The study of adaptation and performance of some species of thyme under dry farming conditions

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Abstract: To perform this research; initially, species of thyme were collected and identified in different habitats of Guilan province. These species include T. kotschyanus, T. caucscus sub sp. grossheimii, T. fedtschenkoi and T. pubesense. By ripening the seeds of these plants, the seeds were collected and it was begun to produce seedlings and the seedlings were cultivated during February (or January). The studied site is located on dry farming lands surrounding shook (Ashkoor owliya) Village in Rood sar. This experiment was performed as split plot within. The framework of perfectly (quite) randomized block basis design in three repetitions. In this study, four species of thyme as original (primary) treatment and density as secondary treatment in three levels of 4.7,10 bushes per square meter (m²) were cultivated. During harvesting, for study of traits, 5 bushes were randomly selected from each plot and the percentage of bush establishment, the number of stems (stalks) in each bush, bush height, aerial organ’s performance, essence percentage and essence percentage were examined. The obtained results show that the greatest performance was obtained by T. kotschyanus species and by a slight difference, T. fedtschenkoi species has the greatest density by 10 bushes and the least of them was obtained by T. caucscus sub sp. grossheimii by a density of 7 bushes in surface unit and the highest performance of aerial organ is related to T. fedtschenkoi by a density of 10 bushes and the least of them is related to T. caucscus sub sp. grossheimii by a density of 4 bushes per square meter (m²).

Keywords: Medicinal plants; Adaptation; Establishment; Species of Thyme; Guilan.

Introduction

Cultivation of plants meaning achievement of planting techniques and exploiting environmental factors to produce agricultural and food products, has an ancient history. Fossil remainings found in Jarmo village located in northern Iran showed that about 10 through 16 thousand years ago, human-beings have produced wheat or one of precedents (ancestors) of wheat in this region as a food (Navee and Mirza, 2007). Over a long-lasting time, there are continually abundant plant species which due to lack of direct role in food resources of human-beings, they have not been cultivated. Among them, there are different species of thyme plant (Thymus) which today, it has increasingly found a more clear position in food and medicinal industries in industrialized countries. Vegetation period of this plant is 200-210 days. In appropriate conditions, it germinates after 4-5 days. 40-50 days after vegetation, the plant flowers (blossoms) and as soon as the flowers are opened and before seed formation, it is harvested. In Iran, first flowers are appeared at the end of spring and until before the occurrence of fall (autumn) cold, they are consecutively appeared (Arbat, 1995). Economically, Cultivation of a medicinal plant is cost-effective when the amount (value) of its secondary metabolites would reach a desired level (Moaveni et al., 2011). Secondary metabolites are a deterministic aspect for many of the medicinal plants which are essentially made by conduct of genetic processes but their construct is obviously influenced by environmental factors (Weiss and Edwards, 1980).

Vegetative body of thyme enjoys a pleasant odor which is resulted from the existence of essence. Essence is made in glandular tomentums and it is stored in them (Tabrizi et al., 2011).
Aerial organs of this plant (except of wooden stalks/stems) containation essence. The amount of essence is different under various climatic conditions and it is between 1-2.5 percent. Except of essence, there are ingredients such as tana, flavenoid, saponin and bitter materials in the vegetative body of thyme (Carroll, 1985). Ecological conditions of the region is a deterministic factor on the quality and quantity of essence and aromatic materials of thyme as well as the main ingredients of this plant’s essence include bornool, carvacrol and thymol and the amount of fresh plant’s essence is 1.861 percent (Jakiemiu et al., 2010). Ecological conditions, available food (nutritional) nutrient elements and farming (cultivation) management have a significant effect on the growth and performance of thyme and decrease in leaf surface index from vegetative stage to reproductive stage is due to thickening the leaves. This phenomenon represents the adaptation of plant with environmental conditions and also, leaf surface (area) index is influenced by the amount of essence in thyme plant (Ramamneh, 2009).

The findings show that for an economic production, determination of planting density, a strategic decision and precise (the exact) determination of planting date, are necessary to increase the quantity and quality of medicinal plants (Arbat, 1995). In a definite density, each medicinal plant produces the highest effective materials. Marigold plant in a density of 20-40 bushes per square meter \( (m^2) \), has the highest value (amount) of effective materials in the flower according to different climatic conditions. In an experiment which was performed to determine the effect of date and density of plantation of marigold (evergreen) plant as factorial based on perfectly randomized blocks in spring of 2009 in research farm of Islamic Azad University, Rasht Branch, it was declared that the greatest number of flowers per bush, dry weight of flower in each bush, the number of stalks (stems) per bush, dry weight of bush in each bush and the amount (value) of essence per flower were obtained 28.33, 4.31g.10.67, 41.06g and 0.16 ml, respectively in 100g dry flower by a density of 20 bushes (Berimavndi et al., 2010).

