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RESEARCH PAPER

# Effect of foliar application of Phosphorus on Growth and development of *Vicia faba L.* under Magnesium levels

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**A B S T R A C T:**

The present experiment was done to study the interaction of foliar application effect of phosphorus and magnesium on faba bean plants. This study conducted in Biology Department in the College of Science- University of Salahaddin- Erbil during November 2, 2017 to February 20, 2018 in the greenhouse as pot experiment. The experiment consisted of combination treatments of foliar spray with different phosphorus (P) concentrations at doses (0, 100, 200, 300, 400, 500 ppm) and soil irrigation by two magnesium (Mg) concentrations (0, 200 ppm). This study consists of 12 treatments with three replications. The following parameters has been observed: plant height, leaf and branch numbers, water content and dry weight of shoot system, leaf area, stem diameter, yield components including pod and seed numbers, dry weight of 100 seeds and photosynthetic pigments. The results indicate that phosphorus and magnesium interactions significantly increase plant height, number of branches, water content, leaf area, number of pods per plant, carotenoid contents.

KEY WORDS: Phosphorus, Faba bean, Magnesium ,Leaf area ,Pigments .
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## 1.INTRODUCTION :

*Vicia faba* L. (faba bean) is a herbaceous annual plant species belongs to Papilionaceae (Fabaceae) family, domesticated in the middle east, Mediterranean region, Ethiopia, and China. It is used as an important crop for human food as dried or fresh vegetables (Shakori & Sharifi, 2016). Nutritionally, it is a main source of potassium, iron and vitamins A and C. (Glow, 2010). Faba bean an important source of protein in plants for humans (Cazzato *et al.*, 2012). Faba bean is a famous winter leguminous crops in Iraq, it is cultivated in crop rotations to improve soil properties, through atmospheric nitrogen fixation and serve as cheap source of protein (Jasim, 2007 and Akibode and Maredia, 2007). Faba beans are rich of vitamins, sugar, carbohydrates, starch, lipids, fats, minerals especially calcium and iron. (Salih *et al.*, 1986).

Phosphorus is an essential mineral nutrient for some of the physiological functions in plants, they required for growth. Phosphorus has basic role in such processes in the plants including photosynthesis process, respiration, energy transfer and storage, important in the division of cell and cell enlargement, nutrients movement within the plant (Jin *et al.*, 2005 and Tang *et al.*, 2009). Phosphorus has their role in increasing growth of faba beans and has it role in increasing the number and size of a nodule which fixing the nitrogen, legumes need some amount of phosphorus for their growth (Hammayun *et al.*, 2011). Plants required uptake of phosphorus a

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nutrient for their growth for all stages from seed to adult plant.

Magnesium is an essential and important macronutrients for growth and development of plants (Cakmak and Kirkby, 2008). Magnesium has some physiological and biological roles in plants, photophosphorylation (formation of nucleic acid is a nucleotide used in cells as a coenzymes formation in chloroplasts) which took the leaves green color, plant respiration, photosynthetic carbon dioxide (CO2) fixation, protein synthesis, chlorophyll formation, phloem loading, photooxidation in leaf tissues, activating such enzymes which have role in process of photosynthesis (Cakmak and Atilla, 2010). Some plants required high amount of magnesium than others like legumes (Wayatt, 1967).

The main objectives of this study were to elucidate the interaction of foliar application of phosphate and soil application of magnesium effects on faba bean plants.

## 2. MATERIALS AND METHODS

This study was conducted in the glasshouse of the biology Department, College of Science, University of Salahaddin-Erbil, during November 2, 2017 to February 20, 2018 to investigate the interaction effects of phosphorus (P) and Magnesium (Mg) on growth and development of faba bean (Elisar). The study involved 36 plastic pots each pot with a diameter of 24 cm in length and 21 cm in dept. Each pot filled with 7kg of dry sandy loam soil of Askikalak area, the soil sieved through 2mm pore size sieves, add in each pot 3 seed were sown. This experiment consisted of combination treatments of foliar spray with different Phosphorus ($NaH_2PO_4$) concentrations at doses (0, 100, 200, 300, 400, 500ppm) and soil irrigation by two Mg ($MgSO_4$) concentrations (0, 200 ppm), and involved 12 treatments with three replications. The following measurements has been taken for each pot: plant height (cm), number of leaves.plant$^{-1}$, number of branches.plant$^{-1}$, shoot dry weight (g),water content of shoot system, leaf area(cm$^2$), stem diameter, yield components such a number of pods.plant$^{-1}$, number of seeds.pod$^{-1}$, dry weight of 100 seeds(g), and photosynthetic pigments.

