

Evaluation of different levels of nitrogen fertilizer on the performance components of safflower forage in dry conditions

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Abstract

The world is facing uneven spatial shortages of water to meet the needs of agriculture and the environment, uneven distribution of rainfall, population growth and the development of agricultural and industrial activities have made the issue of water shortage for various uses critical in most places. The word "drought" is so transparent that it conveys its main nature without the need for any interpretation, and it expresses the lack of water, dehydration, and the scarcity of water along with other associated features, including environmental warming and soil salinity. The present research was conducted in order to investigate different levels of nitrogen fertilizer on the morphological traits of fodder safflower under dry conditions, in the form of a randomized complete block design with three replications in a field located in Kermanshah province, Firozabad district, in the crop year of 1402-1403. The studied factors included 4 levels of nitrogen fertilizer (50, 75, 100, control) kg/ha. The results showed that the fresh weight of a single plant, dry weight of a single plant, the number of sub-branches and biological performance were affected by different levels of nitrogen fertilizer treatment. So that the highest fresh weight of a single plant (69.33 and 65 grams per single plant), respectively, was related to the consumption of 75 and 100 kg per hectare of nitrogen, and the lowest fresh weight of a single plant (50.66 grams per single plant) was related to the control treatment. Also, the dry weight of a single plant was the highest dry weight of a single plant, respectively (15, 14, 13 grams per square meter) related to the treatment of 100, 50, 75 kilograms per hectare of nitrogen consumption, and the lowest control (no use of nitrogen fertilizer) was 9.33 grams per hectare. square meter) showed. And the number of sub-branches, the highest number of sub-branches (15 sub-branches) related to the treatment of 100 kg of nitrogen consumption was obtained, which had a significant difference compared to the control (no use of nitrogen fertilizer) (9.33 sub-branches). The highest biological yield (2880.33 grams per square meter) related to the treatment of 100 kg per hectare of nitrogen consumption was obtained, which was superior to the control (no use of nitrogen fertilizer) (2516.67 grams per square meter). In general, the use of safflower fodder silage fertilized with nitrogen is recommended compared to unfertilized fodder (control).

Keywords: Fodder safflower, nitrogen fertilizer, fodder, dehydration

Introduction

Safflower (*Carthamus tinctorius* L.), cottonseed (*Gossypium* spp.), soybean (*Glycine max*), sunflower (*Helianthus annuus* L), and rapeseed (*Brassica napus* L.) are the most important oil-providing plants in the country (Azimzadeh, 2015).) which in some cases can be used industrially or as fodder. The optimal growth of agricultural plants, including safflower, and achieving the maximum quality and quantity of the product, requires the presence of a sufficient and balanced amount of additional and high-use fertilizers in the soil (Shahrasbi et al., 2015), which can be provided through chemical or organic fertilizers. Excessive consumption of chemical fertilizers causes excessive stimulation of vegetative growth of the plant, thinning and lengthening of the stem, and as a result, the bushes fall asleep and waste large amounts of water (Fowler, 2003). Also, the increase in underground water pollution and the possibility of toxic accumulation of nitrates in the plant tissue are other consequences of this approach (Pirdashti et al., 2010), therefore, it is better to use chemical fertilizers optimally and in combination with organic fertilizers (Pirdashti et al. al., 2010). In addition to producing oil, safflower also has the potential to produce fodder and meal for the animal husbandry industry (Martinez, 2004). It has been reported that fresh safflower forage is equal to a good pasture forage in terms of nutritional value and does not differ much from alfalfa in terms of dry weight (Ravi et al., 2008). In general, the main problem of using safflower fodder is the presence of tannin as an anti-nutritional compound in fresh safflower tissue. To solve this problem, we can use silage or use some additives to increase the palatability of safflower fodder (Ben Salem et al., 2005). Additives such as wood ash, activated charcoal, and polyethylene glycol lead to the destruction of the protein-tannin complex (McSweeney et al., 2001). Increasing the adaptability of crops to maintain the stability of production is one of the main goals of the smart agriculture approach to climate to face climate change. The development of drought-tolerant crops can be an effective strategy to maintain production stability in the face of declining water resources (Polania et al., 2017). Considering the existence of dry and semi-arid climatic conditions in most regions of the country, the study in this field is very important to identify drought tolerant plants and tolerance mechanisms. On the one hand, the safflower plant adapts to areas with little winter and spring rainfall during the period of flowering and seed formation, and on the other hand, having an extensive root system with the ability to absorb water from the lower layers of the soil, is a suitable oilseed plant to face the aforementioned challenges (Hussain). et al., 2016). Saffron is cultivated in almost 60 countries of the world and its cultivated area in the world in 2018 was equal to 1160 thousand hectares and its seed production was 718161 tons per hectare. The cultivated area of safflower in Iran is equal to 6154 hectares with an average yield of one ton per hectare (FAO.2012). Having spring and autumn types, it has a promising future (Omid et al, 2012). in arid and semi-arid regions of IranThe lack of organic matter in the soil as a natural source of nitrogen needed by plants and the presence of moisture stress as the main obstacle to nitrogen absorption have always been discussed, and after moisture stress, nitrogen stress is the most important factor limiting the production of rainfed crops in arid and semi-arid regions. Iran is considered (Sedri et al. 2017). Despite the benefits of nitrogen consumption, the unfavorable use leads to the pollution of surface and underground water reserves. Improper management of nitrogen leads to excessive consumption, wastage of nitrogen from agricultural lands in the form of nitrate leaching, sublimation of ammonia gas and nitrogen oxides. Currently, nitrate leaching and its entry into surface and underground waters are among the environmental problems of developed countries (Ting et al. 2017). Despite the fact that safflower has a relatively high tolerance to drought and salinity stress and shows flexibility to ecological conditions, its cultivation has not received much attention from farmers. On the other hand, the scientific investigation of its fodder aspects has also been overlooked. In case of scientific confirmation of acceptable quantity and quality for safflower fodder, it is hoped that researchers and producers will pay more attention to this plant. Therefore, this research was carried out with the aim of evaluating the effect of nitrogen fertilizer consumption and the use of supplementary fertilizers on the biological performance of safflower fodder.

