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# EFFECT OF SOME GROWTH SUBSTANCES ON KHELLA PLANT (*Ammi visnaga*, (L.) LAM.) GROWING UNDER DIFFERENT LEVELS OF POTASSIUM FERTILIZER

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## ABSTRACT

Two pot experiments were conducted at the Experimental Station and in the Laboratory of Vegetable and Floriculture Department, Faculty of Agriculture, Mansoura University during the two successive seasons of 2005/2006 and 2006/2007 to study the effect of $GA_3$ and ABA at different concentrations on vegetative growth, yield and chemical composition of khella plants growing under different potassium fertilization rates.

The obtained results exhibited that khella plant height, shoot dry weight and content of photosynthetic pigments in the leaves as well as N, P and K concentrations in the shoots were increased with increasing potassium fertilization levels and the highest values were recorded when the plants received the high level of potassium (45 kg/fed.).

$GA_3$ and its interactions with potassium fertilization increased significantly the plant height, shoot dry weight and N, P and K concentrations in the shoots, while the content of photosynthetic pigments in the leaves was decreased. On the other hand, ABA and its interactions with potassium caused a decrease in the previous parameters except for the content of photosynthetic pigments in the leaves which was increased.

Regarding number of umbels and fruit yield per plant as well as the content of khellin and visnagin (%), data showed that potassium fertilization and ABA as well as their interactions significantly increased these parameters. However, $GA_3$ application alone caused a decrease in number of umbels and fruit yield per plant as well as the principle constituents (%). Meantime, $GA_3$ with potassium fertilization at either 30 or 45 kg/fed. increased the fruits content of visnagin.

## INTRODUCTION

Recently, a great attention has been given to medicinal plants in Egypt in order to cover the increasing demand for local industries and for export purposes as well as to avoid the undesirable side effects of synthetic drugs.

Khella (*Ammi visna*ga (L.) Lam.) belongs to family Apiaceae (Umbelliferae) is an annual or biennial herb growing from a taproot erect to a maximum height near 80 cm, leaves are up to 20 cm long and generally oval to triangular in shape but dissected into many small linear to lance-shaped segments. The inflorescence is a compound umbel of white flowers similar to those of other Apiaceae species. The fruit is a compressed oval-shaped body less than 3 mm long. Khella is one of the valuable medicinal plants known in Egyptian folk medicine and still prescribed for renal colic which occurs due mostly to schistosomiasis infections and stone formation. Extracts from khella fruits also function as a diuretic and help the body to release the excessive fluids through an increased urine flow. The main active compounds in khella fruits are khellin and visnagin. They act as spasmolytic and vasodilatory agents on the muscles of the bronchi, biliary tract, urogenital system, and coronary arteries. The plant is widely grown in Mediterranean region and indigenous to the Nile Delta and Fayoum (Wallis, 1967 and Younis *et al*., 2004).

Many extensive investigations in the use of plant growth substances on fruits set and their subsequent development principally on size, shape, rate of maturation and chemical constituents were under taken by many workers (Nickell, 1982). The fundamental roles of growth substances on morphology, physiology, growth and yield of various medicinal plants have been investigated by several research workers (Sobti *et al*., 1978; Salama, 1986; El-Banna, 1989; Khafagy and Salama, 1996; Salama *et al*., 2002 and Khafagy *et al*., 2005).

The effect of gibberillic acid ($GA_3$) was intensively investigated on several medicinal and aromatic plants. It was found that the herbage fresh weight of umbelliferous plants increased due to $GA_3$ application (El-Sahhar, *et al*., 1984). However, the effect of $GA_3$ on the yield of some various medicinal plants was variable (Abou-Zeid, 1973; Sarhan and El-Sayed, 1983 and Khafagy and Salama, 1996).

Regarding the effect of abscisic acid (ABA), Khafagy and Salama (1996) found that ABA increased coriander seed yield, whereas decreased plant height.

Several essential elements, i.e. N, P, Ca, Mg and K have been found in the plant tissues which are absorbed by the plant root hairs. Each of these elements has certain roles in the life of plants. The fundamental roles of potassium in plants are regulatory agents (Hoefner, 1971). It appears that K, in some ways, is involved in protein synthesis and carbohydrate metabolism becomes reduced by inadequate supplies of potassium.

The current research was carried out to study the effect of potassium and growth substances as well as their combinations on growth parameters, fruit yield and chemical constituents of khella plant.

