Effect Of Some Bio-Regulators on Growth and Yield of Some Wheat Varieties Under Newly Cultivated Land Conditions

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Abstract: This investigation was conducted to study the effect of some bio-regulators, tryptophan, cysteine, thiamine, ascorbic acid and yeast extract on growth, yield and its components and some chemical constituents of some wheat varieties; Sakha93, Gemiza7 and Gemiza9 under newly cultivated land conditions. For this purpose two field experiments were carried out during two successive growing seasons (2008\2009 and 2009\2010) at the experimental farm of National Research Center at Nubaria, Egypt. Results revealed that foliar application of different applied growth bio-regulating substances, with different concentrations, significantly increased all growth criteria, plant height, number of tillers and leaves per plant, fresh and dry weight of plant. Grain and straw yield of wheat plants and yield components were also significantly increased as result of foliar application of the used bio-regulators. On the other hand Gemiza-7 variety was most effective of all characters under study compared with the other two varieties Gemiza-9 and Sakha-93.

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1. Introduction

Wheat is one of the major cereal crops with a unique protein, which is consumed by humans and is grown around the world in diverse environments **(Mac Ritchie, 1994).**Wheat provides approximately one fifth of the calories in the human diet and is an important source of vegetable protein and nutrients for a large proportion of the world's population. Modern wheat varieties differ in their grain concentrations of N, Zn and Fe. **(Cakmak *et al.*, 2000)**. **(Sultan *et al.*, 2000)** reported, Wheat cultivars differed in yield and its components. Also **Zaki, *et al.*,(2004)**established that**,**grain, straw and biological yields and its components were significantly differed owing to varietal differences. In addition **Sharaan, (2000)** found that wheat varieties were significantly different in plant height, spike length, number of spikes, number of grains per spike and grain weight per spike **Zaki *et al.*, (2007)**reported that, there were significant differences in all growth characters of wheat cultivars, as follows i.e. (Sakha93, Gemiza7 and Gemiza9) under their study.

Plant growth regulators (PGRs) are actively involved in a multitude of metabolic processes and play essential roles in plant growth and development under both stress and natural conditions. They also act as chemical messengers to modulate various processes or genes involved in plant growth and development **(Morgan, 1990)**.

Plant growth regulators (PGRs) also play important roles in plant adaptationto stressful environments, including drought stress **(Huang *et al.*, 2008)**.

Under both wild and cultivated conditions, plants often experience a multitude of environmental stresses such as drought, salinity, waterlogging, extremes of temperature, and mineral toxicities and deficiencies. Environmental stresses are undoubtedly a major cause of food insecurity in many countries around the world, in particular, in developing countries where there is a major challenge to produce sufficient food. A large proportion of the world, agriculture depends on rainfall for irrigation, as good quality water supply is highly limited or unpredictable. In many of such regions, crops are often negatively affected by severe drought. It has been estimated that the countries that generate two-third of the world's agricultural product experience water-deficit conditions on a regular basis **(Revenga *et al.*, 2000)**.

In plants, amino acids fulfill a wide variety of functions. Their common role is to serve as building blocks of proteins, which exert manifold functions in plant metabolism, and as metabolites and precursors involved in plant defense, vitamin, nucleotide and hormone biosynthesis, and as precursors of a huge variety of secondary metabolites. One way or the other, as active catalysts or as precursors, amino acids are essentially involved in all metabolic, regulatory, and physiological aspects of plant metabolism**(Buchanan *et al.*, 2000)**.

Unlike humans, plants are capable of producing vitamins. In fact, the foods highest in vitamins are plant-based, such as raw fruits and vegetables. Vitamins could be considered as bio-regulators compounds which in low concentrations exerted a profound influence upon plant growth. In general, the energy metabolic pathway could be affected by one or another of these substances. Vitamins could serve as coenzyme in decarboxylation of a-keto acids, such as pyruvic acid and keto-glutamic acid which has its importance in the metabolism of carbohydrates and fats **(Bidwell, 1979)**.

Vitamins are important cofactors for the transketolation reactions of the pentose phosphate cycle, which provides pentose phosphate for nucleotide synthesis and for the reduced NADP required in various synthetic pathways **(Kawasaki, 1992)**.

On the other hand, **Amer, (2004) and Kurtzman and Fell (2005)** demonstrated that, Active dry yeast is a natural safety biofertilizers causes various promotive effect on plants. It is considered as a natural source of cytokinins which simulates cell division and enlargement as well as the synthesis of protein, nucleic acid and vitamin-B. It also releases CO_2 which reflected in improving net photosynthesis.

The objectives of this study was to evaluate the beneficial effect of some bio-regulators as foliar application on growth, yield and yield components and some chemical constituents of some wheat varieties grown under newly reclaimed soil conditions.

2. Materials and Methods

This investigation was carried out at the experimental farm of National Research Center at Nubaria, Egypt, during two successive seasons 2008\2009 and 2009\2010, to study the effect of some bio-regulators on growth development, yield and yield components of three cultivars of wheat plant. (*Triticum aestivum* L.).

Plant Materials:

Pure lines and uniform grains of three local cultivars of wheat plant (*Triticum aestivum* L.) Sakha93, Gemiza-7 and Gemiza-9. These cultivars were obtained from Wheat Research Department, Agricultural Research Center, Ministry of Agriculture, Egypt.

Chemical materials

Three types of chemical materials were used, tryptophan (C6H4NH.CH:C) and cysteine (C3H7NO2S) as amino acids, ascorbic acid (Vitamin-C) (C6H8O6) and thiamine (Vitamin-B1) as vitamins and baking yeast (*Saccharomyces cerevisiae*) extract.

The experiments were carried out under sandy soil conditions. Grains of the three cultivars were sown at 27 and 23 November for the first and the second season respectively. The experimental design was split plot design with three replications. Each experiment included 33 plots and the plot area was 10.5 m^2 (1/400 of feddan), three meters in length and three and half meters in width. Each plot contained twenty rows. Seeds were planted at the rate of 60 Kg/feddan using drilling and cross rows method, the spacing between the rows was 15cm. The treatments of the bio-regulators were distributed at random in the main plot, and the three varieties were assigned in the sub plot randomly too.

Nitrogen fertilizer was applied at the rate of 120 Kg N/feddan in the form of ammonium nitrate (33.5%N) and was divided in ten equal portions. The dosage was added before the irrigation.

Phosphorus fertilizer was applied before sowing (during land preparation) at rate of 50 Kg P_2O_5/feddan in the form of calcium super phosphate (15.5% P_2O_5).

Potassium sulphate was added at rate of 50 Kg per feddan, and applied one month after sowing.

Two concentrations from each bio-regulator (50 and 100 mgl^{-1} of tryptophan, thiamine and ascorbic acid) and 100 and 150 mgl^{-1} of cysteine as well as 1 and 2 gl^{-1} of yeast extract were added twice to the plants as foliar spray in addition to control plants which sprayed with distilled water. First spray was carried out at vegetative stage (30 days after sowing) the spray volume of this sprinkling was 200 liter per feddan, and the second spray was seven days later, its volume was 250 liters per feddan.

The sample was taken fifteen days after the second spray (at heading stage).

Growth and yield measurements:

a. Plant height (cm).
b. Number of tillers per plant.
c. Number of leaves per plant.
d. Fresh weight of shoot per plant.
e. Dry weight of shoot per plant.
f. Flag leaf area (cm^2)

Yield and yield components characters:

At harvest, ten plants from each plot were chosen randomly to estimate the following data.

a. Spike length (cm).
b. Number of spikes per plant.
c. Spike weight (g).
d. Number of grains per spike.
e. Grain weight per spike (g).
f. Grain yield per feddan (Kg) which was determined from the whole grain yield of each

sub-plot and converted to tons of grains per feddan.

