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Rationing of the Use of Nitrogen Fertilizer in Combination with Leaf Spray And Its Effect on The Growth And Yield of Peppermint (Mentha Piperita L.)

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Abstract: *A field experiment was carried out in the field of experiments of the Medical and Aromatic Plants Research Unit at the college of Agriculture - University of Baghdad during the year 2016 - 2017 to study the rationing of the use of nitrogen fertilization by overlap with leaf spraying and its effect on the growth of the peppermint plant (Mentha piperita L.). The experiment was carried out within the design of the complete randomized block design (RCBD) with seven treatments and three replicates. The treatments included control (full chemical fertilization N, P, K) and (1/2 N+ P, K) + spraying 1000ppm and (1/2 N+ P, K) + spraying 2000ppm (N) and (1/4 N, P, K) + spraying 1000ppm (N) and (1/4 N+ P, K) (P, K) + spraying with 1000ppm (N) and (P, K) + spraying 2000ppm (N). The results of the experiment showed no significant decrease in plant height, number of branches, soft weight of leaves, chlorophyll, dry weight of plant, dry weight of leaves and yield of dry leaves of the rationing treatments. The highest percentage of aromatic oil in the treatment of 1/4 (N, P, K) + spraying 2000ppm (N) (1.7%) with a rationing ratio of 50.04% followed treatments (P, K) + spraying 2000ppm (N) and (P, K) + spraying 1000ppm (N) (1.36 and 1.35% respectively) with highest rationing ratio reached 93.04 and 96.67% respectively compared to the control treatment which reached 1.22% and without nitrogen rationing.*

Keywords*: peppermint, rationing , chemical fertilization, spraying, nitrogen*

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I. Introduction

The cultivation and production of medicinal and aromatic plants is one of the most important agricultural sectors in the world because it is the primary source and the basis for the treatment of various diseases directly as herbs or indirectly by entering the manufacture of drugs used in traditional pharmacies or as a guide to manufacture chemical compounds similar to those found in the plant in terms of The chemical and pharmacological influence, which is known as the chemical drugs, as well as its entry into the food industry, preparation of spices, cosmetics, perfumery, soap and disinfectants, and recently in the manufacture of pesticides (environmentally friendly). In all cases, therapy with medicinal plants is absent or has little side effect compared with chemotherapy.The medicinal plant, which is characterized by many therapeutic and industrial benefits is the plant of the mint (*Mentha piperita* L.), which belongs to the family of the Labiatae, a herbaceous plant, Permanent , evergreen, the nature of its growth creeping or erect, the Mediterranean basin is the original of the plant, especially the southern part The continent of Europe and the northern part of Africa. The medicinal importance of the plant comes from its content of oil, which contains various terpen compounds, the most important of which is medical the menthol as it enters in the medicines of colds, and coughs, as well as oil in the expulsion of gases, and in the field of industry enters the preparation of perfumes and soap and some food products such as candy For their taste and flavor (Halabo et al. 1995 and Abu Zeid, 1992).

Based on the above importance of the plant it was necessary to study and develop the performance of the plant with reducing the damage to the environment, as the plant is subject to the effect of genetic factors and environmental conditions and agricultural service treatments from where the increasing or decreasing in growth and production, especially the process of fertilization, including chemical fertilization, That chemical fertilizers have become a source of environmental pollution, especially when excessive use, especially in the leafs crops that fertilize with nitrogen in large quantities in order to increase the yield, so it has become necessary to ration quantities with maintaining the quantity and quality of the Without the damage to the environment, including air and groundwater because the production of chemicals requires large amounts of fuel and the annual production of chemical fertilizers 80 million tons per year, and believed that 80% of the human intake of food from nitrates

originated vegetables, and the nitrat increasing in chemical products, It is known that the plant absorbs nitrates from the soil and if not metabolism in the formation of proteins as stored in the cells in their image and when cooking turn into nitrite, which in turn can be associated with amino compounds composed of carcinogenic

