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THE INFLUENCE OF FOLIAR SPRAY WITH CERTAIN PLANT GROWTH REGULATORS ON GROWTH, CHEMICAL COMPOSITION AND YIELD OF SOME COMMON BEAN CULTIVARS

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ABSTRACT

The present study was performed during the two seasons of 2004 and 2005, to investigate the responses of growth characters, leaf water relations, chemical composition and yield of common bean (*Phaseolus vulgaris* L.) cultivars (Giza 6 and Bronco) to different plant growth regulators (gibberellic acid, naphthalene acetic acid and kinetin). Two pot experiments were carried out to evaluate the effect of 0, 10, 20 and 30 mg/l GA_3, NAA and KIN as a foliar spray. The obtained results revealed that applying GA_3, NAA and KIN at all rates caused significant increases in vegetative growth characters, i. e., root length, plant height, number of leaves, leaflet length and width, leaf area and dry weight of roots as well as shoots. In this respect, best results were recorded by GA_3 at rate of 20 mg/l, which led to the maximum significant increment in vegetative growth characters under study. Both cultivars showed significant increases in all tested growth characters under different growth regulator treatments. The growth characters in cultivar Giza 6 showed significant higher mean values particularly under 20 mg/l GA_3 than that of cultivar Bronco. Spraying bean plants with all rates of GA_3, NAA and KIN significantly increased RWC%, photosynthetic pigments (chl. a, chl. b, chl. a+b and carotenoids), total soluble sugars, total carbohydrates, total free amino acids, total protein and minerals (N, P and K^+) concentrations in bean leaves. The optimum increment was observed by GA_3 at rate of 20 mg/l, NAA and KIN at rate of 30 mg/l. On the other hand, LWD% and total phenols concentration were significantly decreased in relation to different growth regulator concentrations. The effect of growth regulator treatments on the chemical components was more pronounced in cultivar Giza 6 than that of cultivar Bronco. Yield and its components as represented by number of pods/plant, weight of pods/plant, pod length, pod width and number of seeds/pod were significantly improved in response to all plant growth regulator treatments compared with untreated plants. In this regard, the application of GA_3 and NAA at higher level (30 mg/l) was more effective in enhancing yield and its attributes compared with the other growth regulator treatments. Moreover, cultivar Giza 6 successively increased yield and its composition mean values compared with cultivar Bronco, especially under high plant growth regulators level (30 mg/l).

Keywords: Bean cultivars, growth regulators, plant height, dry weight, leaf water relations, photosynthetic pigments, total carbohydrates, yield.

INTRODUCTION

Common bean (*Phaseolus vulgaris* L.) is one of the popular vegetable crops and fundamental protein sources for human consumption in Egypt. It is cultivated for its fresh and dried pods.

Since the dawn of agriculture, one of principal aims of human beings has been the control and promotion of plant growth to satisfy human needs. Growth regulators are important both to internally coordinate the growth and development of different organs and as chemical messengers whose synthesis may be affected by plant environmental conditions. At a molecular level, a plant's response to growth regulators may involve up-regulation or down regulation of genes coding for enzymes involved in synthesis or breakdown of the phytohormones, or genes coding for a receptor of the phytohormones (Lambers *et al*., 1998).

The role of plant hormones is complicated biologically and biochemically. When applied externally, hormones will influence the organization of the internal chemistry of the plant cell, and the interaction among cells, but the degree of interaction will still depend upon the plant specie, the stage of plant development and the external environment (Wright, 1993).

Plant growth regulators such as cytokinins and gibberellins can promote growth of plants by affecting either cambial activity and cell division or expansion and delay protein degradation (Letham, 1994).

Auxins, cytokinins and gibberellins are the principle growth-promoting hormones found in plants. All three control, stimulate, inhibit or alter a plant's development depending upon the external environment (Wright, 1993).

Gibberellic acids are considered to be growth promoters in plants and are known to be involved in numerous developmental functions, such as stem elongation, flowering in long-day plants, modify the flower sex expression in some plants and parthenocarpic fruit development. Gibberellins are well known to promote uniform growth through cell enlargement. They cause plants to grow tall and elongated, with light green leaves and also stimulate seed germination (Moore, 1979 and Wright, 1993).

Many investigators studied the influence of gibberellic acid on the growth, chemical contents and yield of leguminous such as (Abd El-Fattah, 1997; Zaghlool, 2002; Zaghlool and Ibrahim, 2000 and Ngatia *et al*., 2004).

Auxins are involved in several stages of plant growth and development such as tissue differentiation and promote root growth, uniform flowering and fruit set (Costacurta and Vanderleyden 1995). Auxins caused cell elongation and enlargement, an increased growth rate, RNA and protein synthesis and gene activation (Moore, 1979). Auxins tend to promote leaf and fruit retention and directional growth (Wright, 1993).

There are many synthetic auxins affect plant growth and development. These are used commercially rather than IAA because they are cheaper. Synthetic auxins (such as NAA) exhibit physiological action activities similar or more potent than that of indole-acetic acid (IAA) because they are more persistent in the plant than this native hormone (Moore, 1979). The effect of NAA was greatly depended on the used concentration (Ibrahim and Zaghlool, 2005).

The positive effects of NAA on vegetative growth characters, chemical parameters and yield of leguminous were observed by several authors such as El-Beheidi *et al*. (1990); El-Mansi *et al*. (1990 a and 1990 b) and Bisen *et al*. (1991).

Cytokinins can stimulate a variety of physiological, metabolic, biochemical and developmental processes when they are applied exogenously to higher plants and they probably play an important role in the regulation of these events in the intact plant and an important role in the regulation of the growth and development of higher plants (Binns, 1994). Cytokinins promote active cell mitosis, ion transport and general plant vigour (Wright, 1993).

Cytokinins are known to control many physiological responses in plants, including reduced senescence, a permissive role in seed germination, breaking of apical dominance, induction of cell division, morphogenesis of shoot and root, chloroplasts maturation, cell enlargement, mobilization of nutrients and tissue differentiation (Beveridge *et al*., 1997). Cytokinins prolonged vegetative growth and increased the concentration of photosynthetic pigments (Jurekova and Maldy, 1995).

The stimulating effect of cytokinins on *Phaseolus vulgars* was observed by Goring *et al.* (1984) who demonstrated that cytokinin enhanced cell enlargement in primary leaves and induced cell division.

Kinetin is one of the most investigated growth regulators which has an effect on the growth development and chemical components of different plants (Ibrahim and Tarraf, 2000). Kinetin generally induced cell enlargement and cell division (Fosket and Tepfer, 1978), had a promotive effect on the formation of vascular tissues by producing more xylem area and increased phloem elements and encouraged differentiation of wider vessels providing a better conductive system for transporting more absorbed water and nutrients (Helaly *et al*., 1985).

The objective of this study is to investigate the effects of foliar spray with plant growth regulators (gibberellic acid, naphthalene acetic acid and kinetin) at different concentrations on vegetative growth characters, leaf water relations, chemical composition as well as yield and its attributes in some common bean cultivars.

MATERIALS AND METHODS

This study was conducted at the Experimental Farm, Faculty of Agriculture, Minufiya University, Shibin El-Kom, during the two summer seasons of 2004 and 2005. Two pot experiments were performed to investigate the effect of gibberellic acid, naphthalene acetic acid and kinetin on growth characters, leaf water relations, chemical composition as well as yield and its attributes in two common bean (*Phaseolus vulgaris* L.) cultivars.

Seeds of common bean cultivars (Giza 6 and Bronco) were obtained from the Agricultural Research Center, Cairo, Egypt. Plastic pots, 30 cm inner diameter and 30 cm depth were filled with 7 kg air dried soil. Four bean seeds were sown in each pot on the 13^{th} and 14^{th} of April for the first and second seasons, respectively. Four weeks after sowing, seedlings were thinned to two uniformed plants/pot.

Three plant growth regulators; gibberellic acid (GA_3), naphthalene acetic acid (NAA) and Kinetin [6-furfurylaminopurine, $C_{10}H_9N_5O$, (KIN)] were applied as foliar spray treatments at rates of 10, 20 and 30 mg/l, besides distilled water as control treatment. Tween 20 at rate of 0.5% was used as wetting agent. Gibberellic acid and naphthalene acetic acid were dissolved in a small amount of ethyl alcohol, whereas, kinetin was dissolved in a small amount of hydrochloric acid and then adjusted with distilled water to the desired volume. Treatments started 40 days after sowing and were repeated two weeks later.

The experiments were arranged in a split-plot design in randomized complete blocks with five replicates. The experiments included 24 treatments (2 cultivars x 3 growth regulators x 4 growth regulator concentrations). The main plot included the two cultivars, the sub plot occupied by the three growth regulators and sub-sub plot included four growth regulator concentrations.

The soil of these experiments was sand clay in texture with pH 7.5 and 7.7 as well as Ec of 1.03 and 1.08 mmohs/cm and contained 0.168 and 0.177% N, 0.065 and 0.073% P, 0.081 and 0.086% K^+, in the first and second seasons, respectively.

Moisture of the soil was kept at 65% of the total water holding capacity of the soil during the growth period by irrigation with tap water whenever.

The pots received ammonium nitrate (33.5% N) and potassium sulphate (48% K_2O) at rates of 1.36 g/pot and 0.8 g/pot, respectively, which were added in two equal amounts during the growth period. Calcium superphosphate (15.5% P_2O_5) at rate of 1.6 g/pot was applied before sowing. Pest control and other agricultural practices were done as commonly recommended in growing bean.

After 70 days from sowing (2 weeks after the second application of growth regulators), one sample with four plants from each treatment was taken at random and the following data were recorded:

1- Vegetative Growth Characters:

In each plant sample, root length (cm), plant height (cm), number of leaves/plant, leaflet length (cm), leaflet width (cm), leaf area (cm^2/plant) using the dry weight method described by Aase (1978) as well as dry weight of roots and shoots (dried at 70ºC for 72 hrs.), g/plant were recorded.

2- Leaf Water Relations:

Relative water content% (RWC%) and leaf water deficit% (LWD%) were determined using the method described by Kalapos (1994).

3- Chemical Analysis:

a- Photosynthetic pigments were extracted from fresh leaves by acetone 85% and determined according to Wettestein (1957), then calculated as mg/g dry weight.

b- Total soluble sugars and total carbohydrates in dried leaves were measured calorimetrically by the phenol sulfuric acid method of Dubois *et al*. (1956).

c- Total free amino acids concentration in dry bean leaves was estimated using the method of Rosen (1957).

d- Total phenols concentration in dried bean leaves was measured as mg caticol/100gdry weight according to Snell and Snell (1953).

e- Total nitrogen concentration in dry leaves was estimated using semimicro-kjeldahl method as described by Ling (1963).

f- Phosphorus and potassium determined in dried leaves following the method of Chapman and Pratt (1961).

g- Total protein concentration calculated by multiplication total nitrogen by 6.25.

