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# Synergetic Effect of Cytokinin on Growth, Yield, Some Physiological Compositions and Nutrients Content of Faba Bean (Vicia faba) under Different Rates of Zinc fertilization

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## ABSTRACT

The experiment was designed to study effect of cytokinin under different rates of zinc chelated on growth, yield, some physiological compositions (chlorophyll a, b and cartonids) and N, P and K content of faba bean plant. Three rates of zinc (0, 75 and 150 $mgL^{-1}$) combination with three rates of cytokinin (0, 10 and 20 $mgL^{-1}$). Increasing Zn rates from 0 to 150 $mgL^{-1}$ and cytokinin rates from 0 to 20 $mgL^{-1}$ led to increasing the growth and yield parameters. The treatment (150 $mgL^{-1}$ Zn+ 20 $mgL^{-1}$cytokinin) was given high values of all growth and yield parameters. The second rate of Zn (75 $mgL^{-1}$) was enough to achieve high values of chlorophyll a, b and cartonids in leaves of faba bean plants. The high rate of cytokinin (20 $mgL^{-1}$) led to increasing of chlorophyll a, b and cartonids in leaves of faba bean plants. The treatment 75 $mgL^{-1}$ Zn+ 20 $mgL^{-1}$cytokinin was given high values of chlorophyll a, b and cartonids in leaves of faba bean plants. Increasing Zn rates from 0 to 150 $mgL^{-1}$ increased N and K content of leaves but P content of leaves was decreased. Increasing cytokinin rates from 0 to 20 $mgL^{-1}$ increased N, P and K content of faba bean leaves.

Addition of Zn and cytokinin enhancing the growth, yield, physiological compositions and N, P and K content of Faba Bean (Vicia faba) under the good service conditions of faba bean crop.

**KEY WORDS**: Zinc, Cytokinin, Growth, Yield, Physiological compositions, Nutrients content, Faba bean

## INTRODUCTION

Faba bean is one of the most significant leguminous crops cultivated in winter season in various types of Egyptian soils.It is one of the promising pulse crops which can play an important role in increasing legume production in Egypt. Seeds of faba bean are used for human consumption, and contained 35% protein, 45% carbohydrate and 2 % fat.

Zinc is important essential micronutrients for both humans and plants **(Hao *et al*., 2007).** When the supply of available zinc for plants is inappropriate, the yield of cropsisdecreased and the quality of crop products is normally damaged. In plants, zinc played important role as a structural constituent or regulatory cofactor of a wide range of different enzymes and proteins in many important biochemical pathways(**Alloway, 2008**).Plant enzymes activated by Zn are involved in carbohydrate metabolism,preserving of the safety of cellular membranes, protein synthesis, regulation of auxin synthesis and pollen formation (**Marschner, 1995).**

Plant regulators are organic vehicles which, in small amounts, in a way or another amending a certain physiological plant process and scarcely act alone, as the action of two or more of these vehicles is necessary to produce a physiological influence. Cytokinins are known to encourage or inhibit a large number of physiological activities **(Leite *et al*., 2003)**.

The objective of this investigation was to study the effect of different rates of Zn and cytokinin on growth, yield, some physiological compositions (chlorophyll a, b and cartonids) and N, P and K content of faba bean plant.

## MATERIAL AND METHODS

A field experiment was carried out at El-Kalubia governorate during winter season 2015 to clarification the effect of foliar spraying with zinc and cytokinin on some growth, yield, physiological compositions and nutrients content of faba bean (*Vicia faba* L. cv Giza 3). The experiment included nine foliar spray treatments. Three rates of zinc (0, 75 and 75 $mgL^{-1}$) combination with three rates of cytokinin (0, 10 and 20 $mgL^{-1}$) were sprayed on faba bean plant at three times. Superphosphate (15.5 % $P_2O_5$) and potassium sulphate (48 % $K_2O$) were added to soil before

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the sowing at the rates of 100 and 50 kg $fed^{-1}$., respectively. As well as, urea (50 % N) at rate of 25 kg $fed^{-1}$ was added before the first irrigation.

