J. Agric. Sci. Mansoura Univ., 32 (2): 1011 - 1029, 2007

EFFECT OF SOME NATURAL EXTRACTS AND BENZYLADENINE ON GROWTH AND PRODUCTIVITY OF WHEAT (*Triticum aestivum*, L.) PLANTS

Wanas, A.L.
Dept. of Bot., Fac. of Agric., Moshtohor, Benha Univ., Egypt

ABSTRACT

Growth of wheat plants cv. Sakha 93 was significantly enhanced during 2003/04 and 2004/05 seasons by application of the natural yeast and garlic extracts (YE and GE) each at 50 and 100 ml/l as well as benzyladenine (BA) at 25 and 50 ppm. Since, significant increases in stem length, No. of both tillers and leaves, stems and leaves dry weights and total leaf area / plant were obtained with all applied treatments. Meanwhile, significant reduction in the assimilation rate was existed. Besides, different assigned treatments obviously increased the concentrations of photosynthetic pigments, NPK, crude protein and total carbohydrates in the flag leaf of treated plants as compared to those of untreated ones. In addition, all applied treatments caused positive alterations in many anatomical features of stem and flag leaf blade of treated plants. Among of these, the most important ones, increases of lamina thickness, length and width of vascular bundle and thickness of phloem and xylem tissues. Moreover, different applied treatments significantly improved the total grain yield/plant and its components as well as the straw yield/plant compared with those of untreated plants. The highest grain yield was attained by applying GE at 100 ml/l followed by BA at 50 ppm then YE at 100 ml/l.

Hence, the present study strongly admit the use of natural yeast and garlic extracts and benzyladenine not only to improve growth and productivity of wheat plants but also to avoid all cautions (regarding human health) about the use of synthetic growth regulators and the excessive use of mineral nutrients specially on the nutritional crops.

INTRODUCTION

Wheat (*Triticum aestivum*, L.) is one of the most important nutritional cereal crops in Egypt and all over the world. Wheat production is not sufficient for local consumption in Egypt and all developmental countries. Therefore, great efforts have been carried out for improving growth and productivity of wheat plant by the use of different factors including plant growth regulators (Aufhammer and Federolf, 1992), mineral nutrients (Zahran and Mosalem, 1993 and Allam, 2005).

Recently, considering the public health, there are several cautions about the use of synthetic growth regulators and the excess of mineral nutrients specially on the nutritional crops. Therefore, the two natural yeast and garlic extracts and the growth promoter benzyladenine were used in the present work for improving growth and productivity of wheat plant.

Here, yeast extract was suggested to participate a beneficial role during vegetative and reproductive growths through improving flower formation and their set of some plants due to its high auxin and cytokinin contents and enhancement of carbohydrates accumulation (Barnett *et al.*, 1990 and Fathy *et al.*, 2000). Also, it was reported about its stimulatory

effects on cell division and enlargement, protein and nuclic acids synthesis and chlorophyll formation (Fathy *et al*., 2000 and Wanas, 2002 and 2006). In addition to its contents of caryoprotective agents, i.e. sugars, proteins and amino acids and also several vitamins (Mahmoud, 2001). Moreover, improving growth and fruiting of some plants by yeast application was reported by Atawia and El-Desouky (1997), Fathy *et al*. (2000) and Wanas (2006).

As for garlic extract, it was suggested to participate a beneficial role during vegetative and reproductive growth through improving flowers formation and their set of some plants due to its enhancement of endogenous auxins, gibberellins and cytokinin levels and carbohydrates accumulation (El-Desouky *et al.*, 1998). Also, it was reported about its stimulatory effects on cell division and enlargement and biosynthesis of growth promotive hormones (Wanas *et al*., 1998), protein synthesis and chlorophyll formation (El-Desouky *et al.*, 1998 and Seham, 2002), beside its contents of amino acids, antibiotics, sugars, vitamins (Watt and Merrill, 1963).

But for benzyladenine (BA), it belongs to the group of cytokinins known to have a wide mode of action such as increasing cell division and enlargement, branches formation and breaking bud dormancy (Wilkins, 1989 and Chen, 1997). Also, it was demonstrated by Standen and Crouch (1996) that benzyladenine (BA) is one of the naturally occurring cytokinins.

Therefore, the present study aimed to use the natural yeast and garlic extracts and the growth promoter benzyladenine as grain-soaking and foliar spray applications for improving growth and productivity of wheat plant.

MATERIALS AND METHODS

Two field experiments were carried out at the Experimental Farm of the Faculty of Agriculture at Moshtohor, Benha University, Egypt during two successive growing seasons (2003/04 and 2004/05) to investigate the effects of applying the natural yeast and garlic extracts and benzyladenine as grain-soaking and foliar spraying on some growth aspects, chemical components, anatomical features, yield and its components of wheat (*Triticum aestivum*, L.) cultivar Sakha 93. Grains of wheat were secured from the Egyptian Agricultural Research Center, Ministry of Agriculture, Giza, Egypt.

Preparation of extracts :

1- Yeast extract(YE):

It was prepared by using a technique allowed yeast cells (pure dry yeast) to be grown and multiplied efficiently during conducive aerobic and nutritional conditions. To produce *denovo* beneficial bioconstituents, i.e. (carbohydrates, sugars, proteins, amino acids, fatty acids, hormones,... etc), hence allowed such constituents to release out of yeast cells in readly form by two cycles of freezing and thawing for disruption of yeast cells and releasing their content. Such technique for yeast preparation modified after Spencer *et al.* (1983).Yeast extract (YE) was used at two concentrations, i.e., 50 and 100 ml/l.

2- Garlic extract (GE):

Fresh mature garlic cloves were blended in distilled water (1/2 kg cloves/l liter H_2O), frozen and thawed two times, then filtered. The filtrate was used for preparation of different garlic extract concentrations, i.e., 50 and 100 ml/l. Such technique of garlic preparation modified after El-Dessouky *et al.*, (1998).

