Effect of iron and manganese foliar spraying on some quantitative characteristics of canola

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Abstract

Canola is one of the most important oil crops in the world. Canola container valuable fatty acids and amino acid required by the human body, with 40-49 percent and 35-39 percent protein (after oil extraction) and oil respectively. Foliar spraying is a new method for crop feeding, which micronutrients in form of liquid are used into leaves. Iron play many essential roles in plant growth and development, including chlorophyll synthesis, thylakoid synthesis, chloroplast development, contributes in RNA synthesis and improves the performance of photosystems. The field experiment was laid out in randomized complete block design with factorial design with three replications.

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**Introduction**

Rapeseed (*Brassica napus* L.) is one of the most important oilseeds both in Iran and throughout the world with drought stress being one of the main limiting factors of its growth and production in Iran (Moradshahi *et al.*., 2004). Canola is one of the most important oil crops in the world (Bybordi, 2010). Oilseed canola plant (*Brassica napus* L.) is an important agricultural crop grown primarily for its edible oil and the meal that remains after oil extraction has value as a source of protein for the livestock feed industry (Jensen *et al.*, 1996). Canola container valuable fatty acids and amino acid required by the human body, with 40-49 percent and 35-39 percent protein (after oil extraction) and oil respectively. Foliar spraying is a new method for crop feeding, which micronutrients in form of liquid are used into leaves (Nasiri *et al.*, 2010). Foliar application of microelements is more beneficial than soil application. Since application rates are lesser as compared to soil application, same application could be obtained easily and crop reacts to nutrient application immediately (Zayed *et al.*, 2011). In plant, micronutrients play an important role in the production and productivity. Among micronutrients, Iron (Fe) is a cofactor for approximately 140 enzymes that catalyze unique biochemical reactions (Brittenham, 1994) and is an essential element for growth of plants, lack of iron causes young leaves yellow and photosynthesis activity to reduce significantly and consequently biomass is reduce (Briat *et al.*, 2007). Salwa *et al.* (2011) stated that microelements are defined substances that are crucial for crop growth; however, they are used in lower amounts as compared to macronutrients, such as N, P and K. They have a major role in cell division and development of meristematic tissues, photosynthesis, respiration and acceleration of plant maturity (Zeidan *et al.*, 2010). However, it should be noted that soils of Iran, which are categorized under the calcareous soils, due to drought stress, salinity, being calcareous, highly acidity, having low contents of organic materials, continuing drought, and continuing unbalanced consumption of fertilizers, iron and zinc contents are too low. Therefore, the plants which grow in such soils are mainly suffered from shortage of iron and zinc and shortage indications are observed in them (Jaleel *et al.*, 2009). One of the most important roles of micronutrients is keeping balanced crop physiology. Furthermore, these elements play vital roles in CO2 flowing out, improvement in vitamin A and immune system activities (Narimani *et al.*, 2010). Iron play many essential roles in plant growth and development, including chlorophyll synthesis, thylakoid synthesis, chloroplast development, contributes in RNA synthesis and improves the performance of photosystems (Miller *et al.*, 1995; Malakouti and Tehrani, 2005). Foliar spraying of microelements is very helpful when the roots cannot provide necessary nutrients (Kinaci and Gulmezoglu, 2007; Babaeian *et al.*, 2011). Moreover, soil pollution would be a major problem by micronutrients soil application. As people are concerned about the environment and plant leaves uptake nutrients better than soil application, foliar spraying was created (Bozorgi *et al.*, 2011). Crop roots are unable to absorb some important nutrients such as zinc, because of soil properties, such as high pH, lime or heavy texture, and in this situation, foliar spraying is better as compared to soil application (Kinaci and Gulmezoglu, 2007). Narimani *et al.* (2010) reported that microelements foliar application improve the effectiveness of macronutrients. It has been found that microelements foliar application is in the same level and even more influential as compared to soil application. It was suggested that micronutrients could be applied successfully to compensate shortage of those elements (Arif *et al.*, 2006). Natural fertilizers are both economically desirable and stable soil sources, in maintaining long time production and prevention of environmental pollution (Saleh, 2001). Zinc foliar application increases height, branch number per plant and dry weight of stem of grass pea (Thalooth *et al.*, 2006). Also zinc, magnesium and iron foliar application increases growth parameters, yield and plant parts significantly (Thalooth *et al.*, 2006). Glyn (2002) reports that different levels of microelements influenced dry weight of tarragon. Anna Mallay *et al.* (2004) confirmed that by the application of
phosphate solvent bacteries, a significant yield improvement was obtained in (Phyllanthus amarus). Wasule et al. (2002) mentioned that phosphate solvent bacteries and Bradyrhizobium japonicum application on soybeen increased significantly improved some characteristics such as nodulation, dry weight of nodules and plant dry weight. Drought is one of the main restrictive factor which causes production yield in agriculture (Mitra, 2001). Spraying of some nutrient elements (micro-nutrients), some growth regulators (GA3), or liquid organic fertilizer (Aminofert) in order to increase fruit set, yield, and fruit quality of “Hollywood” plum. Mode of action for micro-elements was explained by Larue and Johnson (1989). Iron (Fe) complexes with proteins to form important enzymes in the plant and is associated with chloroplasts, where it has some roles in the synthesizing chlorophyll. Zinc (Zn) has been identified as component of almost 60 enzymes, therefore, it has a role in many plant functions, and it has a role as an enzyme in producing the growth hormone IAA. Manganese (Mn) participates in several important processes including photosynthesis, and metabolism of both nitrogen and carbohydrate. On the other hand, foliar fertilizers as chelate should be easily absorbed by the plants, rapidly transported, and should be easily release their ions to affect the plant Larue and Johnson (1989). Amino acids have a chelating effect on micronutrients when applied together; the absorption and transportation of micronutrients inside the plant is easier, this effect is due to the chelating action, the effect of cell membrane permeability and low molecular weight Westwood (1993). Iron plays an important role in biological oxidation and reduction system and is oxygen carrier in N fixation (Romheld and Marschner, 1991). It also plays a role in the formation of plant chlorophyll. Zn has a role in the production of growth hormone auxin and photosynthesis (Kholdebari and Islamzadeh, 2002). To produce high quality products, manageably usage of essential plant nutrients, involving macro and micronutrient groups are needed (Babalar and Pirmoradian, 2008). Of 17 required nutrients, iron (Fe) has an important role as a micronutrient element. Iron deficiency chlorosis is a common nutritional disorder chiefly associated with high pH or calcareous soils affecting plants, and a limiting factor for fruit agricultural production in many areas of the world (Abadia et al., 2011; Borowski and Michalek, 2011; Fernandez et al., 2006). Iron deficiency impairs fruit quality and yield, and can ultimately lead to tree death (Alvarez-Fernandez et al., 2003, 2006; Fernandez et al., 2006). The foliar application of mineral nutrients using sprays, offers a method of supplying nutrients to higher plants more efficiently than methods involving root application when soil conditions are not suitable for Fe availability (Borowski and Michalek, 2011; Fernandez et al., 2006; Erdal et al., 2004). In calcareous soils, for example, Fe availability is usually very low and Fe deficiency widespread. Foliar spraying under these conditions could be much more efficient than any other applications of Fe to the soil (Amri and Shahsavari, 2009; Erdal et al., 2004). Motivation and aims of the study were evaluation of iron and manganese foliar spraying on some quantitative characteristics of canola.