Leaves samples were grouped from mature faba bean plants at vegetative and harvest period for test. Plant samples were dried at 65C° for 48 hrs, ground and wet digested using $H_2SO_4$: $H_2O_2$method **(Cottenie, 1980)**. The digests were then exposed to measurement of N using Micro-Kjeldahl method; Pwas assayed using molybdenum blue method, while, K was determined by Flame Photometer **(Chapman and Pratt, 1961).**

Total soluble protein in seeds was determined according to **(Bradford, 1976)** and total carbohydrates in seeds were measured according to **(A.O.A.C.)**. Chlorophyll a, b and carotenoids were determined in fresh leaves of faba bean plants according to the methods described by **Wettstein (1957)**.

## RESULTS AND DISCUSSION

Data in (Table, 1) indicated that increasing Zn rates from 0 to 150 $mgL^{-1}$ and cytokinin rates from 0 to 20 $mgL^{-1}$ led to increasing the growth and yield parameters. The treatment (150 $mgL^{-1}$ Zn+ 20 $mgL^{-1}$cytokinin) was given high values of plant height, number of leaves per plant and number of flower per plant (116 cm, 80.2 and 100.1, respectively). As well as, the same treatment given high value of grain, protein and total carbohydrate yield (2.67 ton $ha^{-1}$, 30.5 % and 531.4 mg $g^{-1}$, respectively).

**Table 1: Effect of Zn and cytokinin rates on growth and yield parameters of Faba bean plants.**

| Treatments | | Growth | | | Yield | | |
|---|---|---|---|---|---|---|---|
| Zn ($mgL^{-1}$) | Cytokinin ($mgL^{-1}$) | Plant height | Number of leaves /plant | Number of flower /plant | Grain | Protein | Total carbohydrate |
| | | cm | | | ton $ha^{-1}$ | % | mg $g^{-1}$ |
| 0 | 0 | 91.3 | 66.1 | 80.2 | 1.75 | 19.8 | 493.6 |
| | 10 | 105.9 | 71.5 | 93.8 | 2.53 | 27.0 | 515.8 |
| | 20 | 106.4 | 74.2 | 94.5 | 2.62 | 28.3 | 516.8 |
| 75 | 0 | 99.3 | 71.8 | 85.6 | 2.09 | 24.2 | 508.0 |
| | 10 | 110.6 | 76.7 | 95.1 | 2.65 | 29.3 | 527.8 |
| | 20 | 115.1 | 79.9 | 97.3 | 2.66 | 30.2 | 518.4 |
| 150 | 0 | 108.1 | 72.1 | 89.1 | 2.31 | 24.7 | 516.1 |
| | 10 | 115.7 | 77.6 | 96.1 | 2.76 | 29.8 | 530.7 |
| | 20 | 116 | 80.2 | 100.1 | 2.67 | 30.5 | 531.4 |

Increasing the level of Zn fertilization led to increasing the straw, grain and harvest index because Zn played a significant role in biosynthesis of the indol acetic acid and initiation of primordial for reproductive portions and a result of favorable effect of zinc on the metabolic responses within the plants **(Goswami, 2007 and Singh *et al.*, 2012). Keram *et al.*, (2012)**indicated that the high value of Zn fertilization 20 kg Zn $ha^{-1}$ with recommended NPK led to increasing carbohydrate contentof wheat grain. Increasing zinc fertilization levels led to increasingno significantly of number of pods per plant, plant height at 50% flowering, seedsper pod and plant height at maturity stages of faba bean plant **(Weldu *et al.*, 2012).** Cytokinin was influenced on the growth process and wheat growing period becomes longer,because of that, or so as premature aging is delayed, andlong-term growth period is created for the plants **(Poodineh *et al.*,2014).** A high concentration of cytokinin in the plant increased significantly grain yield of wheat **(Saeidi *et al.*,2006).**

