Applied Ecology and Forestry Science , 2015, Vol. 1, No. 1, 1-4
Available online at http://pubs.sciepub.com/aefs/1/1/1

DOI:10.12691/aefs-1-1-1

The Assessment Effects of Bio and Chemical Fertilizers on Vegetative Growth and Essential Oil of Hyssop (*Hyssopus officinalis* L.)

Naderi Gholamreza[1], Hamid Madani[1,*], Ebrahim Farahani[2]

[1]Department of agriculture and natural resources, Islamic Azad University, Arak Branch, Arak, Iran
[2]Agriculture & Natural Resources Research Center of Tehran Province, Iran
*Corresponding author: h-madani@iau-arak.ac.ir

Received July 31, 2015; Revised September 01, 2015; Accepted September 02, 2015

Abstract In this study the effect of bio and chemical fertilizer on Hyssop (*Hyssopus officinalis* L.) plant characteristics, biomass yield and essential oil was investigated during 2009 -2011. Treatments were Control, without using any fertilizes (F1), Chemical fertilizers application (F2), PSB: Phosphate solublizing Bacteria application (F3) and Nitroxin: Nitrogen fixation Bacteria (F4). The experimental design for both years was complete randomized block design with three replications. The results have shown a significant increase in some plant characteristics and properties of hyssop compare to control. Chemical fertilizers application with by 2824 $kgha^{-1}$ had highest Biomass but the most essential oil yield were obtain in Chemical fertilizers application plus Nitroxin that were significantly increased yield of essential oil by 4.1 kg/ha and biomass yield by 2530 kg/ha.

Keywords: *biomass, PSB, nitroxin, essential oil, number of flowers, yield*

Cite This Article: Naderi Gholamreza, Hamid Madani, and Ebrahim Farahani, "The Assessment Effects of Bio and Chemical Fertilizers on Vegetative Growth and Essential Oil of Hyssop (*Hyssopus officinalis* L.)." *Applied Ecology and Forestry Science*, vol. 1, no. 1 (2015): 1-4. doi: 10.12691/aefs-1-1-1.

1. Introduction

Currently, biological kinds of fertilizers are more conmen in new world. Nitrogen-fixation and Phosphate-solublizing microorganism are two important microbial fertilizers that can be use for increasing the production yields. Azotobacter and Azosperllium are used for nitrogen fixation. Frequently, unavailable phosphorus is fixed in the soils and changed to non-solublizing phosphate. Using bacteria as bio-fertilizers or bio control the pests and diseases, has increased the yield of agricultural crops [1]. Characteristics of phosphate dissolving bacteria has adapted well with various types of soils and aquatic environments and many breeds of phosphate dissolving bacteria have successfully caused increase in plants yield [2].

Hyssop (*Hyssopus officinalis* L.) is herbaceous perennial plants which belong to Lamiaceae family native to Southern Europe, the Middle East, and the region surrounding the Caspian Sea. Due to its properties as an antiseptic, cough reliever, and expectorant, it is commonly used as an aromatic herb and medicinal plant. Hyssop is a brightly colored shrub or sub shrub that ranges from 30 to 60 cm in height. The stem is woody at the base, from which grow a number of straight branches. Its leaves were dark green in color, and from 2 to 2.5 cm long. The amount of essential oil in the vegetative body of *Hyssopus officinalis* L. is different and is between 0.3-1% and the most amount of essential oil in this plant is in the flowering branches [3].

Today Medicinal plants have especial importance as the raw material for pharmaceutical industry. With consideration increase of world population and more need to medication and treatment has resulted in more attention to these plants. Because of lack or small side effects of using these plants than chemical medicines, human's tendency to use these plants has been increased [4]. Nitrogen is one of the nutrients in soil and causes fecundity and fertility of soil. Nitrogen deficiency in soil is resulted in mismatch in growth and shortening plant height and cause yellowing and making leaves mottled. When enough nitrogen is available for the plant the need to main elements such as phosphorus and potassium increases [5]. Nitrogen makes the plant to be able to establish faster and to produce more photosynthesis level [6]. Phosphorus after nitrogen is one of the macro elements for this plant. This element involves in all of the biochemical processes and energy transfer and massages transfer mechanisms. Phosphorus has fundamental role in plants nutrition. Briefly has useful role in root development, cell division, albumen production, flowering, fruiting, crop maturing and plant quality increase. Moreover, availability of phosphate ion causes plant resistance to lodging, crop pre maturity, and higher quality and finally results in performance increase. Phosphorus compounds unlike nitrogenous compounds are almost insoluble and thus their release in soil is very slow. Potassium deficiency intensifies negative effects of extra

nitrogen. However, by increasing nitrogen and phosphorus in soil the need of plant to potassium increases and must be compensated. Thus, the effect of crop increase as a result of using phosphorus and nitrogen fertilizers in soil will be considerable whenever the soil becomes rich of potassium. Potassium has special importance in maintaining water in plant tissues [7]. Excessiveness of potassium ion increases osmotic pressure of vacuole and causes prevention of losing water also, potassium in plants results in efficiency increase of nitrogen fertilizer [8].

