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Effects of chemical and organic fertilizers on yield, yield components and essential oils content of fennel (*Vulgare foeniculum*)

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Abstract

The effects of organic and chemical fertilizer on essential oil yield and yield components of fennel (*Foeniculum vulgare*) in drought conditions at greenhouse pot experiment in 2013 were examined as a factorial design with three replications. Treatments wer three levels of stress (irrigation after 50%, 70% and 100% water consumption as main plot and addition of chemical fertilizer (20 g), manure (10 g), compost (10 g) and control (no fertilizer) as sub plot. Results showed that increasing of stress increased essential oil content, however, the effect of drought stress on grain yield and essential oil yield was decreasing. In addition the results showed that effect of chemical fertilizers treatment on grain yield and essential oil was significant at1% level. Comparison showed that the compost used is optimal conditions, irrigation highest oil yield as much as 192 g per pot to produce this result is due to higher yield rate of 7.2.

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Introduction

Medicinal plants mediated by secondary metabolites or drugs play a major role in human societies have the same active ingredients and final yield based on the amount of active ingredient in the drug crops produced per unit area is measured. Ecology of water and fertilizer in agricultural systems, two key factors determining growth and performance products are cultivated. The use of chemical fertilizers as the fastest way to food shortages and the high cost of chemical fertilizers soil fertility need to be the values of soil and water contamination has led to increased demand for organic fertilizers (Brussard and Ferrera-Cenato, 1997).

Organic fertilizers, especially manure compared with chemical fertilizers can contain large amounts of organic matter and nutrients, especially nitrogen as sources of phosphorus and potassium are considered (Fernandez *et al.,* 1993) but not all of manure to satisfy nutritional requirements of plants. Course with improved soil structure due partly to balance the soil will be. Fertilizers also through the supply immediate food needs of plants, causing a dramatic increase in growth and yield are (Mallanagouda, 1995).

Fennel is a plant with two or more years in a species called *Foeniculum vulgare* is found in both cultivated and wild. Roman clay soils and nutrient substances have a negative impact on product performance. During the relatively large fennel growing food needs. Animal manures are quite Npvsydh disproportionate impact on plant roots. Add 200 kg per N ha after crop emergence increases the amount of 69/51% and increases the amount of oil it 5/33 percent will be, but a further increase in nitrogen reduces the amount of anethole. Fennel dietary needs, such as nitrogen, phosphorus, potash is done through the addition of chemical fertilizers. The aims of this study was to evaluate the effects of different rate of compost along with drought stress on yield, yield components and essential oil yield of fennel.

Materials and methods

Site description

The pot experiment was conducted in 2013 in the city of Zabol. Zabol geographical is coordinates 61 degrees 31 minutes east and latitude 30 degrees 55 minutes north, is located at an altitude of 480 meters above sea level. The weather is very hot and dry climate of the region is based on the coupon classification, with hot summers are classified. According to weather station Zabol long term mean (40 years) rainfall in the area 63 mm, the mean annual evaporation of 4,500 to 5,000 mm, the 40-year average temperature of 23 degrees Celsius maximum and minimum temperature of 49 ° C -7° C. Before starting the tests, treatments, crop land soil to a depth of 30 cm to determine some physical and chemical properties of the samples were taken (Table 1). For the study Includes vermicopost, composting, vermicopost under drought stress (50, 70, 90) percent. Plant height was performed in the laboratory and ruler.

Experimental layout

Dry weight after drying the samples in an oven at 70 ° C was calculated. Fresh weight of plant shoots and roots after separating from each other was doing. Cultivation to form vase at pots to diameters of 14 and height 12 cm performance. Floors pots for drainage pores embedded was and layer to diameter of 3 cm sand to purpose ventilation better at floor each pot Addition was then each pot with soil farm full. Later of preparation pots, implant at October 2013 and seeds to form tangled in the playing pots and soil layer was poured on them. Extracting oil from dried flowers and anise essential oil by consuming [1] and distillation with water for four hours, was conducted in the laboratory of Agriculture. After calculating the weight of the flower essential oil, yield per unit area (g ha) was determined. A 30 gram sample of each vase of dried flowers had been quite powder with 600 ml of distilled water into the flask 1000 cc has been heated four hours. Heat, water vapor pressure increases and the lumps are broken and essential oil containing refrigerant is combined with water vapor. The refrigerant condenses on the action taken and the oil droplets in water as determined by a two-phase dial moves to the tube due to be lighter than the

essence of water, essential oil, water and extra water from the pipe can cluster interface balloons pitted be. To collect the oil, removed and then tap the device to open up the oil into small bottles that already scale with an accuracy of 0.001 by weight were collected. Then the bottles with laboratory scale with an accuracy of 0.001 by weight and weight per hundred grams of dried flowers and essential oil yield per hectare was calculated. Calculate the characteristics of selected plant per pot 2 umbels per plant, and then count to calculate the weight of 1000 seeds, 100 seeds selected by a digital scale with an accuracy of 0.001 g was measured. To calculate was taken using a digital scale weighing and grain yield were obtained. Determine biological function, plant fresh weight determined after the unit oven for 24 h at 70 ° C were then Weight was measured using a digital scale.

