylic acid in the first season, where the highest value 3.96 was obtained from Misr-1 variety when received 400 ppm SA. The interaction effect between salicylic acid (SA) and yeast extract (YE) was significant in both seasons where the highest values of 4.37 and 4.74 were obtained from plants received 400 ppm and 10 ml/L YE in the first and second seasons, respectively. The other interactions did not show significant effect on this trait.

Table (3): Effect of salicylic acid, yeast extract and their interactions on number of branches/plant of two faba bean varieties in 2012/2013 and 2013/2014 seasons.

Seasons		2012/2013				2013/2014			
Varieties	Salicylic Acid	Yeast extract			Mean	Yeast extract			Mean
		Control	5 ml/L	10 ml/L		Control	5 ml/L	10 ml/L	
Misr-1	Control	1.70	2.35	2.58	2.21	2.02	2.70	2.91	2.54
	200 ppm	2.18	3.63	3.94	3.25	2.56	3.84	4.17	3.52
	400 ppm	3.22	4.15	4.50	3.96	3.63	4.58	4.85	4.35
	Mean	2.37	3.38	3.67	3.14	2.74	3.71	3.98	3.47
Giza-843	Control	1.55	2.27	2.46	2.09	1.88	2.68	2.61	2.39
	200 ppm	2.60	3.51	3.85	3.32	3.01	3.87	4.03	3.64
	400 ppm	3.04	3.96	4.23	3.74	3.36	4.53	4.62	4.17
	Mean	2.40	3.25	3.51	3.05	2.75	3.69	3.75	3.40
Mean for (SA)	Control	1.63	2.31	2.52	2.15	1.95	2.69	2.76	2.47
	200 ppm	2.39	3.57	3.90	3.29	2.79	3.86	4.10	3.58
	400 ppm	3.13	4.06	4.37	3.85	3.49	4.56	4.74	4.26
	Mean	2.38	3.31	3.59		2.74	3.70	3.87	

L.S.D. at 5% for

Varieties (V)	N.S	N.S
Salicylic Acid (SA)	0.09	0.13
Yeast extract (YE)	0.10	0.10
V X SA	0.13	N.S
V X YE	N.S	N.S
SA X YE	0.16	0.19
V X SA X YE	N.S	N.S

The application of yeast extract to faba bean plants exerted a significant influence on number of pods/plant in both seasons. In general, number of pods/plant were maximum when applied yeast extract at rate of 10 ml/L to faba bean plants compared to the control in both seasons. The improvement of number of pods in response to the foliar application of yeast extract may be attributed to its contents of different nutrients, higher percentage of amino acids, higher values of vitamins, especially VB Table (1) which may play an important

role in improving growth and controlling the incidence of fungi diseases. These results might be due to the fact that yeast extract contains growth factors and a relatively larger proportion of free amino acids and short peptides of two or three amino acids long chain protein hydrolysates. These results are in agreement with those obtained by Elwakil *et al.* (2009), Khalil, Soha and Ismael (2010), Abido and Seadh (2014) and Mohamed *et al.* (2014).

Results in Table (4) indicate that number of pods/plant was not

significantly affected by the interaction between varieties and salicylic acid in the two seasons. However, the interaction effect between varieties x yeast extract had significant effect on this trait in the first season only. Also, number of pods/plant was significantly affected by the interaction between

salicylic acid and yeast extract in the two seasons, where the highest values of plant pod number of 15.91 and 15.94 were obtained in plants received 400 ppm SA and 10 ml/LYE in the first and second seasons, respectively. The second order interaction was not significant in both seasons.

Table (4): Effect of salicylic acid, yeast extract and their interactions on number of pods/plant of two faba bean varieties in 2012/2013 and 2013/2014 seasons.