Experimental design of treatments:

Each experiment include seven treatments, i.e., the control (distilled water), 50 and 100 ml/l of each of yeast and garlic extracts and 25 and 50 ppm of benzyladenine. Besides, the assigned treatments were applied as grain-soaking for 4 hours then as foliar spraying on seedling growing up at 30 days from sowing. The experiment was performed in a complete randomized block design system with five replicates. The plot area was 7.0 m^2 (10 rows x 0.2 m apart and 3.5 m length). The pre-sowing treated wheat grains were sown in hill (one grain per hill) spaced 10 cm on rows at the 20th of November in the two seasons. Nitrogen fertilizer at rate of 200 kg /fed. was given in form of urea (46% N) in two equal doses (before the first and second irrigation). Calcium superphosphate (15.5 % P_2O_5) and potassium sulphate (48 % K_2O) were added during the preparation of soil in both seasons at the rates of 150 and 100 kg/fed., respectively. The other required culture practices for growing wheat were followed as recommended.

Sampling date and collecting data:

I- Growth characters:

Ten plants were randomly chosen from each treatment at two stages of growth, i.e., at 70 and 100 days after sowing in both seasons to estimate length of the main stem (cm), number of tillers/plant, stems dry weight (g)/plant, number of leaves / plant, leaves dry weight (g) / plant and total leaf area (cm^2) / plant using the disk method as described by **Derieux *et al.* (1973)**. Also, assimilation rate (A.R.) was calculated according to **Wareing and Phillips (1981)** using the following equation:

$$\textbf{A.R.} = \frac{\text{Total leaf area } (cm^2)/\text{plant}}{\text{Total dry weight of leaves } (g)/\text{plant}}$$

II- Photosynthetic pigments:

Chlorophyll a, b and carotenoids in the flag leaf were colorimetrically determined at 105 days from sowing in both seasons according to the method described by Nornal (1982).

III- Chemical constituents in the flag leaf:

Samples from wheat in flag leaf at 105 days from sowing were taken to determine total nitrogen (Horneck and Miller, 1998), phosphorous (Sandell, 1950) potassium (Horneck and Hanson, 1998) and total carbohydrates (Dubois *et al.*, 1956). Also, crude protein was calculated according to A.O.A.C. (1990) using the following equation:

Crude protein = Total nitrogen x 5.7

VI- Anatomical study:

According to the wide differences in the growth and yield characters of wheat plants in the first season due to the treatments used, a comparative anatomical studies on stem and flag leaf balde of treated plants compared with those of the control plants were examined also at 115 days from sowing in the second season.

Specimens of stems (1 cm long) were taken from the middle part of the terminal internode of the main stem, while those of leaves (1 cm^2) were taken from the middle part of the flag leaf blade on the main stem. The specimens were killed and fixed for at least 48 hours in F.A.A. solution, washed in 50 % ethyl alcohol, dehydrated in a series of ethyl alcohols (70, 90, 95 and 100%), infiltrated in xylene, embedded in paraffin wax of a melting point 60-63 °C (Sass, 1950), sectioned at 20μ using a rotary microtome, double stained with fast green and safranin (Johanson, 1940), cleared in xylene and mounted in Canada balsam.

The prepared sections were microscopically examined. Counts and measurements (μ) were taken using a micrometer eye piece. Averages of readings from 4 sections / treatment were calculated.

V- Yield characters:

Then plants per each treatment were randomly taken at harvest time and the following characters were recorded:

(a) Number of spikes / plant.
(b) Length of the main spike.
(c) Number of grains / main spike.
(d) Weight of grains (g)/ main spike.
(e) Weight of 100 grains (g).
(f) Total grain yield (g) / plant.
(g) Straw yield (g)/ plant.
(h) Relative grain yield was calculated as a percentage of the control yield.

VI- Statistical analysis:

Data of vegetative growth, yield and its components were subjected to statistical analysis according to Snedecor and Cochran (1989).

RESULTS AND DISCUSSION

I- Growth characters:

Data in Table (1) clearly indicate that application of YE, GE each at 50 and 100 ml/l and BA at 25 and 50 ppm as grain-soaking then as foliar spray at 30 days from sowing caused a significant increase in different studied growth parameters of treated wheat plants as length of the main stem, number of both tillers and leaves / plant, dry weights of stems and leaves and total leaf area / plant compared with those of untreated plants at the two stages of growth (70 and 100 days from sowing) during the two growing seasons.

T1

In this respect, BA was the most effective followed by GE then YE. Also, increase values were mostly in parallel to the applied concentration of each. Herein, increment of stems dry weight is of great interest because it indicates that more dry matter being allocated for the formation of new tillers which could be later carried an additional spikes. Besides, increment each of total leaf number and total leaf area was mainly attributed to the new formed tillers. That was reversed upon the total leaf dry weight/plant, which means that photosynthetic area and its activity were increased, hence that could be reflected on the final grain yield.

In addition, the calculated assimilation rate (leaf area in cm^2 required for producing one gram of dry matter) may be support the previously mentioned data about vigorous growth of wheat plants as affected by the applied treatments. Since, it showed its significant reduction proportionally with the two assigned concentrations of YE, GE and BA. Reduction of assimilation rate may be considered an evidence to increase the efficiency of photosynthesis process and also synthesize more assimilates per each unit of leaf area, hence high rate of their translocation specially towards sink sites (developing grains).

In general, the above mentioned results showed that different growth aspects of wheat plant were positively affected by the applied YE, GE and BA treatments. As for yeast extract (YE), it has been reported to be a rich source of vitamins, hormones and many other growth factors (Fathy *et al.,* 2000 and Mahmoud, 2001). Also, garlic extract (GE) suggested to be used for enhancement of IAA, GAs and cytokinins biosynthesis (Wanas *et al.*, 1998), beside its content of protein, amino acids, sugars, vitamins, antibiotics, etc. (Watt and Merrill, 1963). So, the enhancement of wheat growth with these natural extracts being logically expected due to their high contents of many growth factors and/or their enhancable effect on the endogenous growth hormones, i.e., auxins, gibberellins and cytokinins. The enhancement of wheat growth by benzyladenine (BA) application might be due to its effect on endogenous cytokinins that have known stimulatory effect on cell division and enlargement, branches formation and breaking bud dormancy (Chen, 1997**)**.

