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Effects of the Boron and Manganese Application on Some Agronomic Characteristics of Chickpea (*Cicer arietinum* L.)

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This study was conducted in Amasya province in Middle Black sea region for 2 years with the aim of determining the effects of boron and manganese fertilization was on some agronomic characteristics of chickpea. This study designed with randomized completed blocks design with 3 replications. Boron (B_0:0, B_1:0.25 ppm, B_2:0.50 ppm) and manganese (Mn_0:0, Mn_1:0.12 ppm, Mn_2:0.24 ppm) doses were been applied from leaf when the plants were in vegetative period. The effect of years was found to be statistically significant on characteristics expect for seed yield and ratio of seed above 9 mm sieve. The highest seed yields were found for B_2 and Mn_2 doses (1462.2 kg ha^{-1}).

Key Words: Chickpea, Microelements fertilizators, Seed yield.

INTRODUCTION

Decrease in soil fertility due to faulty and intensive use of soil is a significant problem in Turkey as in most countries. Another significant problem for agriculturalists is the need to produce more agricultural products with high quality by reason of increasing population and demands.

Demand for healthy and nutritious foods continues to rise. Leguminosae take place in base of Mediterranean diet pyramid that is applied in this geography where exist Turkey. Among the members of the leguminasae family chickpea ranks first in terms of protein content[1]. Chickpea, which is first originated in Anatolia, has the highest production area among the grain legum crops in Turkey. It is important agricultural product in Turkey because it is very much liked and exhausted by public.

Fertilization is one of the most important raising techniques which should be taken into consideration. Macroelements as well as microelements are needed to produce high amounts of products with high quality.

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Both deficiency and excess of boron, which is one of the essential elements for plants, affect plant growth negatively and plant growth can be ceased[2]. Boron contents of dicotyledon plants are higher than those of monocotyledon plants. While available boron levels below 1 ppm indicate boron deficiency, levels above 5 ppm indicate boron toxicity[3].

Manganese deficiency is common in soils that imply high pH. Mn levels above 20-25 ppm are adequate for plant growth. Chloroplast ranks first among the organels in terms of sensitivity to Mn deficiency. In case of Mn deficiency, cells shrink and cell wall dominates. In dicotyledonous plants, Mn deficiency leads to chlorosis. Turgor of plant is lost and leaves dry. Legume plants as bean and pea is the most sensitive on Mn deficiency[3].

Some 16 genotypes of chickpea were evaluated in potted manganese deficient soil (2.75 mg DTPA extractable Mn/kg) for root length, grain yield/pot, 100-grain weight and symptoms in 60 and 90 d old plants[4]. Appearance of deficiency symptoms was inversely related to root length whilst the 100-grain weight was positively related to root length. Adventitious roots developed just below the soil surface and formed the bulk of the root system.

Ghasemi-Fasaei *et al.*[5] was conducted a greenhouse experiment to determine the effect of Fe and Mn on the dry matter yield (DMY) and uptake of other nutrients in chickpea. Results showed that Mn addition had no significant effect on these characters. Günes *et al.*[6] reported that uptake of mineral nutrients in chickpea cultivars might be an important response in drought tolerance. An experiment under controlled conditions was carried out to study the genotypic response of 11 chickpea cultivars to drought and its relations with N, P, K, Ca, Mg, Fe, Zn, Mn and B uptake and uptake efficiency. In general, drought tolerant chickpea cultivars accumulated more N, P, K, Ca, Zn, Mn and B in both drought stress treatments except for Zn and Mn uptake in late drought stress

Fe, Zn, Mn and Cu levels in three Turkish legumes, kidney bean (*Phaseolus vulgaris* L.), lentil (*Lens esculenta*) and chickpea (*Cicer arietinum*), were determined by flame atomic absorption spectrometry[7]. Mn concentration (mg per 100 g sample) was determined in kidney bean as 1.64 ± 0.14, in lentil as, 1.17 ± 0.19 and in chickpea as 1.60 ± 0.43.