Methodology

This experiment was carried out in the crop year of 1402-1403 in Kermanshah province, Firuzabad district, with latitude coordinates of 37 degrees and 5 minutes north and longitude 47 degrees and 40 minutes east. In order to determine the physical and chemical characteristics of the soil of the test site, sampling was done from the depth of 0 to 30 cm. Field soil preparation including plowing and disc and then adding basic fertilizers was done based on soil test. This experiment was conducted as a randomized complete block design in three replications. The treatments investigated in this research included different levels of nitrogen (50, 75, 100, control) kg/hectare, different levels of nitrogen fertilizers were added to the soil at the same time as cultivation. Planting was done on the 9th of Azar by manual method in rows so that each plot includes 6 rows and the dimensions of each plot are (3 x 2) square meters with the distance between the rows of cultivation 40 cm. Cultivation was carried out in a rainfed manner, the amount of seed used for each plot was 20 grams with a distance of 6 cm on the row. The cultivation depth was 5 cm. During the growth period of the plant, the time of greening, rosette, establishment, and five percent flowering stage were recorded. In order to measure the conversion factor of fresh fodder into dry fodder, 10 consecutive plants were harvested from the second row of planting in the 5% flowering stage and their fresh weight was measured. then to measure the dry weight, these plants were dried at 75°C for 48 hours and weighed immediately after removing from the oven. From the ratio of the dry weight of these 10 plants to their weight, the coefficient of conversion of fodder weight to dry weight was obtained. The traits of plant height, number of secondary branches, fresh weight, dry weight, and biological yield were also measured. Data analysis was done using SAS software and Excel 2016.

Table 1-Physical and chemical properties of the experimental field soil

Texture (%)	Nitrogen (%)	Phosphorus (ppm)	Potassium (ppm)	EC	Acidity pH	Organic C (%)
Clay loam	0.20	12.80	229.98	0.394	7.35	1.9

Results and discussion

Plant height

Based on the results of data variance analysis, plant height in different fertilizer treatments was not significant at the probability level of one percent and five percent (Table 1). Based on the average data comparison results (Figure 1), different levels of fertilizer treatments did not significantly increase the height of the safflower forage plant. It seems that the use of urea fertilizer in the test conditions has led to an increase in the height of the stem and probably followed by an increase in the vegetative growth of the plant. With an increase in the amount of nitrogen used, the height of the golezang and chamomile plants increased, which is consistent with the findings of Hoag et al. (2007).