Water content (g.plant$^{-1}$) of shoot system estimated as follows: firstly, fresh shoot has been weight, secondly shoot dried at 110°C for 1 hrs, and then at 70°C for 24 hrs, in an oven. After that cooled at room temperature, dry weight of shoot obtained for half an hour (He *at al.,* 2005).

**Water content =F.wt.-D.wt.**
**F.wt. =fresh weight**
**D.wt. =dry weight**

Chlorophyll content in leaves (mg.g$^{-1}$) estimated by taking 0.5g of fresh leaves left in 10 ml of absolute ethanol for 24 hrs. In dark condition, this process repeated three times to complete extraction of chlorophyll the final volume reached 30 ml were spectrophotometrically estimates on two wavelength 649and 665 nm as follows (Wintermans and Demote, 1967):

**µg chlorophyll a/ml solution = (13.70) (A665nm)-(5.76) (A 649nm)**
**µg chlorophyll b/ml solution = (25.80) (A649nm)-(7.60) (A 665nm)**
**Total chlorophyll =chlorophyll a + chlorophyll b**
**µg Carotenoid/ml solution=(1000 $A_{470}$ -2.13 C a-97.64*C b)/209**
**A=absorbance**
**m =nanometer**

**Statistical analysis**

The data of this study designed according to Factorial Completely Randomized Designs (Factorial C.R.D) with three replications and tweleve treatments. Duncan Multiple Range Test used for the comparison of treatment means at 5% for greenhouse parameters and 1% levels for laboratory parameters (Muhummed, 2004). The statistical analysis was done by using Statistical Package for Social Sciences (SPSS version 16 software). For drawing charts, Excel 2007 software used.

## 3. RESULTS AND DISCUSSION

### 3.1. Vegetative growth characteristics

The data in table (1) shows that foliar application of phosphorus significantly ($p \leq 0.05$) increased plant height at doses (400 ppm) under (0 ppm) of magnesium after 45 days from application as compared with their controls, as well as there were significant differences between treatments (200, 400ppm) under (0ppm) of magnesium after 30 days from application. It was observed that there were significant differences between foliar application of phosphorus at doses

(500 ppm) under (200 ppm) of magnesium after 45 days from application in the number of branches as compared their control (table 3), as well as leaf area also significantly ($p \leq 0.05$) increased by phosphorus application at rate (400 ppm) under (0ppm) of magnesium as compared with their control. Water contents of shoot system significantly ($p \leq 0.05$) increased at doses (100ppm) under (0ppm) of magnesium as compared with their control table (4). These results partially agreed with those obtained by (Turk, 2003) that phosphorus increased plant height. (Ga, 2017) mentioned that phosphorus increased plant height in faba bean plants which increased nitrogen fixation due to growth and developments of plants. (Senbayram *et al.*, 2015) notice that magnesium have many roles in physiological process for plant growth and development.

### 3.2. Yield components

Table (5) shows that foliar application of phosphorus significantly ($p \leq 0.05$) increased number of pods at doses (200 ppm) under (0ppm) of magnesium as compared with their control, and there were significant difference between treatments (100, 300 ppm) under (200 ppm) of magnesium. These results agreed with those obtained by (Hamayun, 2011 and Kleiber *et al.*, 2012) that phosphorus and magnesium increased the plant yields. It was noticed that foliar application of phosphorus under magnesium levels increased yield components which due to increases products of plants.

### 3.3. Photosynthetic pigments

According to the results in table (6) there were significant differences between treatments at dose (100, 400ppm of phosphorus under (0ppm) of magnesium in carotenoid contents. These results partially agreed with those obtained by (Alam and Sheren, 2002) (Kleiber *at al*, 2012) showed that phosphorus and magnesium increased chlorophyll contents of leaves. As well as an increased in the photosynthetic pigments led to increased photosynthetic energy this led to increase process of photosynthesis and growth of plant. (Razaq *et al.*,) mentioned that biosynthesis of green pigments in leaves depend on P concentrations, and also increase production and biomass of carotenoid in plants.