Seasons		2012/2013				2013/2014			
Varieties	Salicylic Acid	Yeast extract			Mean	Yeast extract			Mean
		Control	5 ml/L	10 ml/L		Control	5 ml/L	10 ml/L	
Misr-1	Control	12.33	14.07	14.18	13.53	12.60	14.16	14.18	13.65
	200 ppm	13.43	14.94	15.08	14.48	13.53	15.03	15.08	14.55
	400 ppm	15.17	15.88	15.95	15.67	15.48	15.95	15.99	15.81
	Mean	13.64	14.96	15.07	14.56	13.87	15.05	15.08	14.67
Giza-843	Control	12.50	14.06	14.23	13.60	12.77	14.17	14.23	13.72
	200 ppm	13.58	14.95	15.11	14.55	13.62	15.41	15.11	14.71
	400 ppm	15.80	15.63	15.87	15.77	15.65	15.87	15.88	15.80
	Mean	13.96	14.88	15.07	14.64	14.01	15.15	15.07	14.74
Mean for (SA)	Control	12.42	14.07	14.20	13.56	12.68	14.16	14.20	13.68
	200 ppm	13.51	14.95	15.10	14.52	13.58	15.22	15.10	14.63
	400 ppm	15.49	15.76	15.91	15.72	15.57	15.91	15.94	15.80
	Mean	13.80	14.92	15.07		13.94	15.08	15.10	

L.S.D. at 5% for

Varieties (V)	N.S	N.S
Salicylic Acid (SA)	0.07	0.07
Yeast extract (YE)	0.12	0.13
V X SA	N.S	N.S
V X YE	0.18	N.S
SA X YE	0.22	0.23
V X SA X YE	N.S	N.S

3- Seed yield /plant (gm):-

Data presented in Table (5) indicate that seed yield/plant was significantly differed between the two studied varieties in 2012/2013 season, where Misr-1 variety had higher seed yield /plant than Giza-843 variety. The differences between faba bean

varieties in seed yield/plant may be due to the differences in partitioning and migration of photosynthetic between faba bean varieties and in the content of endogenous hormones. These results are in harmony with those found by Sharaan *et al.* (2004) and El-Banna *et al.* (2009).

Table (5): Effect of salicylic acid, yeast extract and their interactions on seed yield/plant (gm) of two faba bean varieties in 2012/2013 and 2013/2014 seasons.

Seasons		2012/2013				2013/2014			
Varieties	Salicylic Acid	Yeast extract			Mean	Yeast extract			Mean
		Control	5 ml/L	10 ml/L		Control	5 ml/L	10 ml/L	
Misr-1	Control	28.60	33.05	38.17	33.27	29.77	34.20	38.23	34.07
	200 ppm	32.53	37.10	41.24	36.96	33.43	38.55	41.33	37.77
	400 ppm	38.70	40.40	42.22	40.44	39.77	41.23	42.43	41.14
	Mean	33.28	36.85	40.54	36.89	34.32	37.99	40.66	37.66
Giza-843	Control	27.97	32.55	37.11	32.54	29.20	33.56	37.15	33.30
	200 ppm	31.43	38.25	40.73	36.80	32.61	39.08	40.81	37.50
	400 ppm	36.75	40.70	41.95	39.80	37.08	41.87	42.04	40.33
	Mean	32.05	37.17	39.93	36.38	32.96	38.17	40.00	37.05
Mean for (SA)	Control	28.29	32.80	37.64	32.91	29.48	33.88	37.69	33.68
	200 ppm	31.98	37.68	40.99	36.88	33.02	38.82	41.07	37.64
	400 ppm	37.73	40.55	42.09	40.12	38.43	41.55	42.24	40.74
	Mean	32.66	37.01	40.24		33.64	38.08	40.33	

L.S.D. at 5% for

Varieties (V)	Sig.	N.S
Salicylic Acid (SA)	0.22	0.35
Yeast extract (YE)	0.25	0.29
V X SA	0.31	N.S
V X YE	0.35	0.40
SA X YE	0.43	0.49
V X SA X YE	0.61	0.70

Results in Table (5) show that increasing salicylic acid levels up to 400 ppm significantly increased seed yield/plant in both seasons, where the highest values 40.12 and 40.74 gm were obtained when salicylic acid was applied at a level of 400 ppm in both seasons, respectively. The increment in seed yield/plant regarding supplied faba bean plants with level 400 ppm salicylic acid may be attributed to the physiological role of salicylic acid on the meristematic activity of plant tissues and consequently increasing plant growth. Also, this result could be explained in light of the beneficial

effect of salicylic acid in increasing number of branches/plant, number of pods per plant and number of seeds per plant as previously discussed. It is worthy to mention that these results are in good agreement with those obtained by Ismaeil, Faten and Abd El-All (2011), Orabi, Salwa *et al.* (2013), Sadak, Mervat *et al.* (2013) and Mohamed *et al.* (2014).