**Material and methods**

**Location of experiment**

The experiment was conducted at the lawaryab zabedan (In Iran) which is situated between 28° North latitude and 60° East longitude.

**Soil experiment**

The soil of the experimental site belonging loam. Composite soil sampling was made in the experimental area before the imposition of treatments and was analyzed for physical and chemical characteristics.

**Field experiment**

The field experiment was laid out in randomized complete block design with factorial design with three replications.

**Treatments**

Treatments consisted of two cultivare of rapeseed (Factor a) (Hayoula (a1), 003 (a2)) and Iron fertilizer three levels (Factor b) (No spraying (b1), spraying 2 in...
1000 (b2), spraying 4 in 1000 (b3)) and manganese fertilizer three levels (Factor c) (No spraying (c1), spraying 2 in 1000 (c2), spraying 4 in 1000 (c3)).

Data collect
Data collected were subjected to statistical analysis by using a computer program MSTATC. Least Significant Difference test (LSD) at 5 % probability level was applied to compare the differences among treatments’ means.

Results and discussion

Plant height

Analysis of variance showed that the effect of cultivar on plant height was significant (Table 1). The maximum of plant height (119.44) of treatments hayoula was obtained (Table 2). Analysis of variance showed that the effect of iron spraying on plant height was significant (Table 1). The maximum of plant height (121.25) of treatments 4 in 1000 iron spraying was obtained (Table 2). Analysis of variance showed that the effect of manganese spraying on plant height was significant (Table 1). The maximum of plant height (121.18) of treatments 4 in 1000 manganese spraying was obtained (Table 2).

Sub pod length

Analysis of variance showed that the effect of cultivar on Sub pod length was not significant (Table 1). The maximum of Sub pod length (5.02) of treatments hayoula was obtained (Table 2). Analysis of variance showed that the effect of iron spraying on Sub pod length was significant (Table 1). The maximum of Sub pod length (5.13) of treatments 4 in 1000 iron spraying was obtained (Table 2). Analysis of variance showed that the effect of manganese spraying on Sub pod length was significant (Table 1). The maximum of sub pod length (5.04) of treatments 4 in 1000 manganese spraying was obtained (Table 2).

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Table 1. Anova analysis of the rapeseed affected by Cultivar and Iron and manganese spraying.

