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The Effects of Biological and Chemical Nitrogen Fertilizers on Agronomical Traits of winter Safflower cultivars in Saveh region of Iran

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ABSTRACT

In order to investigation of safflower cultivars reaction to different fertilizer, an experimental was carried out in a split plot design based on RCBD with three replications for 2011-2012 year in research farm of Islamic Azad University of saveh, Iran. Treatments were included different fertilizer(bio and chemical fertilizer) in six levels as main plots and spring planting (25 March) and winter safflower varieties as sub plots in three levels (Varamin295, Zarghan279, Goldasht).The result showed that all treatment except than harvest index significant in main factor levels (fertilizers). High plant and seed yield was significant in sub-factor levels (varieties). The result of interaction effect showed that highest seed yield to obtain of Varamin295 variety (3512 kg.ha^{-1} in a5b3 treatment).

Key words: Safflower, Biological and chemical Nitrogen fertilizers, yield and yield components

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INTRODUCTION

Safflower (*Carthamus tinctorius* L) an annual oilseed crop has been cultivated on small area in the world. It is consider one of the alternative oil crops, particularly in the dry and semi dry lands due to its tolerance to drought, salinity and cold stress. Safflower oil quality is high due to its fatty acids composition. As known, the fatty acid composition of vegetable oil is a main factor affecting on its commercial uses. Standard safflower oil contains about 6-8 % palmitic acid, 2-3 % stearic acid, 16-20% oleic acid and 71-75 % linoleic acid. In addition, very low levels of myristic (0.24 %) and behenic (0.43 %) acids were recorded in its oil [1].

In Iran, the main oil seed crops are canola, sunflower, soybean and cotton, nevertheless safflower (*Carthamus tinctorius* L.) is one of the native plants and farmers don't produce safflower in a large scale because it does not have high grain yield and with a low oil content. However, safflower can be a potential oilseed crops for low-rainfall areas such as Iran. The importance of safflower as oilseed crop has increased in recent years, especially with the increasing interest in the production of biofuels [2]. The direct yield components of safflower are number of plants per plot, number of heads per plant, number of seeds per head and weight of seeds [3]. The relative importance of each yield component is affected by many factors, including genotype, environmental conditions and cultural practices. Nutrient management is one of the critical inputs in achieving high productivity of safflower [4]. One of the most important methods for increasing agricultural production in crop management practices is to increase the efficiency of fertilizer dose. With this aim in view, optimum fertilizer application ratios, fertilizer content, nutritional requirements of the plant during the growth season, and the amounts of nutrients present in the soil should be ascertained [5,6].

Nitrogen is a major limiting nutrient for crop production. It can be applied through chemicals or biological resources, but chemical nitrogen fertilizers are expensive. Nitrogen is a fundamentally important element in biologically mediated production and nutrient cycling processes. N2 containing constituents of organic molecules

often confer bioactivity to these molecules. Major cellular, structural and functional constituents have essential and often highly specific requirements for N2 [7]. In natural ecosystems, biological N2 fixation is most important source of nitrogen. The capacity for nitrogen fixation is widespread among bacteria. The estimated contribution of free-living N-fixing prokaryotes to the N input of soil ranges from 0-60 ($kg.ha^1$) year. Azotobacter is used as biofertilizer in the cultivation of most crops. Azotobacter is an obligate aerobic diazotrophic soil-dwelling organism with a wide variety of metabolic capabilities, which include the ability to fix atmospheric nitrogen by converting it to ammonia. Azotobacter naturally, fixes atmospheric nitrogen in the plant rhizosphere. There are different strains of Azotobacter each has varied chemical, biological and other characters. However, some strains have higher nitrogen fixing ability than others [8]. Biological fertilizer with %50 of chemical fertilizers (nitrogen, phosphorus and potassium) led to an increase in plant growth, plant height, branch number, fresh and dry weight of safflower in comparison to applying chemical fertilizers alone, also utilization of azetobacter bio-fertilizer, bio-phosphate fertilizer, organic fertilizers, with half rate of chemical fertilizer, increased grain yield of safflower [9].

