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Effect of foliar application and time foliar application microelements (Zn, Fe, Mn) on safflower

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ABSTRACT: Safflower (*Carthamus tinctorius* .L) along with Canola, Sunflower, Sesame, Soybean and Cotton are the main seed crops in eastern countries since long ago. In order to establish necessary conditions for better use of natural reactions like biologic fixation of nitrogen by biofertilizers, interests have been raised toward environmental friendly sustainable practices which can reduce input costs. The experiment was conducted at the Agricultural Research Station, zahak. This study carried out in factorial experiments based on a randomized complete block design (RCBD) with three replications. Analysis of variance indicated that the effect of foliar application and effect of micronutrient elements Fe, Zn, Mn, and manganese on grain weight statistically significant at the 1% level, however, interaction elements and foliar spray had no significant effect on thousand grain weight.

***Keywords*:** grain weight, Biological yield, grain weight.

INTRODUCTION

Safflower (*Carthamus tinctorius* L.) is an important oilseed crop of the family Asteraceae originated in southern Asia and is known to have been cultivated in China, India, Egypt and Iran (Ashri and Knowles, 1960). Safflower (*Carthamus tinctorius* .L) along with Canola, Sunflower, Sesame, Soybean and Cotton are the main seed crops in eastern countries since long ago. In order to establish necessary conditions for better use of natural reactions like biologic fixation of nitrogen by biofertilizers, interests have been raised toward environmental friendly sustainable practices which can reduce input costs (Salantur, 2005). While in the past, mainly safflower production was in order to take advantage of its pigment in the flowers. At present, the main goal of safflower production is oil extraction from its seeds and its oil has is good quality in various usage. Safflower oil has high quality because of unsaturated fatty acids (more than 78%), oleic acid and linoleic acid especially. One of the main reasons for the low acreage of safflower is low yield and economic outcome. Therefore, the availability of certified seeds with high production potential and support for purchasing seed oil plants by oil factories can be effective in country's oil needs (Weiss, 2000). One of the most important issues about increase of crop yield and improving the quality of agricultural products is balanced plant nutrition. Foliar application of nutrients has become an efficient way to increase yield and quality of crops (Romemheld and El-Fouly, 1999). Sajedi et al, (2008) declare that different levels of nitrogen, iron and zinc have influence on growth, absorption of nutrition and percentage of field corn (single grass 704). Also Ashoka et al, (2008) studied micro-elements effect and found that using microelements results in increase of corn weight, green fodders and grain yield. Zn application resulted in an improvement in root growth in soybean (Glycine max L.) at all levels of water stress and shoot growth under severe water stress (Gadala, 2000). The micronutrients play an important role in increasing crop yield (Mohammadi Ghohsareh and Kamran, 2010). Micronutrients have prominent effects on dry matter, grain yield and straw yield in crop (Asad and Rafique, 2000). Iron (Fe) plays role in biological redox system, enzyme activation and oxygen transferring in nitrogen fixation (Romheld and Marschner,

1991); manganese (Mn) is utilized in enzyme activation, electron transport andin diseases resistance (Burnell, 1988); zinc is important to membrane integrity and phytochrome activities; copper (Cu) is vital for physiological redox processes, pollen viability and lignification's (Marschner, 1995); and boron (B) is required for reproductive plant parts, cell wall formation and stabilization, membrane integrity, carbohydrate utilization, stomatal regulation and pollen tube formation (Marschner, 1995). It is reported that foliar Zn and Mn application can improve the seed yield and seed quality of safflower (Carthamus tinctorius L.) grown under drought stress (Movahhedy-Dehnavy, 2009). Increase of seed yield of safflower due to zinc foliar application has been reported by (Movahhedi- Dehnavi et al., 2009). On the other hand, micronutrients increases photosynthesis rate and improves leaf area duration thus seed yield will be increased (Cakmak, 1999). Micronutrient elements play a critical role in plants that lead to increase of leaf area index and thereby increased light absorption and increase the amount of dry matter accumulation and economic yield (Ravi, 2008). Grewal and Williams, (2000) showed that the ability of alfalfa plants to cope with water stress during early vegetative growth could be enhanced by providing the plants with an adequate Zn supply. However, Hong and Ji-Yun, (2007) reported that the increases of maize growth and Zn uptake due to Zn application were more significant under well-watered conditions than under drying conditions. Also, the other experiment showed that, the increases of plant biomass, stomatal conductance and quantum yield of photosystem 2 due to Zn addition were observed in well-watered maize plants (Wang, 2009). Micronutrients such as manganese and zinc can be important role at nutrition of oil plants. In plants, zinc fertilizer should use at least once, twice or three times at one year and manganese can be used at least once at one year for crops and horticulture (Khoshgoftarmanesh, 2010). It seems that critical level of zinc and manganese in soil is 1mg kg-1 and less than 10mg kg-1, respectively (Marschner, 1995). Zinc also plays an important role in the production of biomass, grain yield, quality and quantity of oil (Kaya and Higgs, 2002; Cakmak, 2008).