II- Photosynthetic pigments in the flag leaf:

Data illustrated in Table (2) show that application of YE, GE and BA at their two assigned concentrations considerably increased photosynthetic pigments as chlorophyll a,b and carotenoids in the flag leaf of treated wheat plants at 105 days after sowing (start of heading) more than those of untreated ones. Also, it could be noticed that each individual pigment and their sum in both seasons were increased in parallel to the applied concentration of YE, GE or BA with the superiority of BA in this respect.

This enhancable effect of YE, GE and BA on photosynthetic pigments might be due to their enhancement of endogenous cytokinins (findings of Wanas *et al.,* 1998 for GE, Mahmoud, 2001 for YE and Mervat, 2005 for BA). Cytokinins have been established to induce the biosynthesis of chloroplast pigments in many plants (Fletcher and Arnold, 1986 and Bondok *et al*., 1995), in turn retard senescence (Chen, 1997).

Table (2): Photosynthetic pigments concentration (mg/g f.wt.) in wheat flag leaf as affected by natural yeast & garlic extracts (YE & GE) and benzyladenine (BA) at 105 days from sowing during 2003/04 and 2004/05 seasons.

Characters / Treatments		Chlorophyll a		Chlorophyll b		Carotenoids		Total determined pigments	
		$\overline{X}$	± %	$\overline{X}$	± %	$\overline{X}$	± %	$\overline{X}$	± %
Season 2003/04									
Control		0.92	0.00	0.42	0.00	0.58	0.00	1.92	0.00
YE	50 ml/l	1.06	+15.22	0.50	+19.05	0.70	+20.69	2.26	+17.71
	100 ml/l	1.16	+26.09	0.58	+38.10	0.74	+27.58	2.48	+29.17
GE	50 ml/l	1.09	+18.48	0.55	+30.95	0.70	+20.69	2.34	+21.88
	100 ml/l	1.17	+27.17	0.59	+40.48	0.78	+34.48	2.54	+32.29
BA	25 ml/l	1.15	+25.00	0.62	+47.62	0.74	+27.58	2.51	+30.73
	100 ml/l	1.33	+44.56	0.67	+59.52	0.83	+43.10	2.83	+47.40
Season 2004/05									
Control		1.03	0.00	0.47	0.00	0.65	0.00	2.15	0.00
YE	50 ml/l	1.15	+11.65	0.54	+14.89	0.75	+15.38	2.44	+13.49
	100 ml/l	1.35	+31.07	0.62	+31.91	0.76	+16.92	2.73	+26.98
GE	50 ml/l	1.21	+17.48	0.59	+25.53	0.74	+13.85	2.54	+18.14
	100 ml/l	1.40	+35.9	0.68	+44.68	0.80	+23.08	2.88	+33.95
BA	25 ml/l	1.29	+25.24	0.67	+42.55	0.78	+20.00	2.74	+27.44
	100 ml/l	1.42	+37.86	0.71	+51.06	0.85	+30.77	2.98	+38.60

± % = ± % relative to the control values.

III- NPK , crude protein and carbohydrates in the flag leaf:

Data in Table (3) revealed that the two assigned concentrations of YE, GE & BA obviously increased each of NPK, crude protein and total carbohydrates concentration in the flag leaf of treated plants at 105 days from sowing during both seasons comparing with those of untreated ones. Again, increases were, in most cases, more obvious with BA followed by GE and YE, respectively.

Herein, it could be concluded that increases of leaf area (Table 1) and photosynthetic pigments (Table 2), consequently increment of the dry matter accumulation in the leaves of treated plants indicate a positive and stimulatory effect of these natural extracts (YE and GE) and benzyladenine (BA) upon the efficiency of photosynthesis process and hence more photosynthates being created as well as enhancement of mineral translocation from roots to leaves, thus a great amount of these constituents could be directed to sink sites (i.e., formed spikes and their developing grains).

The present results and interpretation are in agreement with those of Mervat, 2005 using BA on Soybean, Wanas, 2006 using YE on squash and Wanas, 2007 using GE on faba bean.

Table (3): NPK and some bioconstituents concentrations (mg/g d. wt.) in wheat flag leaves as affected by natural yeast & garlic extracts (YE & GE) and benzyladenine (BA) at 105 days from sowing during 2003/04 and 2004/05 seasons.

Characters / Treatments		N		P		K		Crude protein		Total carbohydrates	
		$\overline{X}$	± %	$\overline{X}$	± %	$\overline{X}$	± %	$\overline{X}$	± %	$\overline{X}$	± %
Season 2003/04											
Control		24.02	0.00	3.54	0.00	25.96	0.00	136.91	0.00	588.32	0.00
YE	50 ml/l	27.14	+12.99	4.62	+30.51	29.32	+12.94	154.70	+12.99	624.84	+6.21
	100 ml/l	31.1	+29.93	4.86	+37.29	33.08	+27.43	177.90	+29.93	661.46	+12.43
GE	50 ml/l	29.06	+20.98	4.54	+28.25	30.24	+16.49	165.64	+20.98	646.42	+9.88
	100 ml/l	33.64	+40.05	5.16	+45.76	35.62	+37.21	191.75	+40.05	675.27	+14.78
BA	25 ml/l	28.27	+17.69	4.78	+35.03	32.46	+25.04	161.14	+17.69	651.65	+10.76
	100 ml/l	31.95	+33.01	5.37	+51.69	35.94	+38.44	182.12	+33.01	678.38	+15.31
Season 2004/05											
Control		25.18	0.00	3.78	0.00	26.62	0.00	143.53	0.00	611.48	0.00
YE	50 ml/l	27.68	+9.93	4.98	+31.74	28.20	+5.94	157.78	+9.93	637.64	+4.28
	100 ml/l	31.04	+23.27	5.26	+39.15	31.20	+17.21	176.93	+23.27	666.16	+8.94
GE	50 ml/l	30.18	+19.86	5.05	+33.60	31.12	+16.90	172.94	+19.86	664.24	+8.63
	100 ml/l	32.34	+28.46	5.38	+42.33	33.76	+26.82	184.34	+28.46	686.85	+12.33
BA	25 ml/l	29.62	+17.63	5.12	+35.45	30.98	+16.38	168.83	+17.63	655.76	+7.24
	100 ml/l	32.28	+28.20	5.86	+55.03	34.54	+29.75	184.00	+28.20	687.44	+12.42

± % = ± % relative to the control values.