Photosynthetic pigments:

Chlorophylls a, b and carotenoids were extracted from fresh leaf tissues and estimated, colorimetrically, according to method described by **Wettstein (1957).**

Statistical Analysis:

Each experiment was statistically analyzed as a spilt plot design according to **Snedecor and Cochran, (1980)**. Combined analysis of the two seasons was carried out whenever homogeneity of variance was detected for all studied traits. The Duncan multiple range test was used to compare the treatment means **(Duncan, 1955)**. The **MSTATC (1989)** program was used in this connection.

3. Results:

Growth characters

Effect of bio-regulators

According to data in Table (1), yeast extract at concentration of 1000 mgl^{-1} was the most effective treatment increasing wheat plant height followed by Cysteine treatment at concentration of 150 mgl^{-1}. Data also show that there was no significant difference between the treatments 150 mgl^{-1} of cysteine and 1000 mgl^{-1} of yeast extract in the second season.

The highest number of tillers and leaves per plant was obtained by using tryptophan at concentration of 50 mgl^{-1}. Data show also that , the highest values of fresh weight of plant wereobtained by treatment of 1000 mgl^{-1} yeast in the second season and combined data of the two seasons. On the other hand treatment of 100 mgl^{-1} ascorbic acid recorded the highest value in the first season whereas, the untreated plants (control) recorded the lowest values of the fresh weight of plant during first, second season and their combined data.

It could be emphasized from the present data that, dry weight of wheat plant was significantly affected by all bio-regulating substances at different concentrations in both season and their combined data. Results show that, the effect was strikingly noticeable with the treatment of ascorbic acid 100 mgl^{-1} in the first season and tryptophan 50 mgl^{-1} in the second season and the combined data.

Table (1): Plant height, number of tillers and number of leaves per plant, as affected by some growth bio-regulators treatments and varieties of wheat at heading stage during two growing seasons and their combined data.

Treatments		Plant height (cm)			No. of Tillers/plant			No. of leaves/plant		
		S1	S2	Comb.	S1	S2	Comb.	S1	S2	Comb.
Control		55.97 d	58.40 h	57.19 e	2.334 e	3.008 f	2.671 f	11.17 g	12.33 g	11.75 h
Tryptophan	50 mgl-1	74.70 ab	77.81 c-e	76.26 c	6.017 a	7.563 a	6.790 a	23.14 a	26.35 a	24.74 a
	100 mgl-1	71.60 c	74.41 g	73.00 d	4.533 c	5.158 d	4.846 d	17.33 ef	18.90 f	18.11 g
Cystine	100 mgl-1	70.74 c	76.43 f	73.58 d	3.691 d	4.250 e	3.971 e	18.03 de	20.78 de	19.40 f
	150 mgl-1	75.73 ab	80.67 a	78.20 ab	5.034 bc	5.750 cd	5.392 c	21.49 b	22.43 c	21.96 c
Thiamine	50 mgl-1	73.80 b		76.34 c	5.046 bc	5.456 cd	5.251 cd	19.75 c	20.58 e	20.17 e
	100 mgl-1	69.51 c	77.09 d-f	73.30 d	4.670 bc	5.264 cd	4.967 cd	18.43 d	20.21 e	19.32 f
Ascorbic Acid	50 mgl-1	75.10 ab	79.47 b	77.28 bc	4.612 bc	5.482 cd	5.047 cd	18.20 d	20.15 e	19.17 f
	100 mgl-1	71.28 c	76.80 ef	74.04 d	5.209 b	6.509 b	5.859 b	20.09 c	21.74 cd	20.91 d
Yeast	1000 mgl-1	76.26 a	80.77 a	78.51 a	5.123 bc	6.611 b	5.867 b	21.10 b	24.98 b	23.04 b
	2000 mgl-1	69.99 c	78.27 b-d	74.13 d	4.867 bc	5.904 c	5.386 c	16.91 f	22.29 c	19.60 ef
Sakha-93		66.26 c	66.74 c	66.50 c	4.706 ab	5.642 a	5.174 a	17.72 c	19.97 c	18.84 c
Gemiza-7		76.92 a	85.39 a	81.16 a	4.432 b	5.275 b	4.853 b	18.65 b	20.50 b	19.58 b
Gemiza-9		70.83 b	76.68 b	73.75 b	4.808 a	5.708 a	5.258 a	19.72 a	22.46 a	21.09 a

S1 = first season **S2 = second season** **Comb. = combined data**

It is clear from Table (2) that, flag leaf area was significantly increased as a result of foliar application with the used bio-regulating substances at different concentrations.Ascorbic acid treatment at 100 mgl^{-1} recorded the highest value in this respect, while, the lowest value obtained by untreated plants (control).

Varieties performance:

Data in Tables (1 and 2) revealed that, the examined varieties significantly varied in their responses to foliar spray with the different bio-regulating substances. Gemiza-7 variety gave the highest values of plant height, fresh and dry weight of plant and flag leaf area. While, Gemiza-9 variety recorded the highest values of number of tiller and leaves per plant and these results were true for the two seasons and their combined data.

Effect of interaction

The results in Tables (3 and 4) cleared that, there were significant increasesof all growth characters under study in the two seasons and their combined data as affected by interaction between wheat varieties and bio-regulating substances.

The highest values of plant heightwere obtained from the treatment 1000 mgl^{-1} of yeast with Gemiza-

7 variety, during the first, second season and their combined data.

Table (2): Fresh and dry weight per plant and flag leaf area, as affected by some growth bio-regulators treatments and varieties of wheat at heading stage during two growing seasons and their combined data.

Treatments		Fresh weight/plant (g)			Dry weight/plant (g)			Flag leaf area (cm2) (Average two seasons)
		S1	S2	Comb.	S1	S2	Comb.	
Control		10.53 f	14.00 h	12.27 h	8.797 f	9.558 g	9.178 g	26.20 g
Tryptophan	**50 mgl-1**	27.20 d	38.78 c	32.99 bc	17.76 b	23.00 a	20.38 a	41.60 b
	100 mgl-1	22.58 e	31.42 e	27.00 f	12.24 e	15.28 ef	13.76 f	37.75 e
Cystine	**100 mgl-1**	21.87 e	28.14 g	25.00 g	15.06 d	16.02 de	15.54 de	37.34 e
	150 mgl-1	30.04 b	35.59 d	32.81 bc	16.36 c	21.04 b	18.70 bc	40.19 c
Thiamine	**50 mgl-1**	29.27 bc	34.91 d	32.09 c	14.52 d	16.75 d	15.64 de	38.94 d
	100 mgl-1	28.76 bc	29.75 f	29.26 e	14.68 d	15.85 d-f	15.26 de	41.67 b
Ascorbic Acid	**50 mgl-1**	28.12 cd	32.63 e	30.37 d	16.99 bc	14.74 f	15.87 d	39.92 c
	100 mgl-1	33.67 a	40.77 b	37.22 a	19.39 a	16.84 d	18.12 c	44.67 a
Yeast	**1000 mgl-1**	32.42 a	43.62 a	38.02 a	19.01 a	19.81 c	19.41 b	38.14 e
	2000 mgl-1	28.17 cd	38.64 c	33.41 b	14.50 d	15.51 ef	15.01 e	36.53 f
Sakha-93		23.03 c	27.83 c	25.43 c	13.36 c	14.07 c	13.72 c	33.11 c
Gemiza-7		29.27 a	38.39 a	33.83 a	17.16 a	19.09 a	18.12 a	45.73 a
Gemiza-9		27.51 b	34.21 b	30.86 b	15.66 b	17.13 b	16.40 b	36.52 b

S1 = first season S2 = second season Comb. = combined data

Table (3): Plant height, number of tillers and number of leaves per plant, as affected by interaction between some growth bio-regulators treatments and varieties of wheat at vegetative growth stage during two growing seasons and their combined data.

