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Effect of nitrogen and phosphorus fertilizers on yield of *Thymus daenensis* in dry condition

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Abstract

Thymus daenensis is an aromatic medicinal plant endemic to Iran. Recent studies have shown that *Thymus* species have strong antibacterial, antifungal, antiviral, antiparasitic, spasmolytic and antioxidant activities. The objective of this study was to assess the effect of two factors of nitrogen and phosphorus on growth, yield, quality and quantity of effective material of *T. daenensis* under dry farming condition. Two randomized block experiment design were established with three and four treatments and three replicates for nitrogen and phosphorus fertilizers, respectively. The designed treatments for phosphorus consisted of 0, 65 and 130 kg/ha triple superphosphate and designed treatments for nitrogen consisted of 0, 50, 100 and 150 kg/ha Urea. In this study, some variables such as wet and dry weight, number of flower and tiller per plant, diameter of canopy, yield and percentage of the essence and plant height was measured. The results indicated that third and fourth treatments of urea had similar effect on *Thymus* and in the similar condition, the third treatment is preferred. Also, third treatment of triple super phosphate was the best treatment. Finally, according to interaction effect of them, treatment of P_3N_3 (100 kg/ha urea and 130kg/ha triple super phosphate) was the best treatment and it was most effective for yield of *Thymus* under dry farming condition.

Keywords: Dry farming, Nitrogen, Phosphorus, *Thymus daenensis*, yield

Introduction

The genus *Thymus* belongs to the family Lamiaceae and includes nearly 215 herbal and small shrub species in the world. The mediterranean area is said to be the origin of this kind of genus (Cronquist, 1988; Heywood, 1993; Morales, 2002). Among 215 species of this genus grown in the world, 14 species are distributed in Iranian flora (Jalas, 1982; Stahl-Biskup and Saez, 2002), which *Thymus carmanicus* Jalas., *Thymus daenensis* subsp. *daenensis* Celak. and *T. daenensis* subsp. *lancifolius*, *Thymus persicus* (Roniger ex Reach. F.) and *Thymus trautvetteri* Klokov and Desj.-Shost. are endemic (Rechinger, 1982). The Persian and local names of *Thymus daenensis* are ''Avishan-e-denaee'' and ''Ooshon-e-kohi'', respectively (Ghasemi Pirbalouti, 2009a; Mozaffarian, 2006). *T. daenensis* generally grows in high altitude places in the submontane. *Thymus* species are commonly used as flavoring agents, spice and medicinal plants because of their biological and pharmacological properties. Recent studies have shown that *Thymus* species have strong antibacterial, antifungal, antiviral, antiparasitic, spasmolytic and antioxidant activities (Zargari, 1990; Mozaffarian, 2006; Sefidkon 2002).

In traditional medicine, leaves and flowering parts of *Thymus* species are widely used as tonic and herbal tea, ahntiseptic, antitussive and carminative as well as treating colds (Amin, 2005; Ghasemi, 2009a; Zargari, 1990). Thymus oils and extracts are widely used in pharmaceutical, cosmetic and perfume industry also for flavoring and preservation of several food products (Bauer *et al*., 1997). Pervious works showed that essential oil of *T. daenensis* leave and flower exhibited antimicrobial activities against *Candida albicans* (Ghasemi *et al*., 2009b), *Listeria monocytogenes* (Ghasemi *et al*., 2009 b), *Campylobacter jejuni* and *Campylobacter coli* (Ghasemi *et al*., 2010) and *Staphylococcus aureus*, *Escherichia coli*, *Pseudomonas aeruginosa* and *Klebsiella pneumonia* (Ghasemi *et al*., 2010).

Recent researches are based on climate and agricultural factors effect such as implant and harvest time, pest recognition and etc on Thymus production (Hornok, 1986). The published results reveal that major volatile constituents obtained from the aerial parts of the plant are thymol (73.9%), carvacrol (6.7%), p-cymene (4.6%), β-caryophyllene (1.5%) and γ-terpinene (1.4%) (Stahl-Biskup, 2005). Best of volatile constituents of Thymus Daenensis is thymol that causes international fame of this plant (Furia, 1995; Sfaei Ghomi, 2009). For assessing light effect on amount of essence, Thymus was put under several intensity of light (sunshade, cloudy, 15%, 27%, 45% and 100% light) and recognized that the maximum essence concentration and thymol got in 100% sunlight and length of leaf decreased with reduce of light levels. Amount of essence not only depended on grow stage of plant but also, temperature, moisture, quality and quantity of light, rainfall are effected on it (Letchamo, 1995).