2. Materials and Methods

This study was carried out during 2009-2011 in Arak, Iran (34°03'08" N, 49°48'26" W; 1711 m above sea level). Treatments were Control, without using any fertilizes (F1), Chemical fertilizers application or N100 P80 K100: pure nitrogen 100 $kg.ha^{-1}$, pure phosphate 80 $kg.ha^{-1}$ and pure potassium 100 $kg.ha^{-1}$ (F2), PSB: Phosphate solublizing bacteria in soil application 100 $g.ha^{-1}$ (F3) and Nitroxin : Nitrogen fixation Bacteria a liter per hectare (F4). The experimental design was a complete randomized block design (CRBD) with three replications. The plant spacing was 40 cm and row spacing was 50 cm with 1-2 cm seeding depth. The length and width of each plot were 8 and 3 meters. The total number of plants in each plot was 40 plants. Irrigation was applied by furrow method. Phosphate solublizing bacteria and Nitrogen fixation bacteria were given to plant through irrigation when plants were at two true leaves stage. The plant characteristics were sampling and measuring 25 days after planting and repeated weekly. 10 plants were picked from each plot to quantify the plant parameters like roots, stems and leaves weight after dried by oven at 75°C for 72 hours. After dried the extraction was performed in the laboratory. To measure the essential oil amount, Clevenger apparatus and water distillation method was used; 100 grams of leaf powder and dried shoot was poured in 1 liter flask of device and 800 ml water to it and heated by 120°C for 2 hours. Statistical analysis of the data based on complete randomize block and comparing their average by (LSD test at 0.05), analyzing the data using SAS 9.1 software.

3. Results and Discussion

3.1. Plant Height

The analysis of variance table showed that the year and treatments had significant effects on plant height at 0.01 levels. Among the treatments, N100P80K100 application with an average 53.42 cm had highest and control with 38.81 cm had least amount. Results show that the application biofertilizer have leaded into significant increase in plant height comparing to control.

3.2. Length of Flowering Branches

The treatments had significant effects on Length of flowering branches at 0.01 levels. With the treatments, N100P80K100 application with an average 15.67 cm had highest and control with 9.39 had least amount. Results show application of Nitroxin has leaded into significant increase in Length of flowering branches compare to control.

3.3. Number of Branches

Investigating analysis of variance table show that the year and treatments had a significant effects on number of branches at 0.05 levels. Between the treatments, N100P80K100 with an average 18 branches had highest and control with 11.22 beaches had least amount.

3.4. Number of Leaves on Main Stem

The Study for analysis of variance table showed that year and treatments had significant effects on number of leaves on main stem at 0.01 levels. N100P80K100 application with an average 181.67 leaves had highest and control with 124.44 leaves had least amount. Application of biofertilizer had a significant increase in number of leaves on main stem compare to control.

3.5. Number of Flowers Per Plant

The analysis of variance table showed that year and treatments had a significant affects on number of flowers at 0.05and 0.01 levels. The highest mean of number of flowers showed in N100P80K100 treatment with 248.78 leaves and control with 98.89 leaves had least amount. Results show that application of biofertilizer has leaded in to a significant increase in number of flowers compare to control.

3.6. Seed Weight

The Study for analysis of variance table showed that year and treatments had a significant effects 1000 seeds weight at 0.01 levels. N100P80K100 application and Nitroxin with an average 0.71 g had highest and control with 0.49 g had least amount. Usage of biofertilizer had a significant increase in 1000 seeds weight stem compare to control.

3.7. Fresh Weight Flowering Branches

The Analysis variance table showed that year and treatments didn't have a significant affects on fresh weight flowering branches. The highest mean of fresh weight flowering branches showed in N100P80K100 application treatment with 14.68 and control with 12.17 g had least amount.

3.8. Dry Weight Flowering Branches

The Study of analysis variance table showed that treatments didn't have significant effects on dry weight flowering branches. N100P80K100 application with an average of 4.71g had highest and control with 3.92 had least amount.