4- Yield and its attributes:

Marketable green pods were harvested 85 days after sowing then the number of pods/plant, weight of pods/plant (g), pod length (cm), pod width (cm) and number of seeds/pod were recorded.

All the data obtained from the two seasons were subjected to the statistical analysis of variance by using Costat Software program (1985). Treatments were compared based on the revised L.S.D. test at 0.05 level according to the procedure outlined by Snedecor and Cochran (1981).

RESULTS AND DISCUSSION

1- Vegetative Growth Characters

Results in Tables (1 and 2) show that there were significant increases in all studied plant growth characters as a result of the application of different plant growth regulators [gibberellic acid (GA_3), naphthalene acetic acid (NAA) and kinetin (KIN)] comparing with control plants.

As seen in Table (1) foliar spraying bean plants with different plant growth regulators significantly enhanced root length, plant height and number of leaves. In this case, GA_3 recorded higher significant increases followed by NAA and KIN, respectively. In this respect, Kof *et al*. (1998) found that GA_3 induced stem elongation in pea plants due to an increase in internode length. The promotive effect of KIN on plant height may be due to enhancing effect on the cell division (Ibrahim and Tarraf, 2000) and cell enlargement (Fosket and Tepfer, 1978).

Data in the same Table reveal that increasing growth regulator levels up to 30 mg/l significantly increased root length, plant height and number of leaves mean values. The maximum increase referred to GA_3 at rate of 20 mg/l, which increased root length by (101.05% and 97.83%), plant height by (85.39% and 69.18%) and number of leaves by (101.96% and 89.29%) in the first and second seasons, respectively, comparing with unsprayed plants. These results are in agreement with those obtained by El-Mansi *et al*. (1990 a) who mentioned that NAA at 10 mg/l increased stem length and number of leaves in pea plants. Bisen *et al*. (1991) found that NAA increased pea plant growth characters. Moreover, El-Mogy (1993) reported that KIN application at 5, 10 and 20 mg/l increased lupine plant height. Furthermore, Abd El-Fattah (1997) recorded that GA_3 increased plant height and number of leaves/plant in broad bean. Zaghlool and Ibrahim (2000) revealed that GA_3 at 25 mg/l increased plant height and number of leaves in cowpea plants. Recently, Ngatia *et al*. (2004) demonstrated that spraying bean plants with GA_3 up to 7.5 mg/l increased plant height.

Analysis of variance pointed out that root length, plant height and number of leaves varied significantly in the two tested bean cultivars. In this regard, the maximum significant values were attained from cultivar Giza 6 (Table, 1).

Concerning the interaction between plant growth regulators and cultivars, the two tested cultivars showed a pronounced increase in root length, plant height and number of leaves under all growth regulator treatments.

T1

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In this connection, Khafaga *et al*. (1997 a) reported that KIN application on Egyptian clover cultivars Fahle and Miskawi increased plant height in cultivar Miskawi and increased the number of branches/plant in both cultivars. The greatest significant increase in these characters was obtained from cultivar Giza 6 under 20 mg/l GA_3 and reached to 100.67% for root length, 91.84% for plant height and 100% for number of leaves compared with control plants. The second season showed the same trend.

As shown in Tables (1 and 2) there were significant differences between the three tested plant growth regulators in leaflet length, leaflet width and leaf area. The application of GA_3 led to the higher significant values followed by NAA and KIN. No significant differences were detected between NAA and KIN in leaflet length and leaflet width, in the second season only. In this concern, Nisha *et al*. (1996) reported that foliar application of KIN to cowpea plants increased leaf growth. Moreover, Khafaga *et al*. (1997 a) observed that KIN increased leaf area of Egyptian clover.

Results recorded in Tables (1 and 2) demonstrate that leaflet length, leaflet width and leaf area were significantly increased with increasing GA_3, NAA and KIN levels up to 30 mg/l. GA_3 at 20 mg/l gave the maximum mean values in these characters. No significant effects were observed by GA_3 at 10 mg/l and 30 mg/l on leaflet length, in both seasons and NAA at 20 and 30 mg/l on leaflet width in the first season only. In this respect, Zaghlool and Ibrahim (2000) mentioned that GA_3 increased leaf area of cowpea. Furthermore, Ngatia *et al*. (2004) found that spraying bean plants with GA_3 up to 7.5 mg/l led to increasing leaf area index.

From the obvious results, it can be noticed that there were significant differences among the two bean cultivars under study in leaflet length, leaflet width and leaf area. Leaves of cultivar Giza 6 were taller and larger than that of cultivar Bronco. Furthermore, Giza 6 showed higher value in leaf area compared with cultivar Bronco.

With respect to leaflet length, leaflet width and leaf area the interaction between plant growth regulator treatments and cultivars was significant in both cultivars. In this respect, GA_3 at 20 mg/l was more effective than NAA and KIN, which increased Giza 6 leaflet length by (88.24% and 90.28%) as well as leaflet width by (112.58% and 103.05%) in the first and second seasons, respectively, as compared to their controls (Tables, 1 and 2).

Data in Table (2) indicate that spraying bean plants with GA_3, NAA and KIN significantly stimulated roots and shoots dry weight. GA_3 gave the maximum increase in this concern. No significant differences were detected between NAA and KIN on roots dry weight, in both seasons.

As seen in Table (2) all growth regulator treatments caused higher values in dry weight of roots and shoots than the control. The highest increases in roots and shoots dry weight were attained by GA_3 at 20 mg/l. Furthermore, foliar spraying bean plants with NAA and KIN at 30 mg/l caused higher significant increment in dry weight of roots and shoots compared with the other treatments and the control, in both seasons. The increase in dry weight could be ascribed to an increase in growth parameters under the effect of growth regulators. These results could be explained on the basis of metabolites accumulation in bean plants (Table, 2). Similar results were obtained by El-Mansi *et al*. (1990 a) on pea who found that NAA at 10 and 20 mg/l increased dry weight of both leaves and total plant. El-Mogy (1993) revealed that KIN at 5, 10 and 20 mg/l increased fresh and dry weight of lupine plants. Moreover, on mungbean (Zaghlool, 2002) and on cowpea (Zaghlool and Ibrahim, 2000) reported that GA_3 at 25 mg/l stimulated fresh and dry weight of seedlings. Ngatia *et al*. (2004) found that GA_3 up to 7.5 mg/l increased root, shoot and total dry mass of bean plants.

Regarding the effect of the two tested bean cultivars on dry weight of roots and shoots, cultivar Giza 6 showed significant increases in these parameters comparing with cultivar Bronco (Table, 2).

The interaction between growth regulator rates and bean cultivars indicated that all growth regulator levels positively influenced roots and shoots dry weight in both cultivars (Table, 2). The highest mean values were achieved by GA_3 at rate of 20 mg/l.

It could be noticed that all tested plant growth regulators significantly stimulated vegetative growth characters compared with untreated plants. Application of GA_3 at rate of 20 mg/l led to the highest significant mean values of the tested growth characters. Furthermore, cultivar Giza 6 showed higher increases in growth characters than cultivar Bronco, especially, under growth regulator treatments.

2- Leaf Water Relations

Relative Water Content% (RWC%) and Leaf Water Deficit% (LWD%)

According to Table (3) the application of GA_3, NAA and KIN differently affected water relations in bean leaves. In this case NAA caused the highest significant increase in RWC% and the maximum reduction in LWD%. On the other hand, KIN led to the lowest RWC% value and the greatest LWD% value.

Data presented in Table (3) reveal that all growth regulator levels significantly increased RWC% and decreased LWD% as compared to control plants. Higher concentration of growth regulators (30 mg/l) gave higher RWC% and lower LWD%. The percent increase in RWC% recorded 48.38% and 54.65% for GA_3 at rate of 30 mg/l, 62.41% and 61.72% for NAA at 30 mg/l as well as 43.37% and 45.52% for 30 mg/l KIN in the first and second seasons, respectively, with respect to control plants. In this case NAA at 30 mg/l exhibited the highest significant RWC% mean value as well as the greatest significant decrease in LWD% (64.6% and 66.44%, in the first and second seasons, respectively).

Results recorded in Table (3) mention that RWC% and LWD% varied among the two tested bean cultivars. In this respect, Giza 6 showed the highest RWC% value, whereas, cultivar Bronco gave the greatest LWD% value.

Table (3): Effect of plant growth regulator levels on leaf water relations (RWC% and LWD %) in two bean cultivars after 70 days from sowing during 2004 and 2005 seasons.

Cvs.	Gr. Reg. Con. mg/l	RWC %			LWD %		
		GA_3	NAA	KIN	GA_3	NAA	KIN
First season (2004)							
Giza 6	0	52.86 d	51.71 d	50.31 d	47.14 a	48.29 a	49.69 a
	10	62.02 c	70.08 c	62.15 c	37.98 b	29.92 b	37.85 b
	20	71.25 b	78.96 b	67.22 b	28.75 c	21.04 c	32.78 c
	30	80.33 a	83.21 a	72.63 a	19.67 d	16.79 d	27.37 d
	Mean	66.62 A	70.99 A	63.08 A	33.39 B	29.01 B	36.92 B
Bronco	0	51.20 d	50.03 d	49.81 d	48.8 a	49.97 a	50.19 a
	10	60.68 c	68.68 c	60.14 c	39.32 b	31.32 b	39.86 b
	20	70.81 b	72.4 b	65.74 b	29.19 c	27.6 c	34.26 c
	30	74.07 a	82.02 a	70.90 a	25.93 d	17.98 d	29.1 d
	Mean	64.19 B	68.28 B	61.65 B	35.81 A	31.72 A	38.35 A
Mean of Gr. Reg. Con.	0	52.03 d	50.87 d	50.06 d	47.97 a	49.13 a	49.94 a
	10	61.35 c	69.38 c	61.15 c	38.65 b	30.62 b	38.86 b
	20	71.03 b	75.68 b	66.48 b	28.97 c	24.32 c	33.52 c
	30	77.20 a	82.62 a	71.77 a	22.8 d	17.39 d	28.24 d
	Mean	65.41 B	69.64 A	62.37 C	34.60 B	30.37 C	37.64 A
Second season (2005)							
Giza 6	0	54.12 d	52.81 d	52.03 d	45.88 a	47.19 a	47.97 a
	10	65.97 c	73.14 c	66.78 c	34.03 b	26.86 b	33.22 b
	20	75.41 b	81.06 b	69.35 b	24.59 c	18.94 c	30.65 c
	30	84.15 a	85.42 a	76.49 a	15.85 d	14.58 d	23.51 d
	Mean	69.91 A	73.11 A	66.16 A	30.09 B	26.89 B	33.84 B
Bronco	0	53.07 d	50.89 d	50.12 d	46.93 a	49.11 a	49.88 a
	10	61.13 c	70.19 c	61.11 c	38.87 b	29.81 b	38.89 b
	20	72.05 b	75.33 b	66.21 b	27.95 c	24.67 c	33.79 c
	30	81.62 a	82.27 a	72.17 a	18.38 d	17.73 d	27.83 d
	Mean	66.97 B	69.67 B	62.40 B	33.03 A	30.33 A	37.60 A
Mean of Gr. Reg. Con.	0	53.60d	51.85 d	51.08 d	46.41 a	48.15 a	48.93 a
	10	63.55 c	71.67 c	63.95 c	36.45 b	28.34 b	36.06 b
	20	73.73 b	78.20 b	67.78 b	26.27 c	21.81 c	32.22 c
	30	82.89 a	83.85 a	74.33 a	17.12 d	16.16 d	25.67 d
	Mean	68.44A	71.39 A	64.28 C	31.56 B	28.61 C	35.72 A

