

EFFECT OF NITROGEN NUTRITION ON GROWTH AND ESSENTIAL OIL PRODUCTION OF PEPPERMINT (*Mentha piperita*)

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ABSTRACT

Peppermint (*Mentha piperita* cv. Mitcham) plants were grown in Investigative Field of Ferdowsi University of Mashhad in IRAN (59° N latitude), and evaluated for their response to nitrogen rates. The form of applied nitrogen was urea. Plants were measured for total essential oil content in flowering stage, plant height, dry matter (DM), leaf and node number, leaf area index (LAI), node and stem length. Rates of nitrogen applied were 0 (control), 75, 150 and 225 Kg ha⁻¹ nitrogen. The results showed that the increased nitrogen rates (0-150 Kg ha⁻¹), the essential oil yield increased and then it decreased. The highest level of essential oil obtained with 150 Kg ha⁻¹ N. The highest level of DM resulted in by nitrogen at 225 Kg ha⁻¹ rate. There was highest height in the plants that treated with nitrogen at 75 and 150 Kg ha⁻¹. The most node and leaf number were in nitrogen at 225 kg ha⁻¹. The least node length observed at 225 kg ha⁻¹.

KEY WORDS: *Mentha piperita*, Essential Oil, Nitrogen Fertilizer, Growth and Development

1. INTRODUCTION

Numerous authors have studied the chemical composition of peppermint that treated with different levels of fertilizers. Zheljaskov and Margina [9] have studied the effect of fertilizer application on quantitative and qualitative characteristics of peppermint. They concluded that the increased fertilizer rates, herbage and essential oil yield are increased. The level of fertilization did not affect significantly the content of main chemical compounds in the oils. Alkire and Simon [1] showed that essential oil yield of peppermint and spearmint affected by rate and form of nitrogen fertilizer. Singh *et al.* [7] have studied the effect of irrigation and levels of nitrogen on herb and oil yield of geranium under semiarid tropical India. They concluded that nitrogen influenced on essential oil of the plant. The results of Salardini *et al.* [5] study showed that potassium fertilization affected yield and pyrethrins concentration of pyrethrum. Sun Liu and He [8] showed that Mn²⁺ and Mg²⁺ had effect on increasing flavonoid content in ginkgo leaves. Berti *et al.* [2] indicated that echinacoside and alkylamides content and root yield of *Echinacea angustifolia* L. were not influenced by N, P, and K or their interactions. Ekonomakis and Yeritsyan [3] results indicated that different levels of iron had influenced on essential oil quality and quantity of oregano. Omidbaigi and Arjmandi [4] indicated that N P- supply had effect on herb yield and active substances of garden thyme. Serrano and Tinoco [6] showed that there were not any significant difference in the oil yield and composition of thyme that treated by N P K Mg fertilizer.

2. MATERIALS AND METHODS

In order to optimize nitrogen rate for some characteristics of peppermint and essential oil production, four levels of nitrogen (as urea) were applied at three times (bed preparing, transplanting, beginning of flowering). This study conducted at the north east of Iran at Research Farm of the Department of

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Horticulture, Ferdowsi University, Mashhad (Table 1). The levels of fertilizer application was the following: 0 (control), 75, 150 and 225 Kg ha⁻¹ nitrogen. The experiment was laid out in RCBD design on a loamy soil with three replications. The peppermint transplants were obtained from Budakalazi Research Station of Hungary. The plant material was herb. The air dried herbs of *Mentha piperita* were hydro-distilled in a laboratory scale extraction by Clevenger-type apparatus to give a green oil.

Table1. Characteristics of experimental field (Mashhad).

Latitude	36° 17' N
Altitude	59° 40' N
Max. Temp.(°C)	41
Min. Temp.(°C)	-6
Rainfall (mm) / Year	153
Altitude form Sea Level (m)	990

3. RESULTS AND DISCUSSION

The results of this study indicated that growth and essential oil production of peppermint significantly affected by nitrogen (Table 2). The results indicated that plant height and plant dry matter (DM) increased with increasing nitrogen levels and there were significant different between treatments (Tab. 3). Leaves number, leaf area index (LAI), node length, node number, and DM influenced by treatments and there were significant different between treatments (Table 3). It was established that the DM, leaf and node number (Table 3), and essential oil content (Fig.1) were increased with increasing fertilizer rates. Zheljazkov and Margina [9] reported that the essential oil yield of mint increased with increasing in fertilizer rates. Alkire and Simon [1] showed that dry mater and essential oil yield of peppermint and spearmint affected by rate and form of nitrogen fertilizer. Singh *et al.* [7] resulted that application of nitrogen (200 kg ha⁻¹) increased herb and oil yields production in geranium. Salardini *et al.* [5] study shown that potassium fertilization resulted in increasing pyrethrins concentration and achene yields of pyrethrum.