3.9. Leaves Dry Weight

Study for analysis of variance table showed that year and treatments had a significant effects leaves dry weight at 0.01 levels. N100P80K100 application with an average 20.74 g had highest and control with 15.74 g had least amount. Usage of biofertilizer had a significant increase in leaves dry weight stem compare to control.

3.10. Shoot Dry Weight

Analysis of variance table showed that year and treatments had a significant affects on shoot dry weight at 0.05 and 0.01levels. N100P80K100 with an average 45.18 g had highest and control with 33.4 g had least amount.

3.11. Biomass Yield

Analysis variance table showed that year and treatments had a significant affects on biomass at 0.05 and 0.01 levels. N100P80K100 application with an average 2824 kg.ha^{-1} had highest and control with 2088 kg.ha^{-1} had least amount.

3.12. Yield of Essential oil

The Study of analysis of variance results showed that experimental treatments had significant effects on essential oil yield at 0.01 levels. N100P80K100 application with an average 6.39 kg.ha^{-1} had highest and control had least amount (3.72 kg.ha^{-1}).

Table 1. Complex analysis variance of effect of fertilizers on Hyssop characteristics in 3 years

SOV	Year (Y)	E y	Fertilizers (F)	Y.F	Ef	CV%
DF	2	6	3	6	18	
Plant Height	254.75 **	14.33	151.21 **	37.080 *	9.44	7.18
Length of flowering branches	11.29 ns	10.11	70.45 **	5.790 ns	4.43	17.52
Number of branches	39.25 *	3.83	39.23 *	8.916 ns	153.66	11.37
Number of leaves on main stem	8627.58 *	4067.63	5004.96 *	329.54 ns	1538.60	15.63
Number of flowers	7365.02 *	7779.86	40622.9 **	2515.40ns	1443.89	12.55
1000 seeds weight	0.17 **	0.02	0.09 **	0.01 *	0.005	11.98
Fresh Weight flowering branches	1.720 ns	25.36	13.00 ns	2.260 ns	6.412	19.27
Dry weight flowering branches	0.64 ns	1.92	1.42 ns	0.23 ns	1.052	13.7
Leaves dry weight	57.44 **	2.8	57.44 **	2.970 ns	6.173	14.23
Shoot dry weight	791.89 *	106.09	295.05 **	25.120 ns	6.17	19.88
Yield of essential oil	0.270 ns	8.05	13.30 **	0.050 ns	29.09	17.34
Yield of biomass	3093382.0 *	414490.4	1152360.1**	98196.30 ns	224809.6	19.88

**: Significant at 1 % levels. *: Significant at 5 % levels. ns: no Significant.

Table 2. Effect of fertilizers on three-year mean of characteristics in *Hyssopus officinalis* L.

Characteristics	Year 1	Year 2	Year 3	$LSD_{5\%}$	F1	F2	F3	F4	$LSD_{5\%}$
Plant Height (cm)	41.49 b	38.91 b	47.86 a	2.63	38.81 c	48.51 a	41.63 bc	42.08 b	3.04
Length of flowering branches(cm)	11.33 a	11.58 a	13.12 a	1.81	9.39 c	15.67 a	10.33 c	12.67 b	2.08
Number of branches	12.75 b	12.50 b	15.75 a	2.51	11.22 b	18.00 a	11.89 b	13.56 b	2.89
Number of leaves on main stem	182.25 a	129.58 b	147.17 b	33.64	124.44 b	181.67 a	149.0 ab	156.89 ab	38.84
Flower numbers	196.5 a	159.4 b	149.5 b	32.59	98.89 c	248.78 a	130.0 bc	196.22 b	37.63
1000 seeds weight(g)	0.711 a	0.493 b	0.699 a	0.065	0.49 b	0.71 a	0.64 a	0.71 a	0.075
Fresh Weight flowering branches (g)	13.45 a	12.72 a	13.25 a	2.17	12.17 a	14.68 a	12.20 a	13.51 a	2.51
Dry weight flowering branches (g)	4.47 a	4.06 a	4.45 a	0.88	3.92 a	4.71 a	4.05 a	4.629 a	1.02
Leaves dry weight (g)	19.35 a	15.06 a	17.94 b	2.13	15.74 b	20.74 a	16.30 a	17.03 a	2.46
Shoot dry weight(g)	46.19 a	29.95 c	38.33 b	6.51	33.40 b	45.18 a	33.57 b	40.48 ab	7.51
Yield of essential oil (kgha^{-1})	4.48 a	4.72 a	4.76 a	1.09	3.72 b	6.39 a	3.91 b	4.58 b	1.26
Yield of biomass (kgha^{-1})	2887 a	1872 c	2396 b	406.7	2088 b	2824 a	2098 b	2530ab	469.58

Means within the same column and factors, followed by the same letter are not significantly difference ($P < 0.05$) using LSD test.