Physical, biological and chemical properties of soils affect growth and effective materials of medicinal plants (Ghasemi, 2009a). With fertilizing of medicinal plants,

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Table1. Analysis of variance for the measured traits

SOV	df	weight		Number of flower and toe in brushwood	canopy	essence		plant height
		wet	dry			yield	%	
Replication	2	89168.5	3845.025	170.058	8.318	124.83	0.00015	1.14
N	3	55801.22**	2097.005**	722.957**	263.57**	240.57**	0.913**	39.9**
P	2	81503.36**	3091.23**	1541.159**	52.88*	225.26**	0.155**	0.58n.s
N×P	6	11251.03n.s	476.791ns	68.35n.s	14.01n.s	28.62*	0.016**	0.9n.s
Error	-	6842.98	260.029	119.51	10.48	8.67	0.00018	2.77
CV(%)	-	17.59	17.04	17.73	13.65	16.41	0.73	8.15

initial and necessary elements of growth such as nitrogen, phosphorus and potassium were supplied. For medicinal plants, similar to other agricultural production, organic and chemical fertilizers can be used together. Today in sustainable agriculture, development of medicinal plants using various amount of organic fertilizer is important (Stahl-Biskup, 2005). Harvest of Thymus is the critical point in agricultural management of this plant. Then, the best time of harvest is early and middle of flowering period for getting maximum effective material (Stahl-Biskup, 2005). Nitrogen is essential and vital element for plant. For evaluating nitrogen fertilizer effect on yield and quality of *Thymus vulgaris*, different level of nitrogen fertilizer (0, 30, 60, 90 and 120 kg net nitrogen /ha) used. The results showed that with increasing amount of fertilizer, plant yield also increased. Fertilizer treatments did not effect the amount of essence and thymol; but with attention to effect of it on plant yield, it increased thymol and essence yield (Ceylan, 1994).

The most important method to supply required nitrogen is using nitrogen fertilizers. Different fertilizers such as Ammonium Nitrate, Ammonium sulfate, Urea, Urea coated with sulfur are most important sources of nitrogen. Phosphorus is another essential element for plants. Total concentration of phosphorus in soil is high but, usually phosphorus is unavailable for plants or it is utilizable only in outside of rhizosphere. The objective of this study was assessing the effect of two factors of nitrogen and phosphorus on growth, yield, quality and quantity of effective material of *Thymus daenensis* under dry farming condition.

Materials and methods

Thymus daenensis is an aromatic medicinal plant endemic to Iran that assessed in this study. Some important places for growing of *Thymus daenensis* in Iran are Ardabil, Zanjan, Kordestan, Kermanshah, Esfehan, Lorestan, Fars, Tehran, Qazvin, Azarbayejan and Hamedan provinces (Rechinger, 1982).

This research was conducted from 2009 to 2010 in research station of Ab-sard-e- Hamband pasture. The study area is located in 70 km east of Tehran and 15 km southeast of Damavand county and covers an area about 500 m^2. Its elevation is about 1960 meters above the sea level.

Moreover, distribution of rainfall is not uniform throughout the year and precipitation mostly occurs during the winter season with an average of about 320 mm. Two randomized block experiment design with three and four treatments and three replicates for nitrogen and phosphorus fertilizers were established, respectively. The designed treatments for phosphorus consisted of 0, 65 and 130 kg/ha Super phosphate Triple and designed treatments for nitrogen consisted of 0, 50, 100 and 150 kg/ha Urea. According to dry farming condition, any irrigation not needed before and after planting and planting was done after last winter rainfall/ precipitation. Also, for there isn't any pest and diseases for this plant in this area and negative effect of pesticide on effective material of plant, no pesticide and insecticide was used. In this study, for assessing the effect of Nitrogen and Phosphorus on yield of *Thymus daenensis*, some variables such as wet and dry weight, number of flower and toe in each brushwood, diameter of canopy, yield and percentage of essence and plant height was measured. The chemical constituents (volatile constituents) of *Thymus daenensis* essential oil was analyzed by Gas Chromatography-Mass Spectrometry (GC/MS) (Gupta, 2000).

