

# Studying the Conventional Chemical Fertilizers and Nano-Fertilizer of Iron, Zinc and Potassium on Quantitative Yield of the Medicinal Plant of Peppermint (*Mentha Piperita L.*) in Khuzestan

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**Abstract:** Peppermint with the scientific name of *Menthapiperita* from the Lamiaceae family is a medicinal and aromatic plant that is planted in different regions of Iran. The present study was conducted to compare the conventional chemical fertilizers and nano-fertilizer of iron, zinc and potassium on quantitative yield of medicinal plant of peppermint (*Mentha piperita L.*) in Khuzestan province, Sardasht city. The experiment was conducted as a completely randomized block design in three replications and the mean comparison was performed by Duncan's test. Four samples were randomly prepared from each treatment in the appropriate time with the interval of once per 7 days and were measured by evaluated characteristics such as plant height, the number of branches, leaves of branch and nodes, and wet and dry weight of leave, stems and plant. The quantitative characteristics were evaluated and compared in order to determine the size by the ruler in cm and a digital scale with the precision of one thousandth. The highest plant height, the number of branches, leaves of branch and nodes, and wet weight of leave, dry weight of leave, wet weight of stems, dry weight of stems, wet weight of plant and dry weight of plant were 11.67 cm, 58.2, 916.3, 16.6, 219 g, 26.7, 66.42, 23.1, 140.8 g and 40.34, respectively, that indicate the effect of nano-fertilizer on the quantity of plant.

**Keywords:** Aromatic Plant, Chemical Fertilizers, Nano-Fertilizer, *Mentha Piperita L.*, Plants.

## 1. INTRODUCTION

Peppermint is from Labatae family with the scientific name of *Mentha.spp* and a very important medicinal plant that is widely used in pharmaceutical and food industries. Study of Peppermint in 1696 AD showed that in the property territory of Hertfordshire located in the south of England, John obtained a kind of ment that was grown in the farms of green mint that was easily distinguished from the other stem due to having the short but stronger stems and also had itself special spicy taste. Later, this plant was called *Menthapalustris* by mentioned scientists in 1704. Undoubtedly, it was a unique stem that later became an origin of appearing the vast expanse of cultivating this plant on earth. A sample of this plant remained in mitcam

and was kept intact.

The specific characteristic of this plant can be referred to their grassy types that generally have the Collenchyma batches in angles of stems below the epidermis and in this case, it causes that the stems of the plants seem to be square. Also, there are 2 to 8 batches of discontinuous xylem in internal cylinder of stem that in each node a batch from each pair enter into the leaf and the remaining batches are divided into two batches and replace the empty xylem. The batches of metaxylem-metaphloem in them are usually seen as non-continuous and discrete.

Herbal medicine is one of the oldest methods of preserving human health and almost all nations and cultures have provided the written materials about their relation with the medicine of using the plants as medicine (medication). Accordingly, the use of medicinal plants in traditional medicine of Iran has also very important. Among the important medicinal plants of Iran, the mint and oregano can be mentioned that their important applications are in the pharmaceutical and healthcare industries as a key factor in the anti-fungal, anti-bacterial and allelopathic agents. (Omid Beigi, 1994)

Considering the growing population and non-systematic use of available resources of water and soil, development of the area under cultivation the area in Iran is associated with serious limitations or it is costly. So the yield per unit area should be increased. (Lebaschi, 2000) The growth of plant requires a sufficient and balanced amount of nutrients in the soil. It may be said that a vegetarian diet is the best hope for solving the food crisis. Plant nutrition science began about 150 years ago with the classic experiments Liebig and Lavs and others. (Kasraei, 1985) The use of chemical fertilizers is essential to food shortages and soil fertility and today the chemical fertilizers are used to achieve the highest yield in the unit area. The chemical fertilizers should be able to improve the quality of agricultural products in addition to increase the production. The curative property of medicinal plants has been considered for several years. nano-fertilizers are materials with special properties, which are made from the very small size. The molecules of these particles have a

size of 8 Å to 10 nm. Particles with this size have a function beyond the conventional physico-chemical laws. (Das, 2004)