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## MATERIALS AND METHODS

Two pot experiments were carried out in the green house at the Experimental Station of Vegetable and Floriculture Department, Faculty of Agriculture, Mansoura University during the two growing seasons of 2005/2006 and 2006/2007. Fruits of *Ammi visnaga* (L.) Lam. were obtained from the National Research Center in Dokki, Egypt. The seeds were sown on October, $13^{th}$ in the two seasons in plastic pots of 40 cm diameter, having drainage holes, filled with clayey soil. After 4 weeks from sowing, the plants were thinned to leave three plants per pot. Table (a) shows the physical and chemical properties of the used soil in both seasons.

The layout of this experiment during both seasons was split plot design with three replicates (Mead *et al*., 1993). Potassium fertilizer levels were assigned to the main plots and the growth substances ($GA_3$ and ABA) concentration treatments to the sub plots. Potassium fertilizer (potassium sulphate 48 % $K_2O$) levels were 15, 30 and 45 kg/fed. and were added in two equal doses.The first dose was added after plant thinning (4 weeks from sowing) and the second dose after three weeks from the first one. The growth substances $GA_3$ and ABA at the concentrations of 0, 50 and 100 ppm of each were applied as a foliar spray to the point of run off using a small hand sprayer. The growth substances were sprayed after 60 and 75 days from sowing. Tween-20 (0.5%) was added as a wetting agent. The used growth substances were obtained from BDH Chemicals Ltd. U. K. All other agricultural practices were carried out as prevailing in the region

**Table (a): Some physical and chemical properties of the used soil during the two seasons of 2005/2006 and 2006/2007**

| Season | Particle size distribution (%) | | | | Soil texture | pH | Total soluble salts (%) | Chemical analysis | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | Available (ppm) | | |
| | Coarse sand | Fine sand | Silt | Clay | | | | N | P | K |
| 2005/06 | 1.9 | 24.8 | 22.4 | 50.9 | clayey | 7.8 | 0.30 | 24 | 11 | 291 |
| 2006/07 | 2.5 | 23.2 | 21.9 | 52.4 | clayey | 8.1 | 0.34 | 26 | 10 | 287 |

After two weeks from spraying (90 days from sowing), plant height (cm) and shoot dry weight (g/plant) were recorded. Photosynthetic pigments (chlorophyll a, b and carotenoids) in the $7^{th}$ leaf from the plant top were extracted and determined according to Saric *et al*. (1967). In shoot dried material, nitrogen (%) was determined by Microkjeldahel method as described by A.O.A.C. (1980), phosphorus (%) was determined colometrically using the method described by Jackson (1973), while potassium (%) was estimated using flame-photometery method according to Cottenie *et al*. (1982).

As the fruits reached ripening stage (200 days from sowing), plant height (cm), number of compound umbels/plant and fruit yield/plant were determined. In addition, fruit active constituents (khellin and visnagin) were determined according to Ibrahim (1985).

The obtained data were statistically analyzed according to MSTAT (1986). The differences between means were tested using L.S.D. at 5% level.

## RESULTS AND DISCUSSION

### 1- Effect of potassium, $GA_3$, ABA and their interaction treatments on plant height and shoot dry weight of khella plant

Data in Table (1) indicated that K fertilization enhanced plant height (during the vegetative and harvesting stage) and dry weight of khella plants in both seasons. The previous parameters were also increased with increasing potassium level. The same Table showed that $GA_3$ at 50 and 100 ppm or their combinations with K fertilization significantly increased plant height as well as dry weight of shoots. On the other hand, ABA treatments at 50 and 100 ppm or their combinations with K fertilization decreased plant height and shoot dry weight throughout the experimental period.

**Table (1): Effect of $GA_3$ and ABA on plant height and shoot dry weight of khella plant growing under different rates of potassium fertilization during 2005/2006 and 2006/2007 seasons**