Data in (Table,2) indicated increasing the rate of Zn to 75 $mgL^{-1}$ enough to achieve high values of chlorophyll a, b and carotenoids in leaves of faba bean plants. As well as increasing the rate of cytokinin from 0 to 20 $mgL^{-1}$ led to increasing of chlorophyll a, b and carotenoids in leaves of faba bean plants. The treatment 75 $mgL^{-1}$ Zn+ 20 $mgL^{-1}$cytokinin given high values ofchlorophyll a, b and carotenoids in leaves of faba bean plants. Cytokinin helps in the regulation of cell division andstorage of photosynthetic material **(Poodineh and Shahraki, 2015).** Foliar application of cytokinin increased carbohydrate content due togood effect on photosynthesis of wheat cultivars under water deficit conditions **(Sarafraz-Ardakani *et al.*,2014).** Cytokinins are important in the development of plants photosynthetic apparatusby directly effecting on chloroplast, increasing thephotochemical activity of photosystem II (PS II) and reducing chlorophyll degradation **(Goltsev *et al.*, 2001).** High level of Zn fertilization (0.5 g $l^{-1}$) increased chlorophyll a, b and cartonids of leaves bean**(El-Tohamy and El-Greadly, 2007)**.

**Table 2 : Effect of Zn and cytokinin rates on Chlorophyll a, b and Carotenoids in leaves Faba bean plants.**

| Treatments | | Chlorophyll a | Chlorophyll b | Carotenoids |
|---|---|---|---|---|
| Zn ($mgL^{-1}$) | Cytokinin ($mgL^{-1}$) | | | |
| 0 | 0 | 0.483 | 0.348 | 0.395 |
| | 10 | 0.714 | 0.473 | 0.483 |
| | 20 | 0.725 | 0.510 | 0.522 |
| 75 | 0 | 0.656 | 0.442 | 0.431 |
| | 10 | 0.735 | 0.552 | 0.575 |
| | 20 | 0.899 | 0.628 | 0.649 |
| 150 | 0 | 0.684 | 0.457 | 0.458 |
| | 10 | 0.788 | 0.600 | 0.611 |
| | 20 | 0.765 | 0.602 | 0.623 |

The effects of Zn and cytokinin rates on N, P and K content of faba bean leaves are shown in Table (3). Increasing Zn ratesfrom 0 to 150 $mgL^{-1}$increased N and K content of leaves but P content of leaves was decreased. Increasing cytokinin rates from 0 to 20 $mgL^{-1}$ increased N, P and K content of faba bean leaves. Increasing total N and K content could be attributed to synergistic effect between N and Zn and because the positive role of K and Zn **(Morshedi and Farahbakhsh, 2010)**. A linear reduction result in total P content was noted with increasing levels of Zn as compare to control. It might be due to competitive impact of P with Zn. Zinc was found to prevent the translocation of P from roots to the tops **(Alam *et al*., 2000).**

**Table 3 : Effect of Zn and cytokinin rates on N, P and K content of faba bean leaves.**

| Treatments | | Nutrients content of faba bean leaves (%) | | |
|---|---|---|---|---|
| Zn ($mgL^{-1}$) | Cytokinin ($mgL^{-1}$) | N | P | K |
| 0 | 0 | 2.16 | 0.295 | 1.76 |
| | 10 | 2.73 | 0.302 | 1.86 |
| | 20 | 2.72 | 0.306 | 1.88 |
| 75 | 0 | 2.73 | 0.272 | 1.80 |
| | 10 | 2.79 | 0.293 | 1.91 |
| | 20 | 2.80 | 0.292 | 1.92 |
| 150 | 0 | 2.81 | 0.281 | 1.90 |
| | 10 | 2.81 | 0.291 | 1.95 |
| | 20 | 2.82 | 0.290 | 1.96 |

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