In order to study the effect of planting density on the performance and components of *Cartamus tinctorinus* in dry farming plantation conditions. By rainfall of 320mm per year and relatively suitable (appropriate) distribution, it was performed within the frame work of perfectly (quite) randomized blocks design (plot) in 5 repetitions by densities of 14, 20 and 29 bushes per square meter \( (m^2) \). The results showed that the greatest numbers of bundles (bolls) in the bush and harvest index in low density were obtained as 5.4 and 29, respectively. Also, increase in density causes decrease in the number of seeds in the bundle (boll); the height and harvest index are meaningfully effective on the number of bundles (bolls) in the bush. The obtained results showed that in ecological conditions of Damavand, the plant of *Cartamus* by a density of 20 bushes per square meter \( (m^2) \), can produce a desired economic performance in surface unit (Ramzani et al., 2006).

In a research which was performed on the medicinal plant of *Plantago ovata* in dry farming conditions in maraveh- Tappeh in Golestan province as single- ground (single – crushed) repetitions and treatments include some seeds in three levels of 2.4 and 6 kg per hectare and plantation date was considered in three levels of 15 and 30 Bahman and 15 Esfand (February 15,20 and March 5).

The results showed that the length of cluster, the number of cluster in each bush are influenced by the value (amount) of the consumed seed and the highest performance is related to the consumed seed value of 6 kg/ hectare (Dari, 2006).

Nitrogen plays the key role in quantity and quality of ingredients (compositions) of medicinal plants and during an experiment by examining the effect of nitrogen and iron on thyme plant, it was declared that spraying solutions (solute) has a more effect on increase in the performance of plant, chemical ingredients (combinations) and essence percentage than using of fertilizer through the soil (Jakiemiu et al., 2010). Tabrizi et. al. (2011) in an experiment in respect of the effect of irrigation and organic fertilizer (manure) on thyme plant, concluded that by increase in organic fertilizer, plant biomass increases meaningfully up to 10tons and by implementation of more than 10 tons, the effect of increase in biomass is not meaningful.
Also, by decrease in irrigation interval, plant biomass increases meaningfully.

Moaveni et al. (2011) by examining the effect of planting date and density on thyme plant, concluded that the number of secondary stems (stalks), plant height, biomass and effective materials are influenced by plantation date and density and the highest biomass, wet weight, the number of secondary stems (stalks) and plant height in a density of 10 bushes per square meter and planting date of April, 20 were obtained. Al-Rahmani (2009) during an experiment on thyme plant, reported the effect of plantation rows (15, 30 and 45 cm) and the effect of harvest stage (getting green, beginning of blossoming, perfect blossoming/flowering and producing seeds). The effect of plantation row was not meaningful during first year on the height, crown cover, wet weight and dry weight of aerial organs, the number of leaves, shoot length, the number and depth of root but the effect of the above-mentioned traits was meaningful during second year at the level of 0.05.

Omidbaigi and Rezaei Nejad (2000) during an experiment declared that the amount (value) of the obtained essence was 0.75% and the highest performance of thyme was obtained as 1238.2 kg/ha at the beginning of Seed-production stage (by blossoming-production of 0.50%).

Materials and methods

This research was performed in order to cultivate thyme species in different habitats of high lands and southern areas of Guilan province by collection of seeds and preparation of seedlings from the available species of T. fedtschenkoi, T. pubescence, T. kotschyanus, and T. caucicus sub sp. Grosheimii and plantation was performed in a pre-prepared field located on surrounding rural village of Shok eshkovart from mountainous districts of east of Guilan province where is located on northern latitude of 36 degrees, 52 minutes and 30 seconds and eastern longitude of 49 degrees, 52 minutes and 15 seconds on a height of 1453 meters over a soil by mexic thermal regime and surfacial horizon of ochric epipdon and non-surfacial horizon of cambic and calcic which based on soil taxonomy key, it was identified (recognized) as clayey Mesic Mixed Typic calcixerepts. In this region, the highest level of rainfall during winter and the least of it occurs during summer season.

The most rainfall and the least rainfall months are Esfand and Mordad, respectively. The warmest and the coldest months are Mordad and Bahman, respectively.