| Growth substance (ppm) (B) | Potassium rate (kg/fed.) (A) | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | First season (2005/2006) | | | | Second season (2006/2007) | | | |
| | 15 | 30 | 45 | Mean (B) | 15 | 30 | 45 | Mean (B) |
| | **Plant height (cm) at vegetative stage** | | | | | | | |
| **Control** | 42.3 | 46.0 | 47.7 | **45.3** | 46.0 | 46.8 | 47.2 | **46.7** |
| **$GA_3$ 50** | 65.6 | 68.7 | 71.5 | **68.6** | 64.2 | 68.3 | 70.4 | **67.6** |
| **$GA_3$ 100** | 74.3 | 70.7 | 71.2 | **72.1** | 73.3 | 72.0 | 71.6 | **72.3** |
| **ABA 50** | 42.6 | 46.8 | 44.0 | **44.5** | 43.5 | 45.2 | 44.8 | **44.5** |
| **ABA 100** | 42.0 | 45.0 | 44.6 | **43.9** | 43.1 | 46.2 | 45.1 | **44.8** |
| **Mean (A)** | **53.4** | **55.4** | **55.8** | ----- | **54.0** | **55.7** | **55.8** | ---- |
| **L.S.D. at 5%** | **A: 0.9** | **B: 1.1** | | **AB: 1.9** | **A: 0.8** | **B: 1.0** | | **AB: 2.2** |
| | **Plant height (cm) at harvesting stage** | | | | | | | |
| **Control** | 67.7 | 75.5 | 83.6 | **75.6** | 65.8 | 74.9 | 81.2 | **74.0** |
| **$GA_3$ 50** | 101.6 | 112.0 | 107.0 | **106.9** | 99.5 | 110.1 | 108.4 | **106.0** |
| **$GA_3$ 100** | 114.7 | 116.2 | 119.6 | **116.8** | 112.8 | 117.1 | 118.4 | **116.1** |
| **ABA 50** | 70.0 | 65.0 | 65.2 | **66.7** | 71.2 | 67.3 | 69.0 | **69.2** |
| **ABA 100** | 62.3 | 65.0 | 64.7 | **64.0** | 63.2 | 66.4 | 65.8 | **65.1** |
| **Mean (A)** | **83.3** | **87.7** | **88.0** | ----- | **82.5** | **87.2** | **88.6** | ---- |
| **L.S.D. at 5%** | **A: 1.1** | **B: 1.4** | | **AB: 2.41** | **A: 0.6** | **B: 0.7** | | **AB: 1.3** |
| | **Shoot dry weight (g/plant) at harvesting stage** | | | | | | | |
| **Control** | 10.98 | 10.62 | 14.70 | **12.10** | 11.52 | 12.13 | 13.81 | **12.49** |
| **$GA_3$ 50** | 12.44 | 16.54 | 13.08 | **14.02** | 12.41 | 13.32 | 14.00 | **13.24** |
| **$GA_3$ 100** | 10.54 | 11.70 | 12.02 | **11.42** | 11.34 | 11.90 | 12.12 | **11.79** |
| **ABA 50** | 10.99 | 11.31 | 10.39 | **10.90** | 10.46 | 11.00 | 11.35 | **10.94** |
| **ABA 100** | 10.58 | 10.92 | 11.46 | **10.99** | 10.42 | 10.51 | 11.42 | **10.78** |
| **Mean (A)** | **11.11** | **12.22** | **12.33** | ----- | **11.23** | **11.77** | **12.54** | ---- |
| **L.S.D. at 5%** | **A: 0.62** | **B: 0.80** | | **AB: 1.39** | **A: 0.66** | **B: 0.85** | | **AB: 1.48** |

The enhancing effect of K on plant height may be due to the increase in both number and length of stem internodes. It is clearly known that K plays an important role in enhancing plant growth and metabolism (Ruf *et al.*, 1963). The promotive effect of K on khella plant dry weight might be due to the higher turger potential of K which induced cell enlargement and cell division (Piringer, 1962). In addition, Saleh (1962) conducted that the increase in plant height due to K fertilizer might be attributed to the balance between the nutrient elements by the addition of established K which may lead to the best conditions for plant growth. Potassium occurs principally as soluble inorganic salts which may move to the growing parts especially the stem apical meristem and intercaloery meristems in the internodes, and therefore stimulates the formation of new leaves and their internodes. The increase in the intercaloery meristems may have brought an increase in internode length. Potassium results in a corresponding increase in protein accumulation necessary for the formation of additional tissues in the internodes. The observed increase in dry matter accumulation due to K fertilization could be related to the increase in plant height.