The presented results reveal that yeast extract possessed significant effect on seed yield /plant in the two seasons. Seed yield/plant tended to increase gradually with increasing yeast extract from 0.0 to 10 ml/L,

reaching their maximum with applied the highest rate of yeast extract (10 ml/L) in both seasons. Such effects might be attributed to increase in plant vegetative growth, via increasing plant photosynthesis and photoassimilates translocation to seed, consequently seed yield/plant could be increased. The increase in seed yield/plant might be associated with high number of pods and branches/plant and seed number /plant. These results are in accordance with those obtained by Al-Tawaha (2011), Abdo, Fatma *et al.* (2012), Abido and Seadh (2014) and Mohamed *et al.* (2014).

The presented results indicated that seed yield/plant was significantly affected by the interaction varieties x salicylic acid in the first season only, where the highest seed yield/plant of 40.44 gm was obtained from Misr-1 variety when received 400 ppm salicylic acid. Also, this trait was significantly affected by the interaction between varieties and yeast extract in the two seasons, where the highest values of 40.54 and 40.66 gm were obtained from Misr-1 variety when received 10 ml/L YE in the first and the second seasons, respectively. Seed yield/plant was significantly affected by the interaction between salicylic acid and yeast extract in both seasons where the highest values 42.09 and 42.24 gm were obtained in plants received 400 ppm SA and 10 ml/LYE in the first and second seasons, respectively. The second order interaction exerted significant effect on seed yield/plant in 2012/2013 and 2013/2014 seasons.

4- 100-seed weight (gm):-

Data in (6) show that 100-seed weight was significantly differed between varieties in 2012/2013 and 2013/2014 seasons. Misr-1 variety surpassed Giza-843 variety. The differences between faba bean varieties in 100-seed weight may be due to the differences in partitioning and migration of photosynthetic products between the two faba bean varieties and the endogenous hormones content. These results agreed with those obtained by Bakheit *et al.* (2001) and Ragab *et al.* (2010).

Applications of salicylic acid levels to faba bean plants had significant effect on this trait in both seasons. The highest 100-seed weight values of 70.78 and 70.91 gm were obtained when salicylic acid was applied at a level of 400 ppm in both seasons, respectively. These results might be attributed to salicylic acid encouraged growth of plants, pod setting and pod and seed filling. This might interpret the increase seed yield /plant and this might account much for a good seed filling and subsequently higher seed index. These results are in accordance with those found by Khafaga *et al.* (2009), Ismaeil, Faten and Abd El-All (2011), Abdel-Monaim (2013), Orabi, Salwa *et al.* (2013), Sadak, Mervat *et al.* (2013), and Jasim and Muhsen (2014) who reported that 100-seed weight was increased by increasing salicylic acid levels.

The application of yeast extract to faba bean plants exerted a significant influence on 100-seed weight in both seasons. In general, the highest 100-

seed weight was recorded when applied yeast extract to faba bean plants at rate of 10 ml/L in 2012/2013 and 2013/2014 seasons. This may be due to that yeast extract increased the vegetative growth of faba bean, in addition to the role of yeast extract in enhancing photosynthesis process. Similar results of yeast extract on 100-seed weight were obtained by Abido and Seadh (2014) and Mohamed *et al.* (2014).

The presented results illustrate that 100-seed weight was significantly affected by the interaction between varieties and salicylic acid in both seasons, where the highest values of 71.42 and 71.50 gm were obtained for Misr-1 variety received 400 ppm of SA in the first and the second seasons, respectively. Also, 100-seed weight was significantly affected by the interaction between varieties and yeast extract in the two seasons, where the highest values of 72.15 and 72.24 gm were obtained for Misr-1 variety when received 10 ml/L yeast extract in the first and the second seasons, respectively. Moreover, 100-seed weight was significantly affected by the interaction between salicylic acid and yeast extract where the highest values of 72.66 and 72.60 gm were obtained in plants received 400 ppm SH and 10 ml/L YE in first and seasons, respectively. The second order interaction exerted a significant effect on 100-seed weight in the first season only, where the highest value (73.43 gm) was obtained from Misr-1 variety received 400 ppm SA and 10 ml/L YE .