<table>
<thead>
<tr>
<th>S.O.V</th>
<th>df</th>
<th>Plant height</th>
<th>Main pod length</th>
<th>Sub pod length</th>
<th>Number of pod in main stem</th>
<th>Number of pod in sub stem</th>
</tr>
</thead>
<tbody>
<tr>
<td>R</td>
<td>2</td>
<td>3.90ns</td>
<td>0.052ns</td>
<td>0.034ns</td>
<td>6.769*</td>
<td>6.889ns</td>
</tr>
<tr>
<td>Cultivar</td>
<td>A</td>
<td>1</td>
<td>28.46**</td>
<td>0.267**</td>
<td>0.202ns</td>
<td>4.96</td>
</tr>
<tr>
<td>Fe (B)</td>
<td>2</td>
<td>196.79**</td>
<td>0.142</td>
<td>0.41**</td>
<td>46.68**</td>
<td>711.50</td>
</tr>
<tr>
<td>Mn (C)</td>
<td>2</td>
<td>183.91**</td>
<td>0.176</td>
<td>0.264</td>
<td>33.91**</td>
<td>500.056</td>
</tr>
<tr>
<td>A*B</td>
<td>2</td>
<td>8.80*</td>
<td>0.040ns</td>
<td>0.022ns</td>
<td>2.57ns</td>
<td>22.241ns</td>
</tr>
<tr>
<td>A*C</td>
<td>2</td>
<td>2.41ns</td>
<td>0.162</td>
<td>0.015ns</td>
<td>0.018ns</td>
<td>10.018ns</td>
</tr>
<tr>
<td>B*C</td>
<td>4</td>
<td>9.39**</td>
<td>0.045ns</td>
<td>0.034ns</td>
<td>2.768ns</td>
<td>31.472**</td>
</tr>
<tr>
<td>A<em>B</em>C</td>
<td>4</td>
<td>3.46ns</td>
<td>0.090</td>
<td>0.027ns</td>
<td>1.379ns</td>
<td>11.380ns</td>
</tr>
<tr>
<td>Error</td>
<td>34</td>
<td>1.68</td>
<td>0.027</td>
<td>0.060</td>
<td>1.54</td>
<td>7.771</td>
</tr>
<tr>
<td>C.V</td>
<td>-</td>
<td>1.09</td>
<td>2.89</td>
<td>4.93</td>
<td>6.22</td>
<td>2.219</td>
</tr>
</tbody>
</table>

*, **, ns: significant at p<0.05 and p<0.01 and non-significant, respectively.

Main pod length

Analysis of variance showed that the effect of cultivar on main pod length was significant (Table 1). The maximum of main pod length (5.79) of treatments 003 was obtained (Table 2). Analysis of variance showed that the effect of iron spraying on main pod length was significant (Table 1). The maximum of main pod length (5.81) of treatments 4 in 1000 iron spraying was obtained (Table 2). Analysis of variance showed that the effect of manganese spraying on main pod length was significant (Table 1). The maximum of main pod length (5.79) of treatments 4 in 1000 manganese spraying was obtained (Table 2).


**Number of pod in main stem**

Analysis of variance showed that the effect of cultivar on number of pod in main stem was significant (Table 1). The maximum of number of pod in main stem (20.37) of treatments hayoula was obtained (Table 2). Analysis of variance showed that the effect of iron spraying on number of pod in main stem was significant (Table 1). The maximum of number of pod in main stem (21.28) of treatments 4 in 1000 iron spraying was obtained (Table 2). Analysis of variance showed that the effect of manganese spraying on number of pod in main stem was significant (Table 1). The maximum of number of pod in main stem (21.22) of treatments 4 in 1000 manganese spraying was obtained (Table 2).

<table>
<thead>
<tr>
<th>Treatment</th>
<th>Mean-square</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cultivar (a)</td>
<td></td>
</tr>
<tr>
<td>a1 (Hayoula)</td>
<td>11.94 a</td>
</tr>
<tr>
<td>a2 (003)</td>
<td>117.98 b</td>
</tr>
<tr>
<td>Iron spraying (b)</td>
<td></td>
</tr>
<tr>
<td>b1 (No spraying)</td>
<td>114.97 c</td>
</tr>
<tr>
<td>b2 (2 in 1000)</td>
<td>119.91 b</td>
</tr>
<tr>
<td>b3 (4 in 1000)</td>
<td>121.25 a</td>
</tr>
<tr>
<td>Manganese spraying (c)</td>
<td></td>
</tr>
<tr>
<td>c1 (No spraying)</td>
<td>115.10 c</td>
</tr>
<tr>
<td>c2 (2 in 1000)</td>
<td>119.86 b</td>
</tr>
<tr>
<td>c3 (4 in 1000)</td>
<td>121.18 a</td>
</tr>
</tbody>
</table>

Any two means not sharing a common letter differ significantly from each other at 5% probability.

**Number of pod in sub stem**

Analysis of variance showed that the effect of cultivar on number of pod in sub stem was significant (Table 1). The maximum of number of pod in sub stem (122.04) of treatments hayoula was obtained (Table 2). Analysis of variance showed that the effect of iron spraying on number of pod in sub stem was significant (Table 1). The maximum of number of pod in sub stem (130.78) of treatments 4 in 1000 iron spraying was obtained (Table 2). Analysis of variance showed that the effect of manganese spraying on number of pod in sub stem was significant (Table 1). The maximum of number of pod in sub stem (129.17) of treatments 4 in 1000 manganese spraying was obtained (Table 2).

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