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Comparison of the Effect of Nano Urea and Nono Iron Fertilizers with Common Chemical Fertilizers on Some Growth Traits and Essential Oil Production of *Borago Officinalis L*

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Abstract

Background and purpose: Quality and quantity of medicinal plants has been interested. Sustainable agriculture has been concerned in use of common chemical fertilizers. Thus, use of new fertilizers may be suitable replacements for chemical fertilizers. Thus, the present study was conducted to compare the effect of nano urea and nono iron fertilizers with common chemical fertilizers on some growth traits and essential oil yield of *Borago officinalis L.*

Methods: The experiment was based on a randomized block completely design in a split plot arrangement. Different levels of fertilizers were considered as main factor as follows; iron sulfate, nano iron 10%, urea and nano urea. Distribution form was considered as secondary factor as follows; foliar application, soil application and foliar+ soil application. The number of seed, plant height, fresh and dry weights of aerial parts and essential oil production were measured at flowering stages.

Results: Urea fertilizer could significantly improve growth traits in terms of dry and fresh weights and also plant height. Nano iron fertilizer could significantly increase plant height and number of seed in plants. Nano urea interestingly increased essential oil production.

Conclusion: Nano iron fertilizer can be suggested as increasing the number of seed for borage without negative effects on plants and environment.

Keywords: Nano urea; Essential oil production; Number of seed; Nano iron; Borage

Introduction

Borage (*Borago officinalis L.*), an annual plant, is member of *Boraginaceae* family [1] and extensively originates from Western regions of Mediterranean area. It has been shown that only seed of borage oil can be internally used because of its toxic pyrrolizidine alkaloids [1]. Its oil has been known to have linoleic acid and γ-linolenic acid. Positive role of these components in nervous system, cardiovascular system and prevention of cancer has been known. It has been reported activity of dried flower of borage for treatment of obsessive compulsive disorder [2,3]. However, quality and quantity of medicinal plants has been interested. Sustainable agriculture has been concerned in use of common chemical fertilizers. Thus, use of new fertilizers may partly compensate effects of usual fertilizers and they also may have not negative effect on environment and human health.

Iron is an essential trace mineral for plants, although it may be required more than other trace minerals [4]. It has been known as essential cofactor for by 140 enzymes involving with biochemical reactions [5]. It is well known that iron deficiency and/or low activity can lead to insufficient production of chlorophyll. On the other hand, insufficient production of chlorophyll can subsequently lower yield. Iron deficiency signs were as follows; yellowish color between leaf veins particularly in young leaves, which can subsequently create necrosis of all these leaves [6]. The use of iron sulfate in the soil has been limited. Thus, the use of replacement combinations may partly

remove limitations. However, urea is the fertilizer most popular which increases nitrogen levels which may then increases susceptibility to pest and diseases. It has been reported that coating and binding of nano and sub nano-composites are capable to regulate the release of nutrients from the fertilizer capsule [7]. The fertilizers prepared by nanotechnology slow up release and they also affect the environment and the contamination of the subsurface water [8]. It has been known that production of plant fresh herb, the essential oil content and its composition may be affected by growth stages, ecological and climatic conditions. Several studies have been reported to increase yield potential of medicinal plants by fertilizers [9,10], but same studies have been concerned with use of inorganic fertilizers which may influence biological aspect of soil. Thus, the present study was conducted to compare the effect of iron sulfate, nano urea and nono iron fertilizers with common chemical fertilizers on some growth traits of *Borago officinalis L.*

Materials and Methods

The present study was conducted in research farm of Islamic Azad University, Tabriz University. Different levels of fertilizers were applied in forms foliar application, soil application and foliar+ soil application. Different levels of fertilizers were considered as main factor as follows; iron sulfate, nano iron 10%, urea and nano urea. Distribution form was considered as secondary factor as follows; foliar application, soil application and foliar+ soil application. In the present study, borage (*Borago officinalis L.*) was planted and harvested. Foliar application was performed at flowering stage. Iron sulfate at concentration 0.005, urea fertilizer at rate of 5% and all nano fertilizers at rate of 0.002 were used. The samples were collected for the preparation of essential from each 5 rows. The plants were cut at ground level and samples of plants were dried in the shade and for extracting essential oils with water practice and Clevenger device [11]. About 100g of each dried sample (aerial parts) was separated, triturated and steam-hydro distilled for 2.5 hours. The extraction of oils was carried out according to method of European Pharmacopoeia (1983). The oils were dried over anhydrous sodium sulphate and stored in sealed vials at 2 °C before analysis. The number of seed, plant height, fresh and dry weights of aerial parts and essential performance were measured at flowering stages. The experiment was based on a randomized block completely randomized design in a split plot arrangement. Analysis variance of data was performed using SAS software and treatment means were compared using Duncan multiple range test ($P<0.05$).