The promotive effect of $GA_3$ on plant height could be attributed to cell elongation rather than cell division (El-Antably *et al*., 1975). In this connection, Sacks (1961) reported that the application of $GA_3$ produces a pronounced increase in cell division in the subapical meristem and causes bolting. The rapid growth that occurs may be the result of both larger number of cells formed and elongation in the individual cells (Muradi *et al*., 2000 and

El-Malt, 2007). Moreover, Runkova (1977) found that $GA_3$ increased plant height by increasing the leaf content of active indolic compounds and accelerated the synthesis of IAA in *Matthiola incana* and *Salvia splendens*. Sherif (1981) reported that the high content of IAA (auxin) inhibited lateral bud formation and induced apical dominance in vascular plants. These findings supported our results which may be explained on the basis that $GA_3$ increased IAA in khella plants which in turn inhibits lateral shoot formation. Abd El-Latif (1984) reported that $GA_3$ decreased the lateral shoots of coriander plants. Helaly *et al.* (1985) reported that $GA_3$ increases IAA inhibiting lateral bud development.

The retardant effects of ABA on plant height obtained in the present investigation may be due to the effects of the increased cytokinin/ABA ratio which induced lateral bud growth (Tucker and Mansfield, 1973), which stimulates subsequent growth of lateral shoots.

**2- Effect of potassium, $GA_3$, ABA and their interaction treatments on some yield parameters of khella plant**

Data in Table (2) revealed that K fertilization alone as well as ABA and their combination treatments significantly increased the number of umbels/plant and fruit yield/plant, while $GA_3$ caused a decrease in these respects. Similar results were reported by El-Banna (1989), Khafagy and Salama (1996) and Khafagy *et al*. (2005) on coriander. In this connection, $GA_3$ probably disturbs the translocation of assimilates (Anderson, 1971). Moreover, Abd El-Latif (1984) found that $GA_3$ inhibits lateral shoot formation, which inhibits subsequent number of umbels. In addition, Helaly *et al*. (1985) reported that the application of $GA_3$ lead to an increase in endogenous GA level in coriander shoots which resulted in a corresponding increase in the number of male flowers and consequently lowered the fruit yield.

**Table (2): Effect of $GA_3$ and ABA on number of umbels and fruit yield of khella plant growing under different rates of potassium fertilization during 2005/2006 and 2006/2007 seasons**

| Growth substance (ppm) (B) | Potassium rate (kg/fed.) (A) | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | First season (2005/2006) | | | | Second season (2006/2007) | | | |
| | 15 | 30 | 45 | Mean (B) | 15 | 30 | 45 | Mean (B) |
| | Number of umbels/plant | | | | | | | |
| **Control** | 3.76 | 3.98 | 4.49 | **4.08** | 3.81 | 4.14 | 4.60 | **4.18** |
| **$GA_3$ 50** | 2.51 | 2.55 | 2.77 | **2.61** | 2.52 | 2.58 | 2.81 | **2.64** |
| **$GA_3$ 100** | 2.51 | 2.19 | 2.47 | **2.39** | 2.40 | 2.41 | 2.55 | **2.45** |
| **ABA 50** | 4.37 | 5.60 | 5.17 | **5.05** | 4.40 | 5.51 | 5.65 | **5.19** |
| **ABA 100** | 4.79 | 5.13 | 5.30 | **5.07** | 4.82 | 5.21 | 5.38 | **5.14** |
| **Mean (A)** | **3.59** | **3.89** | **4.04** | ----- | **3.59** | **3.97** | **4.20** | ---- |
| **L.S.D. at 5%** | **A: 0.35** | **B: 0.45** | | **AB: 0.78** | **A: 0.13** | **B: 0.17** | | **AB: 0.29** |
| | Fruit yield (g/plant) | | | | | | | |
| **Control** | 25.91 | 25.60 | 28.20 | **26.57** | 25.58 | 26.61 | 28.00 | **26.73** |
| **$GA_3$ 50** | 18.02 | 21.88 | 22.68 | **20.86** | 17.99 | 22.12 | 22.86 | **20.99** |
| **$GA_3$ 100** | 8.49 | 12.43 | 14.58 | **11.83** | 9.01 | 12.56 | 13.96 | **11.84** |
| **ABA 50** | 33.62 | 35.58 | 37.25 | **35.48** | 34.20 | 35.70 | 36.95 | **35.62** |
| **ABA 100** | 36.31 | 37.76 | 37.71 | **37.26** | 36.40 | 37.01 | 38.11 | **37.17** |
| **Mean (A)** | **24.47** | **26.65** | **28.08** | ----- | **24.64** | **26.80** | **27.98** | ---- |
| **L.S.D. at 5%** | **A: 0.78** | **B: 1.00** | | **AB: 1.74** | **A: 0.61** | **B: 0.79** | | **AB: 1.37** |

The increase in fruit yield/plant due to ABA and K applications may be attributed to an increase in the number of fruiting branches (Ibrahim and Salama, 1998). El-Banna (1989) and Khafagy and Salama (1996) on coriander reported that ABA and ethrel treatments increased fruit yield/plant and this increase is a result of the considerable increase in fruit size (length and width). The increase in fruit size undoubtedly occurs due to the large amounts of endosperm accumulations materials in fruit seeds. The increase in fruit yield/plant may be also due to an increase in fruit set/umbel.