**Table 1: Interaction effects of phosphorus and magnesium on plant height at different stages of growth**

| Interaction treatments | | Plant height (cm) after (days) from application | | |
|---|---|---|---|---|
| **Mg ppm** | **P ppm** | **15 days** | **30 days** | **45 days** |
| 0 | 0 | 43.00 c | 59.33 ab | 68.33 c |
| | 100 | 46.00 abc | 58.66 c | 69.33 bc |
| | 200 | 48.33 ab | 67.66 a | 76.00 ab |
| | 300 | 43.66 c | 51.66 c | 61.66 d |
| | 400 | 47.33 ab | 66.33 a | 76.66 a |
| | 500 | 45.33 bc | 61.00 ab | 70.66 bc |
| 200 | 0 | 43.33 c | 60.00 ab | 68.68 c |
| | 100 | 44.66 bc | 64.33 ab | 72.00 abc |
| | 200 | 43.66 c | 64.66 ab | 73.33 abc |
| | 300 | 45.66 bc | 59.66 ab | 68.66 c |
| | 400 | 46.33 bc | 60.33 ab | 67.66 cd |
| | 500 | 46.66 bc | 60.66 ab | 70.00 bc |

*Data presented as mean, the same letters mean not significant differences while the different letters mean significant differences $p \leq 0.05$

**Table 2: Interaction effects of phosphorus and magnesium on number of leaves at different stages of growth**

| Interaction treatments | | Number of leaves after (days) from application | | |
|---|---|---|---|---|
| **Mg ppm** | **P ppm** | **15 days** | **30 days** | **45 days** |
| 0 | 0 | 16.33 a | 30.00 a | 39.00 a |
| | 100 | 16.66 a | 33.66 a | 41.66 a |
| | 200 | 16.00 a | 26.33 a | 35.00 a |
| | 300 | 16.16 a | 33.00 a | 41.00 a |
| | 400 | 18.33 a | 30.33 a | 44.33 a |
| | 500 | 18.00 a | 31.00 a | 39.00 a |
| 200 | 0 | 17.66 a | 32.66 a | 41.00 a |
| | 100 | 17.33 a | 31.66 a | 39.33 a |
| | 200 | 17.00 a | 35.00 a | 43.66 a |
| | 300 | 18.33 a | 31.66 a | 38.66 a |
| | 400 | 16.33 a | 33.33 a | 42.33 a |
| | 500 | 18.00 a | 31.33 a | 39.33 a |

*Data presented as mean, the same letters mean not significant differences while the different letters mean significant differences $p \leq 0.05$

**Table 3: Interaction effects of phosphorus and magnesium on number of branches at different stages of growth**

| Interaction treatments | | Number of branches after (days) from application | | |
|---|---|---|---|---|
| **Mg ppm** | **P ppm** | **15 days** | **30 days** | **45 days** |
| 0 | 0 | 8.00 a | 12.33 a | 15.33 b |
| | 100 | 8.66 a | 13.00 a | 16.00 b |
| | 200 | 8.00 a | 13.3 a | 15.00 b |
| | 300 | 8.00 a | 15.00 a | 17.66 ab |
| | 400 | 8.33 a | 13.00 a | 16.00 ab |
| | 500 | 8.66 a | 13.66 a | 14.66 b |
| 200 | 0 | 7.66 a | 13.33 a | 16.00 ab |
| | 100 | 9.00 a | 12.66 a | 16.00 ab |
| | 200 | 8.00 a | 12.33 a | 16.33 ab |
| | 300 | 7.99 a | 13.33 a | 16.66 ab |
| | 400 | 8.33 a | 12.66 a | 17.66 ab |
| | 500 | 8.66 a | 14.33 a | 18.33a |

*Data presented as mean, the same letters mean not significant differences while the different letters mean significant differences $p \leq 0.05$