Treatments			Plant height (cm)			No. of Tillers/plant			No. of leaves/plant		
			S1	S2	Comb.	S1	S2	Comb.	S1	S2	Comb.
control		**Sakha-93**	37.1 n	35.5 q	36.3 o	1.07 l	1.60 kl	1.33 n	5.32 no	5.83 mn	5.58 o
		Gemiza-7	42.7 m	36.8 p	39.7 n	1.33 l	1.20 l	1.27 n	5.15 o	5.34 n	5.24 o
		Gemiza-9	37.5 n	41.3 o	39.4 n	1.75 l	2.40 jk	2.07 m	6.68 n	6.90 m	6.79 n
Tryptophan	**50 mgl^{-1}**	**Sakha-93**	53.9 c-e	53.3 d	53.6 c	4.47 ab	5.15 ab	4.81 ab	15.92 b-d	18.85 b	17.38 bc
		Gemiza-7	57.4 ab	56.9 a	57.2 a	3.53 c-h	4.33 b-e	3.93 c-g	11.12 i-l	11.40 jk	11.26 jk
		Gemiza-9	48.9 f-i	50.9 f	49.9 ef	3.97 ad	5.00 ab	4.48 a-c	12.26 hi	15.82 ef	14.04 fg
	100 mgl^{-1}	**Sakha-93**	42.9 m	42.5 n	42.7 m	2.60 ik	3.03 g-j	2.81 j-l	10.51 j-m	11.24 j-l	10.88 j-l
		Gemiza-7	49.1 f-h	52.8 d	50.9 e	2.80 h-k	3.57 e-i	3.18 h-l	9.877 lm	10.67 j-l	10.27 lm
		Gemiza-9	45.1 l	44.4 lm	44.8l	2.93 g-k	4.16 b-g	3.55 d-i	11.06 i-l	11.87 j	11.47 j
Cysteine	**100 mgl^{-1}**	**Sakha-93**	49.7 fg	46.5 jk	48.1 g-i	2.57 jk	2.68 ij	2.62 lm	9.253 m	10.07 l	9.66 m
		Gemiza-7	54.1 cd	55.9 a-c	55.0 b	2.47 k	3.49 e-j	2.98 i-l	11.17 i-l	13.80 hi	12.49 hi
		Gemiza-9	46.3 j-l	44.8 lm	45.6 kl	2.90 g-k	3.87 c-h	3.38 f-k	12.09 hi	14.47 gh	13.28 gh
	150 mgl^{-1}	**Sakha-93**	52.0 e	49.3 gh	50.7 e	3.80 a-f	4.10 b-g	3.95 c-g	12.59 g-i	15.54 fg	14.06 fg
		Gemiza-7	57.8 a	56.6 ab	57.2 a	3.47 d-h	4.04 b-g	3.75 d-h	14.50 d-f	16.27 ef	15.38 e
		Gemiza-9	48.5 f-i	45.5 kl	47.0 ij	3.87 a-e	4.56 a-e	4.21 b-d	19.77 a	20.24 a	20.01 a
Thiamine	**50 mgl^{-1}**	**Sakha-93**	48.6 f-i	52.1 de	50.3 e	4.30 a-c	4.80 a-d	4.55 a-c	15.21 c-e	17.70 cd	16.45 d
		Gemiza-7	55.8 bc	52.9 d	54.3 bc	3.40 d-i	3.20 f-j	3.30 g-l	11.47 i-k	11.30 j-l	11.38 jk
		Gemiza-9	49.9 f	48.3 hi	49.1 fg	3.60 c-h	3.86 c-h	3.73 d-h	14.80 de	16.39 ef	15.60 e
	100 mgl^{-1}	**Sakha-93**	46.0 j-l	50.3 fg	48.1 g-i	3.00 f-k	3.17 f-j	3.08 h-l	10.23 j-m	11.78 j	11.01 j-l
		Gemiza-7	53.3 de	51.3 ef	52.3 d	2.87 g-k	2.80 h-j	2.83 j-l	9.77 lm	10.35 kl	10.06 lm
		Gemiza-9	47.3 h-k	47.3 ij	47.3 hi	3.68 b-g	3.60 e-i	3.64 d-i	13.97 e-g	15.90 ef	14.93 ef
Ascorbic Acid	**50 mgl^{-1}**	**Sakha-93**	46.9 i-l	49.4 gh	48.1 g-i	3.97 a-d	4.07 b-g	4.02 c-f	12.47 hi	14.40 hi	13.43 gh
		Gemiza-7	54.4 cd	54.9 c	54.7 bc	4.00 a-d	4.37 b-e	4.18 b-e	13.13 f-h	16.80 de	14.9 ef
		Gemiza-9	45.3 kl	44.1 m	44.7 l	3.43 d-h	3.60 e-i	3.52 e-i	11.77 h-j	13.41 hi	12.59 h
	100 mgl^{-1}	**Sakha-93**	46.4 j-l	48.0 i	47.2 i	4.30 a-c	4.90 a-c	4.60 a-c	16.42 bc	19.10 b	17.76 b
		Gemiza-7	58.6 a	56.4 ab	57.5 a	4.10 a-d	4.80 a-d	4.45 a-c	15.32 c-e	18.39 bc	16.85 cd
		Gemiza-9	47.7 g-j	50.1 fg	48.9 fg	4.58 a	5.50 a	5.04 a	19.70 a	20.36 a	20.03 a
Yeast	**1000 mgl^{-1}**	**Sakha-93**	47.2 h-k	49.5 gh	48.4 gh	3.13 e-k	3.70 d-i	3.42 f-j	10.10 k-m	13.20 i	11.65 ij
		Gemiza-7	52.6 de	56.8 a	54.7 bc	4.00 a-d	4.23 b-f	4.11 c-e	16.92 b	19.30 ab	18.11 b
		Gemiza-9	45.4 kl	46.6 jk	45.9 jk	3.33 d-j	3.84 c-h	3.59 d-i	14.54 d-f	15.96 ef	15.25 e
	2000 mgl^{-1}	**Sakha-93**	47.1 h-l	44.8 lm	45.9 jk	2.53 jk	2.90 h-j	2.72 kl	9.60 lm	11.01 j-l	10.31 lm
		Gemiza-7	53.7 de	55.5 bc	54.6 bc	3.60 c-h	2.87 h-j	3.23 h-l	9.86 lm	11.03 j-l	10.45 k-m
		Gemiza-9	45.1 l	45.5 kl	45.3 kl	3.13 e-k	3.04 g-j	3.09 h-l	12.31 hi	14.37 g-i	13.34 gh

S1 = first season S2 = second season Comb. = combined data

Table (4): Fresh and dry weight of plant, as affected by interaction between some growth bio-regulators treatments and varieties of wheat at vegetative growth stage during two growing seasons and their combined data.

