SUMMARY AND CONCLUSION

This investigation was conducted to study the effect of some bio-regulators, spermine and β-sitosterol, on growth, yield and its components of some varieties of chickpea plant; Giza 3, Giza 195 and Giza 531.

For this purpose two field experiments were carried out in the growing seasons 2004\2005 and 2005\2006 at the experimental farm of National Research Center at Shalakan, Kalubia Governorate, Egypt. The split-plot experimental design with three replications was used in both seasons. The main plots were bio-regulators (spermine and β-sitosterol) at three concentrations for each bio-regulator (50, 75 and 100 ppm), as well as, the untreated treatment (control), while the three chickpea cultivars were distributed randomly in the sub-plots.

The results could be, summarized as follows:

1. Growth criteria:

1.1. Effect of bio-regulator concentrations:

a) Both bio-regulators spermine and β-sitosterol positively affected chickpea plant height, number of branches and leaves, fresh and dry weight of branches and leaves during vegetative, flowering and maturity stages in the two seasons and their combined data.

b) The highest values of plant height, number of branches, number of leaves, fresh and dry weight of branches and leaves at the three physiological stages (vegetative, flowering and maturity) were obtained by applying 50ppm of β-sitosterol except number of branches and

number of leaves at maturity stage and fresh weight of branches at the second season and the combined data at vegetative stage and fresh weight of leaves per plant in the first, second season and the combined data of maturity stage whereas obtained by 50 ppm spermine.

c) Growth characters were significantly decreased with increasing bio-regulators concentration from 50 ppm to 100 ppm for the different bio-regulators spermine and β-sitosterol at the two seasons and their combined data for the different growth stages.

1.2. Varietal differences:

a) The differences between varieties were significant with respect to the above mentioned growth characters at the three physiological stages, except number of branches in the combined data and fresh weight of leaves at the vegetative stage and dry weight of branches and leaves at flowering stage during first season too.

b) Except plant height at the vegetative stage in the two seasons and their combined data and number of branches per plant in the second season and combination where, Giza 3 demonstrated the highest response of these characters, Giza 531 variety was superior in most growth characters followed by Giza 195.

c) The variety Giza 195 gave the highest response of number of branches per plant in the first season and the combined data at vegetative stage, number of branches and leaves per plant at flowering stage and number of leaves per plant at maturity stage during the two seasons and their combined data.

d) No varietal differences were detected with respect to characters, fresh and dry weight of branches and leaves per plant at three physiological stages except Giza 3 variety which exceeded in fresh weight of branches and dry weight of leaves per plant and Giza 531 in dry weight of branches per plant both at maturity stage in the two seasons and their combination.

1.3. Effect of interaction:

a) The interaction between chickpea varieties and bio-regulators, i.e., spermine and β-sitosterol led to an increase in all values of growth traits.

b) The low concentration (50 ppm) from spermine and β-sitosterol with the different varieties recorded the highest values in the most growth characters.

2. <u>Yield and yield components:</u>

2.1. Effect of bio-regulator concentrations:

a) Foliar application of spermine and β-sitosterol resulted in highly significant increases in number of pods per plant, number of seeds per pod, 100-seed weight, seeds weight per plant, seed and biological yields per feddan during the two growing seasons and their combined data.

b) The best treatment was 50 ppm β-sitosterol which recorded the highest values of yield and its components during the two growing seasons and the combined data except the biological yield in which 50 ppm spermine exceeded all other treatments.

c) The yield and yield components values were decreased

d) with increasing the concentration of both regulators from 50 ppm to 100 ppm. compared with the control, the highest value of number of pods per plant was 40.61 in the second season.

e) The increments in the number of seeds per pod were 31.1%, 28.4% and 29.9% for the first and second seasons and their combined data respectively, corresponding to 50.2%, 51.5% and 50.8% in the 100-seed weight.

f) The highest values of seeds weight per plant obtained from 50 ppm β-sitosterol treatment which were 9.705, 14.82 and 12.270 g. during first, second season and their combined data respectively. In addition the same treatment gave the highest values of seed yield per feddan which were 1065.0, 928.6 and 996.7 Kg/feddan in the first, second season and their combined data respectively. While, the treatment (50 ppm) spermine gave the highest values of biological yield during the two seasons and the combined data.

2.2. Effect of varieties:

a) The examined genotypes significantly varied in their effect on the yield and yield component characters.

b) The highest number of pods per plant 32.80, 35.99 and 34.40 were obtained by Giza 195 at the two seasons and their combined data respectively.

c) Giza 531 recorded 30.50, 35.11 and 32.81 in the same times and Giza 3 gave the lowest values 27.10, 28.12 and 27.61 pods per plant.

d) The highest values of seeds number per pod were 1.574, 1.714 and 1.644 during different growth seasons and their combined data respectively obtained by Giza 195 and there was no significant difference between Giza 195 and Giza 531 in this character.

e) The variety Giza 531 gave the highest average values in the 100-seed weight, seeds weight per plant, seed yield per feddan and biological yield per feddan.

