The effect of nitrogen fertilizer and humic acid on yield and essential oil percent in mixed cultivation of hyssop and castor medicinal plants in Arak weather conditions

Seyedeh Zahra Sharifi
MSc in Agriculture of Azad Islami University of Arak
Email**:**szahra.sharifi88@gmail.com

Gholamreza Naderi
Department of agriculture and natural resources, Islamic Azad University, Arak Branch, Iran
Email**:**Gh_Naderi_B@yahoo.com

Hamid Madani
Department of agriculture and natural resources, Islamic Azad University, Arak Branch, Iran
Email**:**Hmadania@yahoo.com

Abstract

This research was conducted in order to evaluation of bio-fertilizer Nitroxin, Super-nitro plus, Bio-sulfur and urea fertilizer (NH22CO) in randomized completely block design (RCBD). This trial included of 9 treatments and 3 replications. Data of this experiment analyzed using SPSS software and means comparison studied according to Duncan test.

Bio-fertilizers including bio-fertilizer Nitroxin, Super-nitro plus and Bio-sulfur each one in 4 and 8 kg/ha, urea fertilizer in 75 and 100 kg/ha and control treatment (without using urea fertilizer and bio-fertilizer). The results showed that according to results obtained from variance analysis in Lemon balm medicinal plant found that effect of soil fertilizers including bio-fertilizers (Nitroxin, Super-nitro plus, Bio-sulfur) and urea fertilizer on traits such as plant height, number of stems per plant, fresh weight of stem in plant, dry weight of stem in plant, fresh weight of root in plant, dry weight of root in plant, leaves number per plant, fresh weight of leaves per plant, dry weight of leaves in plant, fresh weight of shoot in plant, essential oil percent, essential oil yield and dry biological yield in 1% level of probability was significant. This trial showed that bio-fertilizers (Nitroxin, Super-nitro plus and Bio-sulfur) could partly compensate the decline in biological yield and essential oil yield resulted from nutrients deficiency caused by not using of fertilizers thus application of these bio-fertilizers (Nitroxin, Super-nitro plus and Bio-sulfur) alone or with less amounts of chemical fertilizer is recommended.

Keywords: humic acid, essential oil percent, hyssop, castor, Nitroxin, Super- nitro plus and Bio-sulfur

Introduction

Medicinal plants are predicated to a wide range of plants containing specific active ingredients which are used in illness treatment and or prevention of it. It should be stated in the deeper meaning that the term of medicinal plants are not applied only to plants that relieve the pain , but they are in food sub group (as flavorings , beverages, sweeteners , natural colors and preservatives) with (Omidbaygi 1384) . From the time that human realized the importance of medicinal plants in the treatment of diseases, began gathering plants from the natural areas which has caused the rangelands degradation and prevention of natural regeneration of these plants. Iran with a variety of climates is a suitable place for growth of medicinal plants so that in Iran lonely there is medicinal plant diversity equal to the whole of Europe and since most of these plants face to ideal conditions, many markets in abroad demand for these plants in form of dried, essential oil, juice and extracts (Naderi and Farahani, 2006).

Scientific name of medicinal plant Hyssop is Hyssopus officinalis and its family name Labiatae. Hyssop derived from Greeck name Azob which means holly plant and is one of the most important of 130 species plants that was used in past to aromatize the beverages. Hyssop is considered one of the most important medicinal and spice plants. In most valid pharmacopoeia the areal parts of Hyssop has been mentioned as medicine.

Hyssop is a woody and perennial plant (Darzi, 2006).

Its essential oil also has anti- bacterial and anti- fungal properties. This plant has several usages in traditional and modern medicine as expectorant, diuretic and appetizer and in the treatment of gastrointestinal disorders, laryngitis, asthma, bronchitis, herpes and acceleration in healing wound has desired effect (Jankovasky, 2002). Essential oil content in growing organ of Hyssop is different and is between 1 and 0.3 percent. The most important constituent of essential oil compounds is ((Pinocamfen)) (50%) and of the other important components of essential oil ((Alpha Vebtapinen)) , ((Camfen)) sesquiterpen alcohols are mentionable. The growing organ of plant also contains flavonoids, tannins (5% to 8 %) and bitter substances (3 to 6%) and other substances such as ((Diozemin)) ((Hysopin)) and mucilage compounds. The plant essential oil is bitter, dry pungent and slightly heating. Hyssop seed growing in moist soils and at the correct temperature is possible. If the seeds are planted early in spring they will green after two to three weeks. The early growth of Hyssop is slow. (Matin, 1983).