MATERIALS AND METHODS

The experiment was conducted at the Agricultural Research Station, zahak (in Iran) which is situated between 54° North latitude and 41° East longitude and at an altitude of 483m above Mean Sea Level. This study carried out in factorial experiments based on a randomized complete block design (RCBD) with three replications. The main cause of foliar zinc, iron and manganese and sub plots sprayed during the various stages of plant development, including stem elongation, heading-bud, Start of flowers, stem elongation + heading-bud. 3 of the thousands of sources on zinc, iron and manganese of 2.5 per thousand from 138 Sequestrine source of manganese sulfate were two thousand. Fertilizer Zn at the rate of three thousand sulfate, zinc, iron and manganese content of 2.5 per thousand from 138 Sequestrine source of manganese sulfate were two thousand. The soil of the experimental site belonging to the order Alfisol is clay loam. Composite soil sampling was made in the experimental area before the imposition of treatments and was analyzed for physical and chemical characteristics. Analysis of variance and comparison of data carried out with using of SAS software and the Duncan's test at 5% level.

RESULTS AND DISCUSSION

Biological yield

Analysis of variance shows that the effects of foliar micronutrient elements Fe, Zn, Mn, manganese on the biological performance was not statistically significant although the effect of spray time was statistically significant at the 1%, and the interaction between the elements and foliar spray had no significant effect on biological yield (Table 1). Comparison results show that although there was no significant difference between foliar nutrients on biological function, but The highest yield of 5.2 per thousand, with an average concentration of foliar Fe 17166.66 kg/ha and the lowest yield of foliar manganese concentration with a mean average of 2 per thousand 15305.55 kg/ha obtained. Most of foliar biological function in stem elongation with average 17333.33 kg/ha respectively, and the lowest foliar bud stage, with an average of 14411.47 kg/ha Were obtained (Table 2). Based on average comparison, the highest biological yield and foliar spray with iron stem elongation was observed. Research involving the use of zinc at different growth stages of soybean plant has indicated that is sprayed on the plant and put it in as soon as possible to improve its performance (jamson et al., 2009).

Table 1. Analysis of variance HI, Thousand grain weight, Biological yield influenced spray nutrients and time spray

SOV	df	HI	Thousand grain weight (gr)	Biological yield (kg/ha)
R	2	12.17^{*}	3.29^{ns}	453679.62^{ns}
spray nutrients	2	7.44^{ns}	25.09^{**}	11953762.36^{ns}
Time spray	3	14.02^{*}	45.86^{**}	15665702.57^{**}
spray nutrients* Time spray	6	6.47^{ns}	6.55^{ns}	9208776.61^{ns}
Error	22	3.58	5.10	3824092.18
CV (%)	-	11.57	4.85	12.20

*, **, ns: significant at p<0.05 and p<0.01 and non-significant, respectively.
C.V: Coefficient of Variation

Thousand grain weight

Analysis of variance indicated that the effect of foliar application and effect of micronutrient elements Fe, Zn, Mn, and manganese on grain weight statistically significant at the 1% level, however, interaction elements and foliar spray had no significant effect on thousand grain weight (Table 1). Comparison results show that the elements Fe, Zn, Mn There are significant differences on thousand grain weight, yield of foliar Fe 2.5 per thousand, with an average concentration of 48.25 g and 45.72 were obtained. The least amount of spray at bud stage, with an average of 40.47 g was obtained (Table 2).

Table 2. Mean comparison HI, Thousand grain weight, Biological yield Influenced spray nutrients and time spray

Treatment spray nutrients	HI	Thousand grain weight (gr)	Biological yield (kg/ha)
Zn	16.09a	45.78b	1561.10a
Fe	15.45a	48.25a	17166.66a
Mn	16.17a	45.72b	15305.55a
Time spray			
Stem elongation	15.45b	49.04a	17333.33a
heading-bud	18.02a	45.06b	14411.47c
flowering	15.62a	44.48b	15407.04b
Stem elongation + heading-bud	16.07a	40.47ab	16888.88a

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

Harvest index

Analysis of variance showed that the effects of foliar micronutrient elements Fe, Zn, Mn, on Harvest index was not statistically significant, But the effect of foliar application on Harvest index was significant at the 5% level of statistical probability and timing of the interaction of foliar spray had no significant effect on Harvest index (Table 1). Comparison results show that although there was no significant difference between foliar elements Harvest index, but the greatest Harvest index of foliar zinc concentration of 3 per thousand, with an average 16.90 percent the lowest Harvest index of foliar iron with an average of 15.45 percent, respectively.

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