Generally nanotechnology is a part of new technologies that is still in the initial stages of their growth. The main difference of nanotechnology with other technologies is in the scale of materials and structures that are used in this technology. In fact, if we want to state difference of this technology with other technologies, we can mention the basic elements as an important criterion. The field of using nano-particles is very diverse. Nano-powders are a mixture of particles with dimensions between 1 and 10 nm. It is claimed that nanotechnology as a factor promoting another industrial revolution has high economic and technological potential. Thus, the discussion and research to study the possible risks of using these particles on human health, safety and the environment is very important and crucial. (Banaei, 2005)

Nano-fertilizers affect the amount and rate of growth by penetrating into the tissue of plant cell and increasing the penetration rate of nutrient required. Also controlling the amount of these elements proportionate to the needs of various plants is one of the considerable points of this technology. In studying the effect of time of spraying iron chelate nano-organic fertilizer on quantitative and qualitative characteristics of dryland wheat, they came to these results that spraying iron chelate nano-fertilizer in the stem elongation stage has had the best result with 99% of increase in the yield and 32.4% of increase in the iron content and reported an increase the quantitative and qualitative characteristics compared to control. (Nazaran, 2009).

Some researchers believe that zinc maintains the integrity of cell membrane by protecting the proteins and lipids against free radicals and other products from the reviving intracellular reaction. Furthermore, the metal with copper forms the main part of superoxide dismutase enzyme as corrosive of free radicals. Also, when zinc accumulates in the soil and eventually in plant tissues, it alters some metabolic processes of plant depending on the plant species and thus interferes with the growth and development of plants.

In studying the effect of different sources of potassium

Depth	EC	PH	TMV	N(Total)	OC	Ca	Soil texture				
							P(ava)	K(ava)	Fe	Zn	
Centimete r	(DS/M)	(pH)	Percent	Percent	Percent	meq.lit-1	-----	ppm	ppm	mg.kg-1	mg.kg-1
0-30	29-Mar	Jul-87	7-Jun	0/019	0/13	5-Jul	Silt-clay	17-Mar	185	23-Feb	0/51

To combat the pest of Mole cricket, in the early stages of plant growth the bait spraying was conducted by poisoned bait (bran soaked in Sovin poison). After planting, until the end of time to conducting the project, any chemical pesticides were not used. To control the weed, the mechanical control and hand weeding were regularly done once every 6 days. Considering the harsh and bitter taste of peppermint plant, no insect damage has been observed over time of conducting the project.

on yield and yield components of wheat under irrigation and low irrigation conditions after flowering, the treatment of potassium chloride in the irrigation condition allocated the highest yield to itself and all treatments had higher amount of seed yield than the control treatment. Use of K fertilizer increases the number of wheat fertile tillers and thus the number of clusters per unit area Akbarinia The amount of potassium in growth has the certainty because this element has an important role in the manufacture of hydrocarbon and protein matters. (Akbarinia, 2011)

## 2. MATERIALS AND METHODS

The experiment with 9 treatments was conducted as a completely randomized block design with three replications in Khuzestan province, Sardasht city. The treatments included: iron, zinc and potassium fertilizers, combining the conventional chemical fertilizers, iron nano-fertilizers, zinc nano-fertilizers, potassium nano-fertilizers, combining the nano-fertilizers and control fertilizers that were considered with the plot size of 350 square meters. The field of experiment was plowed by a moldboard plow and the field leveling operation and taking the sample of soil were conducted by two perpendicular disks and use of the trowel. The results of soil survey are given in Table 1 in which the soil texture was conducted by hydrometer by casa method and measuring K, Zn, and Fe was performed by standard method by the Soil and Water Laboratory of Choopanan Andishe.

*Table 1: Results of soil analysis*

The first irrigation was performed shortly before planting and immediately after planting in the first day of March and then the holes were drilled with the depth of 7 to 8 cm and seedlings were put into them and covered by the soft and moist soil.

