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EFFECT OF DIFFERENT LEVELS OF NITROGEN FERTILIZER ON GROWTH AND OIL CONTENT OF SPEARMINT (*MENTHA SPICATA* L)

Elham Mohammed Babaker Ahmed[1] **Ekhlas Mohamedzein Musa Mohamedzein**[1]

[1] Faculty of Agriculture- University of Sinnar
Email: ekhlasmohamedzein2@gmail.com

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Abstract

A pot experiment was conducted at the Faculty of Enginerring Nursery, Sinnar University to study the effect of nitrogen fertilization on herbage yield and oil content of spearmint (*Mentha spicata* L) during the year 2016. Four levels of nitrogen 0 Kg N/ha, 40 Kg N/ha, 80 Kg N/ha and 120 Kg N/ha were arranged in A Completely Randomized Design with three replicates. Data were collected after 60 and 90 days from planting to determine the mean of plant height, number of leaves, and number of branches, leaf area, fresh and dry weight of plant. The results of oil content were determined after 90 days from planting. The results showed significant increase of plant height, number of leaves, and number of branches, leaf area, fresh and dry weight of plant at 60 and 90 days after planting with increasing levels of nitrogen. The oil content was significantly decreased with the increase of nitrogen levels. Eighty Kg N/ha is the optimum dose for growth and oil content of mint.

Key Words: spearmint, nitrogen fertilizer, yield, oil content

Introduction

Most of the species of the family Labiate are aromatic, herbaceous annulus or perennials while some tropical species are trees (Rizk, 1986). The family Labiate includes 200 genera and about 3300 species (Abdul-Aziz and Hamad, 1988) which are distributed over almost all the temperate and tropical regions. The family is well represented in Mediterranean area and Britain (Gerhenzonm *et.al*., 1989). Many members of this family are used in culinary or medicinal purposes.

The general morphology of spearmint is that the squared and light green stem stands more erect with numerous lateral branches at the leaf axils, some aerial branches spread along soil surface forming roots at nodes, and apical part of the branches changed into rhizome-like root stock when enter the soil. The leaves are lance-shaped, long narrow, light green in color with very short petiole. The flowering spikes are more sharply pointed, long and narrow (Salim, 1997).

Spearmint is chiefly used for culinary purposes it is also used as stimulant, carminative and antispasmodic; it is better adapted for children's maladies. Spearmint oil is added to many compounds on account of its carminative properties because its taste is pleasant. Spearmint solution in distilled water relieves hiccough and flatulence as well as in digestion, for infantile trouble generally the sweetened infusion is an excellent remedy, and is also pleasant beverage in fevers, inflammatory diseases, and is useful in allaying nausea and vomiting and in relieving the pain of colic, and as a local application in painful hemorrhoids. Its principal employment is for its febrifuge and diuretic virtues (Grieve, 1970). Infusion of *menthe spectate* leaves is refreshing carminative, stomach, aphrodisiac, odontaigic, appetizer, especially when mixed with tea; or with vinegar and indigo it from an emetic (Boules, 1983).

Earliest investigation on the chemistry of spearmint oil date back more than a century (Guenther, 1949) the chief constituent of spearmint oil is carvone, there are also present phellandrine, limonene and dihydrocarveol acetate, esters of acetic, butyric and caproic or caprylic acids are also present (Grieve, 1970 and Guenther, 1949). Trease and Evan (1989) mentioned that carvone limone are divergently formed from a common intermediate presence of vitamins such as vitamin A, riboflavin, and vitamin C is also reported in species of genus menthe. Madzharova *et al*., (1979) found that hybrid obtained by crossing *menthe spectate* L. and *menthe viridis* contains 43 mg of vitamin C/ 100g of fresh weigh of spearmint, also it is rich in minerals, it contain 300 mg Ca and 7.7mg Mg/100g of fresh weight of spearmint (Abdur Rahim *et. al*.,1960). In addition to the volatile oil, the members of family labiatae contain di- and tri-rpenoids, saponins, alkaloids, polyphenols, cumarins, sugars such as raffinose and starches (Abdel Aziz and Hamad, 1988).

Spearmint is grown in different areas of Sudan, in Khartoum state it is grown widely in Kuku project, Halfaya, Shamabt and Elezergab areas. Elsharfa is the famous place among others producing spearmint in Gazira State (Salim, 1997). Spearmint grown in a wide range of soils, loamy upland soil or various types of muck (characteristic of drained, but not over drained, former swamplands) being most suited, the ground is prepared by disc ploughing several times, harrowing, dragging with a planker, and fertilizing (Guenther,1949).

A moist situation is preferable, but mint will succeed in almost any soil once started into growth, though in dry sandy soil it is sometimes difficult to grow, and should be planted in coolest and dampest situations (Grieve,1970).

Singh, *et al*., (1989) studied the economic doses of N for *Menthe Verdis*, *Menthe peperita* and *Menthe spectate*, and they found that the best N fertilization doses were 167,153 and145 kg N/ha respectively, and the oil yield expected were 190,103 and 50kg/ha respectively

Singh *et al*., (1992) reported that nitrogen fertilizer inputs below 200 kg urea/ ha increased most growth parameter whereas the oil content of all mint species decreased at that levels of urea.