Values marked with same alphabetical letter(s), within a comparable group of means, do not significantly differ using revised L.S.D. test at 0.05 level.

Concerning the interaction between plant growth regulator treatments and bean cultivars, both cultivars showed significant increases in RWC% under all treatments. In cultivar Giza 6 NAA at rate of 30 mg/l was more effective in improving this respect. Meanwhile, increasing growth regulator levels up to 30 mg/l led to a significant reduction in LWD% in the two tested bean cultivars. This reduction was more pronounced in cultivar Giza 6 at the highest rate of NAA (30 mg/l) than cultivar Bronco and reached to 65.23% and 69.1%, in the first and second seasons, respectively, compared with untreated plants.

3- Chemical Analysis

a- Photosynthetic Pigments

Data recorded in Table (4) demonstrate that the application of GA_3 caused the maximum significant mean values in chl. a, total chlorophyll (chl. a+b) and carotenoids followed by NAA and KIN, respectively, meanwhile, NAA presented higher increase in chl. b, this increase was significant in the second season only. The positive effect of growth regulators on photosynthetic pigments may be due to slowing or inhibiting chlorophyll breakdown and degradation, these resulted in delaying leaves senescence and it maintained photosynthetic activity (Zaghlool *et al*., 2006).

Analysis of variance indicate that increasing growth regulator levels up to 30 mg/l gave significant increases in chl. a, chl. b, chl. a+b and carotenoids compared with control plants. The best effects were obtained by 20 mg/l GA_3 followed by 30 mg/l NAA and 30 mg/l KIN, respectively. In this case, the most increase in photosynthetic pigments was recorded at 20 mg/l GA_3 under which the increment reach 119.51% and 128.63% for chl. a, 49.59% and 55.86% for chl. b, 96.21% and 104.73% for chl. a+b as well as 142.86% and 172.58% for carotenoids, in the first and second seasons, respectively, comparing to the control. These results are in agreement with those obtained by Helaly *et al*. (1985) on petunia plants, who reported that KIN increased photosynthetic pigments. Furthermore, Khafaga *et al*. (1997 b) showed that chlorophyll a, b and carotenoids increased by application of KIN on Egyptian clover. The primary action of KIN on the leaf is to inhibit proteolysis, prevent the rise in nuclease and protease activities, promote mobilization of substances into leaves and greatly delay senescence (Arteca, 1996). Moreover, El-Mansi *et al*. (1990 a) revealed that NAA at 10 mg/l increased chl. a, chl. b, chl. a+b and carotenoids in pea leaves. Abu-Grab and Ebrahim (2000) found that NAA at 25 mg/l significantly increased chl. a, chl. b and chl. a+b in onion leaves. The stimulating effect of GA_3 on photosynthetic pigments was observed by Zaghlool (2002) on mungbean as well as Zaghlool and Ibrahim (2000) on cowpea who mentioned that total chlorophyll significantly increased by application of GA_3.

Moreover, cultivar Giza 6 led to higher significant increases in chl. a, chl. b, chl. a+b and carotenoids compared with cultivar Bronco (Table, 4).

The interaction between bean cultivars and growth regulator treatments indicated that all levels significantly increased photosynthetic pigments in the two tested bean cultivars (Table, 4). In this respect, cultivar Giza 6 had the maximum significant increases in chl. a, chl. b, chl. a+b and carotenoids under 20 mg/l GA_3 followed by NAA and KIN at rate of 30 mg/l.

b- Total Soluble Sugars and Total Carbohydrates Concentrations

Results in Table (5) mention that GA_3 was more effective in increasing total soluble sugars than NAA and KIN. On the other hand, NAA significantly stimulated total carbohydrates concentration comparing with GA_3 and KIN.

A significant increase in total soluble sugars and total carbohydrates concentrations was attained by all tested growth regulator treatments compared with untreated plants (Table, 5). Highly significant increments in total soluble sugars (92.71% and 86.06%) were resulted when bean plants where sprayed with 20 mg/l GA_3, higher KIN level (30 mg/l) caused the highest significant increases in total carbohydrates (96.51% and 89.01%), in the first and second seasons, respectively, compared with control plants.

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T5

Similar results were observed by Labib (1983) on broad bean and Khafaga *et al*. (1997 b) on Egyptian clover who found that KIN increased total carbohydrates. Moreover, Ghosh and Biswas (1995) working on groundnut and Sativir *et al*. (2000) working on chickpea demonstrated that KIN increased sugar concentration. As regard to the stimulation of KIN on carbohydrates of different plants Kikuta *et al*. (1977) stated that application of KIN stimulated glucose catabolism by the pentose phosphate pathway, and increased NADP and NADPH. On the other hand, El-Beheidi *et al*. (1990) revealed that NAA at 10 and 20 mg/l increased total sugars and reducing sugars in pea seeds. Abu-Grab and Ebrahim (2000) reported that NAA at 25 mg/l increased total carbohydrates in onion plants. The promoting effect of NAA on sugars may be due to the increases in the synthesis, translocation and accumulation of carbohydrates in legumes (Hegazy *et al*., 1982). Furthermore, Prasad and Prasad (1999) on pea; Zaghlool (2002) on mungbean as well as Zaghlool and Ibrahim (2000) on cowpea reported that GA_3 significantly increased carbohydrates and total sugars.

Regarding the effect of cultivars, data presented in Table (5) show that total soluble sugars and total carbohydrates concentrations varied among the two tested bean cultivars. Giza 6 showed significantly higher total soluble sugars and total carbohydrates concentrations comparing to cultivar Bronco.

According to the interaction between growth regulators and bean cultivars, results in Table (5) reveal that both bean cultivars showed a significant increase in total soluble sugar and total carbohydrates under all growth regulator treatments. The maximum increases in total soluble sugars (107.07% and 97.51%) were observed in cultivar Giza 6 under 20 mg/l GA_3. Furthermore, the greatest increments in total carbohydrates concentration (151.64% and 154.82%) were obtained from Giza 6 under 30 mg/l KIN, in the first and second seasons, respectively, comparing with untreated plants.

c- Total Free Amino Acids and Total Protein Concentrations

As shown in Table (5) foliar spraying bean plants with GA_3, NAA and KIN significantly influenced total free amino acids and total protein concentrations in bean leaves. In this concern, higher significant values referred to NAA followed by GA_3 and KIN, respectively.

Data in Table (5) point out that, growth regulator levels had a significant stimulating effect on total free amino acids and total protein concentrations compared with untreated plants. The highest significant increment was attained by 30 mg/l NAA. Furthermore, significant increases in these respects were gained from all tested treatments, especially, GA_3 at 20 mg/l and KIN at 30 mg/l. The obtained results are in accordance with those obtained by El-Beheidi *et al*. (1990) who stated that NAA at rates of 10 and 20 mg/l increased protein concentration in pea seeds. The increase in protein concentration may be due to the effect of NAA on nucleic acid and protein synthesis by plants (Rao, 1973). Moreover, El-Mogy (1993) on *Lupinus termis* found that KIN at rates of 5, 10 and 20 mg/l increased total protein. The enhancing effect of GA_3 on protein synthesis was observed by Shady *et al*. (1983) who showed that GA_3 at 10 and 25 mg/l increased protein concentration in *Vicia faba* shoots. Prasad and Prasad (1999) reported that GA_3 at rate of 25 mg/l significantly increased protein concentration in pea plants. Recently, Zaghlool and Ibrahim (2005) mentioned that GA_3 at 25 mg/l significantly increased free amino acids and protein in cotton seedlings and leaves.

Analysis of variance mention, that total free amino acids and total protein concentrations were significantly differed among the two tested bean cultivars. Cultivar Giza 6 gave the highest significant values than cultivar Bronco.

With respect to total amino acids and total protein concentrations the interaction between bean cultivars and growth regulator treatments indicated that under all growth regulator levels both cultivars showed significant increases in total free amino acids and total protein concentrations. Spraying bean plants with 30 mg/l NAA led to the maximum increase in total free amino acids and total protein concentrations (Table, 5).

d- Total Phenols Concentration

Data presented in Table (6) reveal that the application of GA_3, NAA and KIN significantly influenced total phenols concentration in bean leaves. In this regard, GA_3 showed significant higher total phenols accumulation followed by NAA and KIN.

Moreover, total phenols concentration decreased significantly as a result of increasing growth regulator levels up to 30 mg/l. Under high concentration (30 mg/l) the reduction in total phenols concentration reached 39.33%, 46.47% and 44.83% for GA_3, NAA and KIN, respectively, comparing to the control plants. In this connection, Helaly *et al*. (1985) stated that KIN decreased shoot phenol concentration in petunia. Moreover, Ibrahim and Zaghlool (2005) reported that NAA decreased total phenols in onion bulbs.

Concerning the effect of cultivars, data show that cultivar Giza 6 stimulated total phenols concentration significantly compared with cultivar Bronco.

