INNSPUB

International Journal of Biosciences | IJB |
ISSN: 2220-6655 (Print) 2222-5234 (Online)
http://www.innspub.net
Vol. 5, No. 1, p. 61-68, 2014

RESEARCH PAPER OPEN ACCESS

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

Gholam Riki, Hamid Reza Mobasser*, Hamid Reza Ganjali

Department of Agronomy, Islamic Azad University, Zahedan Branch, Zahedan, Iran

Key words: Plant height, Main pod length, Sub pod length.

http://dx.doi.org/10.12692/ijb/5.1.61-68 Article published on July 02, 2014

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.

* **Corresponding Author:** Hamid Reza Mobasser ✉ hamidrezamobasser@gmail.com

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 shoud 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 Shahsavar, 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.

Matherial and methods

Location of experiment

The experiment was conducted at the lawaryab zahedan (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).

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

S.O.V	df	Plant height	Main pod length	Sub pod length	Number of pod in main stem	Number of pod in sub stem
R	2	3.90^{ns}	0.052^{ns}	0.034^{ns}	6.769^{*}	6.889^{ns}
Cultivar (A)	1	28.46^{**}	0.267^{**}	0.202^{ns}	4.96^{*}	689.80^{*}
Fe (B)	2	196.79^{**}	0.142^{*}	0.41^{**}	46.68^{**}	711.50^{**}
Mn (C)	2	183.91^{**}	0.176^{**}	0.264^{*}	33.91^{**}	500.056^{ns}
A*B	2	8.80^{*}	0.040^{ns}	0.022^{ns}	2.57^{ns}	22.241^{ns}
A*C	2	2.41^{ns}	0.162^{**}	0.015^{ns}	0.018^{ns}	10.018^{ns}
B*C	4	9.39^{**}	0.045^{ns}	0.034^{ns}	2.768^{ns}	31.472^{**}
A*B*C	4	3.46^{ns}	0.090^{*}	0.027^{ns}	1.379^{ns}	11.380^{ns}
Error	34	1.68	0.027	0.060	1.54	7.771
C.V	-	1.09	2.89	4.93	6.22	2.219

*, **, 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).

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).

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 2. Comparison of different traits affected by cultivar , iron and manganese spraying.

Treatment	Mean-square				
Cultivar (a)	Plant height	Main pod length	Sub pod length	Number of pod in main stem	Number of pod in sub stem
a1 (Hayoula)	119.44a	5.65b	5.02a	20.37a	122.04b
a2 (003)	117.98b	5.79a	4.90a	19.56b	129.18a
Iron spraying (b)					
b1 (No spraying)	114.97c	5.63b	4.83b	18.17b	118.61c
b2 (2 in 1000)	119.91b	5.72b	4.92b	20.44a	127.44b
b3 (4 in 1000)	121.25a	5.81a	5.13a	21.28a	130.78a
Manganese spraying (c)					
c1 (No spraying)	115.10c	5.61b	4.82b	18.50c	119.56b
c2 (2 in 1000)	119.86b	5.76a	5.02a	20.17b	128.11a
c3 (4 in 1000)	121.18a	5.79a	5.04a	21.22a	129.17a

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).

References

Abadia J, Vazquez S, Rellan-Alvarez R, El-Jendoubi H, Abadia A, Alvarez-Fernandez A, and AF, Lopez-Millan. 2011.Towards a knowledge-based correction of iron chlorosis.review.Plant Physiology and Biochemistry **49(5),** 471-482.
http://dx.doi.org/10.1002/ffj.1562

Alvarez-Fernandez A, Abadia J, Abadia A. 2006. Iron deficiency, fruit yield and quality. In: Barton LL, Abadia J (eds) Iron nutrition in plants and rizospheric microorganisms. Springer, Dordrecht, The Netherlands **10,** 85–101.
http://dx.doi.org/10.1016/j.foodchem.2006.07.051

Alvarez-Fernandez A, Paniagua P, Abadia J, Abadia A. 2003. Effects of Fe deficiency chlorosis on yield and fruit quality in peach (Prunuspersica L. Batsch).J Agric Food Chem **51(19),** 5738– 5744.
http://dx.doi.org/10.1002/(SICI)10991026(199801/02)13:1<1::AID-FFJ672>3.0.CO;2-4