2.3. Effect of interaction:

a) Data indicated that, the treatment 50 ppm β-sitosterol with variety Giza 531 obtained the highest values of number of pods per plant, 100-seed weight, seeds weight per plant and seed yield per feddan during the two seasons and their combined data. While, the treatment 50 ppm spermine with Giza 531 variety gave the highest average in number of seeds per pod except the second season which recorded with Giza 195.

b) Also the highest value of biological yield per feddan was obtained by 50 ppm spermine with variety Giza 531.

3. Chemical Analysis:

3.1. The total photosynthetic pigments:

3.1.1. Effect of bio-regulator concentrations

a) Foliar application by spermine and β-sitosterol caused insignificant effect on the photosynthetic pigments of chickpea plant.

b) The treatment 50 ppm β-sitosterol recorded the highest values in all studied pigments (chlorophyll a, b, a+b and

carotenoids).

c) Photosynthetic pigments content were decreased with increasing the concentration of both bio-regulators (spermine and β-sitosterol).

3.1.2. Difference between chickpea varieties:

a) Except the first stage (vegetative stage) chlorophyll (a) recorded non significant differences between chickpea varieties.

b) Unlike second stage (at full flowering stage) there was insignificant differences on chlorophyll (b) between chickpea varieties. The highest valuesin this respect were 0.156 mg/g fresh weight of leaves obtained by Giza 3, 0.209 mg/g fresh weight of leaves obtained by Giza 531 and 0.214 mg/g fresh weight of leaves obtained by Giza 195 during first, second and third stages, respectively.

c) The mean values of total chlorophyll (a+b) were significantly differed according to varities. The variety Giza 3 was superior in vegetative stage and recorded 0.678 mg/g, Giza 531 in the full flowering stage recorded 0.946 mg/g and Giza 195 in the maturity stage recorded 0.936 mg/g fresh weight of leaves.

d) Significant differences were detected regarding carotenoid content at vegetative stage. Meanwhile, it was insignificant at the flowering and maturity stages.

3.1.3. Effect of interaction:

a) The interaction effect between bio-regulators and the tested varieties led to a significant increase in most determined photosynthetic pigments.

b) The highest values of chlorophyll (a), chlorophyll (b) and chlorophyll (a+b) contents were 0.877, 0.242 and 1.119 mg/g fresh weight of leaves respectively, obtained by the treatments 50ppm β-sitosterol and Giza 195 variety during the third stage. While, the treatment 50 ppm spermine and variety Giza 3 recorded the highest value of total carotenois (0.390 mg/g fresh weight of leaves) during the third stage too.

3.2. Total free amino acids content:

3.2.1. Effect of bio-regulator treatments on total free amino acids:

a) Free amino acids content in stems and leaves significantly increased as result to treatments application compared to the control. The highest value of free amino acids content in leaves was 9.74 mg/g obtained from β-sitosterol at 50 ppm at the vegetative stage while it was 12.89 mg/g obtained from spermine at 50 ppm at the flowering stage.

b) There was no significant difference between the treatments 100 ppm spermine, 50 and 75 ppm β-sitosterol. Also, the total free amino acids content in leaves was significantly increased and the highest value of free amino acids content in stems was 8.06 mg/g

c) obtained by 50 ppm β-sitosterol at vegetative stage. While, it was 11.26 mg/g obtained by 50 ppm spermine at the flowering stage. Data also indicated that there was no significant difference between the treatments 50 ppm spermine and 50 ppm β-sitosterol.

d) Total free amino acids content in stems and leaves were decreased with increasing the concentration of both bio-regulators spermine and β-sitosterol.

3.2.2. Varietal differences in total free amino acids:

a) It could be observed that**,** total free amino acids content in stems and leaves was significantly differed in chickpea varieties. Giza 3 variety recorded the highest values in leaves (10.66 mg/g) during the vegetative stage.

b) Giza 531 recorded the highest value (13.24 mg/g) at the flowering stage. While, the highest value of total free anino acids content in stems was 7.15 and 11.29 (mg/g) obtained by Giza 531 and Giza 3 in the same stages, respectively.

3.2.3. Effect of interaction between bio-regulator treatments and chickpea varieties:

a) The variety Giza 3 recorded the highest value (12.24mg/g) content in the leaves with 50 ppm β-sitosterol treatment at vegetative stage. While, the highest value at flowering stage, was (14.65 mg/g) obtained by Giza 531 with 50 ppm spermine.

b) The highest values of total free amino acids in the stems during two stages (vegetative and flowering) obtained by

Giza 3 with 50 ppm β-sitosterol and 50 ppm spermine respectively, which were 8.250 and 12.82 mg/g.

3.3. Characterization of protein patterns of chickpea:

a) Plants of variety Giza3 which sprayed with different concentrations of spermine exhibited over-expression of a polypeptide bands.

b) The most striking differences were observed with variety Giza195 where, a polypeptide band of 97 KDa was detected only in chickpea control plants and plants sprayed with spermine 50, 75 and 100 ppm. Also, a polypeptide band between 30 KDa and 14 KDa was not detected with plants sprayed with 50 ppm β-sitosterol.

c) Protein profiles of chickpea seeds which were influenced by various levels of spermine and β-sitosterol were similar and no detectable differences were observed in variety Giza531.

Conclusion

It could be concluded that treating the plants of chickpea twice with 50 ppm from spermine or β-sitosterol were obtaining good vegetative growth with higher seed yield and best quality.