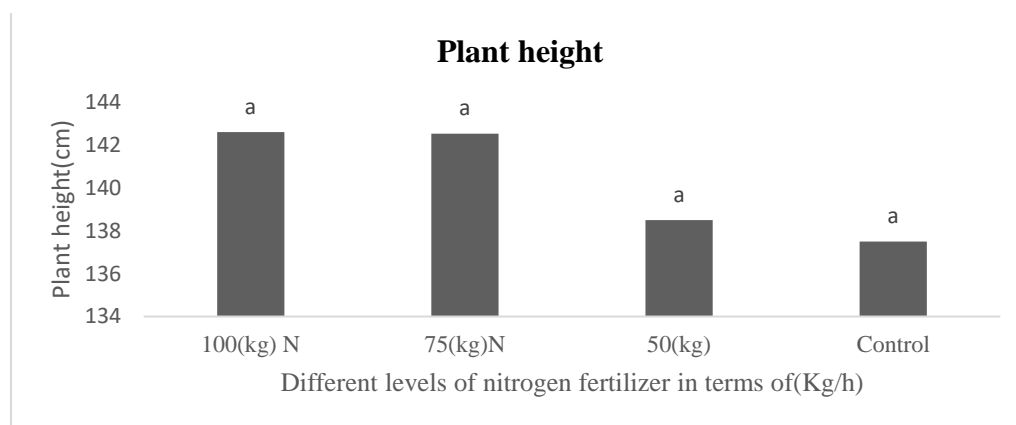


Figure (1) The effect of different levels of nitrogen fertilizer on the height of fodder safflower plant in (cm)

Fresh weight of single plant

The effect of different fertilizer treatments on the weight of a single plant was significant at the five percent probability level (Table 1). The results of the comparison of the average data obtained from the experiment showed that the highest fresh weight of a single plant (69.33 and 65 grams per single plant) corresponded to 75 and 100 kg of nitrogen consumption, and the lowest fresh weight of a single plant (50.66 grams per single plant) was related to Shaheed treatment. figure 2). In an experiment conducted by Naderi et al. (2004), it was found that when the available water for the safflower plant decreases, the biomass yield also decreases. Water shortage and drought stress are effective on the duration of each developmental stage in safflower, so that drought stress caused earlier flowering, faster ripening and reduced yield in safflower.

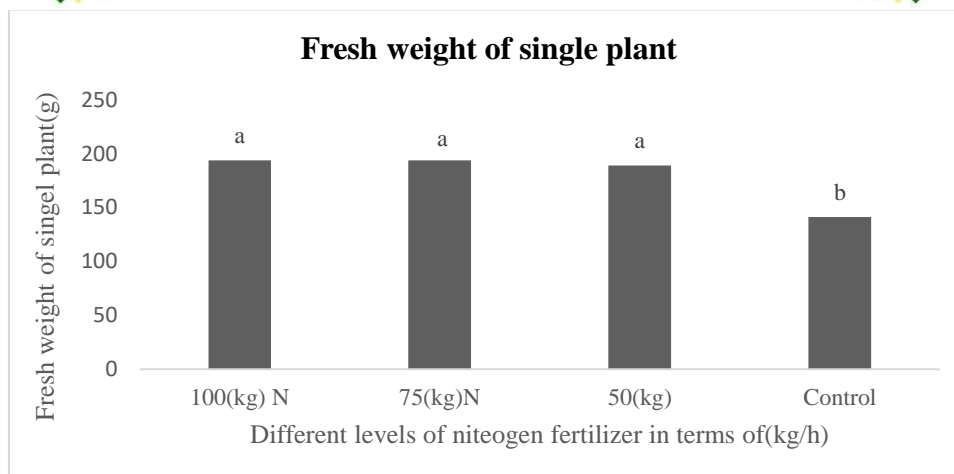


Figure (2) The effect of different levels of nitrogen fertilizer on the fresh weight of a single forage safflower plant in terms of (g)

Table 3. Analysis of variance and mean square Safflower forage

S.O.V	d.f	mean of squares				
		Plant height	Fresh weight of single plant	Dry weight of a single plant	The number of sub-branches	Biological function
Replication	3	20.310 ^{ns}	39.583 ^{ns}	6.250 ^{ns}	1.0833 ^{ns}	2310.750 ^{ns}
Treatment	3	31.356 ^{ns}	1948/30 ^{**}	207.222 [*]	19.194 ^{**}	78597.111 [*]
Error	9	12.064	17.395	23.138	3.527	700.86
CV (%)	%	2.4	1.8	7.9	14.5	1

ns :Non-significant, *and **: Significant at $\alpha=0.01$ & $\alpha=0.05$, respectively.