Oil castor (Ricinus communis) is a perennial and woody herb with 20 to 113 cm height, of Euphorbiaceae family in the tropical regions, with 7.5 to 15 cm stem, but usually as an annual plant grown in temperate areas with a height of 1-3 meters. Stems are meaty, herbaceous, and from different aspects are very diverse.

Castor oil mainly is used as a laxative specially to empty the bowel before the colon exam or x-ray imaging of the gastrointestinal tract, but as a laxative has application in the treatment of acute constipation too.

Castor chemical compounds: per 100 grams of leaves, the leaves contain 24 gr. protein, 5.4 g fat, 57.4 gr. total carbohydrates, 10.3 g fiber, 12.4 g ash, 2.670 mg calcium and 460 mg phosphate. But in the seed: % 1.5 – 6.5 moisture, 12 - 16 % protein, 50-45 % oil, 3.1-7 % ??? and 2 - 2.2% ash. (Matin, 2003).

Today, one of the routines to increase crop yield per area unit is the correct use of fertilizers and bio-fertilizers and plant hormones. Nitrogen after carbon, hydrogen and oxygen is the most abundant element in living organisms.

This element is found in the combinations of proteins, nucleic acids, some plant growth regulators and in many vitamins and for this reason in the most biochemical reactions involves. Because of the vital role of this element in quantitative and qualitative increase of agricultural products, it is sometimes referred to as a growth bottleneck. (Meder et al. 1993).

Nitrogen has major role in the growth and development and its lack at any stages of growth with disorder in synthesis, reduces the number and size of leaves, branches and thus reduction at the plant yield. (Niakan, 1383).

In 2004, Arabaci and Bayram during an investigation by planting Basil under fertilization treatments with and without nitrogen reported that the highest fresh yield, dry yield, essential oil and essential oil yield under fertilization treatment was obtained.

Arjomandi (1998) studied the effects of different levels of nitrogen and phosphorus on fertilization (growth, development and active ingredient) of Thymus Vulgaris. Based on the obtained results, the effect of nitrogen

fertilizer on yield and production of components of essential oil and features of thyme was completely evident.

Today, the use of organic fertilizers is increasing. Humic substances are a mixture of different organic compounds that are derived from the remains of plants and animals with humic acid (McCarthy, 2001).

Important benefits of humic acid are increase of length and weight of root and the initiation of lateral roots (Ayakin et al., 1985).

In studying the effect of humic acid spraying on traits such as plant height, number of leaves, stem fresh weight, dry weight of stem and accumulation of NPK in the leaves of seedlings of eggplant and pepper they realized that with the application of humic acid on pepper and eggplant seedlings, the stem diameter, number of leaves, stem fresh weight, stem and root dry weight significantly increased (Padem et al., 1999).

Intercropping is an adapted pattern of natural sustainable systems of plants including untouched rangelands and forests that shows the nature always prefers the species composition to the single species. Reverse of modern monoculture agriculture, which is based on maximum use of inputs in a short time.

Intercropping means planting more than one type of plant in a plot of land and in a crop year so that one type of plant simultaneously can be grown and harvested. But also it's possible to cultivate simultaneous and awhile after the first type plant and concurrent or after that to harvest it.

The most important advantage of mixed culture is that the yield quantity per area unit will increase than monoculture. Its reason is better use of environmental factors such as light, water and nutrients in the soil. In this type of agriculture, agrochemical consumption to combat pests, diseases and weeds, as well as chemical fertilizers is less. The environmental pollution will be reduced in the same ratio as well.

According to physiologists, intercropping different species due to variations such as differences in morphological and physiological traits by absorbing more solar radiation increases the yield.

Hashemi Dezfuli et al (1996) reported that in studying the effect of mixing ratio and sowing date on quantitative and qualitative yield of forage and grain in maize and sunflower intercropping in Ahvaz, the ratio of 75 % sunflower and 25% corn produces is the maximum fresh crop.

The carried out research in dry lands of Anatolia in Turkey about the effects of intercropping vetch and barley on the crude protein content and forage production have shown that intercropping vetch with barley with ratio of 80 % vetch and 20 % barley has increased the forage yield per area unit than monoculture

.

Material and methods

In spring and summer of 2013 in order to investigate the effects of different levels of nitrogen fertilizer and humic acid on simultaneous cultivation of medicinal plants hyssop and castor, this experiment was conducted at research farm of Islamic Azad University of Arak .