MATERIALS AND METHODS

The present experiment was laid out with the purpose of evaluation of winter safflower cultivars response to different fertilizer in during the 2011-2012 in the Research Field of Islamic Azad University, Saveh, Iran. Saveh city water is dry, semi dry day average precipitation and annual precipitation is about 200 mm .The experimental design was laid out in a Randomized Complete Block with a split plot arrangement of treatments in there replications. Treatments were included different fertilizer and varieties, in main plots include six levels (Urea100%, Azotobucter 100%, Nitroxin 100%, Urea 50% + Azotobucter 50%, Urea 50% + Nitroxin50%, Urea 50% + Azotobucter 25%+ Nitroxin 25%) and winter safflower varieties as sub plots in there levels (Varamin 295, Zaghan 279 and Goldasht). Before the beginning of experiment, soil samples were taken in order to determine the physical and chemical properties. Instructions executed Plan, 46% of 180 kg urea had been selected as 100 % and a third of it before planting well after planting and during the two-step (the stems on the flowers arranged)and two- thirds of the farm will be given. The amount of urea used in the treatment plan will be different than the percentages used were selected.

1 - (100 % urea) = 180 kg ha urea 46 %.
2 - (100 % of the Azotobacter) = 8 g Azotobucter in 1 liter of water.
3- (50 % of the Azotobacter + urea 50%) = 90 $kg.ha^{-1}$ urea + 4 g Azotobacter in 1 liter of water.
4- Urea 50% + Azotobucter 50% = 90 $kg.ha^{-1}$ urea +4 gr Azotobucter in 1 liter of water .
5- Urea 50% + Nitroxin50% = 90 $kg.ha^{-1}$ urea + 35 milliliter nitroxin in 1 liter of water.
6- Urea 50% + Azotobucter 25%+ Nitroxin 25% = 90 $kg.ha^{-1}$ urea+ 2 gr Azotobucter in 1 liter of water + 17.5 milliliter nitroxin in 1 liter of water.

At the end of growing season and prior to crop harvest, 10 plants were chosen randomly from each experimental unit and were cut from the surface. At physiological maturity stage, for determining the seed yield, the crop was harvested from a 4.8 m2 area per each plot and was left in the field for drying until constant weight (up to 12% moisture). In order to separate seeds form pod, a trashing combine harvester was used. The harvested seeds from each experimental unit individually weighed with a precision scale and thereafter seed yield expressed as (kg\ha). In order to measure the seed oil percentage of each experimental plot, about 20 grams of seed was prepared and using an NMR apparatus, the oil percentage was measured. The said apparatus works based on the magnetic induction of hydrogen nucleus which is a spectrometry method. One of the advantages of this method is its being destructive which accelerates the speed and accuracy of measuring the seed oil content. Processed by the combined analysis of variance using MSTAT-C statistical software. Means comparison of the data was done by Duncan's multi-range test (DMRT) ($P<0.05$).

RESULTS AND DISCUSSION

Plant height: The results variance analysis showed significant simple effects of different fertilizer and varieties , and also the interaction effect of the different fertilizer and variety on plant height was at a level one percent ($P<0.01$). The results of mean compared Showed the highest plant height were in the main plot of fertilizer a4, a5 and a6 and plant height highest levels subplots was of Zarghan 279 (b1).(Table 1). Such as mean compared interactions between fertilizer levels and varieties showed the highest values of plant height treatments a5b1, a6b1 , respectively (98.6 ,98 cm)(Table 1). Plant height, application of fertilizers also showed significant differences among varieties probably use of bio fertilizers of Nitroxin and Azotobucter by fixing nitrogen and air balancing basic macro and micro nutrient uptake Cause of root development of nitrogen absorption is better [10]. Application of biological fertilizer increased plant height by increasing plant growth regulator hormones production (such as IAA and GA) [11].

Seed yield: The results variance analysis showed significant simple effects of different fertilizer and varieties (P<0.01) , and also the interaction effect of the different fertilizer and variety on seed yield was at a level 5 % (P<0.05). The results of mean compared Showed the seed yield height were in the main plot of fertilizer a4, a5 and a6**,** and seed yield highest levels subplots was of Varamin 295 (b3).(Table 1). The highest of seed yield treatments a5b3, a6b3 , respectively (3512,3393 kg.ha^{-1})(Table 1). Seed yield, application of fertilizers also showed significant differences among varieties probably use of bio fertilizers of Nitroxin and Azotobucter by fixing nitrogen and air balancing basic macro and micro nutrient uptake**.** N fertilization did not affect the number of heads per plant, which disagrees with our study. The number of seeds per head, number of seeds per primary head and number of seeds per secondary head all increased by increasing N rates from 0 to 150 (kg ha^{-1}) [12]**.**

Harvest index: The results variance analysis showed non-significant simple effects of different fertilizer and varieties (P<0.01) , and the interaction effect of the different fertilizer and variety on Harvest index was significant effect (P<0.05). The highest of seed yield treatments a5b2 respectively (44.92 %)(Table 1). According to the results, harvest index was significant only in the treatment of primary and secondary factors and is not affected and it is for this reason that these varieties had almost the same shoot biomass production were almost identical. And fertilizer levels , did not affect the concentration of harvest index. Biological fertilizer increased harvest index due to increasing economic performance. Results were in agreement with finding most of the workers like [13].