Results and discussion

Statistical analysis on different traits is presented in Table1. Different level of urea and super phosphate triple had significant affect on dry weight, number of flower and toe in brushwood and wet weight (biomass). But their interaction had no significant effect on these traits. Also, obtained results indicated that different level of urea and super phosphate triple had significantly affected yield and percentage of essence with confidence interval of 99% and their interaction had significantly affected essence yield and percentage, with confidence interval of 95% and 99% ($P \leq 0.05$ and $p \leq 0.01$), respectively. Different level of urea and super phosphate triple had significantly affected plant canopy with confidence interval of 99% and 95% ($p \leq 0.01$ and $p \leq 0.05$), respectively. But their interaction had no significant effect on plant canopy. As well as, different level of urea had significantly affected on plant height with confidence interval of 99% ($p \leq 0.01$). But, super phosphate triple and their interaction had no significant effect on plant height.

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Fig.1. Effect of different level of urea on plant canopy and height

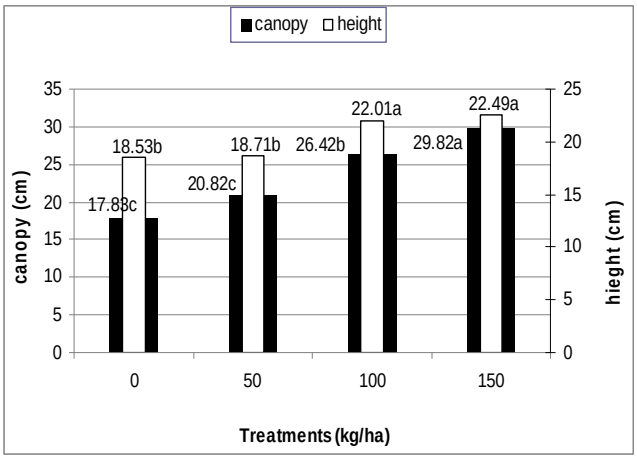

Fig.2. Effect of different level of super phosphate triple on plant canopy and height