VI- Anatomical studies:

1- Anatomy of the main stem:

As shown in Table (4) and Fig. (1) different applied treatments positively affected many anatomical features of the terminal internode of the main stem of treated wheat plants. In this respect, diameter of whole section was increased by 6.1 & 15.0 %, 27.3 & 30.3 % and 25.7 & 27.3% over the control value (100 %) with YE at 50 & 100 ml/l, GE at 50 & 100 ml/l and BA at 25 & 50 ppm, respectively. Hence, GE was the most effective followed by BA then YE, respectively. Also, the obtained data indicate that increment of stem diameter was mainly due to increases of stem hollow diameter and stem wall thickness. Since, e.g., the thickness of stem wall was increased over the control value (100 %) by 6.7 & 23.4 %, 19.4 & 5.7 % and 24.5 & 30.4 % with YE at 50 & 100 ml/l, GE at 50 & 100 ml/l and BA at 25 & 50 ppm, respectively. Here, BA was the most effective than the two natural extracts (YE and GE). In addition, increment of stem wall thickness was accompanied with an obvious increase in thickness of its comprising tissues, i.e., epidermis, clorenchyma tissue beneath the epidermis, peripheral sclerenchyma tissue, and parenchymatous ground tissue as well as increment number of vascular bundles length and width of the largest vascular bundle comparing with those of the control. Moreover, increment of vascular bundle length was mainly due to the increase in thickness of its tissue components, i.e., phloem and xylem tissues, and bundle sheath. Increases were mostly in parallel to the applied concentration of YE, GE or BA. Again, BA was superior in this respect followed by GE, while YE ranked the last one.

T4

2- Anatomy of the flag leaf blade:

As shown in Table (5) and Figs. (2 and 3) application of YE, GE and BA at their two assigned concentrations positively affected different studied anatomical features in blade of wheat flag leaf. Since, thickness of midrib region was increased over the control value by 7.1 & 15.0 %, 7.3 & 30.3 % and 25.7 & 27.3 % with YE at 50 & 100 ml/l, GE at 50 & 100 ml/l and BA at 25 & 50 ppm, respectively. Increment of midrib region thickness was accompanied with an increase in thickness of uppermost and lowermost sclerenchyma tissues and dimension of the main vascular bundle. Increment the length of main vascular bundle reached its highest value (163.8) with GE at 100 ml/l that represent (119.0 %) when compared with the control (100%). Also, the width of this bundle was increased with the applied treatments to reach its maximum (123.5% of the control value) with the same treatment, i.e., GE at 100 ml/l. In addition, increment of vascular bundle length was accompanied with an increase in thickness of its tissue components, i.e., phloem, xylem tissues and bundle sheath.

With regard to lamina thickness as shown in Table (5) and Fig. (3), it was increased with all applied treatments to reach its maximum with BA at 50 ppm (126.4 %) followed by GE at 100 ml/l (121.7%) then YE at 100 ml/l (118.6%) comparing with the control (100%). Increment of lamina thickness was mainly due to increases in thickness of its upper, lower epidermis and mesophyll tissue. Also, the highest increase in thickness of mesophyll tissue was obtained with BA at 50 ppm (27.6 % of increase) followed by GE at 100 ml/l (22.6 % of increase) and YE at 100 ml/l (20.9 % of increase).

In general, these positive alterations in different anatomical traits of stems and flag leaf baldes with all applied treatments at this stage of wheat growth (grain development) are being of great interest. Because these alterations included each of the thickness of photosynthates creator, i.e., mesophyll tissue and the thickness of their passage (phloem tissue) as well as the thickness of different raw materials passage (absorbed by roots), i.e. xylem tissue, that means that these treatments improved translocation and caused more raw materials to be absorbed by roots and reached to leaves and other sinks (as developed grains) as well as more photosynthates to be allocated and partitioned to other plant parts leading to vigorous growth and enhancement of heading and hence increment the final grains and straw yields. In this respect, other studies such as those of Atawia and El-Desouky (1997), Hyam (2006) and Wanas (2006 and 2007) have been confirmed the essentiality of increasing the cross sectional area of phloem and xylem tissues accompanied with creating more photosynthates and absorbing more mineral nutrients for improving growth and productivity of some economical plants.

On the other hand, these positive effects of YE, GE and BA on different anatomical traits of stems and leaf blades might be due to their enhacable effect on the endogenous cytokinins (Atawia and El-Desouky, 1997 for YE; Wanas *et al*., 1998 for GE and YE and Mervat, 2005 for BA). Cytokinins known to increase the extension growth of different plant organs via their role in stimulating of cell division and enlargement (Chen, 1997).

T5

Fig. (1): Transverse sections through the middle part of the terminal internode on the main stem of wheat as affected by YE, GE and BA (X 40).

(a) Control **(b) Yeast extract (YE) at 100ml**

(c) Garlic extract (GE) at 100 ml/l **(d) Benzyladenine (BA) at 50 ppm**

Abb: ep. = epidemis, co. = clorenchyma tissue, p.f. = peripheral fibers, pa.g = parenchymatous ground tissue, b.sh. = bundle sheath, ph.= phloem tissue, xy. = xylem tissue and s.w. = stem wall.

Fig. (2): Transverse sections through the midrib region of the flag leaf of wheat as affected by YE, GE and BA (X 40).
(a) Control (b) Yeast extract (YE) at 100ml
(c) Garlic extract (GE) at 100 ml/l (d) Benzyladenine (BA) at 50 ppm
Abb: up.sc. = uppermost sclerenchyma tissue, l.sc. = lowermost sclerenchyma tissue, b.sh. = bundle sheath; ph.= phloem tissue, xy. = xylem tissue and v.b. = vascular bundle.