The effects of two microelements (B and Mn) on agronomic characteristics of chickpea were investigated in present study. Microelement studies in leguminosae are scarce in Turkey and we think that this study will be beneficial in closing this gap.

EXPERIMENTAL

The experiments have been conducted in order to determine the effect of boron and manganese micro elements on some characteristics of chickpea in Amasya province located in the Middle Black sea region in northern Turkey. Experimental area has an average altitude of 475 m from the sea, has clay loam, neutral pH and unsalty soil type.

Region shows semi-dry terrestrial climate characteristic. According to climate data belonging to long years of region, in the chickpea growth period, its average temperature is 19.9 ºC, average rainfall is 152 mm and humidity percentage is around 56 %. In chickpea cultivation period, monthly average temperature of the first year the experiment has been conducted is 27.2 ºC and of the second year is 27.4 ºC. While 103.5 mm rain has fallen in the growth period in the first year, this value has increased to 166.5 mm in the second year.

Damla-89 chickpea cultivar was used in this study. The experiment was been conducted for 2 years. Experiment was set up in randomized completed blocks with 3 replicates. Sowings were made on 8th April in 1st year and on 22nd March in 2nd year. Sowings were made in 8 m^2 plots with 35 cm row spaces. Three doses of Bortrac commercial fertilizer (0, 2000 and 4000 mL ha^{-1}) (B_0:0, B_1:0.25 ppm, B_2:0.50 ppm) and 3 doses of Mantrac commercial fertilizer (0, 2000 and 4000 g ha^{-1}) (Mn_0:0, Mn_1:0.12 ppm, Mn_2:0.24 ppm) were selected as B and Mn sources. Doses were given as ppm in this article. Fertilizers were been applied from leaf in vegetative period of chickpea. Diammoniumphosphate fertilizer (30 kg N ha^{-1}) was used at the sowing.

The obtained data were analyzed with variance analysis using TARIST program package by being combined over the years. Ortagonal comparison was applied for characteristics with statistical difference[8].

RESULTS AND DISCUSSION

The effects of different B and Mn applications on the agronomic characteristics of chickpea were given in Fig. 1. Years appeared to have significant effect ($p < 0.01$) on characteristics except for seed amount above on 9 mm sieve and seed yield. This can be attributed to the fact that the rainfall in May (during which plants in vegetative growth period) in 1st year (9 mm) was lower compared to that in 2nd year (66 mm).

B and Mn applications had no significant effect on the investigated characteristics, but B × Mn interaction had significant effect on 100 seed weight ($p < 0.05$), seed yield ($p < 0.01$) and on ratio of seed above on 9 mm sieve ($p < 0.01$). The effects of different B and Mn doses on some characteristics are given in Table-1.

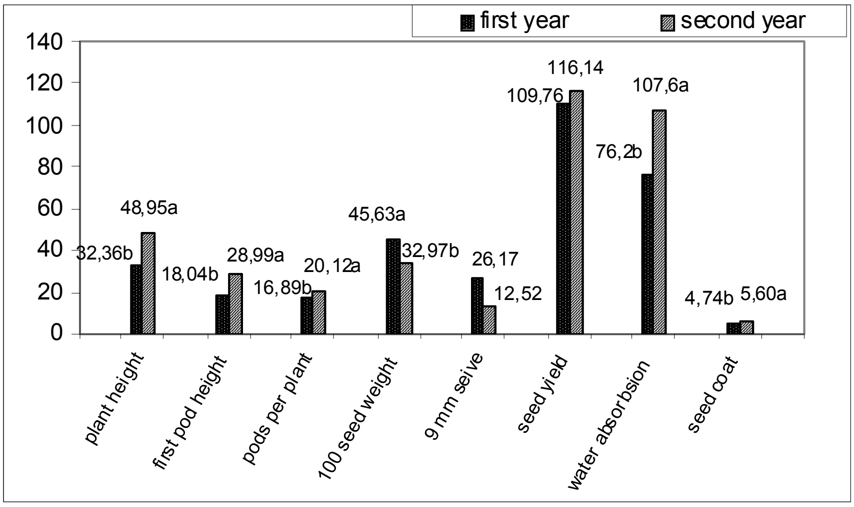

Fig. 1. Effect of years on some characters of chickpea which was treated with boron and manganese

