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ORIGINAL ARTICLE

Effects of Micro Elements spraying on some traits in the Safflower (*Carthamus tinctorius* L.)

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ABSTRACT
This research was done to study effect of polyamine, boron and molybdenum growth stimulant spray on yield and growth indices of two cultivars of safflower in agricultural year of 2011-2012 in Damghan region. Test treatments included control (without spray) and spray after flowering (gradation phase) and the tested cultivars were Mahali Esfahan and Padideh. The presence of significant interaction between levels of cultivar and spray in plant height trait in Padideh cultivar (68.88cm) and Mahali Esfahan cultivar (80.25cm) showed that behavior of cultivars to spray was different. Generally, mean of spray in the treatment without spray was higher than that of control sample in grain oil (%32.11) in index of harvesting (%13.90) and in plant height (32.33cm). in the tested cultivars, mean of Mahali Esfahan cultivar was higher than that of Padideh cultivar in grain oil (%11.56) the number of capitols per plant (24.96) and plant height (73.50cm) but mean diameter of stem in Padideh (12.72mm) was higher than that in Mahali Esfahan cultivar. Grain weight (1000 seeds) in this test was not significant in the studied treatments. Goal of this research was to study effect of micronutrients spray on improvement of qualitative and quantitative yield of the crop of safflower cultivars.
Key Words : safflower , micro elements spray , morphological and physiological traits.

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INTRODUCTION

Increasing growth of population and need for yield of agricultural plans to supply food have led the researchers to follow new researches in this field that is food production should be continually increased to prevent food shortage in many parts of the world [1]. Safflower (*Carthamus tinctorius*) as an indigenous plant of Iran can play important role in expansion of the cultivated surface of oil plants in the country due to its relatively high resistance against salinity and dryness as well as due to high quality oil. Access to the cultivars resistant to dryness can help develop cultivation of this plant under dry climatic conditions [2].

Goal of the foliar application of food during grain filling is not only to remove food shortage of soil but also to increase chlorophyll period and activity of leaves which are the main organ of production and transfer of photosynthetic materials for growth [3]. Foliar application can guarantee access of plants to food elements for obtaining high performance. Ecologically, foliar fertilization is more acceptable because lower amounts of food elements are provided in order to be consumed rapidly by the plant.

Boron deficiency among microelements is the most harmful to the crop after iron and zinc. Amount of boron in plants varies from 5 to 50 PPM but this amount may vary in different plants and soils. When amount of boron in plant is below 15 PPM, signs of deficiency will emerge [4]. Deficient activity of each one of the enzymes or the effective factors for cycles cause accumulation of nitrate, some factors such as inactivity of reductase nitrate enzyme, dryness, hail, cold weather, poisons, excessive use of nitrogen fertilizers, molybdenum and manganese deficiency, low light and salinity can cause accumulation of nitrate [5]. Molybdenum which is necessary for plants in low amount is one of the constituents of reductase nitrate enzyme and participates in nitrogen metabolism by changing capacity. Molybdenum causes rapid increase of activity of reductase nitrate enzyme in the plants which have molybdenum deficiency [6].

Polyamines have distinctive role as modulation of many biological stages such as enzyme activities and maintenance of ion balance in growth and development regulation. These materials can have hormone activity and play effective role in regulation of cellular activities [7].

MATERIAL AND METHODS

In order to study effect of foliar application of microelements of polyamine, boron and molybdenum on yield components of two cultivars of Safflower, a test was performed in Damghan region in agricultural year of 2011-2012. This factorial test was executed with two cultivars of Padideh V1 and Mahali Esfahan cultivar V2 and factor of foliar application with help of boron- molybdenum- polyamine in two levels of F1:(control) and F2: foliar application after flowering as randomized complete block deign with to measure diameter of the plant. four replications in farmland. The studied solution with brand of Nitrate Balancer including boron: 9%, molybdenum: 50 PPM and polyamine: 1 Mm Cultivation lines in this test include 9 lines with row spacing of 50 cm. Cultivation was linearly done in 29 October and after heavy irrigation with hand on hill with depth of 4-5 cm on southern side and in water tail. After flowering of the plant, foliar application with nitrate balancer (polyamine, boron and molybdenum) with concentration of 2 liters in 1000 liters of water in hectare was done.

In order to measure height of the plant, height between soil surface and plant tip was considered 10 stems were randomly considered and its diameter was measured with caliper.

Harvesting index is measured at the end of growth season and the following formula is calculated. **HI= (EY/BY). 100**

At the end of the growing season and after a thorough investigation to determine crop yield equal to 2 m area of each plot was harvested. After removing the seeds and then grinding grain samples, using Soxhlet Extraction apparatus and according to Dini and carapetiant [8], it was performed to extract the oil.