Statistical analysis

Statistical analysis of data and drawing diagrams, respectively, the statistical software SAS, MSTATC and EXCEL Were used and the average using Duncan 1 and 5% were compared.

Results and discussion

Fennel plant

Analysis of variance (Table 2) shows the effect of drought, fertilizer treatments and their interaction has a significant effect on fennel plant height. Average data based on the mean of Duncan at 5% level indicated by increased levels of stress than controls 50% of field capacity, height, fennel, equivalent to 00/52% decrease (Table 3). Maximum height Drtymarkvdshymyayy equivalent of 33/74 is . Drasrtnsh land allocation to shoot Mvadftvsntzy the Amrmvjb reduced plant height is reduced, the result Bantayj Vnvrvzpvr Rezvan Moghaddam (1384) that Nigella Sativa plant height increasing irrigation intervals recede results Karimi *et al* (1387) that reducing irrigation to match the height of corn recede there. Ashour Vshryfy Lbaschy Abadi (1383) also study the different levels of drought drug Brgyahan spherical chord, Yarrow always Bharvbabvnh Batshdydtnsh reported that the dry weight of shoots, plant height was reduced in all plants studied.

Stem diameter

Analysis of variance (Table 2) shows the effect of drought, fertilizer treatments and their interaction has a significant effect on the fennel plant stem diameter. Duncan mean of the average data showed an increased level of stress at 1% control 50% of field capacity, fennel stem diameter of 00/4% decline. (Table 3). Hassani (1385) Effect of water stress on the plant Deracocephalum moldavica L., found that by reducing the amount of soil Rtbt, stem diameter decreased.

Table 1. Results of analysis of soil samples tested.

Electrical conductivity (ds/m)	pH	N	P	K	Fe	Zn	Mn	Silt	Clay	Sand	Soil texture
		Ppm						Percent			
8.1	4.7	2.6	13	195	1.2	2.4	9.2	24	35	41	Sandy clay

Yield components

Analysis of variance (Table 2) shows the effect of drought, fertilizer treatments and the interaction of the fennel plant has a significant effect on the number of side branches. Duncan mean of the average data showed an increased level of stress at 1% control 50% of field capacity, Tdadshakhh fennel side of 41/2 percent decline. (Table 3). The results *et al.* Stamatiadis broccoli plants in 1999 showed that the number of lateral branches per plant, add compost to the soil has increased significantly.

Seed

Analysis of variance in Table 2 shows the effects of drought, fertilizer treatments and their interaction has a significant effect on the number Bzrdrbvth fennel. Duncan mean of the average data showed an increased level of stress at 1% control 50% of field

capacity, fennel Bzrdrbvth of 50/172 percent declined. (Table 3).

Sqh *et al* (1386) found that drought stress reduced the number of grains per panicle seed weight is reduced. The study was conducted to evaluate the effect of irrigation frequency and fertilizer, livestock yield quantitative and qualitative fennel was found to be more drought Tdadchtrdr The plant, number of seeds per plant was lower (Ahmadian, 1383).

Table 2. Analysis of variance Fennel features influenced by fertilizer levels and drought.

Bzrdrbvth	Flowers per plant	Side branches	Root length	Qtrryshh	Stem diameter	Plant height	Degree Freedom df	Sources changes SOV
1219.44 *	0.44ns	2.52 *	4.69 **	36.11ns	10.11 *	1189.19 *	2	Repeat
1510.62 **	30.54 **	5.43 **	5.44 **	109.14ns	21.74 **	807.03 *	3	Fertilizer (A)
2245.02 **	16.36 **	4.11 **	17.69 **	311.11 **	16.44 **	1028.11 *	2	Drought (B)
1804.50 **	4.65 **	0.74ns	6.69 **	1937.03 **	2.96ns	310.70ns	6	A * B
289.14	12:47	12:49	0.60	36.86	1.98	222.16	22	Error
9.06	4.39	23.73	9.02	4.64	23.73	23:24	-	(%) CV

ns: non-significant.

and:Statistically significant at the five and one percent, respectively.