Treatments			Fresh weight/plant (g)			Dry weight/plant (g)		
			S1	S2	Comb.	S1	S2	Comb.
control		Sakha-93	5.71 q	6.770 s	6.240 o	0.973 q	1.577 n	1.275 o
		Gemiza-7	6.62 pq	7.467 s	7.043 o	1.160 pq	1.727 mn	1.443 o
		Gemiza-9	6.95 pq	9.150 r	8.052 n	1.490 op	2.088 lm	1.789 n
Tryptophan	50 mgl^{-1}	Sakha-93	17.42 b	20.97 b	19.20 b	3.777 bc	4.467 bc	4.122 bc
		Gemiza-7	15.92 bc	19.62 c	17.77 d	3.530 cd	4.357 bc	3.943 c
		Gemiza-9	15.27 cd	16.10 g-i	15.68 e-g	3.173 de	3.207 f-i	3.190 d
	100 mgl^{-1}	Sakha-93	10.05 k-n	10.66 pq	10.35 l	1.950 j-n	2.083 lm	2.017 l-n
		Gemiza-7	11.84 g-k	12.62 mn	12.23 jk	2.083 j-m	2.717 jk	2.400 i-k
		Gemiza-9	11.32 h-k	12.12 no	11.72 k	2.363 h-k	2.750 i-k	2.557 h-j
Cysteine	100 mgl^{-1}	Sakha-93	8.680 no	9.390 r	9.035 m	1.863 l-o	1.957 l-n	1.910 mn
		Gemiza-7	13.98 d-f	15.49 hj	14.73 gh	2.380 h-j	3.533 ef	2.957 d-f
		Gemiza-9	10.24 j-n	10.47 q	10.35 l	1.627 no	2.687 k	2.157 k-m
	150 mgl^{-1}	Sakha-93	12.33 f-i	16.91 fg	14.62 h	2.300 h-l	3.600 ef	2.950 d-f
		Gemiza-7	16.33 bc	21.42 b	18.88 bc	3.703 c	4.053 cd	3.878 c
		Gemiza-9	13.32 e-g	17.05 fg	15.19 f-h	2.390 h-j	3.797 de	3.093 d
Thiamine	50 mgl^{-1}	Sakha-93	15.83 bc	16.27 gh	16.05 ef	2.200 i-m	3.783 de	2.992 de
		Gemiza-7	11.72 g-k	13.76 kl	12.74 i-k	1.920 k-o	3.043 g-k	2.482 h-j
		Gemiza-9	15.56 cd	15.24 ij	15.40 f-h	1.953 j-n	3.293 f-h	2.623 g-i
	100 mgl^{-1}	Sakha-93	11.38 h-k	13.87 kl	12.62 i-k	2.187 i-m	3.033 g-k	2.610 g-i
		Gemiza-7	9.453 l-o	11.51 op	10.48 l	1.830 m-o	2.680 k	2.255 j-l
		Gemiza-9	12.17 f-i	14.54 jk	13.35 i	2.753 e-h	3.080 g-k	2.917 d-g
Ascorbic Acid	50 mgl^{-1}	Sakha-93	10.88 i-l	13.83 kl	12.36 i-k	2.677 f-h	3.157 f-j	2.917 d-g
		Gemiza-7	13.06 f-h	17.56 ef	15.31 f-h	3.850 bc	4.087 cd	3.968 c
		Gemiza-9	9.387 l-o	11.95 no	10.67 l	2.070 j-n	2.193 l	2.132 k-m
	100 mgl^{-1}	Sakha-93	12.15 f-j	18.56 d	15.36 f-h	2.730 f-h	3.260 f-h	2.995 de
		Gemiza-7	19.36 a	22.75 a	21.06 a	4.720 a	5.127 a	4.923 a
		Gemiza-9	17.64 b	18.64 d	18.14 cd	3.803 bc	4.210 b-d	4.007 c
Yeast	1000 mgl^{-1}	Sakha-93	10.60 i-m	15.03 j	12.81 ij	2.937 e-g	3.410 e-g	3.173 d
		Gemiza-7	14.94 c-e	18.30 de	16.62 e	4.187 b	4.547 b	4.367 b
		Gemiza-9	11.53 g-k	13.17 lm	12.35 i-k	2.547 g-i	2.883 h-k	2.715 e-h
	2000 mgl^{-1}	Sakha-93	8.817 m-o	11.48 op	10.15 l	2.717 f-h	2.617 k	2.667 f-i
		Gemiza-7	12.03 g-j	13.49 lm	12.76 i-k	3.013 ef	2.917 h-k	2.965 d-f
		Gemiza-9	7.990 op	11.46 op	9.727 lm	1.770 m-o	2.917 i-k	2.265 j-l

S1 = first season S2 = second season Comb. = combined data

Treatment of 50 mgl^{-1} tryptophan with Gemiza-9 variety recorded the highest values of number of tillers in the first, second season and their combined data. While, 50 mgl^{-1} treatment gave the highest number of leaves per plant when used on Sakha-93 variety during the same periods. On the other hand, treatment of 150 mgl^{-1} cysteine with Gemiza-7 variety recorded the highest value of fresh weight of plant in the first season. While, ascorbic acid at 100 mgl^{-1} recorded the highest values of this character when used on Gemiza-9 variety during second season and combined data.

The treatment of 50 mgl^{-1} tryptophan was more effective in increasing dry weight of plant during the second season and the combined data. While ascorbic acid treatment at 100 mgl^{-1} was more effective in the first season when used on Gemiza-9 variety. The most effective treatments for increasing flag leaf area was 150 mgl^{-1} cysteine when used on Gemiza-7 variety followed by thiamine treatment at 100 mgl^{-1} on Gemiza-7 variety also which was no significant difference between them.

Yield and yield components

Effect of bio-regulators

Foliar application of all concentrations of bio-regulating substances under study (Tables 5-6) resulted in significant increases in spike length, number of spike per plant, weight of spike, number of grains per spike, number of spikelet per spike, number of grains per spikelet, grains weight per spike, grain and straw yield of wheat plant, during the two growing seasons and their combined data compared with untreated plants (control).

Tryptophan treatment at 50 mgl^{-1} recorded the highest values of spike length in the combined data. While, concentration of 100 mgl^{-1} was the best treatment in the first season. On the other hand 100 mgl^{-1} thiamine treatment recorded the highest value in this character during second season. Data also show that, yeast extract at 1000 mgl^{-1} concentration gave the highest values of number of spike per plant during first and combined data while, the highest value was obtained by 50 mgl^{-1} tryptophan treatment in the second season.

Also, tryptophan treatment at 50 mgl^{-1} resulted in the highest values of weight of spike per plant and grains weight per spike during the two growing seasons and their combined data as well as grain yield and number of grains per spike during the first season and the combined data, whereas 1000 mgl^{-1} yeast application recorded the highest value in the second season. In addition there was no significant difference between the two treatments in the second season.

Straw yield was positively affected by 100 mgl^{-1} ascorbic acid treatment during the first, second season and their combined data compared with the untreated plants (control).

Varieties performance:

The examined cultivars significantly varied in their response to different bio-regulators in the yield and yield component characters (Tables 5-6). In comparison between varieties, Gemiza-7 variety significantly exceeded in spike length, weight of spike in the two growing seasons and their combined data, number of grains per spike in the second season, grain weight of spike and grain yield in the two growing season and their combined data.

Gemiza-9 variety recorded the highest values of number of spikes per plant in the second season and the combined data, number of grains per spike in the first season and the combined data and straw yield in the two growing season and their combined data. Whereas, Sakha-93 variety was exceeded in number of spikes per plant in the first season.

Table (5): Spike length, number of spikes per plant and weight of spike of some wheat varieties, as affected by some growth bio-regulating substances during two growing seasons and their combined data.