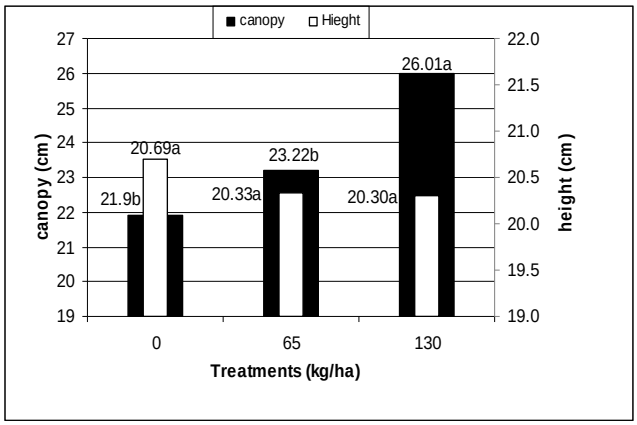

Fig.3. Effect of different level of urea on dry and wet weight

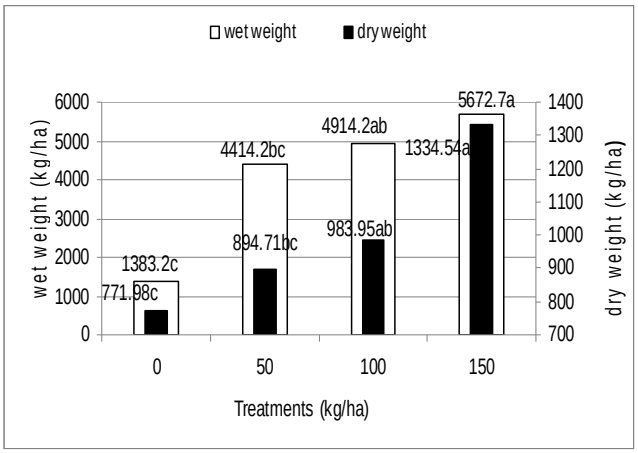

Fig.4. Effect of different level of super phosphate triple on dry and wet weight

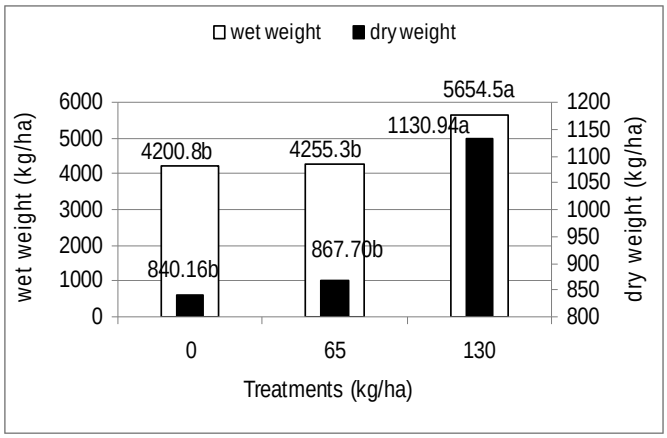

Fig.5. Effect of urea on number of flower and toe in brushwood

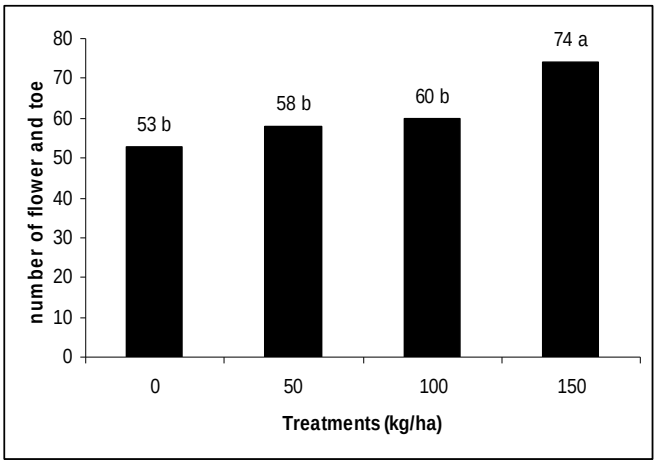

Fig.6. Effect of super phosphate triple on number of flower and toe in brushwood

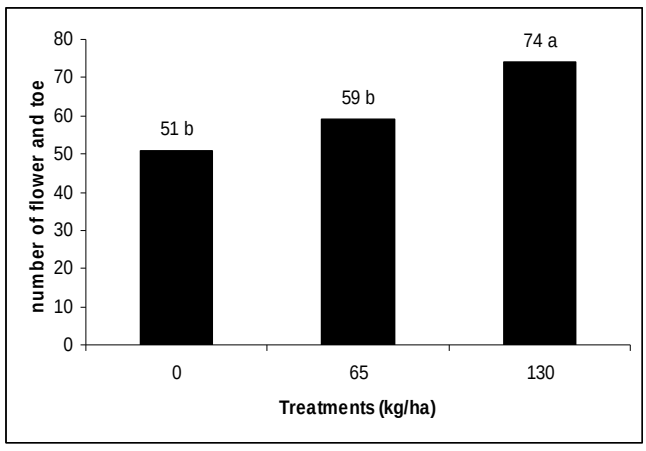

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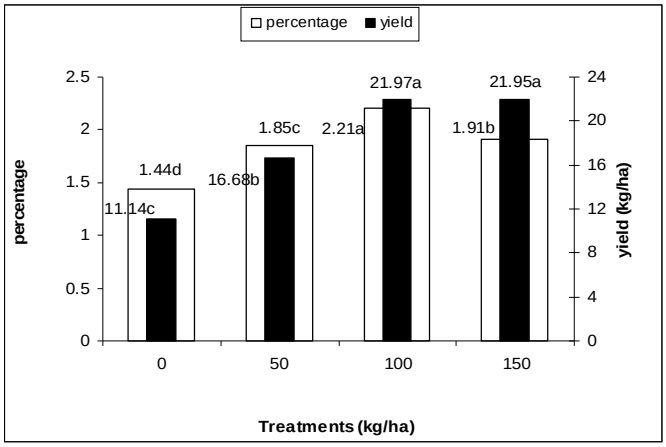
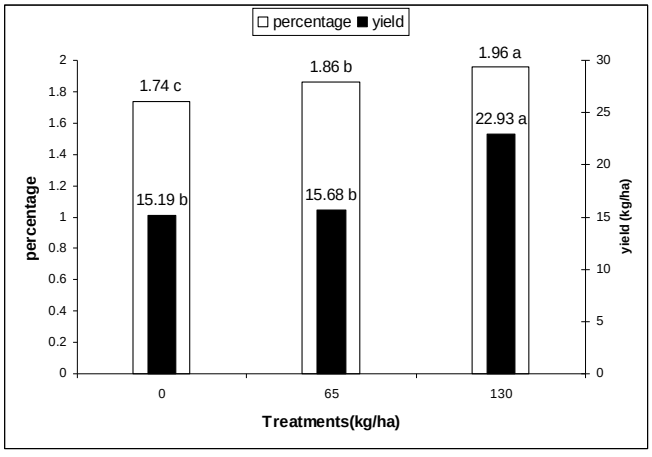
Fig.7. Effect of urea on yield and percentage of essence



Evaluation of different level of urea and super phosphate triple on plant canopy and height are presented in Fig. 1 and 2, respectively. Fig.1 shows that with increasing amount of urea, plant canopy was increased too. So that, least and most amount of canopy were in standard (without using urea) and 150 kg/ha treatments with 17.82 cm and 29.82 cm, respectively. But, first and second treatments (standard and 50kg/ha urea) had similar effect on plant canopy.

Plant height had similar trend of canopy with this difference that first and second treatments and third and fourth treatments had similar effect on plant height. Fig..2 shows that with increasing amount of super phosphate triple, plant canopy was increased too. So that, least and most amount of canopy were in standard (without using urea) and 130 kg/ha treatments with 21.9 cm and 26.01 cm, respectively. But, first and second treatments (standard and 65kg/ha super phosphate triple) had similar effect on plant canopy. Furthermore, super phosphate triple doesn't have any significant effect on plant height. Evaluation of different level of urea and super phosphate triple on dry and wet weight are presented in Figures 3 and 4, respectively. Fig.3 shows that with increasing amount of urea, dry and wet weight was increased too. So that, least and most amount of wet weight were in standard (without using urea) and 150 kg/ha treatments