This design was performed as split plot within the frame work of basic design (plot) of perfectly (quite) randomized blocks in three repetitions and it was cultivated in intervals between 50-cm rows and intervals (distance) between bushes of 20, 28.5 and 50 cm (densities of 4, 7, 10 bushes per surface unit) in dry farming conditions. Statistics achievement of this design (plot) was performed as follow= measurement of vegetative state of plant such as crown diameter, height mean and counting the number of aerial stalks (stems) of each bush, performance of dry aerial organ of the plant and performance of essence and linking to surface unit according to (in) fg from an average 5-bushes which had been selected from the middle of crete, was determined and extraction of essence was performed by system (instrument). For this purpose, 50 g of the dried aerial organ was placed into the system (instrument) and the value of the obtained essence was weighed by a balance (scale) with precision of 0.01g and for measuring the percentage of bush establishment, the number of bushes was counted in surface unit 20 days after plantation and it was expressed relative to the number of seedlings which had been planted according to (in) percent.

Results and Discussion

The analysis of data variance of bushes, height shows that ignoring the effect of block, the effect of species, density and contrast effect of species on density is meaningful at the level of 0.01 and the study of average stalk (stem) height in different (Figure 1) shows that in density of 4 bushes in surface unit, it has highest height and the study of means by (Doncan) Method expresses that T. fedtschenkoi, T. kotschyanus, T. pubesence and finally, T. caucicus sub sp. grosheimii are placed at level A, level B, level C and level D, respectively.
Ignoring the effect of block, variance analysis of the number of stalks (stems) in the studied species in each shows that the effect of species and density is meaningful at the level of 0.01 but the contrast effect of density and species is not meaningful. The most number of stalks (stems) is related to *T. fedtschenkoi* species by an average number of 182.96 by a density of 7 and the least number of stalks (stems) was observed in *T. caucscus* sub sp. *grossheimii* species in density of 7 bushes per surface unit.

Variance analysis of survival percentage shows that there is a meaningful difference between different densities and species at the level of 0.05 but the contrast effect of density and species is not meaningful (significant). By examining mean data based on Doncan method, *T. fedtschenkoi*, *T. kotschyanus* and *T. pubesense* as well as *T. caucscus* sub sp. *grossheimii* are placed at level A, level B and level.

**Table 1:** The results of variance analysis of the studied traits.

<table>
<thead>
<tr>
<th>Source</th>
<th>Performance of essence</th>
<th>Percentage of essence</th>
<th>Performance of aerial organ</th>
<th>Percentage of seedlings establishment</th>
<th>Height Number of stalks (stems) per bush</th>
<th>Height</th>
<th>Df</th>
</tr>
</thead>
<tbody>
<tr>
<td>Repetition</td>
<td>Repetition</td>
<td>242.62&lt;sup&gt;ns&lt;/sup&gt;</td>
<td>1.13E-04&lt;sup&gt;ns&lt;/sup&gt;</td>
<td>34728.48&lt;sup&gt;ns&lt;/sup&gt;</td>
<td>110078.048&lt;sup&gt;ns&lt;/sup&gt;</td>
<td>484686.1&lt;sup&gt;ns&lt;/sup&gt;</td>
<td>29.18&lt;sup&gt;ns&lt;/sup&gt;</td>
</tr>
<tr>
<td>Plant species</td>
<td>Plant species</td>
<td>9796.69&lt;sup&gt;**&lt;/sup&gt;</td>
<td>2.14E-02&lt;sup&gt;**&lt;/sup&gt;</td>
<td>10.88621.8&lt;sup&gt;**&lt;/sup&gt;</td>
<td>601.248&lt;sup&gt;**&lt;/sup&gt;</td>
<td>25736.0&lt;sup&gt;**&lt;/sup&gt;</td>
<td>30875.5&lt;sup&gt;**&lt;/sup&gt;</td>
</tr>
<tr>
<td>Density</td>
<td>Density</td>
<td>510.13&lt;sup&gt;ns&lt;/sup&gt;</td>
<td>5.08E-05&lt;sup&gt;ns&lt;/sup&gt;</td>
<td>1754733.1&lt;sup&gt;ns&lt;/sup&gt;</td>
<td>225.197&lt;sup&gt;ns&lt;/sup&gt;</td>
<td>1235.5&lt;sup&gt;ns&lt;/sup&gt;</td>
<td>615.67&lt;sup&gt;ns&lt;/sup&gt;</td>
</tr>
<tr>
<td>Plant species</td>
<td>Plant species</td>
<td>423.15&lt;sup&gt;**&lt;/sup&gt;</td>
<td>7.78E-04&lt;sup&gt;**&lt;/sup&gt;</td>
<td>90851.36&lt;sup&gt;**&lt;/sup&gt;</td>
<td>69.416&lt;sup&gt;ns&lt;/sup&gt;</td>
<td>69.416&lt;sup&gt;ns&lt;/sup&gt;</td>
<td>226.51&lt;sup&gt;**&lt;/sup&gt;</td>
</tr>
<tr>
<td>Density</td>
<td>Density</td>
<td>29.18</td>
<td>6.55E-05</td>
<td>7471.20</td>
<td>51.905</td>
<td>51.905</td>
<td>3.59</td>
</tr>
<tr>
<td>Error</td>
<td>Error</td>
<td>21.08</td>
<td>16.78</td>
<td>7.45</td>
<td>9.85</td>
<td>9.85</td>
<td>16.8</td>
</tr>
</tbody>
</table>