Fig. (3): Transverse sections through the lamina of the flag leaf of wheat as affected by YE, GE and BA (X 60).
(a) Control (b) Yeast extract (YE) at 100ml
(c) Garlic extract (GE) at 100 ml/l (d) Benzyladenine (BA) at 50 ppm
Abb: up. ep. = upper epidemis, l. ep. = lower epidemis, m. = mesophyll tissue,

V- Yield and its characteristics:

Data recorded in Table (6) indicate that the two assigned concentrations of YE, GE or BA caused a significant increase, of total grain yield / plant compared with that of untreated plants during both seasons. Increase reached its maximum values by applying GE at 100 ml/l (47.11 and 43.24 %) followed by BA at 50 ppm (43.16 and 40.70 %) then YE at 100 ml /l (36.63 and 34.79) over the control value (considered as 100 %) during 2003/04 and 2004/05 seasons, respectively. Also, it could be noticed that increment of total grain yield / plant was accompanied by an increase in its components, i.e., number of spikes / plant, length of the main spike, number and weight of grains / main spike and weight of 100 grains as well.

Table (6): Yield characteristics of wheat plants as affected by natural yeast & garlic extracts (YE & GE) and benzyladenine (BA) during 2004/05 and 2005/06 seasons.

Characters / Treatments		No. of spikes / plant	Length of main spike	No. of grains / main spike	Weight of grains (g)/ main spike	Grain yield (g)/ plant	Straw yield (g)/plant	Grains/ straw ratio (%)	Weight of 100 grains	Relative grain yield (%)
Season 2003/04										
Control		6.50	13.10	52.20	2.09	6.58	8.31	79.20	4.00	100.00
YE	50 ml/l	6.90	13.60	58.10	2.50	8.31	9.96	83.40	4.30	126.29
	100 ml/l	7.20	14.00	61.60	2.70	8.99	10.15	88.57	4.38	136.63
GE	50 ml/l	7.20	14.60	67.10	2.92	8.74	10.14	86.19	4.35	132.83
	100 ml/l	8.30	17.10	68.50	3.02	9.68	10.86	89.19	4.41	147.11
BA	25 ml/l	7.40	14.10	65.20	3.76	8.64	10.26	84.21	4.23	131.31
	100 ml/l	8.20	14.70	67.00	2.91	9.42	10.60	88.87	4.34	143.16
LSD	0.05	0.32	0.43	4.32	0.28	0.52	0.67	-	0.22	-
Season 2004/05										
Control		6.60	13.60	58.40	2.30	7.10	8.86	80.14	3.94	100.00
YE	50 ml/l	7.20	14.10	64.70	2.70	8.88	10.70	82.99	4.17	125.07
	100 ml/l	7.70	14.60	65.30	2.76	9.57	11.15	85.83	4.23	134.79
GE	50 ml/l	7.30	15.00	70.40	2.97	9.26	10.92	84.80	4.21	130.42
	100 ml/l	8.40	16.90	73.00	3.12	10.17	11.62	87.52	4.27	143.24
BA	25 ml/l	7.80	14.80	66.80	2.84	9.31	10.93	85.18	4.25	131.13
	100 ml/l	8.50	15.10	70.80	2.99	9.99	11.51	86.79	4.22	140.70
LSD	0.05	0.46	0.63	5.22	0.36	0.70	0.82	-	0.17	-

Herein, such improvement of grain yield and its characters of wheat plant by application of YE, GE and BA treatments could be attributed to their positive effects on number of tillers, total leaf area and dry matter accumulation (Table, 1), photosynthetic pigments (Table, 2), NPK, protein and carbohydrate concentrations (Table, 3), as well as their positive alterations on the anatomical features in each of stem and flag leaf blades (Tables, 4 and 5 and Figs., 1:3) beside their enhancable effect on the endogenous growth hormones, i.e. auxins, gibberellins and cytokinins

(findings of Wanas, 1998; mahmoud, 2001 and Mervat, 2005).Hence, all of these advantages led wheat plants to grow and yielded well.

In addition, different applied treatments significantly increased the straw yield (g)/ plant in the two growing seasons. This increase was mainly due to increment each of number of tillers / plant and stems dry weight (Table, 1). Moreover, grain/straw ratio was also increased by these treatments. This leads to the assumption that these treatments favoured the accumulation of dry matter in grains more than in vegetative organs.

Finally, it could be concluded that application of the assigned extracts, i.e., YE and GE each at 50 and 100 ml/l and the growth promoter benzyladenine (BA) at 25 and 50 ppm as soaking materials for wheat grains then as foliar spray on seedling growing up caused improvement of grains and straw yields of treated plants (Table, 6). This enhancable effect of such treatments upon grain yield and its characters could be considered a complete reversion of their effects on the early vigorous growth, specially that obvious increase in number of tillers (Table, 1) and its reflection on number of spikes/ plants, as well as increment each of total leaf area (Table, 1) and photosynthetic pigments (Table, 2) and their reflection on increasing the net photosynthesis per unit of leaf area (effects on the source) accompanied by positive alterations in the anatomical features of stem and flag leaf blade, in turn, increasing the assimilates supply towards the developing grains (effects on the sink). Hence, higher grain yield with good quality to be achieved.

Therefore, the present study strongly recommended the use of natural yeast and garlic extracts each at 100 ml/l and benzyladenine at 50 ppm as effective and safe agricultural treatments in cultivation of wheat plants for achieving the highest grain yield with good quality and also for avoidance all cautions about the use of synthetic growth regulators and the excessive use of mineral nutrients, specially on this nutritional crop.

REFERENCES

A.O.A.C. (1990): Official Methods of Analysis, 15th Ed., Association of Official Analytical Chemists, Washington DC, USA.

Allam, S.A. (2005): Growth and productivity performance of some wheat cultivars under various nitrogen fertilization levels. J. Agric. Sci., Mansoura Univ., 30(4): 1871-1880.

Atawia, A.A.R. and El-Desouky,S.A. (1997): Trials for improving fruit set, yield and fruit quality of Washington navel orange by application of some growth regulators and yeast extract as a natural source of phytohormones. Ann. Agric. Sci., Moshtohor, 35(3): 1613-1632.