Amri E, Shahsavar AR. 2009. Comparative efficacy of citric acid and fe(II) sulfate in the

prevention of chlorosis in orange trees (Citrus sinensis L. cv 'Darabi'). Journal of Biol. Envi. Sci. **3,** 61- 65.
http://dx.doi.org/10.3390/12122567

Anna MA, Lakshmi PTV, Lalithakumari D, Murugesan K. (2004). Optimization of biofertilizers on growth, biomass and seed yield of Phyllanthus amarus (Bhumyamalaki) in sandy loam soil. J. Med. Aromat. Plants Sci. **26,** 21-28.
http://dx.doi.org/10.1002/ffj.1328

Arif M, Chohan MA, Ali S, Gul R, Khan S (2006). Response of wheat to foliar application of nutrients. J. Agric. Biol. Sci., **1(4).** 167-182.
http://dx.doi.org/10.1080/22297928.2000.10648269

Babaeian M, Tavassoli A, Ghanbari A, Esmaeilian Y, Fahimifard M. (2011) Effects of foliar micronutrient application on osmotic adjustments, grain yield and yield components in sunflower (Alstar cultivar) under water stress at three stages. Afr. J. Agric. Res. **6(5),** 1204-1208.
http://dx.doi.org/10.1002/cbdv.201000249

Babalar M, Pirmoradian M. 2008. Trees fruit nutrition. university of Tehran Press Third Edition, 316p. (In Persian).
http://dx.doi.org/10.1016/j.foodchem.2005.09.054

Borowski E, Michalek S. 2011.The effect of foliar fertilization of French bean with iron salts and urea on some physiological processes in plants relative to iron uptake and translocation in leaves. Acta Sci. Pol., HortorumCultus **10(2),** 183-193.
http://dx.doi.org/10.1081/PLN-120017665

Bozorgi HA, Azarpour E, Moradi M. (2011). The effects of bio, mineral nitrogen fertilization and foliar zinc spraying on yield and yield components of faba bean. World Appl. Sci. J. **13(6),** 1409-1414.
http://dx.doi.org/10.2134/agronj2002.1530

Briat JF, Curie C, Gaymard F. 2007. Iron utilization and metabolism in plants. Curr. Opin. Plant Biol. **10,** 276- 282.
http://dx.doi.org/10.2135/cropsci1997.0011183X003700010038x

Brittenham GM. 1994. New advances in iron metabolism, iron deficiency and iron overload. Current Opinion in Hematology **1,** 549-556.
http://dx.doi.org/10.1016/j.indcrop.2006.07.004

Bybordi A. 2010. Effects of salinity on yield and component characters in canola (Brassica napus L.) cultivars. Not Sci Biol. **2,** 81-83.
http://dx.doi.org/10.2478/v10247-012-0042-6

Erdeal I, Kepenek K, Kizilgoz L. 2004. Effect of foliar iron applications at different growth stages on iron and some nutrient concentrations in strawberry cultivars.Turk J AgricFor. **28,** 421-427.
http://dx.doi.org/10.1016/j.eja.2005.10.006

Fernandez V, Victor Del R, Javier AB, Anunciacion AB. 2006. Foliar iron fertilization of peach (Prunuspersica (L.) Batsch): effects of iron compounds, surfactants and other adjuvants. Plant Soil. **289,** 239–252.
http://dx.doi.org/10.1017/S0960258500003032

Glyn MF. (2002). Mineral nutrition, production and artemisin content in Artemisia annua L. Acta Hortic., **426,** 721-728.
http://dx.doi.org/10.1017/S0960258500004141

Jaleel CA, Manivanannan P, Wahid A, Farooq MHJ, Al-Juburi HJ, Somasundaram R. 2009 – Drought stress in plant: A review on morphological charactertise and pigments composition. International Journal Agriculture Biological **11,** 100-105 P.
http://dx.doi.org/10.1071/P9930639

Jensen CR, Mogensen VO, Mortensen G, Fieldsend JK, Milford GFJ, Anderson MN, Thage JH. 1996. Seed glucosinolate, oil and protein content of field-grown rape (Brassica napus L.)

affected by soil drying and evaporative demand. Field Crop Res. **47,** 93-105. http://dx.doi.org/10.2135/cropsci1992.0011183X003200030033x

Kholdebarin B, Islamzadeh T. 2002. Mineral feeding of higher plants. Trs. **1,** Shiraz University Press, 500 P. (In Persian). http://dx.doi.org/10.1093/aob/77.6.591