Results

Our findings (Tables 1 & 2) showed that growth traits and essential oil yield were influenced by different fertilizers. Fresh and dry weights of aerial plants and also plant height were increased in borage fertilized by urea fertilizer. Number of seed was significantly higher in plants fertilized with nano iron compared with those fertilized by nano urea. The production of essential oil was significantly increased in plants fertilized with nano urea ($P<0.05$) compared with other groups. The used methods for fertilizer distribution (soil application, foliar application or the both) had not significant effects on the studied traits ($P>0.05$).

Table 1: Data mean comparisons of fertilizers on the studied traits.Subscripts (a-b) show significant differences among groups each column.

Fertilizers	Fresh Weight of Aerial Parts (G)	Dry Weight of Aerial Parts (G)	Plant Height (Cm)	Number of Seed Each Plant	Essential Oil Yield (%)
Iron sulfate	32.70ab	3.71ab	55.85b	263.12ab	5.46b
Nano iron	33.65ab	3.75ab	63.50a	329.59a	6.33b
Urea	35.84a	4.20a	64.22a	268.19ab	6.70b
Nano urea	30.15b	3.50b	58.26b	211.02b	10.96a

Table 2: The data for analysis of variance on some measured traits.Subscripts **and ns show significant differences and non-significant, respectively.

Sources	Df	Fresh Weight of Aerial Parts	Dry Weight of Aerial Parts	Plant Height	Number of Seed Each Plant	Essential Oil Yield
Replicate (R)	2	1078.3**	15.51**	850.10**	54067.89**	56.98**
Fertilizer level (A)	9	62.05**	0.822**	128.85**	21091.71**	41.15**
Ea	18	49.18	0.391	147.67	13209.47	9.25
The used method (B)	2	11.25ns	0.148ns	8.88ns	57.85.53ns	1.26ns
Eb	40	19.98	6.02	11.34	6518.98	2.06
A*B interaction	18	14.39ns	0.119ns	15.83ns	6063.38ns	1.89ns
CV	-	10.12	10.86	5.88	33.24	20.45

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Discussion

Our findings showed that urea fertilizer significantly increased fresh and dry weight and plant weight compared nano urea fertilizer. The data for fresh and dry weight in urea and nano urea fertilizers were as follows; for fresh weight (35.84 vs. 30.15), for dry weight (4.20 vs 3.50) and plant height (64.22 vs 58.26). Numbers of seed were also increased in plants fertilized with nano iron compared those were fertilized with nano urea (329.59 vs 211.02). In contrast with other results, yield of essential oil was significantly increased in borage fertilized with nano urea fertilizer than plants fertilized by iron sulfate (10.96 vs 5.46). Considering the growth parameters, a study has been shown efficiency of chemical fertilizers compared with biological fertilizers for improvement of growth traits in *Trachyspermum copticum* [12]. A partly similar study has been reported efficiency of chemical fertilizers than biological fertilizers on growth traits of borago [13]. An increase in growth parameters by urea fertilizer may be attributed to nitrogen compounds present in urea fertilizer. It has been accepted role of nitrogen as synthesizing the amino acids and nucleic acids. It seems that urea provides the required nitrogen for synthesis of amino acids and nucleic acids and can subsequently increase growth parameters. However, responding level of plant to urea fertilizer can be attributed to the needed nitrogen in soil. A study has been shown that plant does not respond to urea fertilizer when soil nitrogen is enough [14]. The role of nitrogen in photosynthesis may be other reason for improvement in growth traits in plants fertilized by urea fertilizer. This claim was confirmed by previous studies. A study has been reported that nitrogen can be released from organic fertilizer and it subsequently corporates in porphyrin rings of chlorophyll molecules [15] and finally improves growth traits. The numbers of seed and plant height were significantly increased in plants fertilized with nano iron. Parallel to our findings, previous studies have been documented the nano iron activity as increasing the height in plants [16-18]. Also, a study has been reported efficiency of iron as increasing the seed [19]. Relation between chlorophyll and iron has been previously reported and it subsequently increases number of seed. Urea fertilizer could not improve production of essential oil. It has been shown a reverse relation between nitrogen levels and yield of essential oil [20]. It is believed that urea fertilizer increases synthesis of protein for growth and toward to synthesis of protein can prevent fat and essential oil production [21]. It seems the prepared fertilizers in form of nano show lower competition for synthesis of protein and they tend to increase the essential oil. Mechanism of this association is not known.

The applied methods for fertilizers distribution had not significant effect on the investigated traits and also there were no significant interaction between applied methods and fertilizer type. Mohamadipoor et al. [22] showed significant interaction between fertilizer and the applied method. This may be due to fertilizer type, used levels, climate conditions and studied plant [23].

Conclusion

In conclusion, urea fertilizer could significantly improve growth traits in terms of dry and fresh weights and also plant height. Nano iron fertilizer could significantly increase plant height and number of seed in plants. Nano urea interestingly increased essential oil production. Nano iron fertilizer can be suggested as increasing the number of seed without negative effects on plants and environment.

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