Geographical coordinates of the experiment place is 34 degree and 5 minutes north latitude and 49 degrees and 42 minutes east longitude and elevation from sea level is 1757 meters. This area has mild to hot summers and cold winters.

The temperatures changes of this township are very high so that in previous years the absolute minimum temperature has reached to 12.8 ° C and the absolute maximum to 44 ° C.

This study had 9 treatments and conducted as a factorial experiment based on randomized complete block with 3 replications on hyssop and castor.

The experiment treatments were nitrogen fertilizer (46%) in 3 levels:

N3= 90, N2=4, N1=0 (kg ha-1) and Humic acid in 3 levels: H3=200, H2=100 and H1=0 (mg l-1).

In this experiment a piece of land to dimensions of 30 × 20 m considered and the plots dimensions were 4 × 2 m, with line spacing of 50 cm (in each plot 3 planting line). Hyssop and Castor were planted on both sides of the stack. Distance of sowing seeds of Hyssop on one side of stack was 40 cm and the castor seeds cultivation distance in the other side of the stack was 40 cm. The distance between the plots one meter and replications interval from each other was considered 2 m.

Notes from Hyssop plants, including:1- stem height 2- number of stem per plant 3- flowering shoot length 4- flowering shoot fresh weight 5- dry weight of flowering shoot 6 - the weight of one thousand seeds 7- essential oil percent 9- essential oil yield

Notes from Castor plant includes: 1- plant height during flowering 2- main stem length 3- stem diameter 4- Number of nodes per stem 5- number of leaves per stem 6 - seed yield 7 - seed oil percent 8- seed oil yield

Table 1- soil test of experiment location

Sample description	Depth Cm	City name	Ec DS/m	PH of paste	SP	P(ava.)	K(ava.)

						(ppm)	
Soil mass	0-30	Arak Azad University	1.5	8.2	33.6	10	554.4

N	(TNV)	(OV)	(CLAY)	(SILT)	(SAND)	TEXURE	Fe	Zn	Mn	Cu
							(ppm)			
0.14	18.5	1.36	20.5	16	63.5	Sand clay loam	3.2	0.52	–	–

Results and Discussions

Based on the results of variance analysis of castor plant height, under influence of different levels of nitrogen fertilizer (N) and humic acid, in intercropping conditions with Hyssop was found that different levels of nitrogen (N) and different levels of humic acid (H) used in this experiment and also their interaction caused a significant difference in the level of 0.01 on height trait of Castor plant (Table 2). (Table 3).

Table 2- Variance analysis of Castor traits under influence of different levels of nitrogen fertilizer and humic acid

SOV	df	(MS)			
		Plant height	Main stem length	Main stem diameter	nmber of nodes in main stem
Block (R)	2	ns 5.59259	ns 2.77778	ns 0.92593	ns 0.92593
Nitrogen (N)	2	** 1452.26	** 112.000	** 128.259	** 8.03704
Humic acid (H)	2	** 494.704	** 22.111	** 28.2593	** 1.81482
H× N	4	** 46.0370	ns 3.11111	** 10.8148	ns 0.09259
Experiment error	16	5.92592	2.402778	0.80093	0.25925
CV(%)		1.96	1.89	4.48	4.99

n.s , *, **, (non significanr, significant in 5% and 1% level of probability respectively)

Results of means comparison showed that different levels of nitrogen fertilizer has affected on castor plant height so that the most plant height with 134.67 cm average, obtained by average consumption of 150 kg per hectare pure nitrogen and the lowest height in the treatment of non-application of nitrogen fertilizer with 109.78 cm average and there was a significant difference between them.

Also between the treatment of consumption of 75 kg per hectare pure nitrogen with 127 cm and two other levels of nitrogen fertilizer significant difference was observed. (Table 3).