substances (Taiz, Zeiger, 2006, Ridiman and Shennawi, 2005) For the purpose of reducing the quantities of chemical fertilizers added to the soil, a series of studies have been carried out to achieve this aim. in *Foeniculum vulgare* mill. Mahfouz and Sharaf-Eldin (2007) were found superior the treatment of bio-fertilizers + 50% chemical fertilizers K, P, N in fruit yield and total yield (90.32, 91.99 g. plant^{-1}) (3.23, 3.29 ton.h^{-1}) % compared with chemical fertilizer alone (67.67, 68.11 gm. Plants $^{-1}$ 2.42, 2.43 ton. h^{-1}) for seasons respectively). Hendawy (2008) also showed that (*Plantago arenaria*) with compost tea at 300ppm concentration with soil increased the ratio of elements N, P, compared with the control, also Compost tea (300ppm) Compost tea + 50%for chemical fertilizer (N250 P250 K125) lead to significantly increase the amount of Mucilage (848.3 ml. plant^{-1}) compared with 325.1 ml. plant^{-1} at full chemical fertilization and alone N500 P500 K125 (with the same of the amount of potassium). Quader et al. (1998) found a significant increase in carbohydrate content in mulberry plants when spraying with urea compared to the control treatment and chemical ground fertilizer. However, the interaction between spray and soil fertilization significantly increased the leaf yield compared with the control.In order to reduce the use of chemical fertilizers while maintaining the qualitative and quantitative yield or increase in the flaxseed plant, the study aimed to treat the plant with spray fertilization(urea) and reduce the nitrogenous soil fertilizer to half or more .

II. Materials And Methods

A field experiment was carried out in 2017 in the field of experiments of the Medical and Aromatic Plants Research Unit - college of Agriculture - University of Baghdad. The semi-soft mind of the mother plants was prepared in the field and after a good set of roots planted seedlings in plastic pots (diameter 20 cm and length 40 cm weighing 10 kg soil) on 20/3/2017, with homogeneous distribution of seedlings from Where the size and length. Soil for agriculture was prepared and moistened and packaged in polyethylene bags. Soil samples were taken before planting for physical and chemical analysis (Table 1**)**The whole soil chemical fertilizer was added to the potassium fertilizer, phosphorus and the first amount of nitrogen after planting the seedlings, the second amount of nitrogen after 21 days of the first amount. The spraying of the urea was at two levels (1000 and 2000 ppm) by dissolving 2.17 g of urea per liter of water For 1000 ppm (N), twice the quantity of urea per liter of water in the case of 2000 ppm (N), the time between each spray and the other 10 days and by 4 sprinkles until the grass is harvested. The first spray was 72 hours after adding ground nitrogen. The source of nitrogen fertilizer is urea (46% N). Potassium is the source of potassium sulfate (K_2O 50%) and phosphorus is the source of (Magnum fertilizer) (P_2O_5 44%).

Table(1) Physical and chemical properties of soil.

%		mg.kg^{-1} Soil			ppm	meq/L				pH	Ec ds.m-1	%			Texture
N	O.M	P	So_4	Co_3	K	CL	Na	Mg	Ca			silt	clay	sand	Loam
0.0023	1.03	9.3	2.1	Nil	54.1	40.8	5.8	16.1	23.3	7.85	4.5	40.0	20.8	39.2	

The amount of fertilizer added was calculated based on the soil weight of each pot. By knowing the soil weight of hectar(2000000 kg) and the recommended amount of fertilizer, the pot soil was weighed 10 kg was extracted and calculated the recommended quantity each pot on that basis.

$$\text{amount of fertilizer to be added to the pot} = \frac{\text{amount of fertilizer recommended} \times (10\text{kg})}{\text{Soil weight (2000000 kg)}}$$

The experiment was carried out to study different levels of chemical fertilizers with urea spray, compared with full amount the recommended chemical fertilizer (Abu Zeid, 1992) and its effect on the growth and production of grass and oil ratio with ration the amount of adding grownd nitrogen fertilizer. the design of the complete randomized block design (RCBD) with seven treatment and three replicates. The experimental consist of 21 experimental units (as shown below). The characteristics were evaluated according to the least significant difference of 5% LSD (Sahuki and Wahib, 1990).