**3- Effect of potassium, $GA_3$, ABA and their interaction treatments on photosynthetic pigments of khella plant**

Data in Table (3) revealed that the content of chlorophyll a, b and carotenoids in the leaves of khella plants increased with K fertilization and ABA treatments as well as their interactions. On the other hand, $GA_3$ at 50 and 100 ppm caused a significant decrease in the content of photosynthetic pigments. Tisdale and Nelson (1975) reported that photosynthesis was decreased with deficient K in the mature tissues and fruit.

**Table (3): Effect of $GA_3$ and ABA on the content of photosynthetic pigments in the leaves of khella plant (mg/g fresh weight) growing under different rates of potassium fertilization during 2005/2006 and 2006/2007 seasons**

| Growth substance (ppm) (B) | Potassium rate (kg/fed.) (A) | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | First season (2005/2006) | | | | Second season (2006/2007) | | | |
| | 15 | 30 | 45 | Mean (B) | 15 | 30 | 45 | Mean (B) |
| | Chlorophyll a | | | | | | | |
| Control | 1.157 | 1.153 | 1.322 | **1.211** | 1.120 | 1.227 | 1.300 | **1.216** |
| $GA_3$ 50 | 0.831 | 1.169 | 1.118 | **1.039** | 0.910 | 1.156 | 1.130 | **1.065** |
| $GA_3$ 100 | 0.643 | 0.873 | 0.923 | **0.813** | 0.751 | 0.900 | 0.925 | **0.859** |
| ABA 50 | 1.544 | 1.552 | 1.690 | **1.595** | 1.466 | 1.581 | 1.710 | **1.586** |
| ABA 100 | 1,724 | 1.888 | 1.931 | **1.848** | 1.691 | 1.931 | 2.004 | **1.875** |
| **Mean (A)** | **1.180** | **1.327** | **1.397** | ----- | **1.188** | **1.359** | **1.414** | ---- |
| **L.S.D. at 5%** | **A: 0.064** | **B: 0.083** | | **AB: 0.143** | **A: 0.041** | **B: 0.053** | | **AB: 0.092** |
| | Chlorophyll b | | | | | | | |
| Control | 0.582 | 0.673 | 0.783 | **0.679** | 0.605 | 0.711 | 0.805 | **0.707** |
| $GA_3$ 50 | 0.468 | 0.543 | 0.590 | **0.534** | 0.482 | 0.555 | 0.612 | **0.550** |
| $GA_3$ 100 | 0.328 | 0.452 | 0.507 | **0.429** | 0.341 | 0.462 | 0.517 | **0.440** |
| ABA 50 | 0.682 | 0.843 | 0.899 | **0.808** | 0.701 | 0.835 | 0.911 | **0.816** |
| ABA 100 | 0.733 | 0.757 | 0.837 | **0.776** | 0.725 | 0.781 | 0.860 | **0.789** |
| **Mean (A)** | **0.559** | **0.654** | **0.723** | ----- | **0.571** | **0.669** | **0.741** | ---- |
| **L.S.D. at 5%** | **A: 0.029** | **B: 0.038** | | **AB: 0.066** | **A: 0.013** | **B: 0.016** | | **AB: 0.028** |
| | Carotenoids | | | | | | | |
| Control | 0.361 | 0.451 | 0.476 | **0.429** | 0.382 | 0.442 | 0.499 | **0.441** |
| $GA_3$ 50 | 0.285 | 0.319 | 0.305 | **0.303** | 0.295 | 0.324 | 0.316 | **0.312** |
| $GA_3$ 100 | 0.226 | 0.246 | 0.248 | **0.240** | 0.242 | 0.255 | 0.259 | **0.252** |
| ABA 50 | 0.641 | 0.644 | 0.586 | **0.624** | 0.576 | 0.651 | 0.664 | **0.630** |
| ABA 100 | 0.711 | 0.625 | 0.764 | **0.700** | 0.631 | 0.695 | 0.728 | **0.685** |
| **Mean (A)** | **0.445** | **0.457** | **0.476** | ---- | **0.425** | **0.473** | **0.493** | ---- |
| **L.S.D. at 5%** | **A: 0.034** | **B: 0.043** | | **AB: 0.075** | **A: 0.012** | **B: 0.015** | | **AB: 0.026** |

The favorable effects of K on chlorophyll biosynthesis might be due to the effect of K on cytokinins content which delayed leaf senescence (Salama and Wareing, 1979).