Table 3- comparison of traits mean of Castor plant under influence of different levels of nitrogen fertilizer and humic acid

Treatment	MS			
	Plant height (cm)	Main stem length (cm)	Main stem diameter (mm)	nmber of nodes in main stem
Different levels of nitrogen fertilizer				
non-application of nitrogen (N_1)	109.78 c	78.11 b	15.78 c	9.220 c
75 kg pure nitrogen (N_2)	127.00 b	83.44 a	21.00 b	10.22 b

150 kg pure nitrogen (N_3)	134.67 a	84.78 a	23.11 a	11.11 a
Different levels of humic acid				
non-application of humic acid (H_1)	116.78 c	80.44 b	18.00 c	9.670 c
100 mg/l humic acid (H_2)	123.11 b	82.33 a	20.44 b	10.44 b
200 mg/l humic acid (H_3)	131.56 a	83.56 a	21.44 a	10.44 a
N×H intraction				
N_1×H_1	98.333 g	77.33 d	15.67 d	8.667 e
N_1×H_2	109.00 f	78.00 cd	15.67 d	9.667 cd
N_1×H_3	122.00 e	79.00 cd	16.00 d	9.333 de
N_2×H_1	122.67 de	80.67 bc	16.67 d	9.667 cd
N_2×H_2	126.67 cd	83.67 ab	22.33 bc	10.33 bc
N_2×H_3	131.67 b	88.00 a	24.00 a	10.67 ab
N_3×H_1	129.33 bc	83.33 a	21.67 c	10.67 ab
N_3×H_2	133.67 b	85.33 a	23.33 ab	11.33 a
N_3×H_3	141.00 a	85.67 a	24.33 a	11.33 a

The main stem castor: Based on the analysis of variance of main stem length of castor, under different levels of nitrogen fertilizer and humic acid, in intercropping with hyssop was found that different levels of nitrogen (N) and and different levels of humic acid (H) used in this experiment caused significant difference in the level of 0.01 on the trait of main stem length of Castor.

Results of mean comparison showed that of different levels of nitrogen had effect on the main stem length so that the maximum length of the main stem with 84.78 cm average, obtained by average consumption of 150 kg per hectare pure nitrogen and the minimum main stem length was in the treatment of non-application of nitrogen fertilizer with 78.11 cm average, and there was a significant difference between them .
Also there wasn't significant difference between the consumption of 75 kg per hectare pure nitrogen treatment with 83.44 cm and treatment of 150 kg per hectare pure nitrogen but with the treatment of non-application of nitrogen fertilizer significant difference was observed. (Table 2). (Table 3).

Table 4- Variance analysis of Castor traits under influence of different levels of nitrogen fertilizer and humic acid

SOV	df	(MS)			
		number of leaves per palnt	seed yield per hectare	oil content in seed	Oil yield per hactare
) R (Block	2	** 10.0371	ns 4564.9260	ns 0.48148	ns 713.92610
Nitrogen (N)	2	** 56.4814	** 1393550.8	** 138.481	** 924582.93
Humic acid (H)	2	** 25.9259	** 703740.26	** 76.9259	** 137154.04
H× N	4	ns 2.09259	ns 127626.82	* 5.37037	** 18489.204
Experiment error	16	1.45371	1118.051	1.23148	670.384
CV(%)		4.75	2.29	2.31	2.63

Castor plant seed yield per hectare: based on the analysis of variance of castor plant seed yield per hectare, under different levels of nitrogen fertilizer and humic acid, in intercropping with Hyssop was found that treatments of different levels of nitrogen (N) and treatment of different levels of humic acid (H) resulted in significant difference in the level of 0.01 on seed yield per hectare of castor plant (Table 4).
The results of mean comparison showed that different levels of nitrogen fertilizer had effect on grain yield per hectare of castor plant, so that the most seed yield per ha with 1866.22 kg, obtained by using 150 kg per hectare of treatment of pure nitrogen and the lowest yield per hectare with the average of 1080.89 kg by treatment of non-

application of nitrogen fertilizer and there was significant difference between them. Also between consumption of 75 kg per hectare pure nitrogen with 1429.33 kg with two other levels of nitrogen fertilizer significant difference was observed. (Table 4). (Table 5).

Table 5- Comparison of traits mean of castor plant under influence of different levels of nitrogen fertilizer and humic acid