Bashir (2000) found that, there was no significant different between different levels of Nitrogen and chicken manure on growth and oil content of spearmint at Shambat soil.

Shahidullah *et al*., (1997) studied the response of *Menthe spiccata* to different levels of nitrogen, and found that the plant highest, number of branches/plant and herbage yield increased progressively with the increase in nitrogen rate up to 175 kg N/ ha, the highest percentage of oil (50%) was recorded with the application of 200 kg N/ ha. Jaskonis (1967) proved that the herbage increase with the increasing of NPK as applied in form of organic fertilizer, N only, N, P together or as N, K. Also there was an increase in aromatic oil.

Ghosh and Chatterjee (1993) found that the amount of oil content was increased when NPK was used. Cupta, *et al*., (1997) reported that the best oil yield was obtained by using poultry manure.

The objective of this study were to investigate the effect nitrogen fertilizer on growth and oil content of *Menthe spicata* L.

Materials and Methods

A pot experiment was conducted during 2016 to study the effect of different levels of nitrogen on growth, yield and oil content of menth. The experimental site is at the Nursery of Sinnar University, Sinnar city, 297 Km south east of Khartoum, at latitude 12˚ 5′ and 14˚ 7′ and longitude 32˚ 58′ and 35˚ 42′.The general characteristics of the soil used in this study are shown in Table (1). The plant materials used in this experiment were raised from fully spearmint mature plants grown in Almorafa area (30 Km south east of Sinnar city). The plant was classified according to Elgazali *et al*., (1988) as follows:

Common name	Spearmint
Latin name	*Mentha viridis* L
Syn name	*Mentha spectate* L
Family	Labitate

The soil was pounded in a wooden mortor, sieved through 2 mm mesh. Sample of this soil was stored for later use to determine some of its physical and chemical properties (Table 1). The pots (each 0.7 m^2) were filled by the soil; eight seedlings

were transplanted in each pot and irrigated immediately, then every two days. Four treatments and three replicates were arranged in a Completely Randomized Design (CRD) in two portions, one harvest at 60 days and the other harvest at 90 days after transplanting. The treatments were 0Kg N/ha, 40Kg N/ha, 80Kg N/ha and 120Kg N/ha designated as 0N, 1N, 2N and 3N respectively. Urea was used as a source of nitrogen fertilizer; the fertilizer was added after one month from planting date. Weeds will be removed by hand when required.

Three plants from each pot were tagged and harvested after 60 days of planting in portion one and after 90 day of planting in portion two. The parameters which were measured from the tagged plants were plant height (cm), number of branches, number of leaves, leaf area (cm^2), fresh and dry weight of shoot system and oil content (%).

The data were statically analyzed using the standard procedure of analysis (ANOVA), by using SPSS Program. Mean separation was done using least significant differences (LSD).

Table (1): General characteristic of experimental soil

Ec	0.47
N	0.0203
P	3.14
K	0.46

RESULTS and Discussions

Plant height was significantly increased by nitrogen fertilization, the highest plant height was given by the treatment (80 kg N/ha) at 60 days after transplanting and by the treatment (40 kg N/ha) at 90 days after transplanting, and the lowest plant height was given by the treatment (40 kg N/ha) and (0 kg N/ha) at 60 and 90 days after transplanting respectively (Table 2). This results is in line with the results of many workers on spearmint, Singh *et al.* (1989) reported that, plant height of spearmint significantly increased with nitrogen application up to 50.4 kg N/fed; Singh *et al.* (1992) found that, the plant height of *Menthe arvensis* (Japanese mint), *Menthe piprita* (pepper mint) *and Menthe spicate* (spearmint) increased significantly with nitrogen fertilizer up to 100 kg N/ha.

Branches number significantly increased by nitrogen fertilization, the highest number of branches/plant was given by the treatment (80 kg N/ha) at 60 and 90 days after transplanting (Table 3). This results is in line with the results found by Shahidullah *et al.* (1997) who studied the response of spearmint to different levels of nitrogen, and found that, the number of branches/plant increased progressively with the increase in nitrogen rate up to 175 kg N/ ha.

Leaves number significantly increased by nitrogen fertilization, the highest number of leaves/plant was given by the treatment (80 kg N/ha) and (120 kg N/ha) at 60 and 90 days after harvesting respectively (Table 4). This result is in line with the

results found by Singh *et al.* (1992) reported that, nitrogen fertilizer inputs below 200 kg urea/ ha increased most growth parameter such as number of leaves/plant.

Leaf area significantly increased by nitrogen fertilization, the highest leaf area (cm^2) was given by the treatment (80 kg N/ha) at 60 and 90 days after harvesting respectively (Table 5). This results is in line with the results of many workers on spearmint, Singh *et al.* (1989) reported that, leaf area (cm^2) of spearmint significantly increased with nitrogen application up to 50.4 kg N/fed; Singh *et al*. (1992) found that, the leaf area (cm^2) of spearmint increased significantly with nitrogen fertilizer up to 100 kg N/ha.