The reduction in chlorophylls content in khella mature leaves caused by $GA_3$ may be due to chlorophyll degradation. $GA_3$ induced chloroplast degradation in bean leaves and apparently interferes directly with chlorophyll metabolism and therefore decreases carbohydrate metabolism due to inadequate supplies of K (Halevy and Wittwer, 1965). In addition, Hassan (1981) found that $GA_3$ decreased the synthesis of chlorophylls, carotenoids, plastid benzoquinones and anthocyanin.

The increase in the content of photosynthetic pigments due to ABA may have been explained by the stimulation of chlorophyll synthesis and the delay of chlorophyll destruction (Khafagy and Salama, 1996). These results may be explained on the basis that ABA increased cytokinin in khella leaves. However, cytokinins increased number of chloroplasts in the leaf by increasing both intensity of cell growth phytohormones and the activity of cytoplasm ribosomes, thus chlorophyll synthesis is stimulated (Brozenkova and Mokronzov, 1976).

**4- Effect of potassium, $GA_3$, ABA and their interaction treatments on mineral composition in the shoot of khella plant**

Data presented in Table (4) indicated that N, P and K (%) in khella shoots increased with increasing K fertilization rate up to 45 kg/fed. Moreover, $GA_3$ as well as it's interactions with K fertilization increased N, P and K percentages in the shoots of khella plants. Khafagy and Salama (1996) reported that K fertilization and some growth substances as well as their interactions increased N, P and K percentages in coriander leaves.

**Table (4): Effect of $GA_3$ and ABA on mineral content of khella plant growing under different rates of potassium fertilization during 2005/2006 and 2006/2007 seasons**

| Growth substance (ppm) (B) | Potassium rate (kg/fed.) (A) | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | First season (2005/2006) | | | | Second season (2006/2007) | | | |
| | 15 | 30 | 45 | Mean (B) | 15 | 30 | 45 | Mean (B) |
| | N (%) | | | | | | | |
| **Control** | 4.64 | 5.58 | 5.10 | **5.11** | 4.82 | 5.40 | 5.70 | **5.31** |
| **$GA_3$ 50** | 5.20 | 5.33 | 5.57 | **5.37** | 5.12 | 5.47 | 5.64 | **5.41** |
| **$GA_3$ 100** | 5.56 | 5.84 | 5.85 | **5.75** | 5.72 | 5.77 | 5.92 | **5.80** |
| **ABA 50** | 4.50 | 5.35 | 5.14 | **5.00** | 4.62 | 5.22 | 5.41 | **5.08** |
| **ABA 100** | 4.62 | 4.82 | 4.81 | **4.75** | 4.68 | 4.79 | 4.92 | **4.80** |
| **Mean (A)** | **4.90** | **5.38** | **5.29** | **----** | **4.99** | **5.33** | **5.52** | **----** |
| **L.S.D. at 5%** | **A: 0.10** | **B: 0.13** | | **AB: 0.22** | **A: 0.11** | **B: 0.14** | | **AB: 0.23** |
| | P (%) | | | | | | | |
| **Control** | 0.29 | 0.31 | 0.30 | **0.30** | 0.27 | 0.31 | 0.29 | **0.29** |
| **$GA_3$ 50** | 0.31 | 0.32 | 0.32 | **0.32** | 0.29 | 0.31 | 0.32 | **0.31** |
| **$GA_3$ 100** | 0.32 | 0.35 | 0.34 | **0.34** | 0.31 | 0.36 | 0.34 | **0.34** |
| **ABA 50** | 0.26 | 0.30 | 0.31 | **0.29** | 0.27 | 0.30 | 0.31 | **0.29** |
| **ABA 100** | 0.26 | 0.27 | 0.28 | **0.27** | 0.24 | 0.27 | 0.29 | **0.27** |
| **Mean (A)** | **0.29** | **0.31** | **0.31** | **-----** | **0.28** | **0.31** | **0.31** | **----** |
| **L.S.D. at 5%** | **A: 0.01** | **B: 0.01** | | **AB: 0.02** | **A: 0.02** | **B: 0.03** | | **AB: 0.05** |
| | K (%) | | | | | | | |
| **Control** | 0.32 | 0.37 | 0.35 | **0.35** | 0.30 | 0.38 | 0.35 | **0.34** |
| **$GA_3$ 50** | 0.35 | 0.36 | 0.40 | **0.37** | 0.34 | 0.38 | 0.41 | **0.38** |
| **$GA_3$ 100** | 0.38 | 0.40 | 0.42 | **0.40** | 0.36 | 0.41 | 0.44 | **0.40** |
| **ABA 50** | 0.31 | 0.36 | 0.36 | **0.34** | 0.30 | 0.34 | 0.38 | **0.34** |
| **ABA 100** | 0.31 | 0.32 | 0.32 | **0.32** | 0.31 | 0.33 | 0.34 | **0.33** |
| **Mean (A)** | **0.33** | **0.36** | **0.37** | **-----** | **0.32** | **0.37** | **0.38** | **----** |
| **L.S.D. at 5%** | **A: 0.01** | **B: 0.01** | | **AB: 0.02** | **A: 0.02** | **B: 0.03** | | **AB: 0.05** |