Treatment	MS			
	number of leaves per plant	seed yield (kg/ha)	oil content in seed (%)	Seed yield (kg/ha)
different levels of nitrogen				
Non-application of nitrogen(N1)	23.00 c	1080.89 c	44.44 c	627.330 c
75 kg pure nitrogen(N2)	25.22 b	1429.33 b	47.44 b	1079.00 b
150 kg pure nitrogen(N3)	28.00 a	1866.22 a	52.22 a	1247.11 a
different levels of humic acid				
Non-application of humic acid(H1)	23.56 b	1141.78 c	44.89 c	852.778 c
100 mg/l humic acid (H2)	25.78 a	1564.33 b	48.56 b	1003.11 b
100 mg/l humic acid (H3)	26.89 a	1670.33 a	50.67 a	1097.56 a
N×H intraction				
N1×H1	22.00 f	993.333 g	42.33 g	461.000 g
N1×H2	23.00 f	1114.33 f	44.67 ef	652.333 f
N1×H3	24.00 def	1135.00 f	46.33 de	768.667 e
N2×H1	23.33 ef	1121.33 f	43.00 fg	885.667 d
N2×H2	26.00 cd	1517.00 d	47.67 cd	1107.00 c
N2×H3	26.33 bc	1649.67 c	51.67 b	1244.33 ab
N3×H1	25.33 cde	1310.67 e	49.33 c	1211.67 b
N3×H2	28.33 ab	2016.67 b	53.33 ab	1250.00 ab
N3×H3	30.33 a	2226.33 a	54.00 a	1279.67 a

The seed oil content in castor plant: based on analysis of variance of castor seed oil content, under influence of different levels of nitrogen fertilizer and humic acid in intercropping with Hyssop, was found that treatments of different levels of nitrogen (N) and different levels of humic acid (H) at the level of 0.01 and also their interaction between at the level of 0.05 caused significant difference on the trait of seed oil content of castor plant (Table 4).
The results of mean comparison showed that different levels of nitrogen fertilizer had effect on the trait of seed oil content of castor plant so that the maximum seed oil content with an average of 52.22 percent obtained by using 150 kg per hectare pure nitrogen treatment and the least oil yield per ha obtained by using non-application of nitrogen fertilizer with an average of 44.44 percent, and there was a significant difference between them. Also between the consumption of 75 kg per hectare pure nitrogen with 47.44% and the other two levels of nitrogen fertilizer, a significant difference was observed. (Table 4). (Table 5).

Table 6 – variance analysis of different traits of Hyssop plant under influence of nitrogen fertilizer and humic acid

SOV	df	(MS)			
		plant height	Number of stems per plant	Flowering shoot length	Fresh weight of frowering shoot
Block (R)	2	** 12.1111	** 13.4444	** 5.59259	ns 9.14815
Nitrogen (N)	2	** 11.4444	210.111**	** 25.0370	** 122.815
Humic acid (H)	2	** 13.7778	** 22.3333	** 9.03704	** 30.2593
H× N	4	ns 0.72222	ns 0.77778	* 1.70370	ns 1.92593
Experiment error	16	1.69444	1.86111	0.50926	3.93985

CV (%)	3.48	7.82	5.24	10.87

Plant height of Hyssop: based on the analysis of variance of plant height of hyssop, under different levels of nitrogen fertilizer and humic acid in intercropping conditions with castor, was found that treatments of different levels of nitrogen (N) and the treatment of different levels of humic acid (H) caused significant difference at the probability level of 0.01 on hyssop plant height trait (Table 6).
Results of mean comparison showed that the different levels of nitrogen fertilizer had effect on the trait of Hyssop plant height, so that the maximum plant height with average of 38.67 cm, obtained by using 150 kg per hectare pure nitrogen and the lowest plant height in the treatment of non-application of nitrogen fertilizer with an average of 36.44 cm, and there was significant difference between them .
Also between treatment of using 75 kg per hectare pure nitrogen with 37.22 cm and treatment of application of 150 kg ha pure nitrogen, there was significant difference but between treatment of consumption of 75 kg per hectare pure nitrogen and treatment of non-application of nitrogen fertilizer, no significant difference was observed. (Table 6). (Table 7).

Table 7- The traits mean comparison of Hyssop plant under influence of different levels of nitrogen fertilizer and humic acid

Treatment	MS			
	Plant height (cm)	Number of stems per plant	Flowering shoot length (cm)	Fresh weight of flowering shoot(cm)
Different levels of nitrogen fertilizer				
non- application of nitrogen (N1)	36.44 b	12.00 c	12.00 c	14.33 c
75 kg pure nitrogen (N2)	37.22 b	19.11 b	13.56 b	18.78 b
150 kg pure nitrogen (N3)	38.67 a	21.22 a	15.33 a	21.67 a
Different levels of humic acid				
non- application of humic acid (H1)	36.33 b	15.67 b	12.67 c	16.44 b
100 mg/l humic acid (H2)	37.22 b	18.00 a	13.56 b	18.22 ab
200 mg/l humic acid (H3)	38.78 a	18.67 a	14.67 a	20.11 a
intraction N×H				
N1×H1	35.67 c	9.667 e	11.33 c	12.00 d
N1×H2	36.33 bc	12.67 d	12.33 c	14.67 cd
N1×H3	37.33 bc	13.67 d	12.33 c	16.33 c
N2×H1	36.33 bc	17.67 c	12.67 c	16.67 c
N2×H2	36.67 bc	19.33 bc	12.67 c	18.33 bc
N2×H3	38.67 ab	20.33 ab	15.33 a	21.33 ab
N3×H1	37.00 bc	19.67 abc	14.00 b	20.67 ab
N3×H2	38.67 ab	22.00 a	15.67 a	21.67 ab
N3×H3	40.33 a	22.00 a	16.33 a	22.67 a