Oil content: The results variance analysis showed significant simple effects of different fertilizer (P<0.05), and also the interaction effect of the different fertilizer and variety on Oil content was at a level 5 % (P<0.05). The results of mean compared Showed the Oil content height were in the main plot of fertilizer a3, a5 and a6 (Table 1). The highest of seed yield treatments a6b1, a6b2 , a6b3 respectively (33.6 ,34.6 and 33 %) (Table 1). Oil showed a significant difference due to treatments applied and bio-fertilizer treatments increased the amount of oil content. The nitrogen use safflower seed oil content and increased plant growth and the highest yield of respectively, conserving 90 N (kg.ha^{-1}) [14].

Table 1. Mean Comparison: Study of biological and chemical Nitrogen fertilizers on yield and yield components of three cultivars of winter Safflower in saveh region of Iran(2011-2012)

Treatment	**Plant height** (cm)	**Harvest index** (%)	**Oil content** (%)	**Seed yield** (kg.ha^{-1})
Fertilizers (Bio. & Che.) (A)				
F1	68.77b	39.73a	25.0b	2140.6b
F2	54.00c	35.72.a	28.56ab	2079.8b
F3	54.00c	35.13a	30.67a	2115.5b
F4	80.33a	36.79a	28.69ab	2675.2a
F5	86.22a	39.09a	30.57a	2845.8a
F6	84.89a	37.85a	33.78a	2797.6a
Variety (B)				
Varamin295 (B1)	82.72a	36.82a	29.22a	2216.05b
Zarghan279 (B2)	57.00c	38.80a	30.34a	2083.3b
Goldasht (B3)	74.39b	36.53a	29.06a	3028.1a
Fertilizers *variety(A*B)				
F1B1	73.0d	42.23ab	25.33c	1973.3bcd
F1B2	57.67f	39.49b	25.67c	1713.3d
F1B3	75.67de	37.46c	24.0c	2735.3b
F2B1	69.33e	35.56cd	28.68bc	1769.3d
F2B2	34.67g	36.25c	28.33bc	1823.3d
F2B3	58.0f	35.35cd	28.68bc	2647bc
F3B1	67.33e	34.07d	31.33ab	1775d
F3B2	36.33g	36.42c	31.0ab	1871.6d
F3B3	58.33f	34.9d	29.68b	2700b
F4B1	91.33ab	37.45c	26bc	2567.3bc
F4B2	69.67e	36.82c	31.0ab	2278.3bc
F4B3	80.0cd	36.09c	29.0b	3180ab
F5B1	98.67a	35.4cd	30.33ab	2552bc
F5B2	72.37de	44.92a	31.33ab	2473.3c
F5B3	87.67bc	36.97c	30.0ab	3512.3a
F6B1	96.0a	36.24c	33.28a	2659bc
F6B2	71.34de	38.89ab	34.68a	2340c
F6B3	86.68bc	38.42bc	33.0a	3393a
Significant (M.S)				
A	**	ns	*	**
B	**	ns	ns	**
A*B	**	*	*	*
CV%	5.16	7.90	9.72	6.50

Means with similar letter were not significant at the 5% probability level.
Levels of significant: =P< %5, **= P<%1 and NS = not significant*

F1 - (100 % urea) = 180 kg ha urea 46 %
F2 - (100 % of the Azotobacter) = 8 g Azotobucter in 1 liter of water
F3- (50 % of the Azotobacter + urea 50%) = 90 kg.ha^{-1} urea + 4 g Azotobacter in 1 liter of water
F4- Urea 50% + Azotobucter 50% = 90 kg.ha^{-1} urea +4 gr Azotobucter in 1 liter of water
F5- Urea 50% + Nitroxin50% = 90 kg.ha^{-1} urea + 35 milliliter nitroxin in 1 liter of water
F6- Urea 50% + Azotobucter 25%+ Nitroxin 25% = 90 kg.ha^{-1} urea+ 2 gr Azotobucter in 1 liter of water + 17.5 milliliter nitroxin in 1 liter of water

CONCLUSION

The result of infraction factors showed that highest seed yield earned of variety Varamin295 variety and to value 3512 and 3393 (Kg.ha$^{-1)}$ of treatments a5b3,a6b3. the final result showed with notice to was poor region soils of macro elements fertilizers using of biological and nitrogen fertilizers as Azotobacter and Nitroxin whit stabilize air nitrogen and absorption fertilizers at increase agronomy harvest was very suitable specific in safflower.

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