Statistical Analysis

Data variance analysis is based on factorial experimental model as randomized complete block deign and the used statistical software is SAS_9. Means were compared with help of Duncan's Multiple Range test.

RESULT AND DISCUSSION

Oil percent

Based on results of variance analysis (table 1), foliar treatment with polyamine, boron and molybdenum could affect percent of safflower seed oil in probability level of ($P<0.01$) Different cultivars of safflower showed significant difference in terms of seed oil percent in probability level of ($P<0.05$). Interactions between treatments of cultivars and foliar application couldn't affect percent of safflower seed oil in this study. Table of mean comparison showed that oil percent in Mahali Esfahan cultivar averagely contained more oil than Padideh cultivar so that mean of Mahali Esfahan cultivar was 11.56% and mean of Padideh cultivar was 10.43%. Control treatment with 30.48% of oil showed the highest rate of oil and foliar application with 39.29% of oil showed the lowest oil after flowering. Interaction of foliar application in Padideh cultivar was considered 9.53% after flowering and interaction of foliar application in Mahali Esfahan cultivar was considered 11.27% after flowering (table 2). They showed that oil percent had significant correlation with duration of flowering, number of days to flowering, weight of 100 grains, height of plant, number of branch, amount of husk of the plants, number of seed in each husk [9]. Boron consumption causes increase of grain yield and oil percent and they declared that boron caused increase of grain yield by increasing fertility of grain and as a result, increase in the number of grains causes increase of grain yield [10].

Weight of 1000 seeds

In this test, weight of 1000 seeds was not affected by foliar application, cultivar and interaction and was not significant (table 1). Results of mean comparison (table 2) showed that Padideh cultivar had 32.51 grams of 1000 seeds as the highest rate and Mahali Esfahan had averagely 30.18 grams of 1000 seeds as the lowest rate. The highest mean of foliar application in weight of 1000 seeds in the tested treatments related to control foliar application as 31.72 grams and the lowest mean was 31.34 grams for foliar application after flowering. The highest interaction of foliar application in Padideh cultivar was considered with mean of 33.85 grams and the highest interaction of foliar application in Mahali Esfahan cultivar was considered with mean of 29.98 grams after flowering. Weight of 100 seeds is affected by cultivation date and is lost due to delay in cultivation [11]. in their research concluded that foliar application of zinc, manganese and boron had significant effect on weight of 1000 seeds [12]. Weight of 100 seeds is a cultivar characteristic and is affected by genetic factors but its amount is affected by conditions of ripening period. These conditions may cause changes of between 20 and 30% of seed weight [13].

The Number of Capitol in Plant

As observed in table 1, effect of cultivar was significant in probability level of (P<0.05). foliar application and interaction of cultivar and foliar application was not significant in this study. Considering the obtained results in this test, the highest number of seed pod in the plant in Mahali Esfahan cultivar is 33.46 and the lowest number of Padideh cultivar is 24.96. Considering mean number of seed pod in the plant in different foliar application treatments, the highest value related to foliar application after flowering was 32.28 and the lowest mean for control treatment was 26.13. According to results (table 2) of mean comparison, interaction of foliar application in Padideh cultivar shows that the highest mean of foliar application after flowering was 30.82 compared with the control treatment and foliar application in Mahali Esfahan cultivar was 33.73 above the control treatment. Yield of sunflower depends on the number of plant in surface area, the number of seed pod in plant, number of seed in seed pod and average weight of seeds [14]. The most important yield components in safflower are the number of capitol in plant and the number of grain in capitol. In order to achieve the maximum yield, these two components should be improved [15].

Height of plant

Variance analysis results in this test showed that final height of the cultivar was significant in level of (P<0.05). Foliar application with boron, molybdenum and polyamine showed that final height had significant difference in level of (P<0.05). Interaction of cultivar and foliar application showed that final height had significant difference in level of (P<0.05) (table 1). Based on results in (table 2) mean comparison, it was specified that height of Mahali Esfahan cultivar i.e. 73.5 cm was more than height of Padide cultivar i.e. 67.92 cm. mean final height of the plant after flowering was 32.33 cm and the lowest mean height of the control plant was 30.54cm. Interaction in the cultivar and foliar application was significant in this trait. Effect of cultivar on height of safflower became significant. Based on results of the research, it was found that mean height of Mahali Esfahan i.e. 73.5 cm was more than height of Padideh cultivar i.e. 67.92 cm. Height of Padideh cultivar in foliar application after flowering i.e. 68.88 cm was more than height of the control treatment and height of Mahali Esfahan cultivar after flowering i.e. 80.25 cm was more than height of the control treatment. Among morphological characteristics, height of plant in safflower is one of the most evident and effective traits in determination of physical stability, leaf surface and finally yield [21]. Increase in height of the plant population causes to increase light absorption due to formation of more efficient leaves and yields more crops by increasing production of photosynthetic substances and competitive power in the farmland [10].