The interaction between cultivars and growth regulator treatments demonstrated that under all growth regulator levels both cultivars showed a reduction in phenols concentration, especially under higher concentration (30 mg/l), which caused significant decreases reached to 38.61% and 40.19% for GA_3, 46.0% and 47.02% for NAA as well as 44.34% and 45.44% for KIN in cultivar Giza 6 and Bronco, respectively. This reduction was more pronounced in cultivar Bronco than Giza 6.

e- Mineral Concentration: Nitrogen (N), Phosphorus (P) and Potassium (K^+)

Data for mineral concentration are given in Table (6). Spraying bean plants with different plant growth regulators differently affected mineral concentration in bean leaves. NAA showed higher significant increases in N concentration, in both seasons, meanwhile, GA_3 gave the maximum mean values of P and K^+. No significant differences were detected in P concentration between GA_3 and NAA in the second season only.

Moreover, increasing growth regulator levels up to 30 mg/l significantly increased N, P and K^+ concentrations in bean leaves, in both seasons. Similar results were obtained by Labib (1983) who found that KIN increased N and P concentrations in broad bean. Furthermore, El-Mogy (1993) on *Lupinus termis* recorded that KIN at 5, 10 and 20 mg/l increased total N, P and K^+ concentrations.

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In this investigation the best effects were obtained by NAA at 30 mg/l, which gave the maximum increase in N concentration (62.97% and 80.32%) in the first and second seasons, respectively. On the other hand, GA_3 at 30 mg/l caused higher significant increases in P (112.5% and 102.20%) and K^+ (133.53% and 129.69%) in the first and second seasons, respectively. Similar results were observed by Shady *et al*. (1983) who showed that GA_3 at 10 and 25 mg/l increased total N in *Vicia faba* shoots. Prasad and Prasad (1999) found that GA_3 at 25 mg/l significantly increased P concentration in pea. Furthermore, El-Beheidi *et al*. (1990) mentioned that NAA at 10 and 20 mg/l increased N%, P% and K^+% in pea seeds. Abu-Grab and Ebrahim (2000) mentioned that NAA at 25 mg/l increased N, P and K^+ concentrations in onion.

Regarding the effect of cultivars on mineral concentration, cultivar Giza 6 showed significant increases in N, P and K^+ concentrations compared with cultivar Bronco.

With respect to mineral concentration the interaction between bean cultivars and plant growth regulators indicated that all growth regulator rates significantly increased mineral concentration in both cultivars. Under higher NAA concentration (30 mg/l) Giza 6 referred the greatest increase in N concentration. Furthermore, under GA_3 at rate of 30 mg/l cultivar Giza 6 showed higher significant increases in P and K^+ concentrations (Table, 6). The same trend was observed in the second season.

It could be noticed that higher carbohydrates and protein concentrations observed in this work, as a result of application of different plant growth regulators were coincident with a similar effect on the increase of macroelements concentration, therefore, the studied macroelements N, P and K^+ appear to enter into synthesis with the carbohydrates derived material and form the metabolic and structural component of plants (Ibrahim and Tarraf, 2000). Furthermore, elements may accumulate in the vacuole to provide the necessary concentration of the solutes for producing the osmotic pressure excreted by the cell (Nosseir, 1972).

4- Yield and its Components

Data for yield and its attributes expressed as number of pods/plant, weight of pods/plant, pod length, pod width and number of seeds/pod in bean plants are given in Tables (7 and 8). Obtained results reveal that yield and its components were stimulated significantly as a result of foliar spraying bean plants with different plant growth regulators. GA_3 had a pronounced effect on increasing number of pods/plant and pod length, whereas, NAA showed a stimulating effect on weight of pods/plant, pod width and number of seeds/pod. No significant differences were detected between NAA and KIN in number of pods/plant and pod length as well as GA_3 and NAA in number of seeds/pod, in both seasons. In this concern, Mozarkar *et al*. (1991) recorded that the fruit yield of tomato plants was increased by 12, 8 and 6% over controls by application of 30 mg/l NAA, GA_3 and IAA, respectively.

Results in the same Tables point out that all growth regulator treatments caused significant increases in bean yield, particularly at higher concentration (30 mg/l). No significant differences were obtained by 20 mg/l and 30 mg/l GA_3 in number of pods/plant, in both seasons. GA_3 at 30 mg/l increased number of pods/plant by 161.29% and 133.60% as well as pod length by 69.90% and 80.77% in the first and second seasons, respectively. The obtained results are in accordance with those obtained by Abd El-Fattah (1997) who found that GA_3 significantly increased number of green and dry pods/plant, seed yield/plant and seed yield/feddan of broad bean. Ngatia *et al*. (2004) reported that spraying bean plants with GA_3 up to 7.5 mg/l increased yield/plant, pods/plant and 100 seeds mass. In this work, higher NAA level (30 mg/l) led to the maximum significant increment in weight of pods/plant, pod width and number of seeds/pod. Similar results were obtained by El-Mansi *et al*. (1990 b) who showed that NAA at 10 and 20 mg/l increased pod number/plant, pod yield, weight of 100 seeds, weight of seeds/pod, seed/pod ratio and total yield of pea plants. Bisen *et al*. (1991) demonstrated that NAA increased green pod yield of pea plants.

Table (7): Effect of plant growth regulator levels on some yield components in two bean cultivars during 2004 and 2005 seasons.

Cvs.	Gr. Reg. Con. mg/l	Number of pods/plant			Weight of pods/plant (g)			Pod 1ength (cm)		
		GA_3	NAA	KIN	GA_3	NAA	KIN	GA_3	NAA	KIN
First season (2004)										
Giza 6	0	2.33 b	2.33 b	2.00 b	4.77 d	4.53 d	4.21 d	7.37 d	7.21 c	7.13 d
	10	3.33 b	3.33 ab	3.0 ab	6.90 c	8.74 c	5.88 c	8.90 c	8.20 c	8.88 c
	20	5.67 a	4.0 a	3.67 a	9.53 b	10.87 b	8.52 b	10.62 b	10.29 b	9.90 b
	30	6.33 a	4.67 a	4.33 a	12.16 a	13.60 a	10.65 a	12.25 a	11.78 a	11.0 a
	Mean	4.42 A	3.58 A	3.25 A	8.34 A	9.44 A	7.32 A	9.79 A	9.37 A	9.23 A
Bronco	0	2.0 c	2.0 b	1.67 b	3.72 c	3.49 d	3.12 c	6.65 c	6.31 b	6.23 c
	10	2.67 bc	2.3 ab	2.33 b	4.47 c	6.17 c	4.31 c	7.35 c	7.20 b	7.02 bc
	20	3.67 ab	3.0 ab	2.67 ab	8.93 b	9.58 b	7.24 b	8.93 b	8.37 ab	8.98 ab
	30	5.0 a	4.0 a	3.67 a	10.23 a	12.76 a	9.86 a	11.57 a	10.10 a	10.11 a
	Mean	3.34 B	2.83. B	2.59 B	6.84 B	8.0 B	6.13 B	8.63 B	8.0 B	8.09 B
Mean of Gr. Reg. Con.	0	2.17 b	2.17 c	1.84 c	4.25 d	4.01 d	3.67 d	7.01 d	6.76 c	6.68 d
	10	3.0 b	2.83 bc	2.67 bc	5.69 c	7.46 c	5.10 c	8.13 c	7.7 c	7.95 c
	20	4.67 a	3.5 ab	3.17 ab	9.23 b	10.23 b	7.88 b	9.78 b	9.33 b	9.44 b
	30	5.67 a	4.34 a	4.0 a	11.20 a	13.18 a	10.26 a	11.91 a	10.94 a	10.56 a
	Mean	3.88 A	3.21 B	2.92 B	7.59 B	8.72 A	6.73 C	9.21 A	8.69 B	8.66 B
Second season (2005)										
Giza 6	0	2.67 b	2.33 c	2.0 c	4.99 d	4.71 d	4.32 d	7.07 c	7.0 b	6.92 c
	10	4.0 b	3.67 bc	3.33 bc	7.32 c	9.12 c	5.94 c	8.15 c	7.82 b	7.68 c
	20	6.0 a	5.0 ab	4.67 ab	9.99 b	11.05 b	8.93 b	10.04 b	9.87 a	8.88 c
	30	6.67 a	5.67 a	5.33 a	13.76 a	13.72 a	11.0 a	12.13 a	11.16 a	10.42 a
	Mean	4.84 A	4.17 A	3.83 A	9.02 A	9.65 A	7.55 A	9.35 A	8.96 A	8.48 A
Bronco	0	2.33 c	2.0 b	2.0 b	4.21 c	4.01 d	3.53 d	5.93 c	5.73 d	5.62 d
	10	3.0 bc	2.67 b	2.33 ab	5.16 c	6.89 c	4.74 c	7.19 bc	7.11 c	6.93 c
	20	4.33 ab	3.33 ab	3.0 ab	9.43 b	10.23 b	7.69 b	8.74 b	8.33 b	8.41 b
	30	5.0 a	4.33 a	4.0 a	10.89 a	12.94 a	10.27 a	11.36 a	10.02 a	10.23 a
	Mean	3.67 B	3.08 B	2.83 B	7.42 B	8.52 B	6.56 B	8.31 B	7.80 B	7.80 B
Mean of Gr. Reg. Con.	0	2.5 c	2.17 c	2.0 c	4.6 d	4.36 d	3.93 d	6.5 d	6.37 d	6.27 d
	10	3.5 b	3.17 b	2.83 bc	6.24 c	8.01 c	5.34 c	7.67 c	7.47 c	7.31 c
	20	5.17 a	4.17 a	3.84 ab	9.71 b	10.64 b	8.31 b	9.39 b	9.1 b	8.65 b
	30	5.85 a	5.0 a	4.67 a	12.33 a	13.33 a	10.64 a	11.75 a	10.59 a	10.33 a
	Mean	4.26A	3.63 B	3.33 B	8.22 B	9.09 A	7.06 C	8.83 A	8.38 B	8.14 B

Values marked with same alphabetical letter(s), within a comparable group of means, do not significantly differ using revised L.S.D. test at 0.05 level.

The positive effect of KIN on yield was observed by El-Ashkar (1980) on bean; Crospy *et al*. (1981) on soybean; Arafa and Harb (1989) on pea; El-Mogy (1993) on lupine; Ghosh and Biswas (1995) on groundnut and Nisha *et al*. (1996) on cowpeas who stated that KIN application increased pod setting, number of pods and seed yield.

According to the effect of bean cultivars on yield and its components, there were significant differences among the two tested cultivars, Giza 6 showed higher significant increases in all tested characters, in both seasons (Tables, 7 and 8).

