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# EFFECT OF DIFFERENT MAGNESIUM DOSES ON GROWTH AND YIELD OF PEPPER PLANT IN MYCORRHIZA INOCULATED HARRAN SOIL

**Ahmet ALMACA**

Harran University, Faculty of Agriculture, Department of Soil Science and Plant Nutrition, 63300, Sanliurfa, Turkey

Corresponding author email: almaca@harran.edu.tr

***Abstract***

*The aim of the study was to determine stimulating effect of magnesium on phosphorus uptake. At the field experiment the doses of 0 (Mg0), 20 (Mg2), 40 (Mg4), 60 (Mg6), 80 (Mg8) and 100 (Mg10) kg magnesium $ha^{-1}$ was applied to mycorrhiza inoculated soil. Throughout the experiment fruit yield values determined whereas the fruit nutrient content analysed at the end of the experiment. Magnesium application was considerably effective on pepper yield however dose was critical where the lowest dose (Mg2) is not provided any benefit. Although the highest dose is also provided higher yield compared to control, but the peak value was on Mg8. Mg fertilization increased plant N contents by the increasing application doses, but after Mg8 dose tendency was switched to negative. Phosphorus contents were not strongly influenced from Mg fertilization. Considering all parameters determined it can be said that the dose of Mg8 optimum dose on pepper production.*

***Key words****: magnesium, mycorrhiza, pepper, nutrient uptake.*

## INTRODUCTION

Magnesium is one of the macronutrient for the plants and it is the main constituent of the chlorophyll. Magnesium also increases plant phosphorus uptake (Rasul et al., 2011) and water use efficiency. Deliboran et al. (2011) concluded that Mg applications increased the P availability in the soil by the effect of water. Increased water improved both magnesium level and yield. Dursun et al. (2017) represent that the Mg application improved mean fruit weight and length as well as dry matter content of cucumber. Xu et al. (2014) reported that the fate of the phosphorus influenced from the initial concentration of phosphate as well as presence of Mg ions. Phosphor availability is rather limited in both low and high pH. At the high pH soil phosphate ions are precipitated by combining Ca ions.

Most proportion of the soils in Turkey has high pH due to climate regime and geographic condition (Dinc et al., 1988). For such pH soil, Mg can be used as an agent that promoting phosphorus uptake. On the other hand Gerendas and Fuhrs (2013) defined Mg as forgotten element and they want to attract the attention to the role of Mg in quality formation. They also point out to importance of Ca/Mg balance for product quality. Proving this suggestion El-Zanaty et al. (2012) recommended soil amendment instead of foliar fertilization due to it realizes soil nutrient balance.

The aim of this research was to evaluate the effects of different Mg doses on the pepper plant growth and nutrient uptake in mycorrhiza inoculated conditions.

## MATERIALS AND METHODS

Experiment is carried out on Harran soil series in Kisas province at 2015. The location of implementation field is 37°06′N 38°54′E. The basic soil properties are presented in Table 1.

Table 1. Basic physical and chemical properties of experimental soil

| Texture | Saturation (%) | E.C. (dS $m^{-1}$) | pH | $CaCO_3$ (%) |
|---|---|---|---|---|
| C | 82 | 1.27 | 7.81 | 24.8 |

| $P_2O_5$ (kg $ha^{-1}$) | $K_2O$ (kg $ha^{-1}$) | Organic Matter (%) | Mycorrhiza spore number |
|---|---|---|---|
| 49 | 2020 | 1.4 | 34 |

In an 3363 pepper seeds are sown on the viol which filled up by 1:1 peat and perlite mixture as a seedling medium. The medium was sterilized in autoclave at 121°C, two times for 1 hour each. Following the germination, the plants are transferred the holes in the field which all were inoculated by Mikostar BTH-100 mycorrhiza inoculant. Experimental design was randomized complete block with 3 replications. Parcel size was 14.56 $m^2$. Field was fertilized by 210 kg $ha^{-1}$ nitrogen from ammonium sulphate (Karakus and Anlagan, 1996) and 100 kg $ha^{-1}$ phosphorus from triple super phosphate. Magnesium doses were 0, 20, 40, 60, 80 and 100 kg $ha^{-1}$. The doses are labelled as Mg0, Mg2, Mg4, Mg6, Mg8 and Mg10, respectively. $MgSO_4.7H_2O$ was used as a Mg source. Phosphorus and magnesium fertilizer applied full dose at the beginning of experiment whereas nitrogen fertilization realized at two different stages of the plant. Throughout the experiment regular cultivation practices are followed. Fruits are harvested when they reach the standard fruit size and reddish colour. At the end of the experiment plant roots were taken, washed with deionized water and sub-sampled to determine mycorrhizal colonization.

