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

Parizad Mahmoodi1*, Mehrdad Yarnia1, Reza Amirnia2, Alireza Tarinejad3 and Hosein Mahmoodi4

1Department of Agronomy, Islamic Azad University, Iran
2Department of Agronomy, Urmia University, Iran
3Department of Agricultural Biotechnology, Azarbaijan Shahid Madani University, Iran
4Department of Medicine, Islamic Azad University of Medical Sciences, Iran

Submission: March 20, 2017; Published: April 28, 2017

*Corresponding author: Parizad Mahmoodi, Department of Agronomy, Islamic Azad University, Tabriz Branch, Tabriz, Iran, Tel: +989148508992; Email: Parizad.mahmoodi732@gmail.com

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 nano 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 were applied in forms 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                   | 10.96b                 |

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**                    | 5850.10**    | 54067.89**                | 56.98**            |
| Fertilizer level | 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  | 2     | 11.25ns                      | 0.148ns                    | 8.88ns       | 57.85.53 ns               | 1.26ns              |
| Eb               | 40    | 19.98                        | 6.02                       | 11.34        | 6518.98                   | 2.06                |
| A*B interaction  | 18    | 14.39ns                      | 0.119ns                    | 15.83ns      | 6063.38 ns                | 1.89ns              |
| CV               | -     | 10.12                        | 10.86                      | 5.98         | 32.34                     | 20.45               |
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 borage [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.

Acknowledgment

The authors would like to acknowledge the Dr. Ali Olfati (from University of Tabriz, A.olfati65@gmail.com; +98919 596 6273), thank you for keeping me on track, helping me to resolve issues and assisting me to get my dissertation completed.

References

1. Orzeszko-Rywnka A, Recalska M, Balcer E (1990) Przydatnośc czosnku, rumianku i nagietka do zaprawiania nasion warzyw Journal of Research and Applications in Agricultural Engineering 56(4): 52-57.
2. Sayyah M, Boostani H, Pakseresht S, Malaieri A (2009) Efficacy of aqueous extract of Eichium amoenum in treatment of obsessive-compulsive disorder. Prog Neuropsychopharmacol Biol Psychiatry 33(8): 1513-1516.
3. Sarris J, Camfield D, Berk M (2012) Complementary medicine, self-help, and lifestyle interventions for obsessive compulsive disorder (OCD) and the OCD spectrum: a systematic review. Journal of Affective Disorders 138(3): 213-221.
4. Taiz L, Zeiger E (2002) Plant physiology. Sinauer Associates, Inc. Sunderland, Massachusetts, USA.
5. Brittenham GM (1994) New advances in iron metabolism, iron deficiency and iron overload. Curr Opin Hematol 1(2): 549-556.
6. Malakooti MJ, Samar SM (1998) Technical publication, Agricultural education publications Press.
7. Liu X, Feng Z, Zhang S, Zhang J, Xiao Q, et al. (2006) Preparation and testing of cementing nano-subnano composites of slow or controlled release of fertilizers. Science Agriculture Journal 39(8): 1598-1604.
8. Sartain JB (2011) Food for turf: Slow-release nitrogen. Grounds Maintenance University of Florida, Penton media Inc., USA.
9. Das K, Dang R, Shivananda TN, Šekeroğlu N (2007) Comparative Efficiency of Bio- and Chemical Fertilizers on Nutrient Contents and Biomass Yield in Medicinal Plant Stevia rebaudiana Bert. International Journal of Natural and Engineering Sciences 1(3): 35-39.
10. Sharma H, Kumar A (2011) Effect of plant growth regulators and chemical fertilizers on growth and productivity of Chlophophytum tuberosum and Pergularia daemia. Journal of Medicinal Plants Research 5(13): 2647-2651.
11. Yousefzadeh S, Modarres-Sanavy AM, Sefidkon F, Asgarzadeh A, Ghalavand A, et al. (2013) Effects of Azocompost and urea on the herbage yield and contents and compositions of essential oils from two genotypes of dragonhead (Dracecephalum moldavica L) in two regions of Iran. Food Chem 138(2-3): 1407-1413.
12. Alkbarinia A, Ghalavand A, Sefidkon F, Rezaee MB, Sharifi A (2003) Study on the effect of different rates of chemical fertilizer, manure and mixture of them on seed yield and main, compositions of essential oil of Ajowan (Trachyspermum copticum). Iranian Research and Development 16(4): 32-41.
13. Moshkani M, Armin M, Jamimoini M (2013) Investigation of qualitative
and quantitative response of Borago (Borago officinalis L.) to biological and chemical fertilizers. Eco-phytochemical Journal of Medical Plants 3: 57-67.

14. El Hafid, R, Blade SF, Hoyano Y (2002) Seeding date and nitrogen fertilization effects on the performance of borage (Borago officinalis L.). Industrial Crops and Products 16: 193-199.

15. Amujoyegbe BJ, Opabode JT, Olayinka A (2007) Effect of organic and inorganic fertilizer on yield and chlorophyll content of maize (Zea mays L.) and sorghum Sorghum bicolor (L.) Moench. African Journal of Biotechnology 6(16): 1869-1873.

16. Yarnia M, Farajzade A, Nobari N, Ahmadzade V (2007) 10th soil science congress. 26-28 August, Karaj, Iran.

17. Karp K, Starast M, Kaldmae H (2002) Influence of The Age of Plants And Foliar Fertilization on The Yield of Strawberry Cultivar Jonsok Under Plastic Mulch. Acta Horticulturae 567(96): 459-562.

18. Keikha Gh A, Fanaee HR, Polshekan MR, Akbari Moghadam AR (2005) 9th Soil Science Congress of Iran. Tehran, Iran.

19. Haghighatnia G, Rajaee M (2003) 8th Soil Science Congress of Iran. University of Guilan, Rasht, Iran.

20. Lucy M, Reed E, Glick BR (2004) Application of free living plant growth promoting rhizobacteria. Antonie Van Leeuwenhoek 86(1): 1-25.

21. Weise EA (2000) Oil seed crops. Blackwell Sci Ltd Oxford, UK, p. 364.

22. Mohamadipoor R, Sedaghathoor S, Mahboub Khomami A (2013) Effect of application of iron fertilizers in two methods ‘foliar and soil application’ on growth characteristics of Spathiphyllum illusion. European Journal of Experimental Biology 3(1): 232-240.

23. European Pharmacopoeia (1983) Maisonneuve, Sainte Ruffine, pp. 1-8.

Your next submission with Juniper Publishers will reach you the below assets

- Quality Editorial service
- Swift Peer Review
- Reprints availability
- E-prints Service
- Manuscript Podcast for convenient understanding
- Global attainment for your research
- Manuscript accessibility in different formats (Pdf, E-pub, Full Text, Audio)
- Unceasing customer service

Track the below URL for one-step submission
https://juniperpublishers.com/online-submission.php