TABLE-1
EFFECTS OF DIFFERENT B AND Mn DOSES ON SOME AGRONOMIC CHARACTERISTICS OF CHICKPEA

Characters	Boron doses (ppm)			Manganese doses (ppm)		
	0	0.25	0.50	0	0.12	0.24
Plant height (cm)	40.6	41.3	40.2	40.6	40.7	40.6
Pods per plant	18.5	18.1	18.9	18.7	17.6	19.2
First pod height (cm)	23.7	23.6	23.1	23.4	23.6	23.5
100 seed weight (g)	39.49	39.26	39.17	38.77	39.74	39.41
Seed yield (kg ha^{-1})	1071.40	1115.90	1201.30	1066.70	1144.40	1177.60
Seed above 9 mm sieve (%)	20.54	18.97	18.52	19.84	19.00	19.19
Water absorption index of seed	0.91	0.92	0.93	0.90	0.92	0.93
Seed coat (%)	5.28	5.25	4.97	5.00	5.25	5.26

Plant height is an indicator of genetic influence and vegetative growth. Boron affects protein synthesis and its deficiency prevents seed maturation and also leads to formation of immature embryos and amorphous pods. Boron deficiency is more important during generative period in legume crops[9]. This knowledge helps explain why the boron application on leaves did not affect the plant height.

Number of pods per plant ranging from 17.6 to 19.2 were not affected by B and Mn doses. However, Srivastava *et al.*[10] used 0, 0.1, 0.3, 0.5 kg ha^{-1} boron doses and found that all B doses decreased dead flower counts and consequently increased pod number compared to control group (0 kg ha^{-1}).

Big seed size is preferred in Turkey in which chickpea seed are consumed as food and appetizer. B × Mn interaction had significant effect on characteristics of 100 seed weight and seed retained above 9 mm sieve which are the indicator of seed size. 100 seed weight increased by Mn addition in state that wasn't boron application. But while this linear effect was found statistically insignificant, the quadratic effect which indicates the effect from 2nd dose (Mn_1:0.12 ppm) to 3rd dose (Mn_2:0.24 ppm) was significant at $p < 0.05$ significant level (Fig. 2). This indicates that 0.24 ppm Mn decreases 100 seed weight in soil without B. The highest 100 seed weights were obtained with 0.25 ppm B and 0.12 ppm Mn doses.

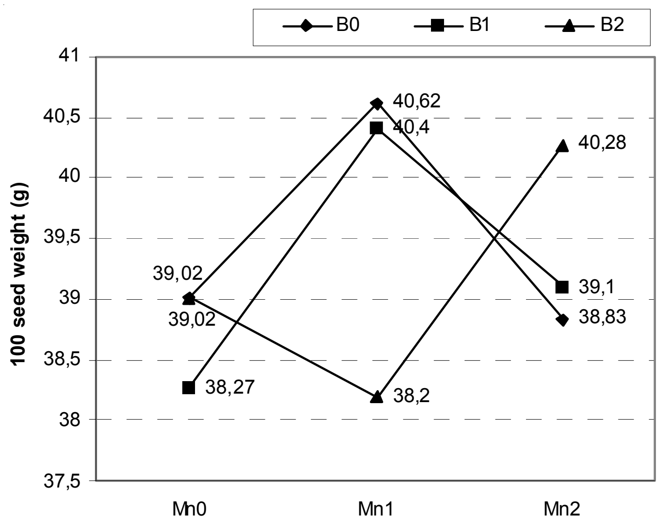

Fig. 2. Effect of B × Mn interactions on 100 seed weight

The ratio of seed above 9 mm sieve, which is another indicator of seed size, changed significantly with B and Mn applications (Fig. 3). The highest value was obtained when both elements were not present.