The interaction between cultivars and growth regulators mentioned that all treatments increased yield and its attributes significantly in both bean cultivars compared with untreated plants, especially under high growth regulators concentration (30 mg/l). These increases were more pronounced in cultivar Giza 6 compared with cultivar Bronco (Tables, 7 and 8).

Table (8): Pod width and number of seeds/pod as affect by plant growth regulator levels in two bean cultivars during 2004 and 2005 seasons.

Cvs.	Gr. Reg. Con. mg/l	Pod width (cm)			Number of seeds/pod		
		GA_3	NAA	KIN	GA_3	NAA	KIN
First season (2004)							
Giza 6	0	1.12 d	1.10 c	1.07 b	3.67 c	3.33 c	3.33 c
	10	1.41 c	1.56 b	1.30 b	4.67 bc	5.0 b	4.33 bc
	20	1.62 b	1.72 b	1.41 ab	5.67 b	6.67 a	5.0 b
	30	1.81 a	1.94 a	1.78 a	7.33 a	7.67 a	6.33 a
	Mean	1.49 A	1.58 A	1.39 A	5.34 A	5.67 A	4.75 A
Bronco	0	1.02 d	1.0 c	0.93 b	3.0 c	3.0 c	2.67 b
	10	1.23 c	1.35 b	1.0 b	4.0 bc	4.33 bc	3.67 ab
	20	1.37 b	1.42 b	1.16 ab	5.0 ab	5.33 b	4.33 a
	30	1.53 a	1.77 a	1.41 a	6.33 a	7.0 a	5.0 a
	Mean	1.29 B	1.39 B	1.13 B	4.58 B	4.92 B	3.92 B
Mean of Gr. Reg. Con.	0	1.07 d	1.05 c	1.00 c	3.34 c	3.17 d	3.0 c
	10	1.32 c	1.46 b	1.15 bc	4.34 bc	4.67 c	4.0 b
	20	1.50 b	1.57 b	1.29 b	5.34 b	6.0 b	4.67 b
	30	1.67 a	1.86 a	1.60 a	6.83 a	7.34 a	5.67 a
	Mean	1.39 B	1.49 A	1.26 C	4.96 A	5.30 A	4.34 B
Second season (2005)							
Giza 6	0	1.10 d	1.07 b	1.03 b	3.33 c	3.0 c	2.67 c
	10	1.37 c	1.52 ab	1.24 b	4.0 bc	4.67 b	3.67 bc
	20	1.55 b	1.77 a	1.36 ab	5.33 b	6.33 a	4.67 b
	30	1.79 a	1.89 a	1.72 a	7.0 a	7.33 a	6.0 a
	Mean	1.45 A	1.56 A	1.34 A	4.92 A	5.33 A	4.25 A
Bronco	0	1.0 b	0.90 c	0.87 b	3.0 c	3.0 c	2.33 c
	10	1.18 ab	1.17 bc	0.91 b	3.67 bc	4.0 bc	3.0 bc
	20	1.26 ab	1.28 b	1.12 ab	5.0 ab	5.33 ab	4.0 a
	30	1.41 a	1.62 a	1.38 a	6.0 a	6.67 a	4.67 a
	Mean	1.21 B	1.24 B	1.07 B	4.42 A	4.75 A	3.5 B
Mean of Gr. Reg. Con.	0	1.05 c	0.99 c	0.95 c	3.17 c	3.0 d	2.5 c
	10	1.28 b	1.35 b	1.08 bc	3.84 c	4.34 c	3.34 c
	20	1.41 b	1.53 ab	1.24 b	5.17 b	5.83 b	4.34 b
	30	1.6 a	1.76 a	1.55 a	6.5 a	7.0 a	5.34 a
	Mean	1.33 A	1.40 A	1.21 B	4.67 A	5.04 A	3.88 B

Values marked with same alphabetical letter(s), within a comparable group of means, do not significantly differ using revised L.S.D. test at 0.05 level.

These results are in agreement with those obtained by Mozarkar *et al*. (1991) who found that tomato cultivars showed different response to growth regulator treatments in respect to fruit yield.

This increase in yield and its components, which achieved in this investigation by applying GA_3, NAA and KIN at different concentrations may be attributed to the increases in vegetative growth characters (Tables, 1 and 2), promoting chemical components (Tables, 4, 5 and 6) which were previously discussed, in which growth regulators can help the transportation of photosynthetic outcome to flower and fruit, increase fruit rate.

Generally, it could be concluded that, foliar spray bean plants with GA_3, NAA and KIN significantly promoted most studied parameters. Increasing growth regulator levels up to 30 mg/l significantly enhanced plant growth characters, RWC%, chemical composition, yield and its attributes, meanwhile, decreased LWD% and total phenols concentration. Best results were observed by GA_3 at 20 mg/l and 30 mg/l followed by NAA and KIN at rate of 30 mg/l, which considered as the best and optimal growth regulator treatments.

These results may confirm the beneficial effect of foliar spraying plant growth regulators and lead us to recommend the use of GA_3, NAA and KIN as a foliar application at rates of 10, 20 and 30 mg/l, in order to increase growth characters, leaf water relations, chemical parameters and yield of common bean plants.

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تـاثير الـرش بـبعض منظمـات النمـو النباتيـة علـى النمـو والتركيـب الكيمـاوى والمحصول لبعض أصناف الفاصوليا

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أجريت هذه الدراسة فى تجربتين أصص بالمزرعة التجريبية لكلية الزراعة بشبين الكوم – جامعة المنوفية خلال الموسمين ٢٠٠٤ و ٢٠٠٥ وذلك لدراسة تأثير الرش بمنظمات النمو النباتية (حامض الجبريلك , نفثالين حامض الخليك , الكينتين) بتركيزات صفر, ١٠, ٢٠, ٣٠ ملليجرام/لتر على صفات النمو الخضرى والتركيب الكيماوى وكذلك المحصول ومكوناته لصنفى الفاصوليا (جيزة ٦ وبرونكو) وقد أشارت النتائج الى مايلى:-

* أوضحت الدراسة أن الرش بمنظمات النمو السابقة بتركيزات (١٠, ٢٠, ٣٠ ملليجرام/لتر) أدى الى زيادة معنوية فى صفات النمو الخضرى المتمثلة فى طول الجذور وأرتفاع النبات وعدد الأوراق وطولها وعرضها ومساحتها وكذلك الوزن الجاف للجذور والأفرع. وقد أدت المعاملة بحامض الجبريلك بتركيز ٢٠ ملليجرام/لتر الى حدوث أعلى زيادة معنوية فى جميع صفات النمو الخضرى.
* أدى استخدام منظمات النمو بتركيزاتها المختلفة الى زيادة صفات النمو الخضرى معنويا فى الصنفين المستخدمين فى هذه الدراسة. وقد أوضحت النتائج أن صفات النمو الخضرى فى الصنف جيزة ٦ كانت اكثر تأثرا بالمعاملة بمنظمات النمو مقارنة بالصنف برونكو حيث أنه عند استخدام حامض الجبريلك بتركيز ٢٠ ملليجرام/لتر أعطى الصنف جيزة ٦ أعلى زيادة معنوية فى صفات النمو الخضرى مقارنة بالصنف برونكو.
* أظهرت النتائج أن رش نباتات الفاصوليا بالتركيزات المستخدمة من منظمات النمو المختلفة أدى الى حدوث زيادة معنوية فى النسبة المئوية للمحتوى النسبى للماء وكذلك فى تركيز كل من صبغات البناء الضوئى (كلوروفيل أ وكلوروفيل ب وكلوروفيل أ+ب والكاروتينيدات) والسكريات الذائبة الكلية والكربوهيدرات الكلية والأحماض الأمينية الحرة الكلية والبروتين الكلى وكذلك النتروجين والفوسفور والبوتاسيوم. وقد أعطت المعاملة بحامض الجبريلك بتركيز ٢٠ ملليجرام/لتر وكذلك المعاملات بنفثالين حامض الخليك أوالكينتين بتركيز ٣٠ ملليجرام/لتر أعلى زيادة معنوية فى التركيب الكيماوى لأوراق الفاصوليا. ومن ناحية اخرى أدى استخدام التركيزات المختلفة من منظمات النمو الى حدوث نقص معنوى فى النسبة المئوية لمعدل نقص الماء فى الأوراق وكذلك تركيز الفينولات الكلية فى أوراق الفاصوليا.
* أدى رش نباتات الفاصوليا بتركيزات مختلفة من حامض الجبريلك أونفثالين حامض الخليك أوالكينتين الى زيادة تركيز المكونات الكيماوية معنويا فى أوراق الصنفين المستخدمين فى هذه الدراسة وكان الصنف جيزة ٦ أكثر استجابة لهذه المعاملات مقارنة بالصنف برونكو.
* أوضحت الدراسة أن استخدام منظمات النمو النباتية بتركيزات مختلفة أدى الى حدوث زيادة معنوية فى المحصول الكلى لنباتات الفاصوليا متمثلا فى عدد القرون/النبات ووزن القرون/النبات وطول القرن وعرضه وكذلك عدد البذور/القرن وذلك مقارنة بالنباتات الغير معاملة. وقد أثر رش نباتات الفاصوليا بالتركيز العالى (٣٠ ملليجرام/لتر) من حامض الجبريلك أونفثالين حامض الخليك تأثيرا ايجابيا حيث أعطى أعلى زيادة معنوية فى المحصول ومكوناته.
* أظهرت النتائج أن رش نباتات الفاصوليا بمنظمات النمو المختلفة أدى الى زيادة المحصول معنويا فى الصنفين المستخدمين فى هذه الدراسة. وقد أعطى الصنف جيزة ٦ أعلى زيادة معنوية فى المحصول ومكوناته مقارنة بالصنف برونكوخاصة عند الرش باستخدام التركيز العالى ٣٠ ملليجرام/لتر.
* أشارت الدراسة أن رش نباتات الفاصوليا بحامض الجبريلك بتركيزات ٢٠ و٣٠ ملليجرام/لتر وكذلك نفثالين حمض الخليك أو الكينتين بتركيز ٣٠ ملليجرام/لتر هى أكثر المعاملات كفاءة حيث أعطت أعلى زيادة معنوية فى صفات النمو الخضرى والتركيب الكيماوى والمحصول لنباتات الفاصوليا وعلى ذلك يمكن التوصية باستخدام منظمات النمو النباتية (حامض الجبريلك, نفثالين حامض الخليك, الكينتبن) للحصول على زيادة فى النمو الخضرى والمكونات الكيماوية والمحصول لنباتات الفاصوليا.