Between the means that at least are common in one word, in Duncan test at the level of 5% there is no significant difference

Length of flowering branch in hyssop plant: based on the results of variance analysis of flowering shoot in hyssop plant, under different levels of nitrogen fertilizer and humic acid, in intercropping with castor was found that treatment of different levels of nitrogen fertilizer (N) and treatment of different levels of humic acid (H) at the level of 0.01 and their interaction at the level of 0.05 caused significant difference on the trait of flowering shoot length in hyssop plant (Table 6).

The results of mean comparison showed that the application of different levels of nitrogen fertilizer had effect on the trait of hyssop flowering shoot length so that the maximum length of flowering shoot with the average of 15.33 cm under influence of application of treatment of 150 kg per ha pure nitrogen and the lowest flowering shoot length in treatment of non-application of nitrogen fertilizer with an average of 12.00 cm was obtained, and there was significant difference between them.

Also between the treatment of consumption of 75 kg per hectare pure nitrogen with 13.56 cm and treatment of 150 kg per hectare pure nitrogen there was significant difference and between the treatment of consumption of 75 kg per hectare pure nitrogen and treatment of non-application nitrogen fertilizer significant difference was observed. (Table 6). (Table 7).

Table 8- variance analysis of different traits of Hyssop plant under influence of nitrogen fertilizer and humic acid

SOV	df	MS			
		Dry weight of flowering shoot	Yield of flowering shoot	Essential oil percent of flowering shoot	Essential oil yiled per hactare
Block (R)	2	ns 1.33778	ns 535.1111	ns 0.48148	ns 0.23021
Nitrogen fertilizer(N)	2	** 6.40111	** 11347.11	** 138.481	** 4.63762
Humic acid (H)	2	** 28.3678	** 2560.444	** 76.9259	** 1.14879
Interaction H× N	4	ns 0.92222	ns 368.8888	* 5.37037	ns 0.11306
Experiment error	16	0.91403	365.6111	1.23148	0.08819
CV (%)		16.55	16.87	5.01	17.14

ns, *, ** non significant, significant at the level of 5% and 1% respectively

Essential oil of flowering shoot in Hyssop plant: Based on the analysis of variance of Hyssop essential oil percent of flowering branch of Hyssop plant, under different levels of nitrogen fertilizer and humic acid in intercropping conditions with castor, was found that using treatments of different levels of nitrogen (N) and treatment of different levels of humic acid (H) at the level of 0.01 and their interaction at the level of 0.05 caused significant difference on the essential oil percentage trait of flowering shoot in Hyssop plant (Table 8).

The results of mean comparison showed that using different levels of nitrogen fertilizer had effect on the essential oil percentage trait of flowering shoot of Hyssop plant essential oils in hyssop affected flowering shoot flowering shoot so that the maximum essential oil percentage of flowering branch with an average of 1.63% under influence of using treatment of 150 kg of pure nitrogen per hectare and the lowest percent of essential oil of flowering branch in treatment of non-application of nitrogen fertilizer with an average of 1.29 % was obtained and there was significant difference between them.

Also between the treatment of consumption of 75 kg pure nitrogen per hectare with 1.44% and the treatments of using 150 kg pure nitrogen per hectare, there was a significant difference and between treatment of consumption of 75 kg per hectare pure nitrogen and treatment of non-application of nitrogen fertilizer significant difference was observed. (Table 8). (Table 9).