1. Chemical fertilization N, P, K (full recommended total). (240 N, 120P and 60 kg h^{-1})
2. 2- fertilization with N, P, K (half the amount of nitrogen) + spraying at 1000ppm (N).
3. Fertilization with N, P, K (half the quantity of nitrogen) + spraying at 2000ppm (N).
4. Fertilization with N, P, K (one amount of nitrogen) + spraying at 1000ppm (N).
5. Fertilization with N, P, K (quarter the amount of nitrogen) + spraying at 2000ppm (N).
6. Spraying at 1000ppm (N) + recommended fertilization without nitrogen.
7. Spraying at 1000ppm (N) + recommended fertilization without nitrogen.

The vegetative Indicators were measured, which included plant length (cm), number of branches (branch $plant^{-1}$), leaf area (dsm^2), chlorophyll content (SPAD), dry weight of plant (gm .$plant^{-1}$), soft weight leaves (kg.$plant^{-1}$) , dry weight leaves (kg.$plant^{-1}$) and yield of dry weight (kg. h^{-1}) at the start of flowering of the plant. The percentage of pilot oil (%) was measured by distillation with distilled water .The method of the leaf disks adopted the information of the area and dried it with drying the leaves of the plant, all of them 40 ° 50 ° C until the weight was determined and the leaf area(dsm^2) was calculated (Watson and Watson, 1953) according to the following equation:

$$\frac{\text{leaf area of disks} \times \text{Dry weight of plant leaves}}{\text{Dry weight of disks}}$$

The chlorophyll was directly measured in the field by chlorophyll SPAD. The soft weight of the leaves was calculated by separating the leaves from the branches by hand, then weighing with a sensitive balance and taking the rate of plants in the experimental unit. In order to calculate the dry weight of the leaves, the leaves were dried in shade and at room temperature in a ventilated place to preserve the largest quantity of aromatic oils and to avoid their volatilization. After dryness the leaves were weighed by the sensitive balance to calculate the dry weight of the leaves and their yield per hectare. The aromatic oil was extracted by distillation with distilled water by taking a known weight of dry leaves (50 g) after grinding (to increase the surface area). Immediately add 750 ml of distilled water after placing it in. Leave the machine working about three hours to extract amount of oil contained in the sample is fully. After extracting the oil as a percentage based on 100 gram dry leaves.

Calculation of Nitrogen rationing ratio:
Nitrogen content per hectare (240 kg N) with urea (46% N):
Full fertilizer(urea) per hectare

$$\frac{100 \times 240(N)}{46} = 521.73 \text{ kg urea per hectare}(h^{-1})$$

• Nitrogen manure when spraying with water-dissolved urea concentrate 1000 ppm N per hectare:
If the preparation of 1 liter of fertilizer solution of urea concentration of 1000 ppm N needs 2.17 g urea.
- Number of plants per hectare = 1000000 plants (10 plants in meter ^{2}).
- Amount of Solution for Urea used for spraying plants until full wetness per hectare (2000 liters).
2000 x 4 sprinkles = 8000 liters
2.17 urea x 8000 L = 17360 g (17.36 kg urea h^{-1}) per hectare
• Nitrogen fertilizer when spraying with water-dissolved urea (2000 ppm N concentration) is: 17.36 × 2 = 34.72 kg urea. h^{-1}.
• The amount of nitrogen fertilizer in urea in the treatment (half the amount of ground nitrogen) + spraying at 1000 ppm (N) is: 260.86 + 17.36 = 278.22 kg urea. h^{-1}.
• The amount of nitrogen fertilizer in the urea in the treatment of (quarter of the amount of ground nitrogen) + spraying at 1000 ppm (N) is: 130.43 + 17.36 = 147.79 kg urea. h^{-1}.
• The amount of nitrogen fertilizer as urea in the treatment (half the amount of ground nitrogen) + spraying at ppm 2000 (N) is: 260.86 + 34.72 = 295.58 kg urea. h^{-1}.
• The quantity of nitrogen fertilizer as urea in the treatment (quarter of the quantity of ground nitrogen) + spraying at ppm 2000 (N) is 130.43 + 34.72 = 165.15 kg urea. h^{-1}.
• The amount of nitrogen fertilizer as urea in spraying treatment at 1000 ppm (N) + the recommended fertilization without nitrogen is: 17.36 kg urea .h^{-1}.
• The amount of nitrogen fertilizer as urea in the spraying treatment at 2000ppm (N) + the recommended fertilization without nitrogen is 34.72 kg urea. h^{-1}.