Fresh and dry weight of spearment significantly increased by nitrogen fertilization, the highest fresh weight was given by the treatment (120 kg N/ha) at 60 and 90 days after harvesting respectively (Table 6) and Table (7). This results is in line with the results of many workers on spearmint, Singh and Duhan (1979) reported that, fresh and dry weight of spearmint significantly increased with nitrogen application up to 50.4 kg N/fed; Singh *et al*. (1992) found that, the fresh and dry weight of spearmint increased significantly with nitrogen fertilizer up to 100 kg N/ha. Singh *et al.* (1992) reported that, nitrogen fertilizer inputs below 200 kg urea/ ha increased fresh and dry weight (gm).

Oil content significantly increased by nitrogen fertilization, the highest percentage of oil content was given by the treatment (40 kg N/ha) at 90 days after harvesting, and the lowest percentage of oil content was given by the treatment (120 kg N/ha) at 90 days after harvesting (Table 8). This result is in line with the result found by Singh *et al.* (1992) who reported that, the oil content spearmint significantly decreased by increasing the rate of nitrogen up to 63 Kg N/fed, Singh *et al*. (2009) reported that, oil content of *Menthe arvensis* (Japanese mint), *Menthe piprita* (pepper mint) *and Menthe spicata* (spearmint) decreased significantly with increasing nitrogen fertilizer up to 100 Kg N/ha.

Table (2): Effect of different levels of nitrogen fertilizer on plant height (cm) of spearmint

Treatments	**Plant height**	
	At 60 days	**At 90 days**
0Kg N/ha	24.52^{b}	26.57^{d}
40Kg N/ha	23.35^{d}	40.70^{a}
80Kg N/ha	29.66^{a}	35.17^{b}
120Kg N/ha	24.28^{c}	31.20^{c}
Mean	25.45	33.41
LSD	0.20	0.02

* Means within the same column followed by the same letter (s) are not significantly different at 0.05 level of probability according to LSD.

Table (3): Effect of different levels of nitrogen fertilizer on number of branches/plant of spearmint

Treatments	Number of branches	
	At 60 days	At 90 days
0Kg N/ha	5.37[d]	5.87[d]
40Kg N/ha	5.53[c]	12.73[b]
80Kg N/ha	17.13[a]	21.77[a]
120Kg N/ha	10.05[b]	10.73[c]
Mean	9.52	12.77
LSD	0.01	0.74

* Means within the same column followed by the same letter (s) are not significantly different at 0.05 level of probability according to LSD.

Table (4): Effect of different levels of nitrogen fertilizer on number of leaves/plant of spearmint

Treatments	Number of leaves	
	At 60 days	At 90 days
0Kg N/ha	43.13[d]	62.73[d]
40Kg N/ha	43.90[c]	95.50[c]
80Kg N/ha	99.57[a]	149.67[b]
120Kg N/ha	61.92[b]	161.77[a]
Mean	62.13	117.42
LSD	0.01	0.04

* Means within the same column followed by the same letter (s) are not significantly different at 0.05 level of probability according to LSD.

Table (5) Effect of different levels of nitrogen fertilizer on leaf area (cm^2) of spearmint

Treatments	Leaf area	
	At 60 days	At 90 days
0Kg N/ha	2.25[b]	1.93[d]
40Kg N/ha	2.34[b]	3.13[a]
80Kg N/ha	2.87[a]	2.90[b]
120Kg N/ha	2.32[b]	2.03[c]
Mean	2.44	2.50
LSD	0.29	0.05

* Means within the same column followed by the same letter (s) are not significantly different at 0.05 level of probability according to LSD.

Table (6): Effect of different levels of nitrogen fertilizer on fresh weight (gm) of spearmint

Treatments	Fresh weight	
	At 60 days	At 90 days
0Kg N/ha	22.67[c]	30.70[d]
40Kg N/ha	16.53[d]	60.67[c]
80Kg N/ha	60.23[b]	100.53[b]
120Kg N/ha	67.63[a]	113.27[a]
Mean	41.77	76.29
LSD	4.04	6.10

* Means within the same column followed by the same letter (s) are not significantly different at 0.05 level of probability according to LSD.

Table (7): Effect of different levels of nitrogen fertilizer on dry weight (gm) of spearmint

Treatments	Dry weight	
	At 60 days	At 90 days
0Kg N/ha	5.23[c]	8.17[d]
40Kg N/ha	3.57[d]	11.83[c]
80Kg N/ha	12.53[b]	23.50[b]
120Kg N/ha	12.97[a]	27.13[a]
Mean	8.58	17.66
LSD	0.31	2.02

* Means within the same column followed by the same letter (s) are not significantly different at 0.05 level of probability according to LSD.

Table (8): Effect of different levels of nitrogen fertilizer on oil content (%) of spearmint at 90 days of planting

Treatment	Oil content
0Kg N/ha	0.200[b]
40Kg N/ha	0.367[a]
80Kg N/ha	0.100[c]
120Kg N/ha	0.058[d]
Mean	0.208
LSD	0.003
C.V.	12.45

* Means within the same column followed by the same letter (s) are not significantly different at 0.05 level of probability according to LSD.

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