Table (1): Effect of plant growth regulator levels on some growth characters in two bean cultivars after 70 days from sowing during 2004 and 2005 seasons.

Cvs.	Gr. Reg. Con. mg/l	Root length (cm)			Plant height (cm)			Number of leaves/plant			Leaflet length (cm)		
		GA_3	NAA	KIN	GA_3	NAA	KIN	GA_3	NAA	KIN	GA_3	NAA	KIN
First season (2004)													
Giza 6	0	8.97 c	8.72 b	8.83 b	35.55 b	34.72 d	33.97 d	9.0 d	9.0 c	9.0 b	7.65 c	7.43 c	7.52 c
	10	12.17 bc	11.0 b	10.53 b	45.25 ab	43.63 c	43.65 c	12.0 c	12.0 bc	10.33 b	10.85 b	9.3 b	9.10 bc
	20	18.0 a	13.93 a	12.27 ab	68.20 a	52.4 b	49.21 b	18.0 a	15.67ab	12.67 ab	14.4 a	10.5 b	10.0 b
	30	15.27 ab	15.63 a	15.43 a	54.2 ab	63.35 a	58.15 a	15.0 b	17.33a	15.0 a	12.15 ab	13.92a	12.12 a
	Mean	13.60 A	12.32 A	11.77 A	50.8 A	48.52 A	46.25 A	13.5 A	13.5 A	11.75 A	11.26 A	10.29 A	9.69 A
Bronco	0	8.22 d	8.37 d	8.2 d	30.3 d	31.2 d	30.04 d	7.33 b	7.0 b	7.33 d	6.43 d	6.31 b	6.07 d
	10	10.53 c	9.99 c	9.42 c	38.7 c	35.71 c	36.39 c	9.0 b	8.67 ab	8.67 c	8.9 c	8.2 ab	7.0 c
	20	16.57 a	12.17 b	10.99 b	53.9 a	42.35 b	43.92 b	15.0 a	10.33 ab	10.0 b	11.38 a	9.1 a	8.2 b
	30	12.37 b	14.5 a	12.19 a	46.33 b	50.86 a	49.65 a	13.0 a	14.0 a	14.67 a	9.3 b	10.32 a	10.5 a
	Mean	11.92 B	11.26 B	10.2 B	42.31 B	40.03 B	40.00 B	11.08 B	10.0 B	10.17 B	9.0 B	8.48 B	7.94 B
Mean of Gr. Reg. Con	0	8.6 d	8.55 d	8.52 c	32.93 c	32.96 d	32.01 d	8.17 d	8.0 c	8.17 c	7.04 c	6.87 c	6.80 d
	10	11.35 c	10.5 c	9.98 bc	41.98 bc	39.67 c	40.02 c	10.5 c	10.33 bc	9.5 bc	9.88 b	8.75 b	8.05 c
	20	17.29 a	13.05 b	11.63 b	61.05 a	47.38 b	46.57 b	16.5 a	13.0 ab	11.34 b	12.89 a	9.8 b	9.1 b
	30	13.82 b	15.07 a	13.81 a	50.27 b	57.11 a	53.9 a	14.0 b	15.67 a	14.84 a	10.73 b	12.12 a	11.31 a
	Mean	12.77 A	11.79 B	10.99 C	46.56 A	44.28 AB	43.13 B	12.29 A	11.75 AB	10.96 B	10.13 A	9.39 B	8.82 C
Second season (2005)													
Giza 6	0	8.49 d	8.21 d	8.16 c	33.05 b	32.82 b	32.17 d	8.67 b	8.33 c	8.0 c	7.51 b	7.23 d	7.41 d
	10	11.92 c	9.27 c	8.43 c	43.25 b	36.39 b	39.96 c	11.33 b	11.67 b	9.67 bc	10.75 ab	8.6 c	8.53 c
	20	17.92 a	12.63 b	10.82 b	59.17 a	40.33 ab	43.10 b	17.0 a	15.33 a	12.0 b	14.29 a	9.97 b	9.34 b
	30	15.20 b	13.93 a	12.86 a	43.5 b	48.18 a	53.16 a	13.33ab	16.67 a	14.67 a	12.07 ab	12.96 a	11.22 a
	Mean	13.39 A	11.01 A	10.08 A	44.74 A	39.43 A	42.10 A	12.58 A	13.0 A	11.09 A	11.16 A	9.69 A	9.13 A
Bronco	0	8.12 d	8.04 d	8.0 c	29.19 d	29.87 d	29.02 d	7.0 b	6.67 c	6.33 c	6.11 d	6.22 c	6.0 d
	10	10.32 c	9.32 c	8.22 c	34.97 c	32.72 c	30.63 c	8.67ab	8.33 bc	8.0 bc	7.12 c	7.42 bc	6.73 c
	20	14.94 a	11.87 b	9.43 b	46.12 a	34.29 b	33.42 b	12.67a	10.0 b	9.67 b	11.13 a	9.2 ab	7.87 b
	30	11.39 b	13.19 a	11.38 a	40.39 b	42.35 a	40.99 a	10.33ab	13.67 a	12.67 a	9.0 b	10.10 a	10.10 a
	Mean	11.19 B	10.61 B	9.26 B	37.67B	34.81 B	33.52 B	9.67 B	9.67 B	9.17 B	8.34 B	8.24 B	7.68 B
Mean of Gr. Reg. Con	0	8.31 d	8.13 d	8.08 c	31.12 c	31.35 c	30.60 d	7.84 c	7.5 d	7.17 d	6.81 c	6.73 d	6.71 d
	10	11.12 c	9.30 c	8.33 c	39 11 b	34.56 bc	35.30 c	10.0 bc	10.0 c	8.84 c	8.94 b	8.01 c	7.63 c
	20	16.44 a	12.25 b	10.13 b	52.65 a	37.31 b	38.26 ab	14.84 a	12.67 b	10.84 b	12.71 a	9.59 b	8.61 b
	30	13.3 b	13.56 a	12.12 a	41.95 b	45.27 a	47.08 a	11.83ab	15.17 a	13.67 a	10.54 b	11.53 a	10.66 a
	Mean	12.29 A	10 .81B	9.67 C	41.21 A	37.12 B	37.81 B	11.13AB	11.34 A	10.13 B	9.75 A	8.97 B	8.41 B

Values marked with same alphabetical letter(s), within a comparable group of means, do not significantly differ using revised L.S.D. test at 0.05 level.

Table (2): Effect of plant growth regulator levels on some growth characters in two bean cultivars after 70 days from sowing during 2004 and 2005 seasons.

Cvs.	Gr. Reg. Con. mg/l	Leaflet width (cm)			Leaf area (cm^2/plant)			Root dry weight g/plant			Shoot dry weight g/plant		
		GA_3	NAA	KIN	GA_3	NAA	KIN	GA_3	NAA	KIN	GA_3	NAA	KIN
First season (2004)													
Giza 6	0	4.69 c	4.49 b	4.21 d	505.12 d	500.33 d	502.42 d	0.21 b	0.20 b	0.22 c	2.56 d	2.37 c	2.44 c
	10	6.52 bc	5.38 b	5.16 c	751.09 c	559.26 c	517.44 c	0.49ab	0.28 b	0.26 c	4.07 c	3.17 c	2.66 c
	20	9.97 a	7.8 a	6.0 b	1912.47 a	908.60 b	749.66 b	0.77 a	0.37 ab	0.35 b	8.83 a	5.27 b	4.0 b
	30	8.86 ab	8.52 a	7.07 a	821.33 b	1139.02 a	1088.74 a	0.58 ab	0.55 a	0.53 a	5.86 b	7.0 a	6.02 a
	Mean	7.51 A	6.55 A	5.61 A	997.50 A	776.80 A	714.57 A	0.51 A	0.35 A	0.34 A	5.33 A	4.45 A	3.78 A
Bronco	0	4.12 b	4.03 d	4.10 d	468.16 d	461.19 d	459.78 d	0.17 b	0.15 c	0.14 d	2.22 d	2.16 d	2.11 d
	10	5.10 ab	4.97 c	4.72 c	679.31 c	540.28 c	509.05 c	0.24 b	0.20 bc	0.20 c	2.88 c	2.67 c	2.40 c
	20	6.99 a	5.62 b	5.53 b	1276.19 a	704.2 b	611.73 b	0.59 a	0.26 b	0.29 b	5.38 a	3.23 b	2.87 b
	30	5.89 ab	6.33 a	6.02 a	721.99 b	880.47 a	794.73 a	0.43 ab	0.40 a	0.38 a	3.96 b	4.36 a	3.93 a
	Mean	5.53 B	5.24 B	5.09 B	786.41 B	646.54B	593.82 B	0.36 B	0.25 B	0.25 B	3.61 B	3.11 B	2.83 B
Mean of Gr. Reg. Con.	0	4.41 c	4.26 c	4.16 d	486.64 d	480.76 d	481.1 d	0.19 c	0.18 c	0.18 d	2.39 d	2.27 d	2.28 c
	10	5.81 bc	5.18 b	4.94 c	715.2 c	549.77 c	513.25 c	0.37 bc	0.24 bc	0.23 c	3.48 c	2.92 c	2.53 c
	20	8.48 a	6.71 a	5.77 b	1594.33 a	806.4 b	680.70 b	0.68 a	0.32 b	0.32 b	7.11 a	4.25 b	3.44 b
	30	7.38 ab	7.43 a	6.55 a	771.66 b	1009.75 a	941.74 a	0.51 ab	0.48 a	0.46 a	4.91 b	5.68 a	4.98 a
	Mean	6.52 A	5.90 B	5.35 C	891.96 A	711.67 B	654.19 C	0.44 A	0.30 B	0.30 B	4.47 A	3.78 B	3.31 C
Second season (2005)													
Giza 6	0	4.92 b	4.48 d	4.53 b	428.12 d	421.88 d	414.31 d	0.19 c	0.17 d	0.16 b	2.26 d	2.13 d	2.18 d
	10	6.82 ab	5.6 c	5.21 b	664.63 c	488.89 c	452.94 c	0.38 b	0.25 c	0.22 b	3.59 c	3.04 c	2.28 c
	20	9.99 a	6.93 b	6.32 a	1654.6 a	868.56 b	682.82 b	0.64 a	0.35 b	0.30 ab	7.47 a	4.75 b	3.63 b
	30	8.79 ab	7.84 a	6.96 a	802.42 b	1069.04 a	1027.85 a	0.45 b	0.52 a	0.48 a	5.26 b	6.49 a	5.74 a
	Mean	7.63 A	6.21 A	5.76 A	887.44 A	712.09A	644.48 A	0.42 A	0.32 A	0.29 A	4.65 A	4.10 A	3.46 A
Bronco	0	4.43 b	4.22 b	4.32 d	415.18 d	403.17 d	411.21 d	0.14 d	0.13 c	0.13 b	1.91 d	1.84 d	1.69 b
	10	5.5 ab	4.95 ab	4.73 c	618.84 c	471.03 c	438.36 c	0.22 c	0.17 bc	0.18 b	2.56 c	2.34 c	2.0 b
	20	6.6 a	5.52 a	5.03 b	1098.12 a	601.06 b	537.04 b	0.56 a	0.21 b	0.23 ab	4.67 a	2.83 b	2.32 a
	30	6.0 ab	6.10 a	5.64 a	661.52 b	781.54 a	729.10 a	0.41 b	0.36 a	0.30 a	3.58 b	2.94 a	3.14 a
	Mean	5.63 B	5.20 B	4.93 B	698.42 B	564.2 B	528.93 B	0.33 B	0.22 B	0.21 B	3.18 B	2.49 B	2.29 B
Mean of Gr. Reg. Con.	0	4.68 c	4.35 d	4.43 d	421.65 d	412.53 d	412.76 d	0.17 d	0.15 d	0.15 c	2.09 d	1.99 d	1.94 c
	10	6.16 bc	5.28 c	4.97 c	641.74 c	479.96 c	445.65 c	0.30 c	0.21 c	0.20 bc	3.08 c	2.69 c	2.14 c
	20	8.30 a	6.23 b	5.67 b	1376.36 a	734.81 b	609.93 b	0.60 a	0.28 b	0.27 b	6.07 a	3.79 b	2.98 b
	30	7.40 ab	6.97 a	6.3 a	731.97 b	925.29 a	878.48 a	0.43 b	0.44 a	0.39 a	4.42 b	4.72 a	4.44 a
	Mean	6.63 A	5.71 B	5.35 B	792.93 A	638.15B	586.71 C	0.38 A	0.27 B	0.25 B	3.92 A	3.30 B	2.88 C