Table2. Effect of nitrogen on growth and essential oil production of peppermint (Analysis Variance).

Characteristics	MS			
	FA(Nitrogen)	Error	Prob	CV (%)
Plant Height	523.879	30.181	**	9.84
DM %	36.771	0.001	**	0.01
Stem Length	0.369	0.070	*	9.43
Leaf No.	4247.779	1237.62	ns	26.64
Node No.	1703.259	89.727	**	14.25
LAI	5.751	1.588	ns	14.85
Essential Oil	1.647	0.001	**	0.01

ns None Significant

* Significant at 5 % Probability Level

** Significant at 1 and 5 % Probability Level

DM. Dry Matter

LAI. Leaf Area Index

Table3. Effect of nitrogen on some characteristics of peppermint (Means comparisons with multiple range Duncan's test)

Characteristics	N ₀ (Control)	Treatments (Nitrogen Kg ha ⁻¹)		
		N ₁ (75)	N ₂ (150)	N ₃ (225)
DM (%)	25.70 c	26.6 bc	28.90 b	32.60 a
Height (cm)	54.57 b	60.3 ab	70.40 a	38.50 c
Node No.	40.30 b	70.30 ab	80.52 ab	91.83 a
Leaf No.	80.71 b	142.5 ab	134.30 ab	170.80 a
LAI (cm ²)	9.607 a	8.663 ab	9.19 a	6.493 b
Node Length (cm)	4.297 a	4.037 ab	4.15 a	3.55 b

- There are Significant Different in Each Rows With Different Letters (P=5 %).

DM. Dry Matter

LAI. Leaf Area Index

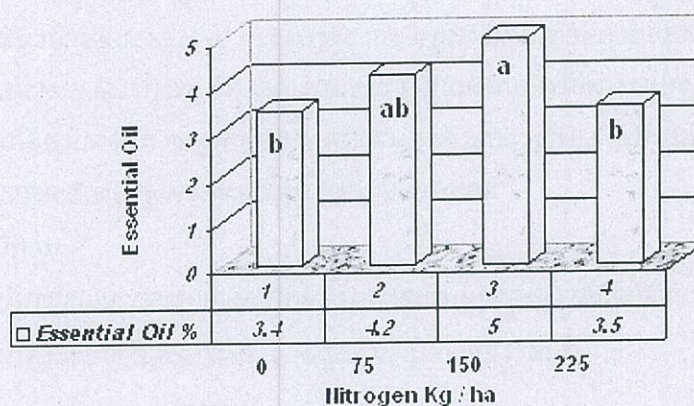


Figure 1. Effect of nitrogen on essential oil production of peppermint.

4. CONCLUSION

Peppermint (*Mentha piperita* cv. Mitcham) plants were grown in Investigative Field of Ferdowsi University of Mashhad in IRAN (59° N latitude), and evaluated for their response to nitrogen rates. The form of applied nitrogen was urea. Plants were measured for total essential oil content in flowering stage, plant height, dry matter (DM), leaf and node number, leaf area index (LAI), node and stem length. Rates of nitrogen applied were 0 (control), 75, 150 and 225 Kg ha⁻¹ nitrogen. The results showed that the increased nitrogen rates (0-150 Kg ha⁻¹), the essential oil yield increased and then it decreased. The highest level of essential oil obtained with 150 Kg ha⁻¹ N. The highest level of DM resulted in by nitrogen at 225 Kg ha⁻¹ rate. There was highest height in the plants that treated with nitrogen at 75 and 150 Kg ha⁻¹. The most node and leaf number were in nitrogen at 225 kg ha⁻¹. The least node length observed at 225 kg ha⁻¹.

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