Diameter of stem

In this study, final diameter of the plant was significant in probability level of (P<0.01) and didn't have significant different in foliar application and interaction. (Table 1) indicates this case. Results of mean comparison (table 2) indicated that mean diameter of stem of Mahali Esfahan cultivar i.e. 10.78 mm was lower than that of Padideh cultivar (12.72 mm). The highest rate of foliar application after flowering was 47.30 mm and the lowest rate for control treatment was 44.50 mm. Interaction of Padideh cultivar and foliar application after flowering indicated higher index (13.08 mm) than the cultivar without foliar application and interaction of Mahali Esfahan cultivar and foliar application after flowering indicated higher index (11.01 mm) than the control treatment. Studying 16 traits in safflower evaluated correlation between diameter of stem, height of plant and length of lateral branch and yield of grain to be positive and significant studied [16]. spring cultivation of safflower in Esfahan and declared that there was positive and significant correlation between height of plant and diameter of stem [17].

Harvesting index

Harvesting index is obtained by dividing yield of grain by biological performance in percent. Variance analysis results (table 1) showed that harvesting index was affected by growth stimulators of boron, molybdenum and polyamine and became significant in probability level of (P<0.05) but it didn't have significant difference in cultivar and interaction. According to table 3 of mean comparison, harvesting index was 27.64% for Mahali Esfahan cultivar and 24.06% in Padideh cultivar. Mahali Esfahan cultivar had higher performance than Padideh cultivar. The mean harvesting index in foliar application after flowering was 13.90% and the mean harvesting index in foliar application before flowering was 8.85% as the highest and lowest means of harvesting index respectively in the studied levels. The interaction showed that harvesting index of Padideh cultivar after flowering was 19.88% higher than that in presence of foliar application and harvesting index of control Mahali Esfahan cultivar was 24.65 % higher than the mean harvesting index after flowering. Harvesting index is one of the important physiological indices which indicates transfer rate of photosynthetic substances from vegetative organs to grains [18]. declared that harvesting index was not affected by the cultivars [19] and [20].The harvesting index was a criterion for efficient transfer of photosynthetic substances produced in plant to grain [20].

Table 1 -analysis of variance(Mean Squares) spraying boron, molybdenum and polyamine for plant of safflower

Means Squares							
Source of Variation	df	*oil*	Seed weight	*capitol per plant*	harvest index	*plant height*	*diameter of stem*
Cultivar	1	7/370*	31/73ns	433/330*	76/612ns	187/042*	22/776**
Spraying	2	22/843**	221/635ns	75/616ns	524/388*	142/948*	0/515ns
Rep	3	1/218ns	63/666ns	33/171 ns	54/410ns	115/569*	6/029*
Spraying * *cultivar*	3	2/190 ns	155/67ns	171/664ns	40/544ns	228/448*	0/024ns
Error	15	2/156	99/791	87/214	106/561	37/128	1/805

ns: Non- significan

*, **: :Significant at P<0.05 and P<0.01 probability levels, respectively

Table 2 - Effect of various treatments Irrigation, cultivar, Spraying on studied traits

Treatment		*oil*%	Seed weight) g(	*capitol per plant*	harvest index%	*plant height*) cm(	*diameter of stem*) Mm(
Cultivar (V)	v1	10/43	32/51	24/96 a	12/72a	67/92a	24/06
	v2	11/56	30/18	33/46b	10/78b	73/50b	27/64
Spraying (F)	f1	30/48	31/72	26/13a	44/50a	30/54a	12/58
	f2	32/11	31/34	32/28a	47/30a	32/33b	13/90
Padideh cultivar (V_1.F)	v1×f1	8/85	33/85	24/43a	12/61a	60/13b	16/64
	v1×f2	9/53	33/7	30/82a	13/08a	68/88b	19/88
Mahali Esfahan cultivar (V_2.F)	v2×f1	10/55	29/59	27/82a	10/64a	72/25b	24/65
	v2×f2	11/27	29/98	33/73a	11/01a	80/25a	23/6

Means in each column followed by similar letter(s) are not significantly different at (P<0.05) probabilitylevel, using Duncan's Multiple Range Test
F1:(control) , F2: foliar application after flowering

CONCLUSION

Considering that this test was performed in two levels of foliar application and no foliar application after flowering, results showed that foliar application after flowering caused improvement of the yield of studied traits compared to the control and foliar application of boron, molybdenum and polyamine caused increase of the effective matter and increase of the oil percent in safflower.

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