Values marked with same alphabetical letter(s), within a comparable group of means, do not significantly differ using revised L.S.D. test at 0.05 level.

Table (4): Effect of plant growth regulator levels on photosynthetic pigments (mg/g d. wt.) in two bean cultivars after 70 days from sowing during 2004 and 2005 seasons.

First season (2004)													
Cvs.	Gr. Reg. Con. mg/l	Chl. a			Chl. b			Chl. a+b			Carotenoids		
		GA_3	NAA	KIN	GA_3	NAA	KIN	GA_3	NAA	KIN	GA_3	NAA	KIN
Giza 6	0	2.93 d	2.90 d	2.87 c	1.39 d	1.35 d	1.31 c	4.32 c	4.25 c	4.18 c	0.78 d	0.72 d	0.68 d
	10	4.65 c	3.59 c	2.97 c	1.61 c	1.72 c	1.33 c	6.26 b	5.31 bc	4.3 bc	0.97 c	0.91 c	0.94 c
	20	5.93 a	4.83 b	3.72 b	1.99 a	2.07 b	1.56 b	7.92 a	6.9 ab	5.28 b	1.92 a	1.20 b	1.11 b
	30	5.47 b	5.79 a	4.68 a	1.74 b	2.23 a	1.97 a	7.21 ab	8.02 a	6.65 a	1.31 b	1.49 a	1.48 a
	Mean	4.75 A	4.28 A	3.56 A	1.68 A	1.84 A	1.54 A	6.43 A	6.12 A	5.10 A	1.25 A	1.08 A	1.05 A

			1.92 d 2.unTra lai em niem vui khi duoc gan ben em, tra lai em loi yeu thuong em dem, tra lai em niem tin thang nam qua ta dap xay. Gio day chi la nhung ky niem buon... http://nhatquanglan1.0catch.com										

	Mean	3.58 B	3.25 B	2.78 B	1.35 B	1.23 B	1.17 B	4.93 B	4.48 B	3.96 B	1.16 B	0.99 B	0.94 B
Mean of Gr. Reg. Con.	0	2.46 d	2.41 d	2.38 d	1.23 d	1.18 d	1.17 c	3.69 d	3.59 d	3.55 c	0.70 d	0.65 d	0.62 d
	10	4.17 c	3.15 c	2.74 c	1.36 c	1.40 c	1.23 c	5.53 c	4.55 c	3.97 c	1.1 c	0.90 c	0.90 c
	20	5.4 a	4.04 b	3.26 b	1.84 a	1.66 b	1.38 b	7.24 a	5.70 b	4.63 b	1.70 a	1.19 b	1.13 b
	30	4.62 b	5.46 a	4.31 a	1.64 b	1.92 a	1.65 a	6.26 b	7.38 a	5.97 a	1.32 b	1.42 a	1.35 a
	Mean	4.17 A	3.77 B	3.17 C	1.52 A	1.54 A	1.36 B	5.68 A	5.30 B	4.53 C	1.21A	1.04 B	0.99C
Second season (2005)													
Giza 6	0	2.62 d	2.55 d	2.47 d	1.3 d	1.26 d	1.21 d	3.92 d	3.81 d	3.68 d	0.70 d	0.67 d	0.61 d
	10	4.33 c	3.36 c	2.89 c	1.53 c	1.65 c	1.43 c	5.86 c	5.01 c	4.32 c	0.89 c	0.82 c	0.80 c
	20	5.74 a	4.45 b	3.46 b	1.94 a	1.99 b	1.69 b	7.68 a	6.44 b	5.15 b	1.85 a	1.04 b	1.02 b
	30	5.25 b	5.5 a	4.42 a	1.62 b	2.15 a	1.91 a	6.87 b	7.65 a	6.33 a	1.20 b	1.57 a	1.39 a
	Mean	4.49 A	3.97 A	3.31A	1.6 A	1.76 A	1.56 A	6.08 A	5.73 A	4.87 A	1.16 A	1.03 A	0.96 A
Bronco	0	1.91 c	1.98 d	1.7 d	0.92 b	0.88 c	0.83 c	2.83 d	2.86 c	2.53 c	0.53 c	0.50 d	0.48 c
	10	3.45 b	2.40 c	2.28 c	0.98 b	0.94 c	0.99 b	4.43 c	3.34 bc	3.27 b	1.22 b	0.79 c	0.77 b
	20	4.64 a	3.08 b	2.6 b	1.52 a	1.16 b	1.07 b	6.16 a	4.24 b	3.67 b	1.53 a	1.01 b	1.0 a
	30	3.53 b	4.93 a	3.67 a	1.48 a	1.52 a	1.31 a	5.01 b	6.45 a	4.98 a	1.32 b	1.22 a	1.12 a
	Mean	3.38 B	3.10 B	2.56 B	1.23 B	1.13 B	1.05 B	4.61 B	4.22 B	3.61 B	1.15 A	0.88 B	0.84 B
Mean of Gr. Reg. Con.	0	2.27d	2.27 d	2.09 d	1.11 d	1.07 d	1.02 d	3.38 d	3.34 d	3.11 d	0.62 d	0.59 d	0.55 d
	10	3.89 c	2.88 c	2.59 c	1.26 c	1.30 c	1.21 c	5.15 c	4.18 c	3.80 c	1.06 c	0.81 c	0.79 c
	20	5.19 a	3.77 b	3.03 b	1.73 a	1.58 b	1.38 b	6.92 a	5.34 b	4.41 b	1.69 a	1.03 b	1.01 b
	30	4.39 b	5.22 a	4.05 a	1.55 b	1.84 a	1.61 a	5.94 b	7.05 a	5.66 a	1.26 b	1.40 a	1.26 a
	Mean	3.94 A	3.54 B	2.94 C	1.41 B	1.45 A	1.31 C	5.35 A	4.98 B	4.24 C	1.16 A	0.96 B	0.90 C

Values marked with same alphabetical letter(s), within a comparable group of means, do not significantly differ using revised L.S.D. test at 0.05 levels.

Table (6): Effect of plant growth regulator levels on total phenols and mineral concentrations in two bean cultivars after 70 days from sowing during 2004 and 2005 seasons.

First season (2004)													
Cvs.	**Gr. Reg. Con. mg/l**	**Total phenols (mg caticol/100 g d. wt.)**			**N concentration (mg/g d. wt.)**			**P concentration (mg/g d. wt.)**			**K^+ concentration (mg/g d. wt.)**		
		GA_3	**NAA**	**KIN**	**GA_3**	**NAA**	**KIN**	**GA_3**	**NAA**	**KIN**	**GA_3**	**NAA**	**KIN**
Giza 6	0	23.18 a	22.13 a	19.51 a	22.95 d	23.14 d	21.12 d	2.31 d	2.26 d	2.13 b	19.23 d	18.53 d	17.11 d
	10	19.05 b	18.82 b	17.05 b	24.70 c	26.70 c	23.73 c	3.58 c	3.01 c	2.56 b	24.32 c	23.42 c	21.40 c
	20	16.66 c	15.32 c	14.86 c	33.57 a	34.28 b	25.24 b	3.99 b	4.00 b	3.8 a	32.54 b	29.55 b	28.75 b
	30	14.23 d	11.95 d	10.86 d	30.08 b	36.48 a	28.14 a	4.95 a	4.62 a	4.02 a	40.28 a	36.17 a	32.23 a
	Mean	18.28 A	17.06 A	15.57 A	27.83 A	30.15 A	24.56 A	3.71 A	3.47 A	13.13 A	29.09 A	26.92 A	24.87 A