Aufhammer, W. and Federolf, K.G. (1992): Effects of seed treatments with plant growth regulators on development and yield of winter hard wheat (*Triticum durum*). Bodenkulture, 43(2): 99-108.

Barnett, J.A.; Payne, R.W. and Yarrow, D. (1990): Yeasts, characteristics and identification. Cambridge Univ. Press, Pub. by the Press Syndicate of the Univ. of Cambridge. Camb. CBZBR, 40 West 20th St., pp.999.

Bondok, M.A., Fouad-Nadia, A. and Felaifel, M.S.F. (1995): The effect of some triazol compounds on the productivity of squash plants. J. Agric. Sci., Mansoura Univ., 20(8): 3677-3690.

Chen, C.M. (1997): Cytokinin biosynthesis and interconv. Physiol. Plant., 101: 665-673.

Derieux, M.; Kerrest, R. and Montalon, Y. (1973): Etude de la sulface foliare et de L'activite photosynthetique chez qulques hybrids de mais. Ann. Amelior Plantes, 23: 95-107.

Dubois., M.; Gilles, K.A.; Hamilton, J.; Rebens, P.A. and Smith F. (1956): Colorimetric method for determination of sugars and related substances. Anal. Chem., 28: 350-356.

El-Desouky, S.A.; Wanas, A.L. and Khedr, Z.M.A. (1998): Utilization of some natural plant extracts (of garlic and yeast) as seed-soaked materials to squash (*Cucurbita pepo*, L.) 1-Effect on growth, sex expression and fruit yield and quality. Ann. Agric. Sci., Moshtohor, Zagazig Univ., 25(2): 839-854.

Fathy, El-S.L.; Farid, S. and El-Desouky, S.A. (2000): Induce cold tolerance of outdoor tomatoes during early summer season by using adenosine triphosphate (ATP), yeast, other natural and chemical treatments to improve their fruiting and yield. J. Agric. Sci. Mansoura Univ., 5(1): 377-401.

Fletcher, R.A. and Arnold, V. (1986): Stimulation of cytokinins and chlorophyll synthesis in cucumber cotyledons by triadimefon. Physiol. Plant., 66: 197-201.

Horneck, D.A. and Hanson, D. (1998): Determination of potassium and sodium by Flame spectrophotometry. In Handbook of Reference Methods for Plant Analysis. Kalra, Y.P. (Ed.): 153-155.

Horneck, D.A. and Miller, R.O. (1998): Determination of total nitrogen in plant tissue. In Handbook of Reference Methods for Plant Analysis. Kalra, Y.P. (Ed): 75-83.

Hyam, A. Abd El-Gawad (2006): Growth performance of black cumin (*Nigella sativa*, L) plants using certain growth conditions. Ph.D. Thesis, Fac. of Agric., Moshtohor, Benha Univ.

Johnason, D. A. (1940): Plant Microtechnique. New York and London Mc Grow-Hill Book Co. Inc., pp. 27-154.

Mahmoud, T. R. (2001): Botanical studies on growth and germination of magnolia (*Magnolia grandiflora,* L.) plants. M.Sc. Thesis, Fac. of Agric., Moshtohor, Zagazig Univ., Egypt.

Mervat, S.H. Gad (2005): Physiological studies on the effect of some growth regulators on soybean plant. M. Sci. Thesis, Fac. of Agric., Moshtohor, Zagazig Univ.

Nornal, R. (1982): Formulate for determination of chlorophyllous pigments extracted with N,N-Dimethylformamide. Plant Physiol., 69: 1371-1381.

Sandell, R. (1950): Colorimetric determination of traces of metal 2nd Ed., Interscience Publishers Inc., New York.

Sass, J.E. (1950): Botanical Microtechnique. Iowa State Collage Press, Ames., Iowa, pp.228.

Seham, M.M. Aly (2002): Effect of some Agriculture treatments on yield productivity of squash. Ph.D. Thesis, Fac. of Agric., Moshtohor, Zagazig Univ.

Snedecor, G.W. and Cochran W.G. (1989): Statistical Method 8th Ed., Iowa State Univ. Press., Ames. Iowa, USA.

Spencer, T.F.T., Dorothy, S.M. and Smith, A.R.W. (1983): Yeast Genetics. "Fundamental and applied aspects", pp. 16-18, ISBNO-387-390973-9, Springer-Verlag, New York, U.S.A.

Staden, J. V. and Crouch, N.R. (1996): Benzyladenine and derivatives. Their significance and interconversion in plants. Plant Growth Regulation, 19: 153-175.

Wanas, A. L. (2002) : Response of faba bean *(Vicia faba,* L.) plants to seed-soaking application with natural yeast and carrot extracts as phytohormones and other growth. factors-rich sources. Ann. Agric. Sci., Moshtohor, 40(1) : 83 – 102 .

Wanas, A.L. (2006): Response of squash plants grown in winter season to some natural extract and antioxidants. Ann. Agric. Sci. Moshtohor, 40(1): 83-102.

Wanas, A.L. (2007): Response of faba bean plants to seed-treating application with garlic extract, salicylic acid and paclobutrazol. J. Agric. Sci., Mansour Univ., (In press).

Wanas, A.L.; El-Desouky, S.A. and Khedr, Z.M. (1998): Utilization of some natural plant extracts (of garlic and yeast) as seed-soaked materials to squash (*Cucurbita pepo*, L.). II-Effects on the Histological features and the endogenous hormones. Ann. Agric. Sci. Moshtohor, Zagazig Univ., 35(2): 855-878.

Wareing, P.E. and Phillips, I.D.J. (1981): Growth and differentiation in plants 3rd Ed., Pergamon Press. Oxford.

Watt, B.K. and Merrill, A.L. (1963): Composition of Foods. US Dept. Agric., Handbook No. 8, 190 p.

Wilkins, M.B. (1989): Advanced Plant Physiology. Longman Scientific and Technical, EIBS (Ed.), England.