Treatments		Spike length (cm)			No. of Spikes/plant			weight of spike (g)		
		S1	S2	Comb.	S1	S2	Comb.	S1	S2	Comb.
Control		7.15 c	6.87 e	7.01 e	1.75 e	2.33 d	2.044 e	1.84 e	2.77 e	2.30 h
Tryptophan	**50 mgl^{-1}**	9.21 ab	12.14 a	10.68 a	3.92 a-c	5.56 a	4.74 a	4.39 a	6.42 a	5.40 a
	100 mgl^{-1}	9.43 a	10.77 cd	10.10 bc	3.41 b-d	4.33 bc	3.87 b-d	3.81 b	5.42 cd	4.62 c-e
Cysteine	**100 mgl^{-1}**	8.55 b	11.33 bc	9.94 cd	2.82 d	3.78 c	3.30 d	3.36 cd	5.79 b-d	4.57 d-f
	150 mgl^{-1}	9.04 ab	10.65 d	9.85 cd	3.17 cd	4.00 c	3.58 cd	3.13 d	5.34 d	4.23 g
Thiamine	**50 mgl^{-1}**	9.26 ab	11.04 cd	10.15 bc	3.50 b-d	4.42 bc	3.96 b-d	3.11 d	5.63 b-d	4.37 e-g
	100 mgl^{-1}	8.86 ab	12.19 a	10.52 ab	3.61 b-d	3.94 c	3.78 b-d	3.79 b	5.95 a-c	4.87 bc
Ascorbic Acid	**50 mgl^{-1}**	8.89 ab	10.82 cd	9.85 cd	3.41 b-d	3.94 c	3.68 cd	3.80 b	6.12 ab	4.96 b
	100 mgl^{-1}	8.68 ab	11.88 ab	10.28 a-c	4.04 ab	4.78 a-c	4.41 ab	3.23 d	5.66 b-d	4.44 d-g
Yeast	**1000 mgl^{-1}**	8.77 ab	11.65 ab	10.21 a-c	4.44 a	5.22 ab	4.83 a	3.52 c	5.90 a-c	4.71 b-d
	2000 mgl^{-1}	8.51 ab	10.62 d	9.56 d	3.72 a-c	4.50 bc	4.11 bc	3.33 cd	5.24 d	4.29 fg
Sakha-93		8.09 c	9.96 c	9.023 c	3.56 a	4.33 ab	3.94 a	2.75 c	5.02 c	3.88 c
Gemiza-7		9.81 a	12.31 a	11.06 a	3.30 a	3.98 b	3.64 b	3.84 a	6.09 a	4.96 a
Gemiza-9		8.38 b	10.45 b	9.416 b	3.46 a	4.45 a	3.95 a	3.59 b	5.32 b	4.46 b

S1 = first season S2 = second season Comb. = combined data

Table (6): Number of grains per spike, grainsweight per spike, grain and straw yield per feddanof some wheat varieties, as affected by some growth bio-regulating substances during two growing seasons and their combined data.

Treatments		No. of grains/spike			Grains weight(g)/spike			Grain yield (Tons/feddan)			Straw yield (Tons/feddan)		
		S1	S2	Comb.	S1	S2	Comb.	S1	S2	Comb.	S1	S2	Comb.
Control		30.01 g	29.63 d	29.82 e	1.33 f	1.94 e	1.64 g	1.61 f	2.00 f	1.80 f	1.82 g	2.37 f	2.09 h
Tryptophan	**50 mgl-1**	55.48 a	69.44 ab	62.46 a	2.85 a	5.18 a	4.01 a	2.59 a	3.02 a	2.80 a	4.26 bc	4.95 b	4.60 b
	100 mgl-1	44.93 d	59.47 c	52.20 cd	2.44 bc	4.14 d	3.29 c-e	2.37 bc	2.73 b	2.55 b	3.49 e	4.02 d	3.75 e
Cysteine	**100 mgl-1**	45.47 cd	72.14 a	58.80 b	2.22 cd	4.81 a-c	3.51 bc	1.83 e	2.30 e	2.06 e	2.88 f	3.61 e	3.25 g
	150 mgl-1	38.61 f	60.08 c	49.34 d	1.83 e	4.14 d	2.98 f	2.33 bc	2.46de	2.40 cd	4.19 c	4.43 c	4.31 c
Thiamine	**50 mgl-1**	41.07 e	65.04 bc	53.05 c	2.01 de	4.56 b-d	3.29 c-e	2.17 d	2.50 c-e	2.34 d	3.76 de	4.29 cd	4.02 d
	100 mgl-1	50.44 b	67.73 ab	59.08 b	2.61 ab	4.91 ab	3.76 ab	2.32 c	2.63b-d	2.48 bc	4.53 b	5.04 b	4.79 b
Ascorbic Acid	**50 mgl-1**	47.81 c	70.35 ab	59.08 b	2.42 bc	4.96 ab	3.69 b	2.11 d	2.47 de	2.29 d	4.00 cd	4.51 c	4.25 c
	100 mgl-1	40.34 ef	64.92 bc	52.63 c	2.09 c-e	4.36 cd	3.23 d-f	2.42 b	2.69 bc	2.56 b	4.97 a	5.63 a	5.30 a
Yeast	**1000 mgl-1**	47.14 cd	65.32 bc	56.23 b	2.20 cd	4.82 a-c	3.51 b-d	2.32 c	3.14 a	2.73 a	2.99 f	4.05 d	3.52 f
	2000 mgl-1	41.28 e	60.69 c	50.99 cd	1.90 de	4.20 d	3.05 ef	2.09 d	2.52 b-d	2.31 d	2.80 f	3.43 e	3.12 g
Sakha-93		42.97 b	61.51 a	52.24 b	1.84 b	3.89 c	2.86 c	1.95 c	2.36 b	2.15 c	3.54 a	4.23 a	3.88 b
Gemiza-7		42.63 b	62.63 a	52.63 b	2.41 a	5.00 a	3.71 a	2.42 a	2.73 a	2.57 a	3.58 a	4.03 b	3.81 b
Gemiza-9		46.02 a	62.62 a	54.32 a	2.26 a	4.21 b	3.24 b	2.22 b	2.67 a	2.45 b	3.70 a	4.37 a	4.04 a

S1 = first season S2 = second season Comb. = combined data

Effect of interaction

The effect of interaction between foliar application of bio-regulating substances and the three wheat varieties on yield and its components was significant and highly increased all yield components compared with the untreated plants (Tables 7-8).

Data indicated that, the highest value of spike length was obtained by thiamine treatment when used at 50 mgl^{-1} concentration in the first season and 100 mgl^{-1} in the second season and combined data when used with Gemiza-7 variety. The highest value of number of spikes per plant in the first season had been resulted by the interaction between 1000 mgl^{-1} yeast extract with Sakha-93 variety, while it had been resulted from interaction between 50 mgl^{-1} of tryptophan with Gemiza-9 variety during the second season and the combined data analysis.

The most effective treatment in the mean values of spike weight was that of 50 mgl^{-1} tryptophan with Gemiza-9 variety in the first season. On the other side ascorbic acid treatment at 50 mgl^{-1} was more effective on the weight of spike when used on Gemiza-7 during the second season and the combined data analysis. Results showed that, the most effective treatment on grains weight per spike in the first season was that of 50 mgl^{-1} tryptophan on Gemiza-7 variety, while, ascorbic acid was more effective in the second season and the combined data when used at 50 mgl^{-1} concentration on the same variety.

Foliar application of 50 mgl^{-1} tryptophan on Gemiza-9 variety recorded the highest values in grain yield in the first, second season and their combined data.

The best treatments of straw yield was foliar application of 100 mgl^{-1} ascorbic acid on Sakha-93 variety during the first season and combined data and the same treatment with Gemiza-9 in the second season.

Table (7): Spike length, number of Spikes per plant and weight of spike of, as affected by interaction between some growth bio-regulating substances treatments and wheat varieties during two growing seasons and their combined data.