The rationing ratio was calculated by nitrogen chemical fertilizer (urea) according to the following law:

$$\text{The rationing ratio} = \frac{\text{full Fertilizer(urea)} - \text{urea in rationing}}{\text{Full fertilizer(urea)}} \times 100$$

III. Results And Discussion

The results of Tables (2.1) indicate that there is no significant decrease in the parameters of the control treatment (complete soil chemical fertilization) in vegetative characteristics of plant height, number of branches, dry weight of the plant, chlorophyll content, soft and dry weight of leaves and dry leaves. At the same time most the treatment of rationing improvement compared with control, while the treatment of (P, K) + spraying with ppm1000 (N) increased significantly in the leaf area (15.19 dsm^2) compared with the control (10.03 dsm^2). It is known and scientifically proven that the ratio and the sum oil yield depends on several factors, including the soft weight of the leaves (Not always) and the dry leaves. Therefore, the significant decrease of these two characteristics, as well as the improvement of them in some rationing treatment compared with the control (full fertilization) means the establishment of a field of conservation of vegetative growth, (Frans, Barker, 2005, and Abu Zeid, 1992), despite the reduction in the amount of nitrogen fertilization added to the soil, which ranged from half to a quarter of the amount, also non- soil addition in the treatment of regulation (P, K) + Spraying 1000ppm (N) and (P, K) + spraying 2000ppm (N) with Compensation
by very small amounts of leaf spray (Table 4). Reducing the amount of nitrogen fertilizer means reducing environmental pollution (as will be discussed later), as well as reducing production costs.

Table 2. Interaction effect of soil chemical fertilizer with urea leaf spray in plant height (cm), number of branches (plant), dry weight (gm. plant $^{-1}$) and leaf area (dsm^2) of peppermint**.**

Characters / Treatment	plant height (cm	n. of branch (plant)	leaf area (dsm^2)	dry weight (plant)
N,P,K Complete	44.39	20.39	10.03	12.95
1/2N,P,K+ spray 1000 ppm (N)	42.44	19.65	12.55	12 47
1/2N,P,k + spray 2000 ppm (N)	41.15	21.73	11.58	12.60
1/4N,P,k + spray 1000 ppm (N)	45.83	20.30	14.14	12.41
1/4N,P,k + spray 2000 ppm (N)	48.27	20.86	12.55	12.83
P,k + spray 1000 ppm (N)	46.50	19.11	15.19	15.2
P,k + spray 2000 ppm (N)	47.22	16.88	14.30	13.63
L.S.D(0.05) of treatment	N.S	3.74	5.06	N.S

Table 3. Interaction effect of soil chemical fertilizer with paper spray of urea in soft weight of leaves (gm. plant^{-1}), dry leaf weight (gm. plant^{-1}) , yield dry leaf yield (kg. h^{-1}) and chlorophyll(SPAD) of peppermint**.**

Characters / Treatment	plant height (cm	n. of branch (plant)	leaf area (dsm^2)	dry weight (plant)
N,P,K Complete	44.39	20.39	10.03	12.95
1/2N,P,K+ spray 1000 ppm (N)	42.44	19.65	12.55	12 47
1/2N,P,k + spray 2000 ppm (N)	41.15	21.73	11.58	12.60
1/4N,P,k + spray 1000 ppm (N)	45.83	20.30	14.14	12.41
1/4N,P,k + spray 2000 ppm (N)	48.27	20.86	12.55	12.83
P,k + spray 1000 ppm (N)	46.50	19.11	15.19	15.2
P,k + spray 2000 ppm (N)	47.22	16.88	14.30	13.63
L.S.D(0.05) of treatment	N.S	3.74	5.06	N.S