Kinaci E, Gulmezoglu N. (2007). Grain yield and yield components of triticale upon application of different foliar fertilizers. Interciencia **32(9),** 624-628. http://dx.doi.org/10.1016/S0308-521X(01)00023-3

Laure JH, Hohnson RS. (1989): Peaches, plums and nectarines growing and handling for fresh market. Copyright the Regent of the Univ. of Calif., Division of Agric. And Ntural Resources pub. **33,** 74-81. http://dx.doi.org/10.2478/v10247-012-0052-4

Malakouti M, Tehrani M. 2005. Micronutrient role in increasing yield and improving the quality of agricultural products. 1st ed. Tarbiat Modarres Press. Tehran. http://dx.doi.org/10.1006/anbo.1999.1076

Miller GW, Huang IJ, Welkie GW, Pushmik JC. 1995. Function of iron in plants with special emphasis on chloroplasts and photosynthetic activity. In: Abadia, J., (Ed.). Iron nutrition in soils and Plants. Kluwer Academic Publishers, Dordecht. 19-28 P.

Mitra J. (2001). Genetics and genetic improvement of drought resistance in crop plants. Curr. Sci. **80,** 758- 763. http://dx.doi.org/10.4141/cjps94-012

Moradshahi A, Salehi Eskandari B, Kholdebarin B. 2004, some physiological responses of canola (Brassica napus L.) // Iranian Journal of Science and Technology Transaction A- Science **28,** 43–50 p (in Persian).

Narimani H, Rahimi MM, Ahmadikhah A, Vaezi B. (2010). Study on the effects of foliar spray of micronutrient on yield and yield components of durum wheat. Arch. Appl. Sci. Res. **2(6),** 168-176. http://dx.doi.org/10.1016/j.eja.2005.08.001

Nasiri Y, Zehtab-Salmasi S, Nasrullahzadeh S, Najafi N, Ghassemi- Golezani K. (2010). Effects of foliar application of micronutrients (Fe and Zn) on flower yield and essential oil of chamomile (Matricaria chamomilla L.). J. Med. Plants Res., **4(17),** 1733-1737. http://dx.doi.org/10.1016/S0074-7696(08)62489-4

Romheld V, Marschner H. 1991. Genotypic differences among graminaceous species in release of phytosiderophores and uptake of iron of phytosiderophores. Plant Soil, **123,** 147–153. http://dx.doi.org/10.1104/p.109.2.499

Saleh RN. (2001). Biofertilizers and their role in order to reach to sustainable agriculture. Acompilation of papers of necessity for the production of biofertilizers in Iran, 1- 54 P. http://dx.doi.org/10.2135/cropsci2003.2135

Salwa AIE, Taha MB, Abdalla MAM. (2011). Amendment of soil fertility and augmentation of the quantity and quality of soybean crop by using phosphorus and micronutrients.

Thalooth AT, Tawfik MM, Magda MH. (2006). A comparative study on the effect of foliar application of zinc, potassium and magnesium on growth. yield and some chemical constituents of mungbean plants grown under water Stress Conditions. World J. Agric. Sci. **2(1),** 37-46. http://dx.doi.org/10.1016/S0014-5793(00)01822-6

Wasule DL, Wadalkar SR, Buldo AN. (2002). Effect of phosphate solubilizing Bacteria on role of Rhizobium on Nodulation by soybean. Proceeding of the 15 th Meeting on Microbial Phosphate Solubilization. Spain: Salamanca University Publication, 38-49.

http://dx.doi.org/10.2135/cropsci2002.1996

Westwood MN. (1993): Temperate – zone pomology physiology and culture. Third Edition. Himber press, Portland, Oregon, 523 P. http://dx.doi.org/10.1017/S0960258599000057

Zayed BA, Salem AKM, El Sharkawy HM. (2011). Effect of different micronutrient treatments on rice (Oriza sativa L.) growth and yield under saline soil conditions. World J. Agric. Sci. **7(2),** 179-184. http://dx.doi.org/10.1002/(SICI)1521-186X

Zeidan MS, Hozayn M, Abd El-Salam MEE. (2006). Yield and quality of lentil as affected by micronutrient deficiencies in sandy soils. J. Appl. Sci. Res. **2(12),** 1342-1345. http://dx.doi.org/10.1109/27.842898

Zeidan MS, Mohamed MF, Hamouda HA. (2010). Effect of foliar fertilization of Fe, Mn and Zn on wheat yield and quality in low sandy soils fertility. World J. Agric. Sci. **6(6),** 696-69.