Treatments			Spike length (cm)			No. of Spikes/plant			weight of spike (g)		
			S1	S2	Comb.	S1	S2	Comb.	S1	S2	Comb.
control		Sakha-93	6.91 m	6.80 m	6.85 p	1.67 h	2.67 g-i	2.17 lm	1.69 o	2.79 l	2.24 n
		Gemiza-7	7.41 j-m	7.07 m	7.24 p	1.93 gh	2.33 hi	2.13 lm	2.19 mn	2.68 l	2.44 n
		Gemiza-9	7.14 lm	6.73 m	6.94 p	1.67 h	2.00 i	1.83 m	1.65 o	2.83 l	2.24 n
Tryptophan	50 mgl^{-1}	Sakha-93	8.68 f-i	12.56 cd	10.62 e-g	3.25 b-f	4.50 b-f	3.87 c-k	3.78 d-g	6.78 ab	5.28 b-d
		Gemiza-7	10.24 ab	12.33 de	11.28 b-d	4.00 a-e	5.17 b-e	4.58 b-f	4.60 ab	6.29 b-f	5.44 ab
		Gemiza-9	8.72 f-i	11.53 ef	10.13 f-i	4.50 ab	7.00 a	5.75 a	4.78 a	6.19 b-g	5.48 ab
	100 mgl^{-1}	Sakha-93	8.93 e-g	9.67 i-l	9.30 k-n	3.33 b-f	3.50 f-h	3.42 i-k	3.25 hi	5.30 hi	4.27 ij
		Gemiza-7	10.16 bc	11.34 f	10.75 d-f	3.06 c-g	4.00 c-g	3.53 g-k	4.12 c-e	5.50 f-i	4.81 d-h
		Gemiza-9	9.21 c-f	11.30 f	10.26 f-h	3.83 a-e	5.50 bc	4.67 b-e	4.07 c-e	5.48 f-i	4.77 e-h
Cysteine	100 mgl^{-1}	Sakha-93	7.97 g-l	10.57 f-j	9.27 k-n	3.25 b-f	4.00 c-g	3.62 f-k	3.45 g-i	5.04 ij	4.24 ij
		Gemiza-7	9.84 b-e	12.82 b-d	11.33 b-d	2.33 f-h	3.50 f-h	2.92 kl	3.44 g-i	6.46 a-d	4.95 c-f
		Gemiza-9	7.84 h-m	10.61 f-i	9.23 k-n	2.89 e-g	3.83 d-g	3.36 i-k	3.18 ij	5.88 c-i	4.53 f-i
	150 mgl^{-1}	Sakha-93	8.62 f-i	9.567 kl	9.09 l-n	3.33 b-f	4.17 c-g	3.75 d-k	2.58 k-m	4.46 jk	3.52 lm
		Gemiza-7	10.19 bc	12.77 cd	11.48 bc	3.17 c-g	4.00 c-g	3.58 g-k	3.61 e-i	6.28 b-f	4.95 c-f
		Gemiza-9	8.32 f-k	9.60 j-l	8.96mn	3.00 d-g	3.83 d-g	3.42 i-k	3.21 ij	5.27 hi	4.24 ij
Thiamine	50 mgl^{-1}	Sakha-93	8.85 e-h	9.66 i-l	9.25 k-n	4.00 a-e	5.00 b-f	4.50 b-h	2.27 l-n	5.07 ij	3.67 kl
		Gemiza-7	11.14 a	12.53 d	11.84 ab	3.50 b-f	4.27 c-f	3.88 c-k	3.54 f-i	6.57 a-c	5.06 b-e
		Gemiza-9	7.80 i-m	10.93 f-h	9.36 k-n	3.00 d-g	4.00 c-g	3.50 i-k	3.51 f-i	5.26 hi	4.39 h-j
	100 mgl^{-1}	Sakha-93	8.37 f-j	10.58 f-j	9.47 i-m	3.50 b-f	3.83 d-g	3.67 f-k	3.63 e-i	5.29 hi	4.46 f-j
		Gemiza-7	9.95 b-d	14.87 a	12.41 a	4.17 a-e	4.33 b-f	4.25 c-j	3.90 c-g	6.84 ab	5.37 a-c
		Gemiza-9	8.26 f-k	11.12 fg	9.69 h-l	3.17 c-g	3.67 e-h	3.42 i-k	3.84 d-g	5.72 d-i	4.78 e-h
Ascorbic Acid	50 mgl^{-1}	Sakha-93	7.43 j-m	10.06 h-k	8.74 n	3.42 b-f	4.00 c-g	3.71 e-k	2.76 jk	5.62 e-i	4.19 ij
		Gemiza-7	10.40 ab	11.57 ef	10.98 c-e	3.11 c-g	3.50 f-h	3.30 jk	4.38 a-c	7.12 a	5.75 a
		Gemiza-9	8.84 e-h	10.82 f-h	9.83 h-k	3.71 b-e	4.33 b-f	4.02 c-j	4.26 b-d	5.62 e-i	4.94 c-f
	100 mgl^{-1}	Sakha-93	7.70 i-m	11.14 fg	9.42 j-n	4.03 a-e	5.00 b-f	4.52 b-g	2.70 kl	5.39 g-i	4.04 jk
		Gemiza-7	9.72 b-e	13.49 bc	11.60 bc	3.83 a-e	4.17 c-g	4.00 c-j	3.75 e-h	6.02 b-h	4.88 d-g
		Gemiza-9	8.61 f-i	11.01 f-h	9.81 h-k	4.25 a-d	5.17 b-e	4.71 b-d	3.24 i	5.57 e-i	4.41 g-j
Yeast	1000 mgl^{-1}	Sakha-93	8.21 f-k	10.16 g-k	9.18 k-n	5.00 a	5.83 ab	5.42 ab	1.90 no	5.34 hi	3.62 kl
		Gemiza-7	9.03 d-f	13.73 b	11.38 b-d	4.17 a-e	4.50 b-f	4.33 c-i	4.67 ab	6.81 ab	5.74 a
		Gemiza-9	9.06 d-f	11.06 fg	10.06 g-j	4.17 a-e	5.33 b-d	4.75 bc	3.98 c-f	5.53 f-i	4.76 e-h
	2000 mgl^{-1}	Sakha-93	7.32 k-m	8.75 l	8.03 o	4.33 a-c	5.17 b-e	4.75 bc	2.19 mn	4.16 k	3.17 m
		Gemiza-7	9.83 b-e	12.84 b-d	11.34 b-d	3.00 d-g	4.00 c-g	3.50 h-k	4.01 c-f	6.38 a-e	5.19 b-e
		Gemiza-9	8.37 f-j	10.26 g-k	9.32 k-n	3.83 a-e	4.33 b-f	4.08 c-j	3.79 d-g	5.19 h-j	4.49 f-j

S1 = first season **S2 = second season** **Comb. = combined data**

Table (8): Number of grains per spike, grains weight per spike and grain and straw yield as affected by interaction between some growth bio-regulators treatments and varieties of wheat, during two growing seasons and their combined data.