Table 9- comparison of traits mean of Hyssop plant under influence of different levels of nitrogen fertilizer and humic acid

Treatment	Mean of squares			
	Dry weight of flowering shoot(g)	Yield of flowering branch (kg/ha)	Essential oil of flowering branch (%)	Essential oil yield (kg/ha)
different levels of nitrogen fertilizer				
non-application of nitrogen (N1)	3.94 c	78.889 c	1.29 c	1.025 c
75 kg pure nitrogen (N2)	5.90 b	118.00 b	1.44 b	1.713 b
150 kg pure nitrogen (N3)	7.49 a	149.76 a	1.63 a	2.460 a
different levels of humic acid				
non-application of humic acid (H1)	4.89 b	97.778 c	1.38 b	1.371 c
100 mg/l humic acid (H2)	5.88 a	117.56 b	1.44 b	1.742 b
200 mg/l humic acid (H3)	6.57 a	131.33 a	1.55 a	2.085 a
intraction N×H				
N1×H1	3.50 c	70.000 c	1.24 e	0.869 f
N1×H2	4.07 c	81.333 c	1.26 de	1.026 f
N1×H3	4.27 c	85.333 c	1.38 cd	1.180 ef

N2×H1	4.37 c	87.333 c	1.43 bc	1.249 ef
N2×H2	6.07 b	121.33 b	1.35 cde	1.641 de
N2×H3	7.27 ab	145.33 ab	1.55 b	2.248 bc
N3×H1	6.80 ab	136.00 ab	1.46 bc	1.994 cd
N3×H2	7.50 ab	150.00 ab	1.70 a	2.559 ab
N3×H3	8.17 a	163.33 a	1.73 a	2.827 a

Between the means that at least are common in one word, in Duncan test at the level of 5% there is no significant difference

The essential oil yield in Hyssop plant: based on analysis of variance of Hyssop essential oil yield, under different levels of nitrogen fertilizer and humic acid, in intercropping conditions with castor was found that using treatments of different levels of nitrogen (N) and treatment of different levels of humic acid (H) at the level of 0.01 resulted in significant difference in the trait of essential oil yield of Hyssop plant (Table 8).

The result of mean comparison showed that the application of different levels of nitrogen fertilizer had effect on the essential oil yield of hyssop plant, so that the maximum essential oil yield with the average of 2.45 kg per hectare under influence of the treatment of consumption of 150 kg per hectare pure nitrogen and the minimum essential oil yield in the treatment of non-application of nitrogen fertilizer with 1.03 kg per ha was obtained and there was significant difference between them.

Also between the consumption of 75 kg per hectare pure nitrogen with 1.71 kg per hectare and treatment of consumption of 150 kg per hectare pure nitrogen treatment there was significant difference and between treatment of consumption of 75 kg per hectare pure nitrogen and treatment of non-application of nitrogen fertilizer, significant difference was observed. (Table 8). (Table 9).

Conclusion:

The results obtained from carried out experiment on castor plant in intercropping with hyssop

The results of mean comparison showed that the maximum plant height (134.67 cm), the length of the main stem (84.78 cm), main stem diameter (23.11 mm), the number of nodes on the main stem (11.11), number of leaves per plant (28.00 leaves), grain yield per hectare (1866.22 kg per hectare), the percent of oil in seed (52.22%) and oil yield (1247.11kg per hectare) was obtained under influence of treatment of 150 kg per hectare purified nitrogen based on the experiment.

Studying the results of the mean comparison showed that the maximum plant height (131.56 cm), the length of the main stem (83.56 cm), main stem diameter (21.44 mm), the number of nodes on the main stem (10.11), number of leaves per plant (26.89 leaves), grain yield per hectare (1670.33 kg per hectare), the percent of oil in seed (50.67%) and oil yield (1097.56 kg per hectare) was obtained under influence of application of humic acid treatment with concentration of 200 mg per liter.

Studying the interaction of different levels of nitrogen fertilizer and humic acid on average properties of castor showed that treatment N3H3 (150 kg N/ha + consumption of humic acid at a concentration of 200 mg per liter) had the maximum plant height (141.00 cm), the length of the main stem (85.67 cm), main stem diameter (24.33 mm), the number of nodes on the main stem (11.33), number of leaves per plant (30.33 leaves), grain yield per hectare (2226.33 kg per hectare) , oil content in the seeds (54.00 %) and oil yield (1279.67 kg per ha).

But the treatment N3H3 (150 kg per hectare nitrogen fertilizer + humic acid consumption at a concentration of 200 mg per liter) with treatment N2H3 in terms of main stem length, stem diameter, number of nodes on the main stem and oil yield per hectare didn't show significantly different.