Dry weight of a single plant

The results of variance analysis of the data showed that different levels of fertilizer treatments on the dry weight of a single fodder safflower plant were significant at the probability level of 1% (Table 1). The comparison of the averages showed (Figure 3), that the highest dry weight of a single plant was obtained respectively (15, 14, 13 grams per square meter) related to the treatment of 100, 50, 75 kg nitrogen consumption and the lowest control (no nitrogen fertilizer consumption)) showed 9.33 grams per square meter. The results of the research of Asgharzadeh and Fathi Nasri (2013) showed that safflower can be used as a quality fodder in animal nutrition, and the use of nitrogen and phosphorus fertilizers significantly improved the ruminal fermentation quality of the dry matter of the plant. Silage of the plant improved its nutritive value compared to silage and non-silage.

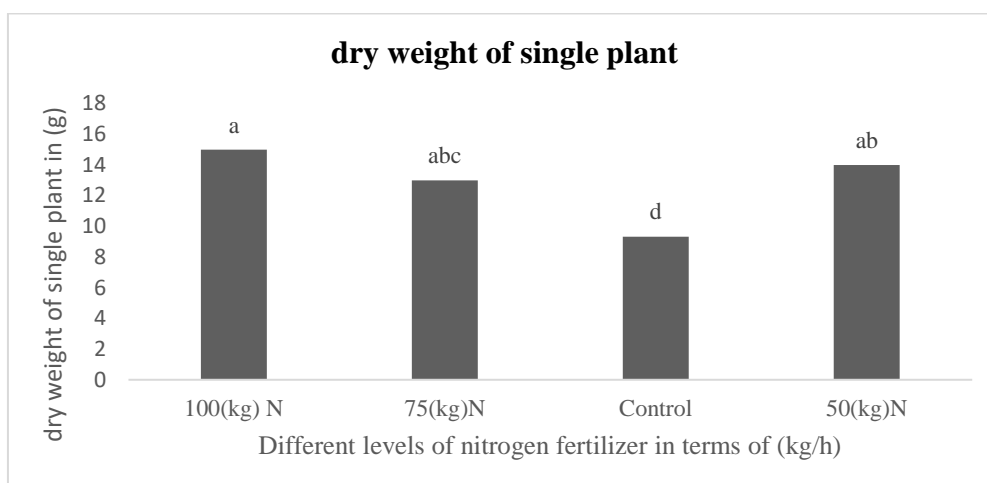


Figure (3) The effect of different levels of nitrogen fertilizer on the dry weight of a single fodder safflower plant in terms of (g)

The number of sub-branches

The results of variance analysis of the data showed that different levels of fertilizer treatments on the number of fodder safflower sub-branches were significant at the 1% probability level (Table 1). The comparison of the averages showed (Figure 4) that the highest number of secondary branches (2880.33 grams per square meter) related to the treatment of 40 grams of nitrogen consumption was obtained, which compared to the control (no use of nitrogen fertilizer) (2516.67 grams per square meter) had the highest number of secondary branches. shows. Nitrogen element has the greatest effect on the growth of aerial organs and by increasing the amount of net absorption of photosynthetic substances, it can increase the amount of biomass production. In safflower, biomass increase will be in the form of increased branching and plant height (Forooghi & Ebadi, 2012).