In the protection stages, the fertilizers required have been the treatments containing the Fe chelate fertilizer, Zn nano-fertilizer and K nano-fertilizer and control treatment (no fertilizer) in 3 replications in each plot during 2 steps 2 with the total amount of 7, 25, 200, 232, 1, 5, 40 and 47 kilograms per hectare and without fertilizer.

After elimination of marginal effect (first and last two lines and 50 cm from the beginning and end of medial lines) the sampling was performed from the medial lines to measure the characteristics. Each treatment used 4 plants to measure the characteristics and the plants were taken of the surface of ground soil. After collecting, the samples were placed into the plastic bags and then after transferring to the laboratory and separating the different components and measuring the wet weight and counting

related to each characteristic, the samples were placed in a paper bag to obtain the dry weight of the plant components and were placed in an oven at 70 ° C for 48 hours and after complete drying, weighing was performed by using a digital scale with a precision of one thousandth. SAS software (version 1.9) was used for statistical analysis and Duncan's test was used for mean comparison at the level of 5%. To draw graphs and calculate the regression relationships, Excel and SPSS software were used. The

results showed that the effect of chemical fertilizers and nano-fertilizers on the plant height, number of branches, wet weight of leaves and wet weight of stem at the level of 1% and wet weight of plant at the level of 5% were significant indicating the effect of nano-fertilizers and also lack of having negative effects of chemical fertilizers and recommending to use the nano-fertilizers. The results obtained from the fertilizer treatments with 3 replications were determined as follows (Table 2 and 3)

Table 2. Variance of the effect of chemical fertilizers and nano-fertilizers for the evaluated characteristics of mint

Characteristics	Df	Plant height	Number of stem	Number of leaf	Number of branch	Wet weight of leaf	Dry weight of leaf
Repetition	2	53.6**	11.72**	102516.61ns	77.6**	4239.01*	72.14**
Treatment	8	54.6**	10.23**	93882.5*	78.23**	3658**	63.25ns
Error	16	45.26	10.45	923058	74.08	3365.1	73.54
Total	27	11.11	17.14	81.13	18.13	18.17	47.11

ns,\* and \*\* indicate no significant difference and significant difference at the level of 5% and 1%, respectively.

Table 3. Mean comparison of the effect of treatments on the evaluated characteristics of Peppermints

Treatment	Plant height (cm)	Number of stem (g/m <sup>2</sup> )	Wet weight of stem (g/m <sup>2</sup> )	Dry weight of stem (g/m <sup>2</sup> )	Number of leaf	Wet weight of leaf (g/m <sup>2</sup> )	Dry weight of leaf (g/m <sup>2</sup> )	Wet weight of plant (g/m <sup>2</sup> )	Dry weight of plant (g/m <sup>2</sup> )	Number of branch	Number of nod	Biological yield (kg/ha)
Fe fertilizar	10,67 a	12ab	56,99 b	17,4 d	780 a	130 d	10,30d	121,3d	40,3abcd	57,68a	14,40ab	1739a
Zn fertilizar	9,11c d	11c	55,39c	23,18c	800c	127,7d	16,22b c	122,5a	37,68abcd	47c	13,2bcd	1645a
K fertilizar	10,89 b	12c	68,52a	18,75 d	830c	166,40 a	17,17b	111,12 e	31,25bc	43,18cd	14,27b	1315e
Combining the conventi Onal fertiliz er	8,5 e	8e	69,37a	25,7ab	916,3a	91,19c	18,2a	106e	30,23c	48,83b	8,3 cd	1321e
Fe nano-fertilizer	9,20c d	10d	56,09a b	20,37a	837,4cd	137,1b	14,08a	140,08 a	30,5c	53,82a	14,3c	1497b
Zn nano-fertilizer	13a	13a	47,03c	23,1a	538,4d	160,6b	12,51d	.184a	34,5ab	53,5ab	15,3a	1637abc
K nano-fertilizer	11,67 b	12ab	44,53c	18,79 b	538,2d	170,7a	26,7a	162,1c	32,4b	40,42cd	16a	1328e
Combining nano-fertilizer	12,5a	12a	66,42b	26,44a	877,3a	219a	19,75a	175b	46,65a	58,2a	16,6a	1970a
control	7e	7e	44,7e	17d	399,3d	115d	9,42e	95e	25,25d	45,67cd	5,8cd	1250e

The number with similar letters in each column does not have significant difference at the level of 5% based on Duncan.