In figures, the numbers of 4, 7 and 10 are related to densities and to represent (display) plant species, their first letters are used as abbreviation.

<sup>ns</sup> means non-meaningful (non-significant), single-star means meaningful (significant) at the level of 0.05 and double-star represents the significance at the level of 0.01.

The analysis of data variance of performance of aerial organ according to (as) kg/ha shows that ignoring the effect of block, there is a meaningful difference between different densities and species as well as the contrast effect of density and species at the level of less than 0.01 and by examining the average data based on Doncan method, *T. fedtschenkoi*, *T. kotschyanus* and *T. pubesense* as well as *T. caucscus* sub sp. *grossheimii* are placed at level A, level AB, level B and level C, respectively and the highest (greatest) performance of aerial organ is related to *T. fedtschenkoi* by a density of 10 bushes per surface unit. The analysis of variance of essence percentage shows that there is a meaningful difference between different densities and species as well as the contrast effect of density and species at the level of less than 0.05. *T. fedtschenkoi*, *T. fedtschenkoi*, *T. kotschyanus* and *T. pubesense* have not a meaningful difference at the same level and relative to each other. Also, the highest (greatest) percentage of essence is related to *T. kotschyanus* species and after it, there is *T. fedtschenkoi* by a density of 4 bushes which the Values of 0.2368 and percent essence were obtained respectively.
In the analysis of data variance of essence performance in surface unit according to (as) kg, it shows that there is a meaningful between different densities and species as well as the contrast effect of density and species at the level of less than 0.01. *T. fedtskenko* and *T. kotschyanus* have a meaningful difference at the same level and relative to *T. pubesence* and *T. caucscus* sub sp. *grossheimii*. Also, the most (highest) performance is related to *T. kotschyanus* species by a density of 10, by a performance of 31.42 and after it, the most (greatest) performance of essence is related to *T. fedtschenkoi* species by a density of 10 and by an average performance of 31.17 kg/ha per year (annually) which are not meaningful relative to each other and in examining the average performance based on Doncan method, these two species fall into the same class and *T. pubesence* and *T. caucscus* sub sp. *grossheimii* species fall into the next levels.

The Amount (value) of essence in different climatic conditions of this plant is different and is between 1-2.5 percent (5) and in this study, the most percentage of essence is related to *T.*
Adaptation and performance of some species of thyme

Thymus transcaspicus species and after it, there is T. fedtschenkoi species which the values of 0.2368 and 0.274 percent essence were obtained respectively. Also Moaveni et.al. (2011) obtained the most biomass, wet weight, the number of secondary stalks (stems) and plant height in a density of 10 bushes per square meter (m²) resulted from planting thyme plant. Al- Rahmani (2009) obtained the highest performance and the heaviest wet weight and dry weight and dry weight of argan in harvest stage after blossom (flower)-production in 15-cm row and in the studies of Omidbaigi and Rezaei Nejad (2000), the highest (greatest) performance of thyme was obtained as 1238.2 kg/ha. In these studies, the highest (greatest) average performance of aerial is related to T. fedtschenkoi species with 1872.20 kg/ha and the average performance of essence is related to T. kotschyanus species with 31.42 kg/ha and with a slight difference, it was obtained for T. fedtschenkoi species by an average performance of 31.17 kg/ha in a density of 10 bushes per surface unit.

Finally, it can be said that although T. fedtschenkoi species has a more (higher) performance relative to T. kotschyanus species and T. kotschyanus has a more (greater) ability to produce the essence than T. fedtschenkoi but they have not statistically meaningful difference to each other. In conclusion, both species are developed for planting in this region and in regions where have similar climatic conditions.

References


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