**Table 4: Interaction effects of phosphorus and magnesium on some vegetative growth characteristics**

| Interaction treatments | | vegetative growth characteristics | | | |
|---|---|---|---|---|---|
| Mg ppm | P ppm | Shoot dry weight ($g.plant^{-1}$) | Leaf area $cm^2.plant^{-1}$ | Stem diameter (cm) | Water contents ($g.plant^{-1}$) |
| 0 | 0 | 1.92 a | 540.06 b | 1.92 a | 9.52 b |
| | 100 | 2.01 a | 676.09ab | 2.01 a | 10.13 ab |
| | 200 | 2.20 a | 627.53 ab | 2.20 a | 11.96 ab |
| | 300 | 2.13 a | 512.21 b | 2.13 a | 10.79 ab |
| | 400 | 2.23 a | 846.10 a | 2.23 a | 11.07 ab |
| | 500 | 2.09 a | 688.33 ab | 2.09 a | 11.81 ab |
| 200 | 0 | 2.21 a | 694.56 ab | 2.22 a | 13.38 ab |
| | 100 | 2.04 a | 592.30 ab | 2.04 a | 14.500 a |
| | 200 | 1.87 a | 652.18 ab | 2.11 a | 12.95 ab |
| | 300 | 2.19 a | 734.78 ab | 2.24 a | 10.68 ab |
| | 400 | 2.15 a | 623.97 ab | 2.26 a | 10.87 ab |
| | 500 | 2.06 a | 685.30 ab | 2.06 a | 13.0 b |

*Data presented as mean, the same letters mean not significant differences while the different letters mean significant differences $p \leq 0.05$

**Table 5: Interaction effects of phosphorus and magnesium on some yield components**

| Interaction treatments | | yield components | | |
|---|---|---|---|---|
| Mg ppm | P ppm | Number of $pods.plant^{-1}$ | Number of $seeds.pod^{-1}$ | Dry weight of 100 seeds(g) |
| 0 | 0 | 7.00 b | 3.66 a | 62.33 b |
| | 100 | 8.33 ab | 4.33 a | 68.33 ab |
| | 200 | 10.66 a | 4.66 a | 61.33 b |
| | 300 | 10.33 ab | 5.00 a | 62.00 b |
| | 400 | 8.66 ab | 4.66 a | 65.00 ab |
| | 500 | 9.00 ab | 5.33 a | 66.33 b |
| 200 | 0 | 10.00 ab | 4.66 a | 69.33 ab |
| | 100 | 9.33 ab | 5.00 a | 72.33 a |
| | 200 | 8.33 ab | 5.33 a | 65.66 ab |
| | 300 | 10.33 ab | 5.66 a | 72.00 a |
| | 400 | 10.66 a | 4.66 a | 67.33 ab |
| | 500 | 9.66 ab | 4.33 a | 68.33 ab |

*Data presented as mean, the same letters mean not significant differences while the different letters mean significant differences $p \leq 0.05$.

**Table 6: Interaction effects of phosphorus and magnesium on photosynthetic pigments of leaves (mg.g$^{-1}$fresh weight)**

| Interaction treatments | | Photosynthetic pigments (mg.g$^{-1}$fresh weight) | | | |
|---|---|---|---|---|---|
| Mg ppm | P ppm | Chlorophyll a | Chlorophyll b | Total chlorophyll | Carotene |
| 0 | 0 | 1.64 a | 1.55 ab | 3.19 bcd | 0.83 abcd |
| | 100 | 2.05 a | 1.57 ab | 3.62 abcd | 0.91 a |
| | 200 | 1.77 a | 1.16 b | 2.93 d | 0.79 d |
| | 300 | 1.99 a | 2.10 a | 4.10 a | 0.90 abc |
| | 400 | 2.01 a | 1.76 ab | 3.77 ab | 0.92 a |
| | 500 | 1.97 a | 1.31 b | 3.29 bcd | 0.86 abcd |
| 200 | 0 | 1.88 a | 1.75 ab | 3.64 abc | 0.80 cd |
| | 100 | 1.90 a | 1.12 b | 3.21 bcd | 0.83 abcd |
| | 200 | 1.97 a | 1.31 b | 3.28 bcd | 0.81 cd |
| | 300 | 1.92 a | 1.30 b | 3.04 cd | 0.86 abcd |
| | 400 | 1.88 a | 1.34 b | 3.22 bcd | 0.84 abcd |
| | 500 | 1.96 a | 1.38 b | 3.34 bcd | 0.89 ab |

*Data presented as mean, the same letters mean not significant differences while the different letters mean significant differences $p \leq 0.01$

## 4. CONCLUSIONS

According to the obtained results from the present study, the interaction effect of foliar application of phosphorus and soil irrigation of magnesium has effective role in growth and development of faba bean plants through significantly increased plant height, number of branches, leaf area, water content, dry weight of shoot system and yield characteristic number of pods per plant, dry weight of 100 seeds, as well as chlorophyll b, total chlorophyll and carotene pigments.

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