Seed yield was not affected by B and Mn applications (Table-1). Bayrak *et al.*[11] showed in their study, which was conducted in Konya with the aim of determining B doses on 4 chickpea varieties, that B doses affected seed yield, plant height, pods number, stalk yield and crude protein content significantly.

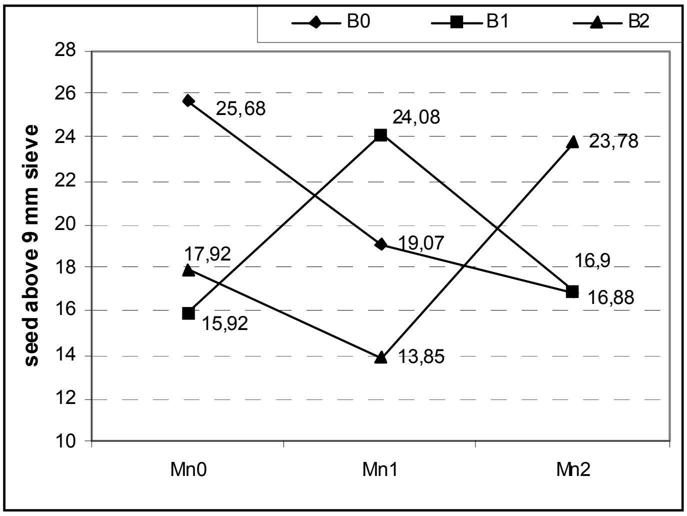

Fig. 3. Effect of B × Mn interactions on grains retained on 9 mm sieve

B × Mn interaction affected seed yield (Fig. 4). Ortagonal comparison showed that first dose of Mn (1139.8 kg ha^{-1}) increased seed yield compared to control (1036.8 kg ha^{-1}) when the B application was not present. Linear relationship between first 2 doses were found significant ($p < 0.05$). Quadratic relationship, which indicates the transition from 2nd dose to 3rd dose, was not significant (Fig. 4). Mn_2 application led to a decrease in yield (Fig. 4). The highest yield was obtained from B_2 and Mn_2 doses (1462.2 kg ha^{-1}) and quadratic affect between $B_2 \times Mn_1$ and $B_2 \times Mn_2$ doses was found significant ($p < 0.05$).

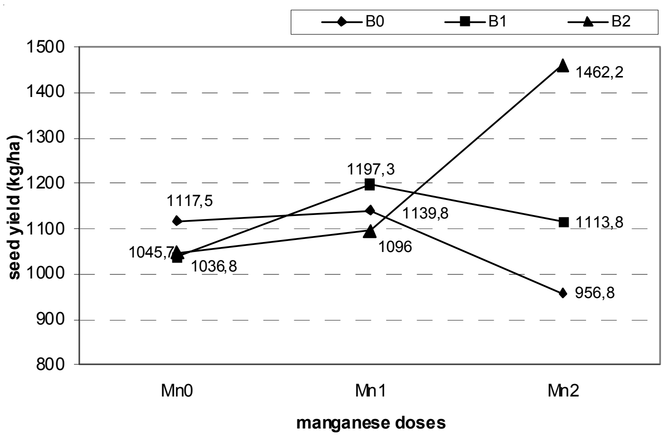

Fig. 4. Effect of B × Mn interactions on grain yield

Fertilizer is a very important input in agricultural production. But, faulty fertilization applications lead to environmental pollution. For this reason, it is essential to take the results of studies into consideration in order to ensure proper use of fertilizers. With a more objective approach to micro element fertilizations, developing practical methods that determine plant's need immediately and coming with dose suggestions would be more realistic. In many countries like Turkey where the resources for researching are limited, studies like dose studies are needed in order to arrive at this point.

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