The stimulatory effect of K on increasing total N in khella shoots may be due to the relationship between K fertilizer and N uptake which might be attributed to the synergistic effects of K on protein metabolism (Evans and Sorger, 1966).

The increase in K (%) due to K fertilization might be due to K presence in the medium and its effects on increasing rate of K uptake and/or increasing the absorption surface, in addition to the increase in free diffusion of the ions through cells of the root system (Khafagy and Salama, 1996).

The promotive effect of $GA_3$ on increasing total N in khella plants may be explained on the basis that $GA_3$ has a pronounced effect on soluble nitrogen accumulation. The enhancing effect of $GA_3$ on protein breakdown to soluble-N may be attributed to a higher activity of protease and like enzymes (Paul *et al*., 1970). Younis *et al*. (1970) showed that whenever an increase in soluble-N due to $GA_3$ treatments was detected, there was a decrease in protein nitrogen. They added that the breakdown of protein and formation of soluble-N increased progressively with increasing $GA_3$ level.

The promotive effects of $GA_3$ on P and K (%) in plant shoots coincided with the finding of Castro *et al*. (1978) who reported that $GA_3$ treatments stimulated the accumulation of P in *Zinnia elegans*. Moreover, Misra and Singh (1975) found that K content was sharply increased after treatment with $GA_3$ in chrysanthemum plants. The favourable effects of $GA_3$ treatments on N concentration in khella tissues may be attributed to the formation of more extensive roots after these treatments, and therefore increases the absorption of N from the soil. In addition, the increase in N, P and K concentrations due to used growth substances may be the result of their roles on regulating ions and modifying the movement of nutrients within the plant tissues (Khafagy and Salama, 1996).

**5- Effect of potassium, $GA_3$, ABA and their interaction treatments on the principle constituents of khella fruits**

Data in Table (5) revealed that the percentage of total chromones (khellin and visnagin) in khella fruits was increased with increasing K fertilization level and ABA application as well as their interactions.

The promotive effect of K fertilization and ABA applications as well as their interaction may be due to the increase in endosperm dimensions (width and length). Similar results were previously reported by El-Banna (1989) and Khafagy and Salama (1996) on coriander and Ibrahim and Salama (1998) on *Ammi visnaga*.

**Table (5): Effect of $GA_3$ and ABA on total chromones (%) in the fruits of khella plant growing under different rates of potassium fertilization during 2005/2006 and 2006/2007 seasons**