5- Seed yield (ard. /fed.):-

The presented results in Table (7) indicate that the differences between the two faba bean varieties were significant for seed yield /fed. in 2012/2013 and 2013/2014 seasons. Furthermore, results showed clearly that Misr-1 variety surpassed Giza-843 in seed yield /fed. in the two seasons. The differences between faba bean varieties in the productivity potential efficiency may be due to the genetical constituents and its interaction with environmental conditions which reflected on partitioning and migration of photosynthetic between faba bean varieties, consequently an increase in number of pods/plant, seeds weight, seed index and harvest index, and ultimately seed yield could be expected . These results are in harmony with this found by El-Banna *et al.* (2009).

It could be concluded that applied salicylic acid levels had significant effect on this trait in both seasons, where the highest seed yield /fad. 11.14 and 11.32 ard./fed. were obtained when salicylic acid was applied at a level of 400 ppm in both seasons, respectively. The increase in seed yield /fad. of faba bean in response to salicylic acid could be attributed its role in regulating plant growth which improving the nutrient uptake from the soil and subsequently increasing the plant growth of increasing the photosynthetic rate. Also, may be due to the effect of salicylic acid in increasing plant growth and the percentage of flowering and setting which reflected

on the number of pods /plant, seed index and seed yield/plant and decreased the percentage of flowers and pods abscission. It is worthy to mention that these results are in good agreement with those obtained by Abdel-Monaim (2013) and Orabi,Salwa *et al.* (2013).

The presented results illustrate that application of yeast extract to faba bean plants exerted significant influence on seed yield /fed. in the two seasons. In general, the highest seed yield /fed. was recorded when applied YE at rate of 10 ml/L to faba bean plants compared to the control in the

first and the second seasons. Such effects increased plant vegetative growth, consequently an increase in LAI means the increase in plant photosynthesis and photo assimilates translocation to seed,which increasing seed yield/fed. Also, may be due the increase in seed yield/fed. might be associated with high number of pods and number of branches/plant, 100-seed weight and seed yield/plant. These results of yeast extract on seed yield ard./fed. obtained in the study are in those agreement with obtained by Abido and Seadh (2014).

Table (6): Effect of salicylic acid, yeast extract and their interactions on 100-seed weight (gm) of two faba bean varieties in 2012/2013 and 2013/2014 seasons.

Seasons	2012/2013				2013/2014				
	Varieties	Salicylic Acid	Yeast extract			Mean	Yeast extract		
Control			5 ml/L	10 ml/L	Control		5 ml/L	10 ml/L	Mean
Misr-1	Control	61.48	67.13	69.86	66.16	62.57	68.00	69.94	66.84
	200 ppm	66.95	71.10	73.17	70.41	68.08	71.32	73.54	70.98
	400 ppm	69.20	71.64	73.43	71.42	69.45	71.80	73.24	71.50
	Mean	65.88	69.96	72.15	69.33	66.70	70.37	72.24	69.77
Giza-843	Control	62.15	65.37	68.52	65.35	62.42	66.07	68.72	65.74
	200 ppm	66.33	68.95	69.28	68.19	66.74	68.11	69.43	68.09
	400 ppm	69.00	69.55	71.89	70.15	69.28	69.74	71.97	70.33
	Mean	65.83	67.96	69.90	67.89	66.15	67.97	70.04	68.05
Mean for (SA)	Control	61.82	66.25	69.19	65.75	62.50	67.04	69.33	66.29
	200 ppm	66.64	70.03	71.23	69.30	67.41	69.71	71.49	69.53
	400 ppm	69.10	70.59	72.66	70.78	69.37	70.77	72.60	70.91
	Mean	65.85	68.96	71.03		66.42	69.17	71.14	

L.S.D. at 5% for

Varieties (V)	Sig.	Sig.
Salicylic Acid (SA)	0.19	0.24
Yeast extract (YE)	0.21	0.29
V X SA	0.27	0.34
V X YE	0.30	0.42
SA X YE	0.37	0.51
V X SA X YE	0.52	N.S

Data recorded in Table (7) showed that, the interaction between varieties x salicylic acid was significant in both seasons, where the highest values of 11.46 and 11.62 ard./fed. were recorded for Misr-1 variety received 400 ppm SA in the first and the second seasons, respectively. Also, seed yield/fed. was significantly affected by the interaction

between salicylic acid and yeast extract where the highest values of 11.53 and 11.60 ard./fed. were obtained in plants received 400 ppm and 10 ml/LYE in both seasons, respectively. The interaction Varieties x yeast extract interaction and the second order interaction were not significant on this trait in both seasons.