with 1383.2 cm and 5672.2 kg/ha, respectively. But, first and second treatments (standard and 50kg/ha urea) had similar effect on wet weight. Dry weight had similar trend of wet weight. Fig.4 shows that with increasing amount of super phosphate triple, wet weight was increased too. Also, first and second treatments (standard and 50kg/ha urea) had similar effect on wet weight. Dry weight had similar trend of wet weight.

Fig.8. Effect of super phosphate triple on yield and percentage of essence



The effect of different level of urea and super phosphate triple on number of flower and toe in brushwood are presented in Fig. 5 and 6, respectively. Comparing means in Fig.5 shows that three treatments of 0, 50 and 100 kg/ha urea had similar effect on number of flower and toe in brushwood, however third treatment increased them. Effect of different level of urea on plant canopy and height Compare means in Fig.6 shows that first and second treatments (0 and 65 kg/ha super phosphate triple) had similar effect on number of flower and toe in brushwood and these treatments had not significantly difference but third treatment had significantly affected on this characteristic.

The effect of different level of urea and super phosphate triple on yield and percentage of essence are presented in Fig. 7 and 8, respectively. Fig.7 shows that maximum amount of essence percentage was in third treatment (100kg.ha urea) and with increasing from 100 to 150 kg/ha urea, essence percentage decreased. Least amount of essence percentage was in first treatment (standard). Essence yield had similar trend of percentage. Also, there isn't any significant difference between third and fourth treatment and they have similar effect on essence yield. For this reason, third treatment (100 kg/ha urea) is best treatment of economical and environmental condition. According to Fig.8, minimum and maximum amount of essence percentage was in first and third treatments, respectively. Essence yield had similar trend of percentage. So, third treatment is the best treatment for this trait such as last traits.