Bronco	0	20.6 a	18.97 a	17.21 a	18.76 d	20.01 d	19.87 c	2.01 d	2.01 d	1.87 c	14.41 d	14.01 d	13.57 d
	10	17.45 b	15.23 b	16.50 a	23.71 c	26.36 c	22.75 bc	3.12 c	2.97 c	2.26 c	22.10 c	18.64 c	17.02 c
	20	15.12 c	13.60 b	13.22 b	31.86 a	30.74 b	24.43 b	3.54 b	3.30 b	3.17 b	29.55 b	28.54 b	25.93 b
	30	12.32 d	10.05 c	9.39 c	27.71 b	33.85 a	28.36 a	4.22 a	4.11 a	3.79 a	38.28 a	34.33 a	30.54 a
	Mean	16.37 B	14.46 B	14.08 B	25.51 B	27.74 B	23.85 A	3.22 B	3.10 B	2.77 B	26.09 B	23.88 B	21.77 B
Mean of Gr. Reg. Con.	0	21.89 a	20.55 a	18.36 a	20.86 d	21.58 d	20.50 d	2.16 d	2.14 d	2.0 c	16.82 d	16.27 d	15.34 d
	10	18.25 b	17.03 b	16.78 b	24.21 c	26.53 c	23.24 c	3.35 c	2.99 c	4.41 c	23.21 c	21.03 c	19.21 c
	20	15.89 c	14.46 c	14.04 c	32.72 a	32.51 b	24.84 b	3.78 b	3.65 b	3.49 b	31.05 b	29.05 b	27.34 b
	30	13.28 d	11.00 d	10.13 d	28.90 b	35.17 a	28.25 a	4.59 a	4.37 a	3.91 a	39.28 a	35.25 a	31.39 a
	Mean	17.33 A	15.76 B	14.83 C	26.67 B	28.95 A	24.21 C	3.47 A	3.29 B	2.95 C	27.59 A	25.4 B	23.32 C
Second season (2005)													
Giza 6	0	22.36 a	20.76 a	18.72 a	23.73 d	21.89 d	20.64 d	2.94 d	2.73 c	2.44 c	18.98 d	17.51 d	16.67 d
	10	18.60 b	17.78 b	16.12 b	25.87 c	27.93 c	24.27 c	4.12 c	3.98 b	2.83 c	22.85 c	21.72 c	19.88 c
	20	15.83 c	14.42 c	13.02 c	35.21 a	35.72 b	26.94 b	4.97 b	4.85 a	4.09 b	31.96 b	28.64 b	27.96 b
	30	12.17 d	9.97 d	9.54 d	31.69 b	38.37 a	29.63 a	5.87 a	5.32 a	5.16 a	38.72 a	34.83 a	30.53 a
	Mean	17.24 A	15.73 A	14.35 A	29.13 A	30.98 A	25.37 A	4.48 A	4.22 A	3.63 A	28.13 A	25.68 A	23.76 A
Bronco	0	20.01 a	17.35 a	16.13 a	20.12 a	19.16 d	18.19 d	2.51 d	2.51 d	2.13 c	13.75 d	12.82 d	12.07 d
	10	17.22 b	14.42 b	15.16 b	24.31 c	27.87 c	23.13 c	3.44 c	3.62 c	2.51 c	20.32 c	17.75 c	16.62 c
	20	14.18 c	12.27 c	12.04 c	33.27 a	32.43 b	26.07 b	4.32 b	4.36 b	3.69 b	27.67 b	26.81 b	23.89 b
	30	11.27 d	9.88 d	8.78 d	28.92 b	35.67 a	29.49 a	5.17 a	4.97 a	4.31 a	36.48 a	32.69 a	28.77 a
	Mean	15.67 B	13.48 B	13.03 B	26.66 B	28.78 B	24.22 B	3.86 B	3.87 B	3.16 B	24.56 B	22.52 B	20.34 B
Mean of Gr. Reg. Con.	0	21.19 a	19.06 a	17.43 a	21.93 d	20.53 d	19.42 d	2.73 d	2.62 d	2.29 d	16.37 d	15.17 d	14.37 d
	10	17.91 a	16.1 b	15.64 b	25.09 c	27.9 c	23.7 c	3.78 c	3.8 c	2.67 c	21.59 c	19.74 c	18.25 c
	20	15.01 c	13.35 c	12.53 c	34.24 a	34.08 b	26.51 b	4.65 b	4.61 b	3.89 b	29.82 b	27.73 b	25.93 b
	30	11.72 d	9.93 d	9.16 d	30.31 b	37.02 a	29.56 a	5.52 a	5.15 a	4.74 a	37.6 a	33.76 a	29.65 a
	Mean	16.46 A	14.61 B	13.69 C	27.90 B	29.88 A	24.80 C	4.17 A	4.05 A	3.40 B	26.35 A	24.1 B	22.05 C

Values marked with same alphabetical letter(s), within a comparable group of means, do not significantly differ using revised L.S.D. test at 0.05 level

Table (5): Chemical analysis of bean leaves (mg/g d. wt.) as affected py growth regulator levels after 70 days from sowing during 2004 and 2005 seasons.

First season (2004)													
Cvs.	**Gr. Reg. Con. mg/l**	**Total soluble sugars**			**Total carbohydrates**			**Total free amino acids**			**Total Protein**		
		GA_3	**NAA**	**KIN**	**GA_3**	**NAA**	**KIN**	**GA_3**	**NAA**	**KIN**	**GA_3**	**NAA**	**KIN**
Giza 6	0	12.03 d	11.87 d	11.32 d	87.5 d	83.06 d	80.97 d	16.88 d	18.64 d	15.12 d	143.44 d	144.63 d	132.00d
	10	17.27 c	15.8 c	14.23 c	109.06 c	143.44 c	111.25 c	18.9 c	32.28 c	25.65 c	154.38 c	166.88 c	148.31 c
	20	24.91 a	18.13 b	17.89 b	163.13 a	159.06 b	186.25 b	63.72 a	56.61 b	46.82 b	209.81 a	214.25 b	157.75 b
	30	19.69 b	22.03 a	20.45 a	112.19 b	208.13 a	203.75 a	55.76 b	85.97 a	54.26 a	188.00 b	228.00 a	175.88 a
	Mean	18.48 A	16.96 A	15.97 A	117.97 B	148.45 A	145.56 A	38.82 A	48.38 A	35.46 A	173.91A	188.44 A	153.49 A

Bronco	0	11.55 d	11.16 c	10.89 d	116.56 d	104.16 d	100.0 d	15.2 d	17.59 d	13.72 d	117.25 d	125.06 d	124.19 d
	10	14.95 c	13.89 bc	12.11 c	136.25 c	127.81 c	120.0 c	20.15 c	26.46 c	20.79 c	148.19 c	164.75 c	142.19 c
	20	20.52 a	15.36 b	15.81 b	153.75 a	135.01 b	128.56 b	58.19 a	53.16 b	38.89 b	199.13 a	192.13 b	152.69 b
	30	17.58 b	21.48 a	18.81 a	142.56 b	143.75 a	151.88 a	50.72 b	76.05 a	52.75 a	173.19 b	211.56 a	177.25 a
	Mean	16.15 B	15.47 B	14.41 B	137.28 A	127.68 B	125.11 B	36.07 B	43.32 B	31.54 B	159.44 B	173.38 B	149.08 B
Mean of Gr. Reg. Con.	0	11.79 d	11.52 d	11.11 d	102.03 d	93.66 d	90.49 d	16.04 d	18.12 d	14.42 d	130.35 d	134.85 d	128.10 d
	10	16.11 c	14.85 c	13.17 c	122.66 c	135.63 c	115.63 c	19.53 c	29.37 c	23.22 c	151.29 c	165.82 c	145.25 c
	20	22.72 a	16.75 b	16.85 b	158.44 a	147.04 b	157.41 b	60.96 a	54.89 b	42.86 b	204.47 a	203.19 b	155.22 b
	30	18.64 b	21.76 a	19.63 a	127.38 b	175.94 a	177.82 a	53.24 b	81.01 a	53.51 a	180.6 b	219.78 a	176.57 a
	Mean	17.32 A	16.22 B	15.19 C	127.63 C	138.07 A	135.34 B	37.45 B	45.85 A	33.5 C	166.68 B	180.91 A	151.29 C
Second season (2005)													
Giza 6	0	12.83 d	12.56 c	12.03 d	89.70 d	86.13 d	82.34 d	15.71 d	16.12 d	14.51 d	148.31 d	136.81 d	129.00 d
	10	18.11 c	16.23 b	16.13 c	114.20 c	151.72 c	118.12 c	18.28 c	31.86 c	24.89 c	161.69 c	174.56 c	151.69 c
	20	25.34 a	19.07 b	18.32 c	172.30 a	163.97 b	192.33 b	58.85 a	52.74 b	45.48 b	220.06 a	223.25 b	168.38 b
	30	20.47 b	23.12 a	21.01 a	121.42 b	214.32 a	209.82 a	52.99 b	76.19 a	51.73 a	198.06 b	239.81 a	185.19 a
	Mean	19.19 A	17.75 A	16.87 A	124.41 B	154.04 A	150.65 A	36.46 A	44.23 A	34.15 A	182.03 A	193.61 A	158.57 A
Bronco	0	12.13 d	11.91 d	11.78 c	122.71 d	117.52 d	112.21 d	14.77 d	16.31 d	13.14 d	125.75 d	119.75 d	113.69 d
	10	15.37 c	13.98 c	12.98 c	141.32 c	132.63 c	127.31 c	19.63 c	25.66 c	20.03 c	151.94 c	174.19 c	144.56 c
	20	21.09 a	15.87 b	16.31 b	160.51 a	142.41 b	133.94 b	55.52 a	50.71 b	37.95 b	207.94 a	202.69 b	162.94 b
	30	18.14 b	22.35 a	19.17 a	149.15 b	150.63 a	157.92 a	50.34 b	71.36 a	51.48 a	180.75 b	222.94 a	184.31 a
	Mean	16.68 B	16.03 B	15.06 B	143.42 A	135.80 B	132.85 B	35.07 B	41.01 B	30.65 B	166.60 B	179.89 B	151.38 B
Mean of Gr. Reg. Con.	0	12.48 d	12.24 d	11.91 d	106.21 d	101.83 d	97.28 d	15.24 d	16.22 d	13.83 d	137.03 d	128.28 d	121.35 d
	10	16.74 c	15.11 c	14.56 c	127.76 c	142.18 c	122.72 c	18.96 c	28.76 c	22.46 c	156.82 c	174.38 c	148.13 c
	20	23.22 a	17.47 b	17.32 b	166.41 a	153.19 b	163.14 b	57.19 a	51.73 b	41.72 b	214.00 a	212.97 b	165.66 b
	30	19.31 b	22.74 a	20.09 a	135.29 b	182.48 a	183.87 a	51.67 b	73.78 a	51.61 a	189.41 b	231.38 a	184.75 a
	Mean	17.94 A	16.89 B	15.97 C	133.92 C	144.92 A	141.75 B	35.77 B	42.62 A	32.4 C	174.32 B	186.75 A	154.98 C

Values marked with same alphabetical letter(s), within a comparable group of means, do not significantly differ using revised L.S.D. test at 0.05 level.