From the table(4)The results showed that the percentage of oil was significantly affected by the rationing treatment, with the highest percentage of oil (1.7%) in the treatment of rationing (1/4) N, P, K + spraying by 2000ppm (N) Followed by regulation treatment (P, K) + 2000ppm, (P, K) +, 1000 ppm (N) and (1/4 N, P, K) + 1000 ppm which reached 1.36 , 1.35 and 1.28 respectively, without a significant decrease of the control (1.22%). The increase in the percentage of oil in some rationing treatments, especially the treatment (1/4 N, P, K) + spraying with 2000 ppm (N), may be attributed to better nitrogen fertilization efficiency by nitrogen-sprayed plants, As it is known that a large amount of soil-added nitrogen fertilizer is washed into groundwater and another part of the nitrogen fertilizer volatiles as ammonia and the other part of the fertilizer is benefit from it the plant (Abu Dhahi and Yunis, 1988). Spraying on the plant will be a direct and quick benefit from leaves, with avoid the great exaggerating of fertilizers added to the soil as well as the preservation of the environment from pollution, air, soil or groundwater which leads to maintain human health as well as reduce the costs of production. The large amount of chemical fertilizers into the soil, especially nitrogen, lead to increased nitrates in the soil and irrigation process leads to the washing by percentage (2-10%), especially sandy soils which leads to groundwater pollution through nitrate increase in drinking water (Savci, 2012, Rosen and Horgan, 2017) . The increase in nitrate in soil and water it causes the risk of health as a result of the increase in the ratio of nitrates of 10 parts per million (ppm) in drinking water can lead to a phenomenon called Cyanotic methemoglobinemia, also if animals take 5 parts per million nitrates in drinking water leads to the injury by disease (Pimentel , 1997), as well as the transformation of nitrates into nitrite and the last association with amino compounds, causing cancer (Taiz, Zeiger, 2006, Ridiman and Shennawi, 2005). Nitrogen oxide emissions as ammonia are 2-20%, which increases from nitrogen ratio as No_2, N_2o and No which lead to atmospheric pollution. The Nitric oxide contributes in negative effect on the ozone layer because it the basis for the formation of nitrous oxide which absorbs the infrared rays and contributes to global warming, depletion of the ozone layer and damage to human health. The transition from nitrogen to soil to the organic image is 15-25%. Finally, the plant uses only 50% of the soil-added nitrogen fertilizers (Savci, 2012 and Choudhury and Kennedy, 2005

As for the reduction of production costs, Table (5) shows that the amount of Nitrogen fertilizers used in their rationing treatment were reduced and without a significant decrease of the control in oil ratio, as the rate of rationing from 43.34% in the treatment of (1/2 N, P, K) + spraying with 2000 ppm (N) to 96.67% at the treatment of (P, K) + spraying with 2000 ppm (N) with oil ratio 1.36% and the percentage of oil was not significant difference of control treatment (1.22%). The rationing rate reached 68.34% at the treatment of (1/4 N, P, K) + spraying with 2000 ppm (N) which used 260.63 kg urea with the highest percentage of aromatic oil (1.7%) compared to the control treatment which used 521.73 kg urea of nitrogen fertilizer with oil ratio of 1.22%.

Table 4. Interaction effect of soil chemical fertilizer with urea leaf spray in percentage of volatile oil (%).

Treatment	N,P,K Complete	1/2N+P,K + 1000 ppm(N)	1/2N+P,K + 2000 ppm(N)	1/4N+P,K + 1000 ppm(N)	1/4N+P,K + 2000 ppm(N)	P,K + 1000 ppm(N)	P,K + 2000 ppm(N)
Ratio(%)	1.22	1.01	1.12	1.28	1.7	1.35	1.36
L.S.D(0.05)	0.45						

Table 5. Rate of rationing in natrogenic fertilizer and its costs with the effect of rationing treatments compared with the soil chemical fertilization(Kg. h^{-1}) of the whole amount of nitrogen.

Treatment	N,P,K Complete	1/2N+P,K + 1000 ppm(N)	1/2N+P,K + 2000 ppm(N)	1/4N+P,K + 1000 ppm(N)	1/4N+P,K + 2000 ppm(N)	P,K + 1000 ppm(N)	P,K + 2000 ppm(N)
Amount of nitrogen fertilizer as urea	521.73	278.22	295.58	147.79	165.15	17.36	34.72
ratio of rationing (%)		46.60	43.34	71.67	68.34	96.67	93.04

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