Table (7): Effect of salicylic acid, yeast extract and their interactions on seed yield (ard./fed.) of two faba bean varieties in 2012/2013 and 2013/2014 seasons.

Seasons		2012/2013				2013/2014			
Varieties	Salicylic Acid	Yeast extract			Mean	Yeast extract			Mean
		Control	5 ml/L	10 ml/L		Control	5 ml/L	10 ml/L	
Misr-1	Control	8.88	9.21	9.50	9.20	9.00	9.35	9.74	9.36
	200 ppm	9.75	10.73	11.03	10.50	9.93	11.04	11.28	10.75
	400 ppm	10.84	11.66	11.87	11.46	11.00	11.92	11.93	11.62
	Mean	9.82	10.53	10.80	10.39	9.98	10.77	10.98	10.58
Giza-843	Control	8.35	9.07	9.37	8.93	8.57	9.27	9.56	9.13
	200 ppm	9.20	10.17	10.76	10.04	9.34	10.52	11.00	10.29
	400 ppm	10.36	10.98	11.18	10.84	10.52	11.23	11.29	11.02
	Mean	9.30	10.07	10.44	9.94	9.48	10.34	10.62	10.15
Mean for (SA)	Control	8.62	9.14	9.44	9.06	8.78	9.31	9.65	9.25
	200 ppm	9.48	10.45	10.90	10.27	9.64	10.78	11.14	10.52
	400 ppm	10.60	11.32	11.53	11.14	10.76	11.58	11.60	11.32
	Mean	9.56	10.30	10.62		9.73	10.56	10.80	

L.S.D. at 5% for

Varieties (V)	Sig.	Sig.
Salicylic Acid (SA)	0.12	0.14
Yeast extract (YE)	0.11	0.100
V X SA	0.18	0.19
V X YE	N.S	N.S
SA X YE	0.19	0.17
V X SA X YE	N.S	N.S

6- Straw yield (ton/fed.).

Results in Table (8) illustrate that the differences between the two faba bean varieties were significant for straw yield /fed. in 2012/2013 and 2013/2014 seasons. Misr-1 variety had higher straw yield /fed. than Giza-843

variety in both seasons. The differences between faba bean varieties in straw yield could be due to the differences in partitioning and migration of photosynthetic, plant height and number of branches/plant of faba bean varieties. These results

agree with those obtained by Ahmed and El-Abagy (2007).

The results in the same Table illustrate that applied salicylic acid levels had significant effect on this trait in the two seasons, where the highest straw yield/fed. values of 2.57 and 2.57 ton/fed. were obtained when salicylic acid applied at rate of 400 ppm in first and second seasons, respectively. This may be due to that salicylic acid encouraged the vegetative growth of faba bean plants for which plant height as well as branching capacity could be taken as good criteria. This might interpret the increased straw yield due to salicylic acid application.

It can be seen from Table (8) that application of yeast extract to faba bean plants exerted a significant influence on straw yield in 2012/2013 and 2013/2014 seasons. In general, the highest straw yield/fed. was recorded when applied yeast extract at rate of 10 ml/L compared to the control in the two seasons. Yeast foliar application had positive effect due to stimulatory effect on straw yield may be due to the ability of yeast to increase the production of stimulants for plant growth, especially Gibberellins, Auxins and Cytokines which work to improve the plant cell division and its growth. Also, the increase in straw yield (ton/fed.) might be associated with high plant height and number of branches/plant.

The Results reveal that straw yield ton/fed. was not significantly affected by all possible interactions among experiment factors.

B- Chemical analysis:-

1- Protein percentage:-

Illustrated results in Table (9) clearly indicate that the two varieties were significantly different for seed protein percentage in 2012/2013 and 2013/2014 seasons. Misr-1 variety surpassed Giza-843 in protein percentage in both seasons. These results are in line with those found by Ahmed and El-Abagy (2007) and El-Banna *et al.* (2009).