Conclusion

The overall results of this experiment indicated that third and fourth treatments of urea had similar effect on *Thymus daenensis* and in similar condition third treatment was preferred. Furthermore, third treatment of super phosphate triple was the best treatment. Finally, according to interaction effect of them, treatment of P_3N_3 (100 kg/ha urea and 130kg/ha super phosphate triple) was the best treatment and it was most effective for yield of *Thymus daenensis* under dry farming condition.

References

1. Amin G (2005) Popular medicinal plants of Iran. Tehran, Iran, Tehran University of Medical Sciences Press. (In Persian).

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2. Bauer KD, Garbe H and Surburg H (1997) Common fragrance and flavor materials. Weinheim, Germany: Wiley-VCH Verlag.
3. Ceylan A, Bayram E and Ozay N (1994) The effect of N-fertilizer on the yield and quality of *Thymus Valgaris* in ecological of Bornova-Izmir. *Turkish J. Agri. & Frosty*. 18 (4), 249-255.
4. Cronquist A (1988) The evolution and classification of flowering plants, 2nd ed. The New York Botanical Garden, NY, USA.
5. Furia TE and Bellance N (1995) Fenarolis handbook of ingredient. Vol. 1, 3rd Ed. CRC press.
6. Ghasemi Pirbalouti A (2009a) Medicinal plants used in Chaharmahal and Bakhtyari districts, Iran. *Herba Polon*, 55, 69-75.
7. Ghasemi Pirbalouti A, Bahmani M and Avijgan M (2009b) Anti-Candida activity of Iranian medicinal plants. *Elect*. *J. Bio*. 5, 85-88.
8. Ghasemi Pirbalouti A, Moosavi SH, Momtaz H and Rahimi E (2010) Antibacterial activities of the essential oils of some Iranian herbs against *Campylobacter jejuni* and *Campylobacter coli. Adv. Food Sci*. 32 (1), 30-34.
9. Gupta PK (2000) Soil, plant, water and fertilizer analysis. Agrobios, New Delhi, India.
10. Heywood VH (1993) Flowering plants of the world. London University Press. London, England.
11. Hornok L (1992) Cultivation and processing of medicinal plant. Akademiai Budapest, Hungary.
12. Jalas J (1982) Thymus. In: Flora Iranica. Rechinger KH (Ed.). Springer, NY, USA. 150, 536-538.
13. Letchamo W and Gosselin A (1995) Variation in photosynthetic potential of *Thymus Vulgaris* selection under two light regimes and three soil water levels. *Sciennita Horticulture*. 30-35.
14. Morales R (2002) The history, botany and taxonomy of the genus *Thymus.* In: Thyme: The Genus *Thymus.* Stahl-Biskup & Saez F (Eds), Taylor and Francis, London, 1-43.
15. Mozaffarian V (2006) A dictionary of Iranian plant names. Farhang Mosavar Publ., Tehran, Iran. (In Persian).
16. Rechinger KH (1982). Flora Iranica,.152. Austria, Graz: Akademische Druck und Verlagsanstalt.
17. Sefidkon F, Dabiri M, Alamshahi A (2002). Analysis of the essential oil of Nepeta fissa C.A. Mey from Iran. *Flavour Fragr. J*. 17: 89-90.
18. Sfaei Ghomi J, Meshkatalsadat MH, Shamai Sh, Hasheminejad M and Hassani A (2009) Chemical characterization of bioactive volatile molecules of four Thymus species using nanoscale injection method. *Digest J. Nanomaterials & Biostructures*. 4 (4), 835-841.
19. Stahl-Biskup E and Saez F (2002) Thyme, The genus *Thymus*. Taylor &Francis. pp:331.
20. Stahl-Biskup E and Saez F (2005) Thymus. London & New York press. pp:330.
21. Zargari A (1990) Medicinal plantsTehran University, Tehran, Iran (In Persian).