Zahran, M. and Mosalem, M.E. (1993): Effect of foliar application of some micro nutrients under different levels of nitrogen on the productivity of wheat. J. Agric. Res., Tanta Univ., 19(1): 52-62.

تأثير بعض المستخلصات الطبيعية والبنزيل أدينين على نمو وإنتاجية نباتات القمح

أحمد لطفى ونس
قسم النبات الزراعى ـ كلية الزراعة بمشتهر ـ جامعة بنها ـ مصر

تحسن نمو نباتات القمح صنف سخا ٩٣ خلال موسمى الزراعة ٢٠٠٣/٢٠٠٤، ٢٠٠٤/٢٠٠٥ باستخدام مستخلصات طبيعية من الخميرة والثوم بتركيزى ٥٠، ١٠٠ ملى /لتر من كل منهما وكذلك منظم النمو "البنزيل أدينين" بتركيزى ٢٥، ٥٠ جزء فى المليون. حيث حدثت زيادة معنوية فى طول الساق ـ عدد الأشطاء ـ عدد الأوراق ـ الوزن الجاف لكل من السوق والأوراق وكذلك مساحة الأوراق الكلية/نبات وفى نفس الوقت حدث نقص معنوى فى معدل التمثيل وذلك مع كل المعاملات المستخدمة. وبجانب ذلك فقد سببت جميع المعاملات المستخدمة زيادة واضحة فى تركيز صبغات التمثيل الضوئى، عناصر النيتروجين والفوسفور والبوتاسيوم، البروتين الخام والكربوهيدرات الكلية فى أوراق العلم لنباتات القمح المعاملة مقارنة بنظيراتها فى النباتات غير المعاملة. وبالإضافة إلى ذلك أدت معاملات مستخلصات الخميرة والثوم وكذلك البنزيل أدينين إلى حدوث تغيرات إيجابية فى العديد من الصفات التشريحية لحامل السنبلة الرئيسية وكذلك نصل ورقة العلم للنباتات المعاملة، ومن أهم هذه التغيرات زيادة سمك النصل والنسيج المتوسط فى ورقة العلم وزيادة أبعاد الحزمة الوعائية، وكذلك سمك نسيجى اللحاء والخشب فى كل من حامل السنبلة وورقة العلم. علاوة على ذلك فقد سببت جميع المعاملات المستخدمة زيادة معنوية فى محصول الحبوب ومكوناته وكذلك زيادة محصول التبن للنباتات المعاملة. وقد تم الحصول على أعلى محصول للحبوب باستخدام مستخلص الثوم بتركيز ١٠٠ ملى / لتر يليه البنزيل أدينين بتركيز ٥٠ جزء فى المليون ثم مستخلص الخميرة بتركيز ١٠٠ ملى / لتر.

وبناء على ذلك، فإن هذه الدراسة توصى وبقوة باستخدام هذه المستخلصات الطبيعية للخميرة والثوم وكذلك البنزيل أدينين ليس فقط من أجل تحسين نمو وإنتاجية نباتات القمح بل وأيضاً لتجنب كل التحذيرات المتعلقة بصحة الإنسان والخاصة باستخدام منظمات النمو المخلقة صناعياً والاستخدام المفرط للعناصر المعدنية خصوصاً على مثل هذه المحاصيل الغذائية.

1027

1028

1029
1024

1025

1026

1030

Table (1): Growth behaviour of wheat plants as affected by natural yeast & garlic extracts (YE & GE) and benzyladenine (BA) at 70 and 100 days from sowing during 2003/04 and 2004/05 seasons.

Characters / Treatments		Days after sowing													
		70							100						
		Length of the main stem (cm)	No. of tillers/ plant	Stems dry weight (g)/ plant	No. of leaves / plant	Leaves dry weight (g)/ plant	Total leaf area (cm^2)/ plant	A.R. (cm^2/g)	Length of the main stem (cm)	No. of tillers/ plant	Stems dry weight (g)/ plant	No. of leaves / plant	Leaves dry weight (g)/ plant	Total leaf area (cm^2)/ plant	A.R. (cm^2/g)
Season 2003/2004															
Control		39.20	4.00	1.96	27.20	4.31	1206.00	279.81	83.00	5.80	10.19	34.40	27.00	1543.78	214.41
YE	50 ml/l	43.60	4.60	2.54	30.20	5.14	1380.02	268.49	89.40	6.00	12.70	38.20	9.12	1852.85	203.16
	100 ml/l	48.20	5.20	2.68	34.40	5.82	1550.99	266.49	95.00	6.80	15.36	41.40	10.02	2001.16	199.72
GE	50 ml/l	49.20	5.00	2.45	30.20	5.34	1399.55	262.08	93.40	6.60	14.40	37.80	10.11	1962.50	194.11
	100 ml/l	50.40	5.40	2.73	33.60	5.88	1535.49	261.13	97.20	7.80	15.06	44.20	11.62	2178.60	187.49
BA	50 ml/l	43.60	5.20	2.63	34.40	5.56	1450.02	260.79	91.20	7.00	13.54	42.20	9.83	1902.50	193.54
	100 ml/l	49.40	5.80	3.06	38.20	6.26	1627.99	260.06	95.20	7.80	16.08	46.40	11.31	2103.96	186.03
LSD 0.05		3.10	0.45	0.36	1.75	0.52	73.60	3.95	5.10	0.65	1.55	1.61	1.15	108.56	4.76
Season 2004/2005															
Control		43.60	4.20	2.26	29.00	4.58	1373.51	299.89	89.40	6.00	11.93	33.80	7.93	1714.85	219.65
YE	50 ml/l	48.20	5.00	2.83	3.80	5.66	1601.99	283.04	95.60	6.80	14.60	42.80	9.88	2085.00	208.30
	100 ml/l	52.60	5.80	3.02	36.20	6.55	1827.49	279.01	100.20	7.00	16.58	44.20	10.66	2196.85	206.08
GE	50 ml/l	53.00	5.20	2.92	31.80	5.79	1583.02	273.41	102.20	7.00	15.12	43.00	10.68	2118.66	198.38
	100 ml/l	55.60	6.00	2.98	36.40	6.21	1682.87	270.99	104.80	8.00	16.80	48.20	12.96	2490.85	192.19
BA	50 ml/l	49.40	5.40	2.89	38.60	6.06	1640.49	270.71	95.80	7.60	14.57	45.00	10.26	2030.60	197.91
	100 ml/l	52.60	6.00	3.33	41.20	6.76	1807.26	267.35	89.60	8.40	16.96	51.00	12.78	2426.66	189.87
LSD 0.05		3.45	0.78	0.48	2.00	0.71	96.30	5.18	5.95	0.67	1.88	2.45	6.8	58.94	1.24

*** Stems = Main stem + tillers.**

Table (4): Anatomical features of wheat stem as affected by natural yeast & garlic extracts (YE & GE) and benzyladenine (BA) during 2004/05 season.