Percent oil

Analysis of variance (Table 2) shows the effect of drought, fertilizer treatments and their interaction has a significant effect on oil percentage. Average data based on the mean of Duncan at the 1% level indicated by increased levels of stress than controls 90% of field capacity, oil of anise, equivalent to 67/1 percent decline., But the highest percentage of the oil produced in 50% of field capacity field was observed. The increase in the amount of fertilizer Da 85/1, respectively (Table 3). The results also show that aggravate drought, oil yield decreased. Essential oil yield loss, thereby decreasing soil moisture may result from deleterious effects of drought stress on vegetative growth and yield is configured. Bad effects of stress on essential oil yield decreased by Hosni and Amydbygy (1381) and Rafat and Saleh (1997) has reported on the basil.

Table 3. Comparison of the average characteristics under the influence of fertilizer levels and drought Fennel.

Bzrdrbvth (gr)	Flowers per plant	Side branches	Root length (cm)	Qtrryshh (cm)	Stem diameter (cm)	Plant height (cm)	Treatments
			Fertilizer				
198.55a	17.55a	3.88a	9.44a	130.00ab	7.77a	67.88a	Control (no fertilizer)
189.66a	16.77b	2.88b	9.00ab	135.11a	5.77b	74.33a	Chemical fertilizers (N, P, K)
193.00a	15.00c	3.11b	7.66c	131.11ab	4.00c	62.22ab	Manure
168.88b	13.44d	2.00c	8.33bc	126.66b	6.22b	52.00b	Municipal solid waste compost
			Drought				
199.25a	16.83a	3.58a	9.75a	135.16a	7.16a	73.16a	50% of field capacity
190.83a	15.75b	2.91b	8.75b	131.83a	5.83b	64.50ab	70% of field capacity
172.50b	14.50c	2.41b	7.33c	125.16b	4.83b	54.66b	90% of field capacity

Means which share common letters in each column according to Duncan's multiple range test at the five percent level, no significant differences.

Seed weight

Analysis of variance (Table 2) shows the effect of drought, fertilizer treatments and their interaction has a significant effect on seed weight. Average data based on the mean of Duncan at the 1% level indicated by increased levels of stress than controls 90% of field capacity, seed weight equivalent to 29/2 per cent diminished. But the highest percentage of

seed weight at 70% of field capacity field was observed. The increase in manure application rate equivalent to 88/2%, respectively (Table 3). Asrtnsh dry the grain filling stage is obvious, as is the potential performance of seed weight depending on the subject matter accumulation in the grain is required (small Vsrmd 1382 Taghinia).

Plant fresh weight

Analysis of Variance Table 1-4 shows the effects of drought, fertilizer treatments and their interaction has a significant effect on plant fresh weight. Average data based on the mean of Duncan at the 1% level indicated by increased levels of stress than controls 90% of field capacity, fresh weight of the plant equivalent of 38/1 percent decline, but the highest percentage of fresh weight of the plant at 50% capacity Farm crops were observed. The rate of increase in the control treatment of 72/1, respectively (Table 2) Fricke and Vogtman (1994) Effects of municipal compost on herb rosemary during two consecutive seasons concluded that plants treated with municipal compost increase in fresh and dry weight and plant flowers in this experiment the compost fresh weight increase The plant, which corresponded with the results of this research.

Table 4. Comparison of features fennel Average fertilizer and drought affected areas.

Dry weight (gr)	Wet weight (gr)	Seed weight (gr)	Stem weight (cm)	Essence (gr)	Treatments
			Fertilizer		
30.66a	1.73a	2.61b	29.33a	1.84a	Control (no fertilizer)
25.66b	1.40b	2.62b	25.33c	1.84a	Chemical fertilizers (N, P, K)
27.66b	1.50b	2.88a	27.33b	1.85a	Manure
25.55b	1.64a	2.27c	24.33c	1.55b	Municipal solid waste compost
			Drought		
29.25a	1.72a	2.71a	27.75a	1.91a	50% of field capacity
27.25b	1.60b	2.79a	26.75ab	1.73b	70% of field capacity
25.66b	1.38c	2.29b	25.25b	1.67b	90% of field capacity

Means which share common letters in each column according to Duncan's multiple range test at the five percent level, no significant differences.

Dry weight

Analysis of Variance Table 1-4 shows the effects of drought, fertilizer treatments and their interaction has a significant effect on the dry weight. Average data based on the mean of Duncan at the 1% level indicated by increased levels of stress than controls 90% of field capacity, dry weight, equivalent to 66/25 percent decline. But the highest percentage of dry weight at 50% of field capacity field observation Were. The rate of increase in the control treatment of 25/29%, respectively (Table 2).

Vassilev In 2003 the dry weight of root and shoot under drought stress in sunflower reported.

Harvest Index

Results by from Research Sentence A. Pour and Colleagues (Hokm Alipour *et al.,* 2008) show the with Increase Consumption Fertilizer N, Of Transfer Material Dry of Shoot Organs Bush Corn to Seeds Reduction Increases.

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