Therefore, treatment N2H3 (75 kg per hectare nitrogen fertilizer + consumption of humic acid at a concentration of 200 mg per liter) in terms of lower costs and reduction of consumption of chemical fertilizer is recommended for this trait. It is also observed that 200 mg per liter application of humic acid could reduce 50% of nitrogen fertilizer consumption.

The results obtained from carried out experiment on hyssop plant in intercropping with castor

The results of mean comparison showed that the maximum plant height (38.67 cm), the number of stems per plant (21.22 stem), length of flowering shoot (15.33cm), fresh weight of flowering branch (21.67 g), dry weight of flowering shoot (7.49 g), essential oil percentage (1.63%), dry yield of flowering shoot (149.78 kg per hectare) and essential oil yield (2.46 kg per hectare) was obtained under influence of treatment of 150 kg per hectare purified nitrogen according to the experiment.

Survey the results of mean comparison showed that application of treatments with the maximum plant height (38.78 cm), the number of stems per plant (18.67 stems), length of flowering shoot (14.67 cm), flowering shoot fresh weight (20.11 g) dry weight of flowering branch (6.57 g), essential oil percent (1.55%), dry yield of

flowering shoot (131.33 kg per hectare) and essential oil yield (2.08 kg per hectare) were obtained under influence of treatment of consumption of humic acid with a concentration of 200 mg per liter.
Studying the interaction of different levels of nitrogen fertilizer and humic acid on average characteristics of Hyssop plant showed that the treatment N3H3 (150 kg per hectare nitrogen fertilizer + consumption of humic acid at a concentration of 200 mg per liter) had the maximum plant height (40.33 cm), the number of stems per plant (22.00 stems), length of flowering shoot (16.33 cm), fresh weight of flowering branch (22.67 g), flowering shoot dry weight (8.17 g), essential oil percent (1.73%), dry yield of flowering shoot (163.33 kg per hectare) and essential oil yield (2.83 kg per ha).

References:

1-Arjomandi, Ali Khalil, 1998, Study the effect of different levels of nitrogen and phosphorus on fertilization (growth, development and active ingredient) Tymus Vulgaris /; Supervisor: R. Amidbaygi, Thesis (MA), Tarbiat Modarres University, Faculty of Agriculture
2- Amidbaygi, R. 2005. Research Journal of aromatic and medicinal plants, volume 21, issue 4.
3-Darzi, M. T., Ghalavand, A., Rejali, F. & Sefidkon, F. 2006. Survey of application of bio-fertilizers on yield and yield components of Fennel medicinal plant. (Foeniculum vulgare Mill) from 0.292 to 276 research of medicinal and aromatic plants of Iran (22:4). 276-292
4-Matin, A. 2002. Treatment prescriptions with medicinal plants from the garden of God. First Edition, Falahat Iran Publishing.
5-Nadri Boroujerdi, G., Madani. H., & Farahani, E. 2006. Determine the most suitable planting date, irrigation period and plant density on yield and essential oil content of hyssop plant in Markazi province (Arak). 9th Congress on agriculture and plant breeding of Iran. page 600
6-Niakan, M., khavari Nejad, R., & Rezaei, M.B. 2004. The effect of different ratios of 3 fertilizers K , P and N on the vegetative traits of Mint. Research of Medicinal and Aromatic Plants of Iran, 148: 20-131.
7-Hashemi Dezfuli. A., Kouchaki A. 1998. Increasing crop yield. Translation (N. Kafajerya) Mashhad Jihad University Press.
8-Arabaci, O. and Bayram, E., 2004. The effect of nitrogen fertilization and different plant densities on some agronomic and technologic characteristic of basil (Ocimum basilicum L.). Journal of Agronomy, 3(4): 255-256.
9-Aiken, G.R., McKnight, D.M., Wershaw, R.L. and MacCarthy, P., 1985. Humic Substances in Soil, Sediment, and Water. New York. USA: Wiley InterScience.
10-Jankovasky, M and T. Landa. 2002. Genus Hyssopus L. recent knowledge. Horticultural Science. 29: 119-123.
11-Maccarthy, P., 2001. The principles of humic substances. Soil Science 166:738– 751.
12-Mader, P., Pfiffner, L. and Nigeli. U., 1993. Effect of Tree farming systems (Bio-dynamic, Bio-organic, Conventional. Acta Horticulture. 339:11-31.)
13-Padem, H., Ocal, A. and Alan, R., 1997. Effect of humic acid added foliar fertilizer on seedling quality and nutrient content of eggplant and pepper. ISHS Symposium on Greenhouse Management for Better.