Measurements (μ) & counts / Treatments			Diameter of whole section	Diameter of stem hollow	Thick. of stem wall	Thick. of epidermis	Thick. of clorenchyma beneath the epidermis	Thick. of peripheral fibers	Thick. of parenchymatous ground tissue	No. of vascular bundles	Length of the largest v. bundle	Width of largest v. bundle	Thick. of the bundle sheath	Thick. of phloem tissue	Thick. of xylem tissue
Control		$\overline{X}$	2970.9	1869.3	505.8	15.30	71.10	19.80	444.60	56.50	158.40	153.90	18.90	38.70	81.00
YE	50 ml/l	$\overline{X}$	3151.8	1976.4	587.7	17.10	82.80	25.20	462.60	61.30	174.60	158.40	20.70	41.40	91.80
		%	106.1	105.7	106.7	111.8	116.50	127.30	104.00	108.50	110.20	102.90	109.50	107.00	113.30
	100 ml/l	$\overline{X}$	3419.5	2060.5	679.5	18.00	80.10	23.40	558.00	71.08	180.90	155.70	23.40	40.50	92.70
		%	115.0	110.2	123.4	117.60	112.70	118.20	125.50	127.10	114.20	101.20	123.80	104.70	114.40
GE	50 ml/l	$\overline{X}$	3780.5	2465.5	657.5	18.00	108.90	23.40	507.20	70.50	176.40	157.50	22.50	40.50	90.90
		%	127.3	131.9	119.4	117.6	153.20	118.20	114.10	124.80	111.40	102.30	119.00	104.70	122.20
	100 ml/l	$\overline{X}$	3871.8	2487.6	692.1	18.90	110.70	20.70	541.80	76.30	193.50	180.00	22.50	43.20	105.30
		%	130.3	133.1	125.7	123.50	155.70	104.50	121.90	135.00	122.20	117.00	119.00	111.60	130.00
BA	25 ml/l	$\overline{X}$	3735.9	2364.3	685.8	19.80	89.10	24.30	552.60	62.00	180.00	170.10	21.60	43.20	93.60
		%	125.7	126.5	124.5	129.40	125.30	122.70	124.30	109.70	113.60	116.50	114.30	111.60	115.60
	50 ml/l	$\overline{X}$	3782.7	2346.3	718.2	20.70	109.80	27.00	560.70	71.80	188.10	169.20	23.40	42.30	99.9
		%	127.3	125.5	130.4	135.30	154.40	136.40	126.10	127.10	118.80	109.90	123.80	109.30	123.30

*** Control values are considered as 100%**

*** Thick. of stem wall = Thick. of (epidermis + clorenchyma tissue + peripheral fibers + parenchymatous ground tissue).**

Table (5): Anatomical features of wheat flag leaf blade as affected by natural yeast & garlic extracts (YE & GE) and benzyladenine (BA) during 2004/05 season.

Measurements (μ) & Counts / Treatments			Thick. of midrib	Thick. of uppermost sclerenchyma tissue	Thick. of lowermost sclerencyma tissue	Length of main vascular bundle	Width of main vascular bundle sheath	Thick. of bundle sheath	Thick. of phloem tissue	Thick. of xylem tissue	Thick. of lamina	Thick. of upper epidermis	Thick. of lower epidermis	Thick. of mesophyll tissue
Control		$\overline{X}$	493.20	250.20	72.00	137.70	153.00	17.10	34.20	69.30	332.20	18.00	15.30	138.90
YE	50 ml/l	$\overline{X}$	528.30	270.00	79.20	145.80	162.00	18.00	38.70	71.10	258.30	18.00	15.30	225.00
		%	107.10	107.90	110.00	105.90	105.90	105.30	113.20	102.60	111.0	100.00	100.00	113.10
	100 ml/l	$\overline{X}$	589.50	316.80	77.40	154.80	160.0	18.90	40.50	76.50	275.40	18.90	16.20	240.30
		%	119.50	126.60	107.50	112.40	104.70	110.50	118.40	110.40	118.60	105.00	105.90	120.90
GE	50 ml/l	$\overline{X}$	529.20	264.60	79.20	149.40	163.80	18.00	39.60	77.40	255.60	19.80	116.20	219.60
		%	107.30	105.80	110.00	108.50	107.10	105.30	115.80	111.70	110.10	110.00	105.90	110.40
	100 ml/l	$\overline{X}$	650.70	342.00	106.20	163.80	189.00	20.70	44.10	78.30	28.60	20.70	118.00	243.90
		%	131.90	136.70	147.50	119.00	123.50	121.10	128.90	113.00	121.70	115.00	117.60	122.60
BA	25 ml/l	$\overline{X}$	580.50	314.00	75.60	154.80	156.60	18.00	43.20	75.60	261.90	19.80	16.20	225.90
		%	117.70	125.50	105.00	112.40	102.40	105.30	126.30	109.10	112.80	110.00	105.90	113.60
	50 ml/l	$\overline{X}$	675.00	384.30	88.20	162.90	180.90	19.80	43.20	80.10	293.40	21.60	18.00	253.80
		%	136.90	153.60	122.50	118.30	118.20	115.80	126.30	115.60	126.40	120.00	117.60	127.60

*** Control values are considered as 100%.**

J. Agric. Sci. Mansoura Univ., 32 (2): 1011 - 1029, 2007