Mycorrhizal colonization was done based on the staining procedure by Koske and Gemma (1989). Infection rate was determined by the grid-line intersection method (Giovannetti and Mosse, 1980).

The N concentration of the plant was determined according to Kjeldahl distillation method (Bremner, 1965). P and K analysed by Vanadomolibdophosphoric yellow colour (Kacar and Inal, 2008) and flame photometric methods, respectively. For Ca, Mg and micronutrient analyses the samples were wet digested using nitric-perchloric acid mixture and the nutrient contents of the filtrate determined by ICP-OES (Isaac and Johnson, 1998).

## RESULTS AND DISCUSSIONS

The total yield values determined in the experiment are presented in Figure 1. Magnesium application found to be effective on pepper yield however the smallest amount (Mg2) did not provide any benefit and the highest dose (Mg10) provided even lower yield than control (Mg0). Among the doses Mg8 was the optimum application which the highest yield observed. Mg2 seems to be insufficient to provide enough Mg nutrition, probably due to the interactions by other nutrients.

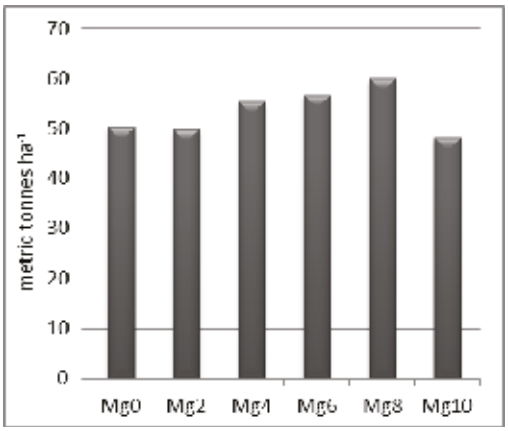

Figure 1. Yield values

Based on the plant height values (Figure 2), slight increases were determined in Mg6 and Mg8 doses, but there was no significant difference within the others. Stem diameter (Figure 2) represent similar values with plant height values; however the thickest diameter obtained from the lowest dose (Mg2). When the yield and stem diameter considered together it can be said that the plant used the photosynthate to build up strong body instead of producing fruit.

This assumption should be further synthesized by prospective studies. Fruit length (Figure 2) showed tendency that the increasing Mg doses increased length of the fruit except Mg10. In general the higher nutrient accumulation expected in case of suppressed plant growth due to the concentration effect, but in this particular case Mg10 decreases both Mg concentration and yield together.

Vitamin C contents of the pepper fruit is presented in Figure 3.

There was no tendency on vitamin C contents depending on Mg doses whereas great fluctuation was observed. The highest vitamin C content determined in Mg8 and the lowest value was in Mg2.