Treatments			No. of grains/spike			Grains weight(g)/spike			Grain yield (Tons/feddan)			Straw yield (Tons/feddan)		
			S1	S2	Comb.	S1	S2	Comb.	S1	S2	Comb.	S1	S2	Comb.
control		Sakha-93	37.63 l	32.67 h	35.15 m	1.13 o	2.28 m	1.71 n	1.55 o	1.88 m	1.71 q	1.50 m	2.04 r	1.77 p
		Gemiza-7	27.00 n	25.47 h	26.23 n	1.29 no	1.72 m	1.50 n	1.72 l-o	2.06 lm	1.89 o-q	1.75 lm	2.09 r	1.92 p
		Gemiza-9	25.40 n	30.75 h	28.08 n	1.58 k-o	1.82 m	1.70 n	1.55 o	2.07 k-m	1.81 q	2.22 k-m	2.97 q	2.59 o
Tryptophan	50 mgl-1	Sakha-93	54.12 bc	73.83 a-d	63.97 ab	2.69 a-e	5.80 ab	4.24 ab	2.35 g	2.64 e-i	2.49 d-i	4.46 a-d	5.00 a-f	4.73 c-f
		Gemiza-7	53.00 b-d	58.17 fg	55.58 c-i	3.08 a	4.70 d-i	3.89 b-f	2.66 a-c	2.91 c-f	2.78 bc	4.17 b-e	4.56 d-j	4.36 e-i
		Gemiza-9	59.33 a	76.33 a	67.83 a	2.78 a-c	5.04 b-f	3.91 b-f	2.75 a	3.51 a	3.13 a	4.15 b-e	5.28 a-d	4.71 c-g
	100 mgl-1	Sakha-93	41.73 i-k	59.67 e-g	50.70 i-k	1.97 g-m	3.83 j-l	2.90 j-l	2.08 hi	2.30 h-l	2.19 k-n	3.29 e-i	3.63 l-q	3.46 k-m
		Gemiza-7	46.53 e-h	57.83 fg	52.18 g-j	2.67 a-f	4.43 e-j	3.55 d-h	2.35 fg	2.48 f-k	2.42 g-j	3.39 e-i	3.59 m-q	3.49 k-m
		Gemiza-9	46.53 e-h	60.92 e-g	53.72 d-j	2.67 a-f	4.17 g-j	3.42 f-i	2.67 ab	3.40 ab	3.03 a	3.78 d-g	4.83 c-h	4.31 e-j
Cysteine	100 mgl-1	Sakha-93	48.20 ef	71.23 a-e	59.72 b-e	1.81 i-n	3.85 i-l	2.83 j-l	1.68 m-o	2.06 lm	1.87 pq	3.16 f-j	3.89 j-p	3.52 k-m
		Gemiza-7	46.53 e-h	75.19 a-c	60.86 bc	2.51 a-g	5.60 a-c	4.06 b-d	1.93 h-k	2.57 f-j	2.25 j-n	2.77 h-k	3.68 k-q	3.23 l-n
		Gemiza-9	41.67 i-k	70.00 a-f	55.83 c-i	2.35 b-i	4.97 b-g	3.66 d-g	1.88 i-l	2.27 i-m	2.07 m-p	2.71 h-k	3.27 o-q	2.99 m-o
	150 mgl-1	Sakha-93	38.53 kl	53.08 g	45.81 kl	1.64 j-o	3.32 kl	2.48 lm	1.97 h-j	2.19 j-m	2.08 m-p	4.25 b-e	4.70 d-i	4.47 d-h
		Gemiza-7	39.50 j-l	67.58 a-f	53.54 e-j	2.08 f-l	5.14 b-e	3.61 d-h	2.61 a-d	2.66 e-i	2.63 c-g	4.12 b-e	4.20 g-n	4.16 f-j
		Gemiza-9	37.80 l	59.57 e-g	48.68 j-l	1.76 i-n	3.97 h-k	2.87 j-l	2.42 d-g	2.53 f-j	2.47 e-j	4.19 b-e	4.38 e-l	4.29 e-j
Thiamine	50 mgl-1	Sakha-93	47.27 e-g	62.42 c-g	54.84 c-j	1.40 m-o	3.94 h-l	2.67 k-m	2.13 h	2.24 i-m	2.19 k-n	4.13 b-e	4.36 e-l	4.25 e-j
		Gemiza-7	37.13 l	65.39 a-g	51.26 h-k	2.33 b-i	5.55 a-c	3.94 b-e	2.44 d-g	2.99 c-e	2.72 cd	3.34 e-i	4.09 h-n	3.72 j-l
		Gemiza-9	38.80 kl	67.31 a-f	53.05 f-j	2.30 b-i	4.20 f-j	3.25 g-j	1.95 h-k	2.26 i-m	2.10 l-o	3.80 d-g	4.40 e-k	4.10 h-j
	100 mgl-1	Sakha-93	53.00 b-d	67.50 a-f	60.25 b-d	2.53 a-g	4.34 e-j	3.43 e-i	2.36 fg	2.55 f-j	2.45 f-j	4.20 b-e	5.02 a-f	4.61 c-h
		Gemiza-7	48.33 ef	67.11 a-f	57.72 b-h	2.74 a-d	5.61 a-c	4.17 a-c	2.60 a-e	3.00 c-e	2.80 bc	4.58 a-d	5.00 a-f	4.79 b-e
		Gemiza-9	50.00 de	68.57 a-f	59.28 b-f	2.55 a-g	4.79 c-h	3.67 d-g	2.00 h-j	2.34 g-l	2.17 k-n	4.81 a-c	5.11 a-e	4.96 a-d
Ascorbic Acid	50 mgl-1	Sakha-93	41.69 i-k	70.08 a-f	55.89 c-i	1.89 h-m	4.16 g-j	3.02 i-k	1.82 j-m	2.24 i-m	2.03 n-p	3.47 e-h	4.27 f-n	3.87 i-k
		Gemiza-7	45.82 f-h	75.58 ab	60.70 bc	2.88 ab	6.20 a	4.54 a	2.40 e-g	2.67 e-i	2.54 d-h	4.60 a-d	4.95 b-g	4.78 b-e
		Gemiza-9	55.93 b	65.39 a-g	60.66 bc	2.48 a-h	4.53 d-j	3.50 e-i	2.11 h	2.49 f-k	2.30 i-m	3.93 c-f	4.31 f-m	4.12 g-j
	100 mgl-1	Sakha-93	31.63 m	69.58 a-f	50.61 i-k	1.84 i-n	3.92 i-l	2.88 j-l	2.12 h	2.54 f-j	2.33 h-l	5.24 a	5.65 ab	5.45 a
		Gemiza-7	42.97 h-j	62.08 d-g	52.53 g-j	2.24 c-j	4.98 b-g	3.61 d-h	2.55 b-f	2.78 d-f	2.66 c-f	4.77 a-c	5.51 a-c	5.14 a-c
		Gemiza-9	46.42 e-h	63.08b-g	54.75 c-j	2.21 c-j	4.19 f-j	3.20 g-j	2.61 a-d	2.77 d-g	2.69 c-e	4.90 ab	5.73 a	5.31 ab
Yeast	1000 mgl-1	Sakha-93	45.20 f-i	62.28 d-g	53.74 d-j	1.81 i-n	4.21 f-j	3.01 i-k	1.76 k-n	3.14 a-d	2.45 f-j	2.26 j-m	4.01 i-n	3.13 l-o
		Gemiza-7	43.80 g-i	68.90 a-f	56.35 c-i	2.61 a-f	5.75 ab	4.18 a-c	2.73 ab	3.22 a-c	2.97 ab	2.99 g-k	3.52 n-q	3.25 l-n
		Gemiza-9	52.43 b-d	64.78 a-g	58.60 b-g	2.16 d-k	4.49 d-j	3.32 g-j	2.47 c-g	3.06 b-e	2.76 bc	3.72 d-g	4.60 d-j	4.16 f-j
	2000 mgl-1	Sakha-93	33.63 m	54.25 g	43.94 l	1.52 l-o	3.13 l	2.32 m	1.62 no	2.20 j-m	1.91 o-q	2.94 g-k	3.98 i-o	3.46 k-m
		Gemiza-7	38.33 kl	65.67 a-g	52.00 g-j	2.10 e-l	5.32 b-d	3.71 c-g	2.59 a-e	2.72 e-h	2.66 c-f	2.94 g-k	3.10 q	3.02 m-o
		Gemiza-9	51.87 cd	62.17 d-g	57.02 c-i	2.08 e-l	4.15 g-j	3.11 h-k	2.07 hi	2.65 e-i	2.36 h-k	2.51 i-l	3.21 pq	2.86 no

S1 = first season **S2 = second season** **Comb. = combined data**

The total photosynthetic pigments:

Effect of bio-regulator treatments:

Data presented in Table (9) showed that, total photosynthetic pigments (chlorophyll a, b and carotenoids) were significantly increased as affected by bio-regulating substances compared to the untreated plants (control) at the two growth stages.

Tryptophan was more effective in all studied characters, when used at the concentration of 50 mgl^{-1} except the total carotenoids which was more affected by 1000 mgl^{-1} of yeast extract.

Varieties performance:

There were no significant differences between Gemiza-7 and Gemiza-9 varieties in chlorophyll (a) content.The highest value was obtained by Gemiza-9 variety during heading stage. While, the last variety was Sakha-93 which recorded the lowest value in this parameter. Gemiza-7 variety exceeded the other two varieties in chlorophyll (b) during heading stage.