The results obtained from this study indicate the role of chemical fertilizers of iron, zinc, and potassium, combining the chemical fertilizers and Zn, Fe and K nano-fertilizers, and combining the nano-fertilizers on the quantitative changes in the Peppermint. So that except the changes in the number of leaves, number of nodes and wet weight of plant, the difference is significant in the mean of other quantitative characteristics of different treatments of chemical fertilizers and Zn, Fe and K nano-fertilizers (at the level of 5% and 1%) (Table 2).

The number of node in 4 groups, number of stems, number of leaves, number of branches, wet weight of plant, dry weight of plant in 5 groups, changes in plant height, wet weight of leaf, biological yield in 6 groups and dry weight of leaf in 7 groups were variable (table 3).

### 3. RESULTS

The present study indicates that using the chemical fertilizers and especially nano-fertilizers cause many changes in the quantitative growth of medicinal plant of Peppermint that it can be due to using the fertilizers and the inductive effect of fertilizers on growth and cell

divisions in plant components and that's why more photosynthetic materials are produced in plant that provide the conditions for maximum growth.(Meawad *et al* , 1988; Omidbaigi *et al* , 1992).

It can be said that by using the chemical fertilizers and nano-fertilizers as a food, the plant can grow ideally and consequently the improvement of important development indicators can be observed in the plant and considering the new emergence of nanotechnology and growing trend of researches in the field of nano-fertilizers, There are few reports on increasing the quantity of plant growth.

#### 4. DISCUSSION

Comparison of conventional chemical fertilizers and nano-fertilizers on the quantitative yield of medicinal plant of Peppermint with other reports from different parts of Iran and the world represents the difference in quantitative characteristics in this species is in all studies conducted. Generally, vegetative growth such as wet and dry weight of leaves, stems and whole plant and plant height has been reported in most plants from Lamiaceae family but in terms of the type and amount of chemical fertilizers and nano-fertilizers there are many differences in some vegetative characteristics of plant. Given that the most important parameter in planting peppermint was oral intake of this plant after the amount of aromatic material and the economic value of the plant is in its vegetative and reproductive growth. So, the main objective of this experiment in planting and protecting peppermint is the quantitative yield. Fischer *et al* (1975) stated that increasing the vegetative characteristics in condition of using the chemical fertilizers led to more expansion and continuation of vegetative growth.

According to Clark research (Yadav, *et al* 1985 and 1985) it was found that mineral elements, organic materials and chemical fertilizers change the metabolic activity of medicinal plants in addition to stimulating the growth and development. In studying the effect of iron on the growth of basil, a significant morphological change has been observed between the plants treated with iron and control .( Rajab Beigy, 2006)

Nano-fertilizers affect the amount and rate of growth by penetrating into the tissue of plant cell and increasing the penetration rate of nutrient required. Increasing the penetration rate of nutrient required also affects the amount and rate of growth. Also controlling the amount of these elements proportionate to the needs of various plants is one of the considerable points of this technology. And the interesting thing is what has drawn the whole precision and attention of scientists to nano-fertilizers is not only their positive amazing capabilities, but also their negative environmental effects. According to researches and experiments conducted, both negative and positive approaches of the technology requires extensive and wide-ranging studies and tests on more time in order to understand it comprehensively so that the humanity will not suffer a new and irrecoverable difficulty.(Muller,2005)

#### 5. SUGGEST

Considering the results obtained from this research, the following cases can be done to complete above test in order to achieve better results and enjoying more of peppermint plant.

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