The results indicate that salicylic acid levels significantly increased protein content in faba bean seeds in both seasons. The highest values of 28.63 and 29.32% were obtained when salicylic acid was applied at a level of 400 ppm in 2012/2013 and 2013/2014 seasons, respectively. In this respect, high seed protein content may be a direct result for high rates of photosynthesis with great efficiency. These results are in accordance with those found by Ismaeil, Faten and Abd El-All (2011), Abdel-Monaim (2013), Orabi, Salwa *et al.* (2013), Sadak, Mervat *et al.* (2013) and Jasim and Muhsen (2014).

The presented results illustrate that application of yeast extract to faba bean plants exerted a significant influence on seed protein content in the two seasons. In general, protein content in seeds was gradually increased with increasing YE from 0.0 to 10 ml/L to faba bean plants compared to the control in the first and the second seasons. The increase in protein percentage under the effect of yeast application could be attributed to the growth hormones produced by

yeast and/or stimulation the synthesis of protein. These results are in line with those found by Khalil, Soha and Ismael (2010) and Abido and Seadh (2014) who reported that crude protein content was significantly affected by yeast extract.

Protein content in seeds were significantly affected by the interaction between salicylic acid and yeast

extract during the two seasons. Where the highest values of 29.55 and 30.45% were recorded for plants received 400 ppm SA and 10 ml/L YE in both seasons, respectively. Varieties x salicylic acid, varieties x yeast extract and the second order interaction did not significantly affect on this trait in the first and second seasons.

Table (8): Effect of salicylic acid, yeast extract and their interactions on straw yield (ton/fed.) of two faba bean varieties in 2012/2013 and 2013/2014 seasons.

Seasons		2012/2013				2013/2014			
Varieties	Salicylic Acid	Yeast extract			Mean	Yeast extract			Mean
		Control	5 ml/L	10 ml/L		Control	5 ml/L	10 ml/L	
Misr-1	Control	2.16	2.27	2.49	2.31	2.21	2.36	2.64	2.40
	200 ppm	2.27	2.39	2.67	2.44	2.35	2.50	2.80	2.55
	400 ppm	2.40	2.48	2.79	2.56	2.46	2.56	2.84	2.62
	Mean	2.28	2.38	2.65	2.44	2.34	2.48	2.76	2.53
Giza-843	Control	2.03	2.23	2.40	2.22	2.09	2.29	2.57	2.32
	200 ppm	2.18	2.26	2.51	2.32	2.25	2.35	2.63	2.41
	400 ppm	2.32	2.41	2.64	2.46	2.37	2.47	2.69	2.51
	Mean	2.18	2.30	2.52	2.33	2.24	2.37	2.63	2.41
Mean for (SA)	Control	2.10	2.25	2.45	2.26	2.15	2.33	2.61	2.36
	200 ppm	2.23	2.33	2.59	2.38	2.30	2.43	2.72	2.48
	400 ppm	2.36	2.45	2.72	2.57	2.42	2.52	2.77	2.57
	Mean	2.23	2.34	2.58		2.29	2.42	2.70	

L.S.D. at 5% for

Varieties (V)	Sig.	Sig.
Salicylic Acid (SA)	0.05	0.05
Yeast extract (YE)	0.05	0.06
V X SA	N.S	N.S
V X YE	N.S	N.S
SA X YE	N.S	N.S
V X SA X YE	N.S	N.S

2- Phosphorus percentage:-

Results presented in Table (10) reveal that the two studied varieties did not differ significantly for this trait in 2012/2013 and 2013/2014 seasons. Same conclusions was found by Khalil et al. (2004).

The results indicate that applying salicylic acid concentrations significantly affected phosphorus content in seeds in the two growth seasons. However, the highest values 0.58% and 0.59% were obtained when salicylic acid was applied at a

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concentration of 400 ppm in the first and second seasons, respectively. In this respect, high content phosphorus content may be a direct result for high rates of photosynthesis with great

efficiency. That was preceded with large photosynthetic rate. These results are in accordance with those found by Ismaeil, Faten and Abd El-All (2011).

Table (9): Effect of salicylic acid, yeast extract and their interactions on protein percentage of two faba bean varieties in 2012/2013 and 2013/2014 seasons.