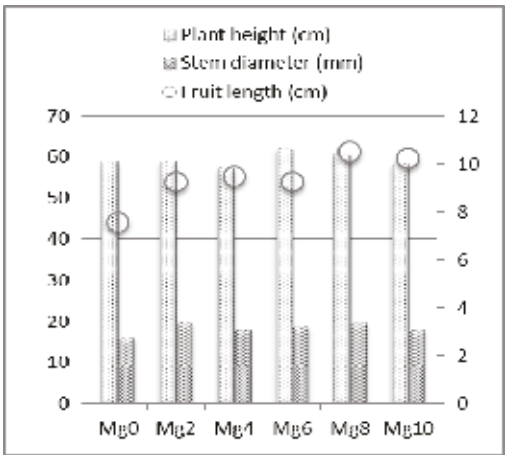


Figure 2. Plant height, stem diameter and fruit length

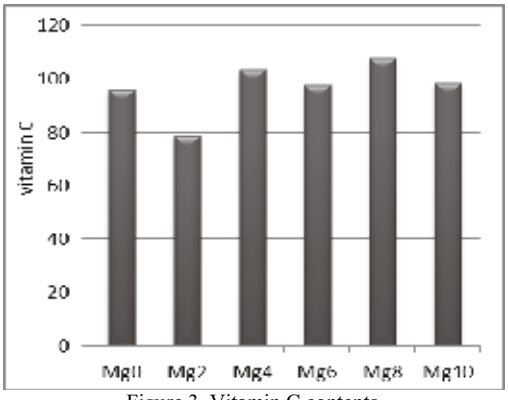


Figure 3. Vitamin C contents

The determined N, P, K, Ca and Mg concentrations are given in Table 2. Fertilization with Mg increased plant N contents by the increasing application doses, but after Mg8 dose tendency was switched to negative. Even though, the higher N contents were determined in Mg applied pots. Phosphorus contents were not strongly influenced from Mg fertilization. In some doses P content increase but for others values were lower than control. This finding is not in accordance with the hypothesis of the manuscript where Mg application is not clearly improved P uptake. However Mg8 dose provide the highest P content. The higher potassium content was also determined in Mg8 and generally all Mg doses except Mg10 stimulated the K uptake evidently. Ca and Mg concentration is not seems to be greatly influenced form Mg application. This was also not expected situation because Mg fertilization should increase plant Mg concentration in normal condition.

Table 2. N, P, K, Ca and Mg concentration (%)

| | N | P | K | Ca | Mg |
|---|---|---|---|---|---|
| Mg0 | 3.51 | 0.243 | 0.91 | 4.44 | 0.96 |
| Mg2 | 3.70 | 0.233 | 1.12 | 4.49 | 0.88 |
| Mg4 | 3.76 | 0.257 | 1.77 | 4.57 | 1.05 |
| Mg6 | 3.84 | 0.237 | 1.35 | 4.72 | 1.01 |
| Mg8 | 4.24 | 0.293 | 1.81 | 4.88 | 1.05 |
| Mg10 | 3.97 | 0.263 | 0.97 | 4.62 | 0.98 |

The micronutrient contents as Cu, Fe, Mn and Zn are given in Table 3. Mg8 dose is an exception; none of the Mg dose was effective on Cu content. Fe concentration is greatly influenced form Mg, the highest value was achieved in Mg6 whereas the lowest Fe was in Mg2. Zinc concentration is also influenced from Mg. The highest value determined in Mg8.

Table 3. Cu, Fe, Mn and Zn concentration (mg $kg^{-1}$)

| | Cu | Fe | Mn | Zn |
|---|---|---|---|---|
| Mg0 | 18 | 204 | 201 | 25 |
| Mg2 | 18 | 182 | 197 | 21 |
| Mg4 | 18 | 247 | 224 | 26 |
| Mg6 | 17 | 251 | 216 | 24 |
| Mg8 | 20 | 223 | 215 | 33 |
| Mg10 | 16 | 232 | 196 | 23 |

Infection rates are presented in Figure 4. No relation was determined between Mg doses and infection rate. None of the application was improved infection over 50%.

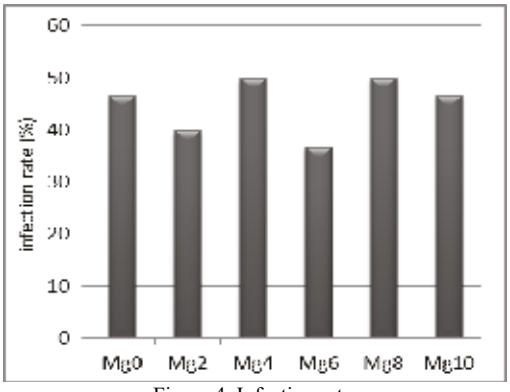


Figure 4. Infection rate

## CONCLUSIONS

Based on the overall results magnesium application is effective on most of the determined parameters.

That is clearly indicated that magnesium fertilizer is required for Harran soil. But the dose seems to be critical both lower and the highest doses are not providing benefit, even the highest dose reduced yield which is predominate factor for the farmers. In this research it is evaluated that Mg application is not stimulate P uptake which is contrary to expectation that Rasul et al. (2011) reported. Thus further studies should be studied to clarify the mechanism behind this phenomenon.


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