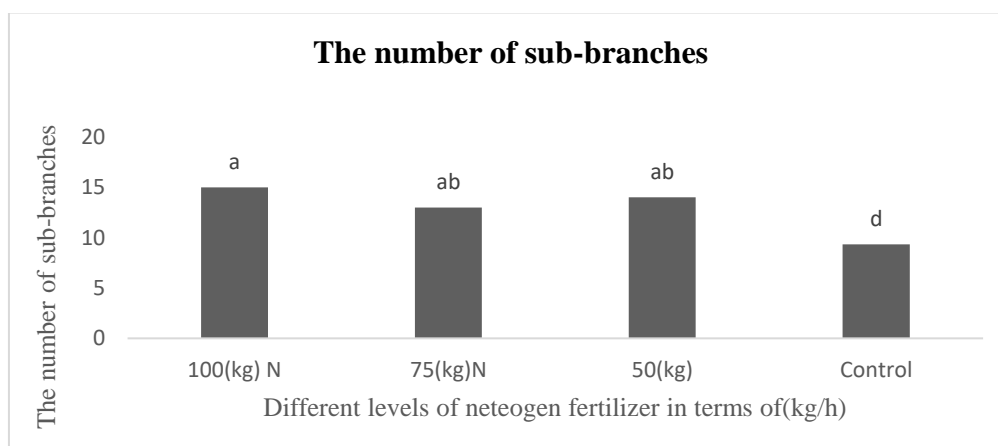


Figure (4) The effect of different levels of nitrogen fertilizer on the the number of sub-branches safflower plant

Biological function

The results of data variance analysis showed that different levels of fertilizer treatments on the biological performance of fodder safflower were significant at the probability level of 1% (Table 1). The comparison of the averages showed (Figure 5) that the highest biological yield (2880.33 grams per square meter) related to the treatment of 100 grams of nitrogen consumption was obtained compared to the control (no use of nitrogen fertilizer) (2516.67 grams per square meter). The results of Marajipour's (2012) research on saffron also showed that the highest biological yield was obtained from the consumption of the highest amount of nitrogen consumption. The results of Abdul Rahman's (2008) study on sesame also indicated that the highest biological yield was obtained from the application of the highest amount of nitrogen fertilizer (180 kg/ha) and the lowest biological yield was obtained from the control treatment.

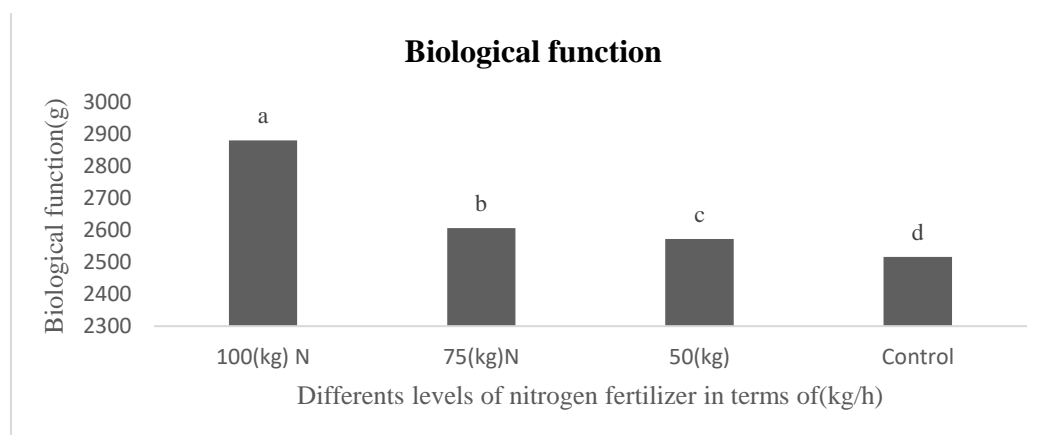


Figure (5) The effect of different levels of nitrogen fertilizer on the height of fodder safflower plant in terms of (grams per square meter)

Conclusion

Although the use of nitrogen fertilizer increases the growth indicators of fodder safflower in drylands, this practice also increases the length of the safflower growth period. Therefore, in the years when the distribution of rainfall is normal, the use of nitrogen fertilizers can increase the morphological traits in safflower forage. Nitrogen element in dry soils can increase the total yield in fodder safflower. The results of this experiment showed that the consumption of 100 kg of nitrogen fertilizer improved most of the agricultural traits (number of sub-branches, biological yield, fresh weight, dry weight) and safflower yield. Nitrogen fertilizer in rainfed agriculture can increase crop yields.

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