Concerning total carotenoids in the leaves Gemiza-7 variety exceeded the other two varieties in this respect during heading stage.

Effect of interaction:

Data in Table (10) indicated that, thiamine treatment when used at 100 mgl^{-1} concentration with Gemiza-7 variety resulted in the highest value of chlorophyll (a) at the heading stage.

The highest value of chlorophyll (b) was produced from interaction between 50 mgl^{-1} tryptophan with Sakha-93 variety during heading stage.

As for the effect of the interaction on the carotenoids contents in the leaves of wheat plants, the most effective treatments was 1000 mgl^{-1} of yeast extract with Sakha-93 variety at heading stage.

Table (9): Average values of the photosynthetic pigments content (mg/g fresh weight of wheat leaves) , as affected by some growth bio-regulators treatments and varieties of wheat. (Average of two seasons).

Treatments		Chlorophyll (a) mg/g	Chlorophyll (b) mg/g	Carotenoids mg/g
Control		0.6661 j	0.3028 h	0.2219 h
Tryptophan	50 mgl-1	1.229 a	0.6101 a	0.4390 a
	100 mgl-1	1.021 e	0.5308 c	0.3901 bc
Cysteine	100 mgl-1	0.6857 i	0.3446 g	0.2723 g
	150 mgl-1	0.8428 h	0.4350 f	0.3169 ef

Thiamine	**50 mgl-1**	0.8422 h	0.4370 f	0.3092 f
	100 mgl-1	1.173 b	0.5323 c	0.3977 b
Ascorbic Acid	**50 mgl-1**	0.8592 g	0.5052 d	0.3218 e
	100 mgl-1	1.092 c	0.5607 b	0.3847 c
Yeast	**1000 mgl-1**	1.037 d	0.4882 e	0.4434 a
	2000 mgl-1	0.8741 f	0.4360 f	0.3649 d
Sakha-93		0.863 b	0.4673 b	0.3244 b
Gemiza-7		0.971 a	0.4746 a	0.3660 a
Gemiza-9		0.981 a	0.4715 ab	0.3628 a

Duncan's Multiple Range Test In a column, means followed by common letter are not significantly different at *(5%)* level

Table (10): Effect of interaction between wheat varieties and bio-regulator treatments on the photosynthetic pigments content (mg/g fresh weight of wheat leaves) (average of two successive seasons).

Treatments			Chlorophyll (a) mg/g	Chlorophyll (b) mg/g	Carotenoids mg/g
control		**Sakha-93**	0.540 n	0.292 o	0.213 q
		Gemiza-7	0.626 m	0.294 o	0.211 q
		Gemiza-9	0.832 jk	0.323 n	0.242 op
Tryptophan	**50 mgl-1**	**Sakha-93**	1.263 b	0.638 a	0.437 de
		Gemiza-7	1.261 b	0.624 a	0.479 b
		Gemiza-9	1.162 cd	0.568 cd	0.401 g
	100 mgl-1	**Sakha-93**	0.993 f	0.526 e	0.365 ij
		Gemiza-7	1.168 c	0.555 d	0.426 ef
		Gemiza-9	0.900 g-i	0.511 e	0.379 hi
Cystine	**100 mgl-1**	**Sakha-93**	0.544 n	0.344 m	0.203 q
		Gemiza-7	0.821 jk	0.379 l	0.370 i
		Gemiza-9	0.692 l	0.311 n	0.244 op
	150 mgl-1	**Sakha-93**	0.821 jk	0.433 j	0.287 n
		Gemiza-7	0.932 gh	0.435 j	0.382 hi
		Gemiza-9	0.776 k	0.437 j	0.281 n
Thiamine	**50 mgl-1**	**Sakha-93**	0.869 ij	0.464 gh	0.319 m
		Gemiza-7	0.939 fg	0.464 gh	0.350 jk
		Gemiza-9	0.718 l	0.384 l	0.259 o
	100 mgl-1	**Sakha-93**	0.910 g-i	0.492 f	0.324 m
		Gemiza-7	1.473 a	0.526 e	0.456 c
		Gemiza-9	1.135 cd	0.579 c	0.413 fg
Ascorbic Acid	**50 mgl-1**	**Sakha-93**	0.778 k	0.481 fg	0.278 n
		Gemiza-7	0.638 m	0.479 fg	0.237 p
		Gemiza-9	1.161 cd	0.556 d	0.451 cd
	100 mgl-1	**Sakha-93**	0.874 h-j	0.515 e	0.317 m
		Gemiza-7	0.959 fg	0.564 cd	0.342 kl
		Gemiza-9	1.443 a	0.603 b	0.495 ab
Yeast	**1000 mgl-1**	**Sakha-93**	1.074 e	0.493 f	0.501 a
		Gemiza-7	0.930 gh	0.458 hi	0.401 g
		Gemiza-9	1.108 de	0.513 e	0.429 ef
	2000 mgl-1	**Sakha-93**	0.828 jk	0.465 gh	0.326 lm
		Gemiza-7	0.927 gh	0.443 ij	0.373 i
		Gemiza-9	0.867 ij	0.400 k	0.396 gh

Duncan's Multiple Range Test In a column, means followed by common letter are not significantly different at (5%) level.

4. Discussion:

Effect of bio-regulators on growth

According to the present data, the effect of foliar application of the different applied bio-regulating substances at different concentrations on plant height, number of tillers and leaves per plant and fresh and dry weight of plant at heading stage were high significantly increased in both season and their combined data of all bio-regulator treatments. These results are in harmony with those obtained by Gamal El-Din and Zaki (2005) who found that, at harvest stage all treatments of (Lysine, phenylalanine and L-cysteine) led to significant increases in plant height, number of pods and seeds per plant, dry weight of pods of lupine plants. EL-Bassiouny (2005) found that application of nicotinamide or tryptophan resulted in significant increases in plant growth and grain yield, concomitantly with an increase in the level of IAA, GA3, cytokinins, photosynthetic pigments and a decrease in ABA content of wheat plant.

On the other hand, Gadalla, (2009) reported that, application of ascorbic acid increased significantly flag leaf area in wheat plants grown under salinity conditions. These results may be due to the effect of ascorbic acid on osmotic adjustment and maintaining leaf turgor potential as a consequence of increasing leaf water potential and relative water content as compared to control plants. Farouk, (2011).

Yield and yield components

As for the effect of bio-regulating substances on yield and yield components the present data show that, foliar application of all used concentrations of bio-regulating substances significantly increased the yield and yield components of all used wheat varieties. Similarly, El-Bassiouny, (2005) reported that application of tryptophan resulted in significant increase in plant growth and grain yield, concomitantly with an increase in the level of IAA, GA3, cytokinins, photosynthetic pigments and a decrease in ABA content of wheat plant. Also, Abdel-Halim (1995)reported that, ascorbic acid at 100 and 200 ppm led to increased contents of indols (IAA, IAN and IBA) in the shoot of tomato. Amin *et al.,* (2008) reported that ascorbic acid recorded the highest increase in straw yield per plant and per feddan of wheat plant cv. Gemiza10.

These results might emphasize the role of ascorbic acid as scavenge the free radicals which caused increase in the oxidation in plant tissues (Noctor and Foyer, 1998).

Photosynthetic pigments:

It is observed from the presented data that, total photosynthetic pigments (chlorophyll a, b and carotenoids) were significantly increased as affected by the different bio-regulating substances compared to untreated plants (control), these results are true for all photosynthetic pigments.

The induced effect of tryptophan on chlorophyll biosynthesis may be due to its role in IAA biosynthesis (Arshad *et al.,* 1995; Barazani and Friedman, 2000). Also, the positive effect of foliar application of amino acids in enhancing all photosynthetic pigments percentage might be attributed to its positive effect on the succnyl COA (Kerb's cycle intermediate) and their effect in initiating the biosynthetic pathway leading to chlorophyll formation.

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