| Growth substance (ppm) (B) | Potassium rate (kg/fed.) (A) | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | First season (2005/2006) | | | | Second season (2006/2007) | | | |
| | 15 | 30 | 45 | Mean (B) | 15 | 30 | 45 | Mean (B) |
| | Khellin | | | | | | | |
| **Control** | 1.18 | 1.30 | 1.33 | **1.27** | 1.20 | 1.28 | 1.35 | **1.28** |
| **$GA_3$ 50** | 1.14 | 1.27 | 1.26 | **1.22** | 1.16 | 1.25 | 1.30 | **1.24** |
| **$GA_3$ 100** | 1.10 | 1.19 | 1.26 | **1.18** | 1.11 | 1.20 | 1.29 | **1.20** |
| **ABA 50** | 1.32 | 1.31 | 1.34 | **1.32** | 1.30 | 1.31 | 1.35 | **1.32** |
| **ABA 100** | 1.30 | 1.29 | 1.35 | **1.31** | 1.31 | 1.30 | 1.38 | **1.33** |
| **Mean (A)** | **1.21** | **1.27** | **1.31** | ----- | **1.22** | **1.27** | **1.33** | ---- |
| **L.S.D. at 5%** | **A: 0.03** | **B: 0.04** | | **AB: 0.07** | **A: 0.02** | **B: 0.03** | | **AB: 0.05** |
| | Visnagin | | | | | | | |
| **Control** | 0.66 | 0.70 | 0.72 | **0.69** | 0.64 | 0.72 | 0.76 | **0.71** |
| **$GA_3$ 50** | 0.63 | 0.71 | 0.72 | **0.69** | 0.61 | 0.74 | 0.72 | **0.69** |
| **$GA_3$ 100** | 0.60 | 0.72 | 0.74 | **0.69** | 0.59 | 0.75 | 0.79 | **0.71** |
| **ABA 50** | 0.72 | 0.78 | 0.80 | **0.77** | 0.71 | 0.79 | 0.82 | **0.77** |
| **ABA 100** | 0.74 | 0.76 | 0.79 | **0.76** | 0.75 | 0.79 | 0.83 | **0.79** |
| **Mean (A)** | **0.67** | **0.73** | **0.75** | ----- | **0.66** | **0.76** | **0.78** | ---- |
| **L.S.D. at 5%** | **A: 0.03** | **B: 0.03** | | **AB: 0.06** | **A: 0.03** | **B: 0.03** | | **AB: 0.06** |

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## تأثير بعض مواد النمو على نبات الخلة البلدى النامى تحت مستويات مختلفة من التسميد البوتاسى

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أجريت تجربتا اصص بمحطة تجارب قسم الخضر والزينة، كلية الزراعة جامعة المنصورة خلال الموسمين ٢٠٠٥/٢٠٠٦ و ٢٠٠٦/٢٠٠٧ وذلك لدراسة التغيرات فى بعض خصائص النمو الخضرى، محصول الثمار والتركيب الكيمائى لنباتات الخلة البلدى النامية تحت مستويات مختلفة من السماد البوتاسى وذلك عند معاملتها ببعض منظمات النمو.

ولقد أوضحت النتائج المتحصل عليها أن التسميد البوتاسى قد أدى إلى زيادة فى إرتفاع النبات، الوزن الجاف للمجموع الخضرى وصبغات البناء الضوئى وكذلك تركيز النتروجين والفوسفور والبوتاسيوم فى المجموع الخضرى للنباتات. ولقد نتجت أعلى القيم لهذه الصفات عند المستوى العالى من التسميد البوتاسى (٤٥ كجم/فدان).

أيضا أدت المعاملة بالجبيريللين وكذلك تفاعلاته مع التسميد البوتاسى إلى زيادة معنوية فى إرتفاع النبات والوزن الجاف للمجموع الخضرى وتركيز النيتروجين والفوسفور والبوتاسيوم، بينما أدت إلى نقص محتوى الأوراق من كلوروفيللى أ، ب والكاروتينويدات. أما المعاملة بحمض الأبسيسيك وكذلك تفاعلاته مع التسميد البوتاسى فقد أدت إلى نقص فى الصفات السابقة ماعدا محتوى الأوراق من الصبغات الذى حدثت فيه زيادة .

أما بالنسبة لعدد النورات ومحصول الثمار للنبات وكذلك محتوى الثمار من الخلليين والفيسناجين (%)، فلقد أوضحت النتائج أن التسميد البوتاسى والمعاملة بحمض الأبسيسك وتفاعلاتهم قد أدى إلى زيادة معنوية فى هذه الصفات. فى حين أن المعاملة بحمض الجبيريلليك مفردا قد أدت إلى نقص فى عدد النورات للنبات ومحصول الثمار للنبات وكذلك النسبة المئوية للمادة الفعالة فى الثمار. ولكن فى نفس الوقت أدت المعاملة بحمض الجبيريلليك مع التسميد البوتاسى بمعدل ٣٠ أو ٤٥ كجم/فدان إلى تحسن فى محتوى ثمار الخلة من الفيسناجين.