Seasons		2012/2013				2013/2014			
Varieties	Salicylic Acid	Yeast extract			Mean	Yeast extract			Mean
		Control	5 ml/L	10 ml/L		Control	5 ml/L	10 ml/L	
Misr-1	Control	20.10	21.93	24.00	22.01	21.40	24.30	26.67	24.12
	200 ppm	25.10	26.00	26.70	25.93	25.33	28.50	29.00	27.61
	400 ppm	27.40	29.67	29.90	28.99	27.30	30.70	30.80	29.60
	Mean	24.20	25.87	26.87	25.64	24.68	27.83	28.82	27.11
Giza-843	Control	19.00	22.23	24.10	21.78	20.50	23.00	25.20	22.90
	200 ppm	23.94	24.80	25.00	24.58	25.10	27.00	27.50	26.53
	400 ppm	26.80	28.80	29.20	28.27	27.40	29.60	30.10	29.03
	Mean	23.25	25.28	26.10	24.87	24.33	26.53	27.60	26.16
Mean for (SA)	Control	19.55	22.08	24.05	21.89	20.95	23.65	25.93	23.51
	200 ppm	24.52	25.40	25.85	25.26	25.22	27.75	28.25	27.07
	400 ppm	27.10	29.23	29.55	28.63	27.35	30.15	30.45	29.32
	Mean	23.72	25.57	26.48		24.51	27.18	28.21	

L.S.D. at 5% for

Varieties (V)	Sig.	Sig.
Salicylic Acid (SA)	0.74	0.42
Yeast extract (YE)	0.88	0.52
V X SA	N.S	N.S
V X YE	N.S	N.S
SA X YE	1.52	0.89
V X SA X YE	N.S	N.S

Data in Table (10) revealed that application of yeast extract to faba bean plants exerted a significant influence on phosphorus content in 2012/2013 and 2013/2014 seasons. In general, phosphorus content was high when applied YE at rate of 10 ml/L to faba bean plants compared to the control in two seasons. The increase in phosphorus content under the effect of yeast application could be attributed to the growth hormones produced by

yeast. The results of yeast extract on phosphorus percentage are in agreement with those obtained by.

Results recorded in Table (10) showed that, the interaction between varieties x salicylic acid had significant in effect on this trait in the second season only. All other interactions among studied factors did not show significant effect on this trait in both seasons.

Table (10): Effect of salicylic acid, yeast extract and their interactions on phosphorus percentage of two faba bean varieties in 2012/2013 and 2013/2014 seasons.

Seasons		2012/2013			2013/2014				
Varieties	Salicylic Acid	Yeast extract			Mean	Yeast extract			Mean
		Control	5 ml/L	10 ml/L		Control	5 ml/L	10 ml/L	
Misr-1	Control	0.43	0.47	0.53	0.48	0.44	0.47	0.58	0.49
	200 ppm	0.47	0.52	0.56	0.52	0.49	0.54	0.59	0.54
	400 ppm	0.53	0.59	0.63	0.58	0.55	0.59	0.64	0.59
	Mean	0.47	0.53	0.57	0.53	0.49	0.53	0.60	0.54
Giza-843	Control	0.40	0.44	0.48	0.44	0.39	0.47	0.51	0.46
	200 ppm	0.46	0.52	0.57	0.52	0.49	0.56	0.60	0.55
	400 ppm	0.53	0.60	0.62	0.58	0.55	0.61	0.63	0.60
	Mean	0.46	0.52	0.56	0.51	0.48	0.55	0.58	0.53
Mean for (SA)	Control	0.42	0.46	0.51	0.46	0.42	0.47	0.55	0.48
	200 ppm	0.46	0.52	0.57	0.51	0.49	0.55	0.60	0.55
	400 ppm	0.53	0.59	0.63	0.58	0.55	0.59	0.64	0.59
	Mean	0.47	0.52	0.57		0.49	0.54	0.59	

L.S.D. at 5% for

Varieties (V)	N.S	N.S
Salicylic Acid (SA)	0.03	0.01
Yeast extract (YE)	0.02	0.18
V X SA	N.S	0.17
V X YE	N.S	N.S
SA X YE	N.S	N.S
V X SA X YE	N.S	N.S

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