4. Conclusions

Application of chemical fertilizer (N100P80K100 application) had considerably increased the average of plant height, length of flowering branches, number of branches, number of leaves on main stem, number of flowers on plant, 1000 seed weight, dry weight of leaves, shoot dry weight, yield of essential oil and biomass dry yield compare to control.

Using phosphorus biofertilizer (PSB) had considerably affected the mean height of plant (41.6 cm), number of flowers on plant (130) and 1000 seeds weight (0.64 g) compare to control.

Using nitrogen biofertilizer (Nitroxin) had considerable increase on mean height of plant (42.1 cm), length of flowering branches (12.7 cm), number of flowers on plant (196), 1000 seeds weight (0.71 g), fresh weight of flowering branches (10.3 cm), dry weight of flowering branches (4.04 g), leaves dry weight (17.0 g), shoot dry weight (40.5 g), yield of essential oil (4.1 kg.ha^{-1}) and biomass dry yield (2530 kg.ha^{-1}) compare to control treatment. These results are in agreement with those obtained by Haridy et al (2001) [5] on lemongrass, El-Ghadban et al (2002) [3] on *Origanum majora* and Hanafy Ahmed et al (2002) [4] on rocket plants. Finally, the results showed a beneficial effect of bio fertilizers on the growth characteristics and essential oil yields of hyssop. The treatment of using bio fertilizers application are

recommended for increasing the dry yield of flowering branches and yield of essential oil of *Hyssopus officinalis* L. in the region.

Acknowledgments

Appreciation is extended to the Islamic Azad university, Arak branch and Research Farm managers and to head of the agricultural faculty of Armenia for their assistance with this study.

References

[1] Bulllock J., 1999. Proposal for gaining information on producing Tanacetum (fever few) as a high dollar perennial crop. North Carolina State University Publication, 10p.

[2] Davision J., 1988. Plant beneficial bacteria. Bio/tech. 6: 282-286.

[3] El-Ghadban E.A.E., GALLAB A. M., ABDELWAHAB A. F., 2002. Effect of organic fertilizer (Bio green) and bio fertilization on growth, yield and chemical composition of Marjoram plants growth under newly reclaimed soil conditions, 2nd Congress of Recent Technologies in Agriculture, 2, 334-361.

[4] Hanafy A., Kahlil M.K., Farrag A.M., 2002. Nitrate accumulation, growth, yield and chemical composition of Rocket (*Eruca vesicaria* Sub sp. sativa) plant as affected by NPK fertilization, kinetin and salicylic acid, Annals of *Agricultural Science*. *Ain Shams University*., Egypt, 47, 1-26.

[5] Harridy I.M.A. SOLEIMAN S.G.I., MERVAT T.A., 2001. Physiological, chemical and biological studies on Lemongrass *Cymbopogon citratus* (DC) stapf in response to diastrophic bacteria, Agric. J. Sci. Mansoura Univ., 26, 6131-6152.

[6] Malakoti J., 1997. Sustainable agriculture and yield increase by optimization of fertilizer application in Iran. Iranian Press for Organization of Research and Extension of Agriculture. 297.

[7] Matin A., 1972. Technology, physiology and using ways of fertilizers in arid areas. Ahvaz, Iran Jondishapour University press,. 339 p.

[8] Omidbeighi R., 1998. Studying the aspects of thymus and processing its essential oil, Pajoohesh and Sazandegi. Year 10, No. 36, 67-71.

[9] Rao I.M., FRIESEN D.K., HORST W.J., 1999. Opportunities for germ plasm selection to influence phosphorus acquisition from low- phosphorus soils. Agroforestry forum. 9: 13-17.

[10] Ravanbakhsh J., 1998. Extraction and determining the active compounds and constituents of essential oil of Thymus. Thesis (MA) –University of Medical Sciences, Tabriz, Iran.

[11] Rezanejad A., 1997. Studying effect of different levels of nitrogen and harvest time on fertility of thymus (growth, development, yield and amount of active ingredient; Master science thesis, Tarbiyat Modares University, Tehran, Iran.