PHYSIOLOGICAL STUDIES ON SOME AROMATIC PLANTS

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A C K N O W L E D G M E N T

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I N T R O D U C T I O N

An increasing interest in the cultivation of aromatic plants has been shown in the U.A.R. in order to cover the increasing demands of the local industries as well as for export purpose. The total area cultivated by such crops reaches about 15,000 feddans annually. The income from such area amount to about 4 million Egyptian pounds, of which 2 million are in foreign currancy, which is considered very encouraging as compared with other field crops.

Recently, many investigations are mainly concerned with the quantity and quality of many crops as affected by fertilization. In the medicinal and aromatic plants it is very essential to deal with the active principle as well as the major crop. There is still an unsolved problem, whether the plants have a certain mechanism for building the active principles in aromatic and medicinal plants or if these active principles are present in the plant tissue as natural by-products of the normal metabolism. This makes it difficult for the investigators to indicate the role of each macro nutrient element on the building process of the active principle.

Among the most important aromatic crops in the U.A.R. are mint and geranium. The present investigation was planned mainly to study the effect of nitrogen and phosphorus levels on the yield and the oil content of mint and geranium under natural field conditions in order to reveal the best fertilization treatment for each. Besides, the physicochemical properties of the essential oil were further determined in order to evaluate its quality. In order to throw some light on the synthesis of oil and other metabolites of the tissue, this investigation included the determination of the percentages of nitrogen, phosphorus and major carbohydrate fractions in relation to oil determination.

REVIEW OF LITERATURE

There are several species and varieties of mint plant. *Mentha piperita*, *M. arvensis*, *M. spicata* (*M. viridis*), and *M. citrata* are the most important sources of mint oil. *M. piperita* and *M. spicata* are the two species mainly growing in the U.A.R., *M. piperita* is the most important one for the medicinal industry.

It is characterized by having square branching stems, which are of dark green to deep purple colour, and bear opposite, lanceolate, slightly serrate leaves of deep green colour, 1 - 2 in. long. The plant spreads by a system of branching underground root stocks, and grows erect or ascending stems to a height of 1½ - 3 ft. Small purplish blossoms, which flower from late July to early September are born in terminal spikes on the main stems and branches, (Guenther, 1961).

The commercial types of geranium oil are derived from several species, varieties, and strains of pelargonium. *Pelargonium graveolens*, *P. roseum*, *P. radula*, *P. capitatum*, *P. odoratisimum*, *P. fragrans*, and *P. terebinthinaceum*, have been stated as sources of geranium oil.

According to Beckley (1937), it is questionable whether some of these terms are not fancy horticultural names, with no real botanical meaning.

The parent plant of all pelargonium varieties used to day for the commercial production of geranium oil seems to be P. graveolens Ait (Guenther, 1961).

P. graveolens is a bushy plant growing to 2 - 3 feet in height, becoming woody, grayish green and hairy pubescent. The leaves have petioles and are broadly cordate to nearly circular in shape. It has 5 - 7 lobes close together extending nearly to the base, on a digitate order. The margins of the leaves are variously dentate. The flowers are small and among the leaves. They are found in dense little umbles on short peduncles, nearly or quite sessile. The corolla about ½ in. long, rose or pink and veined purple. The petals are entire and the two upper ones are longer than the rest, (Bailey, 1961).

Environmental Factors Affecting Production of Mint Oil :

The climatic conditions has a great influence on the growth and yield of mint plants. The oil content in the leaves was a direct function of the mean temperature during the growth period e.g. mint harvested in July contained 2 percent of oil, that harvested in October contained 0.6 percent of oil, (Mikalov, 1930). Another study indicated that the essential oil content of the mint plants increased steadily from 0.05% on June 18th to 0.28% on August 28th (Nakamura, 1949). The length of time required for pepper mint plants to initiate flowers is greatly influenced by any small change in temperature. The optimum temperature for flower initiation occurring between 70 - 80°F. Raising either the night or day temperature increased the number of oil glands per unit area of leaf surface, (Biggs, 1955).

Mint must be planted in sufficiently humid, permeable, and easily cultivated fertile soil, rich in humus, light, in which the underground parts of the mint can easily penetrate without resistance. On the contrary in infertile soil, arid, acid, or more often alkaline , the mint cultures are poor, (Tucakov, 1958). Peat and muck soils from recent alluvial land of fine sandy-loam to silt texture were suitable for mint, (Powers, 1947). Mint plant grows on a wide range of soils. It requires a well drained soil of pH 6 - 7.5, and free from weeds, (Levac, 1949).

The oil content changes at the different stages of growth, e.g. the oil percentage increased gradually until flowering, after which it either decreased or remained constant, (Bauer, 1939). The oil yield increased as the herb approached maturity, i.e. full blooming stage and then decreased, (Fahmy, 1955). Falling and withering of leaves cause the decrease of oil during the flowering stage, (Tucakov, 1958). The harvesting should be practised when the mint is in full bloom in order to obtain maximum oil yield, and menthol content, (Guenther, 1961). He also stated that the oil content decreased rapidly after full bloom, as the foliage began to fall.

The Effect of Fertilization on the Production of Mint Oil:

Mentha piperita is highly sensitive to all mineral deficiencies which caused a decrease of oil glands and volatile oil, (Alonso, 1955). Many investigators studied the fertilization of mint in different countries. Khotin (1950), found that, fertilization with sodium nitrate, and ammonium sulphate nearly doubled the yield in comparison with the unfertilized plants. The effect was particularly pronounced when fertilization was done in early stages of growth.

Kalinkevic (1950), concluded that reducing the concentration of K, increased the essential oil percentage in the leaves of mint and camphor basil plants, grown in water culture.

Baird (1957), reported that nitrogen fertilized pepper mint plants produced a marked increase in herb and oil of Mentha. Slight increase in yield occurred in phosphorus fertilized plants. Both K and P fertilization produced negligible effects on the yield. Schratz(1957), found that the oil percentage and number of glands per mm^2 increased to a maximum of 2.85 and 6.75 respectively, when the following amounts of fertilization were added per plant 1.2 g N, 1.32 g. P_2O_5 and 0.8 g. K_2O .

Ellis (1960), reported that fertilization of mint had no effect on the composition of the oil although it increased the yield of plants. He also concluded that within limits, there was no relation between total growth and yield of oil. No one element was extremely specific for increasing the production of oil. The production of oil was far more elusive than the grain or total dry matter.

Dutta (1961), studying the chemical fertilization of <u>Mentha arvensis</u> L., came to the conclusion that the yield of green matter increased with the increase of nitrogen level, but the yield of oil was maximum at 50 lb N/acre. Byron (1964), found that the nitrogen fertilizer had a significant effect on the yield of the fresh herb of the 1st cut while P and K had no significant effect on the yield of the fresh herb of *Mentha piperita*. The essential oil of the 1st cut was increased by N, P and K and N + P fertilization. The composition of the oil was not affected by the fertilizers used.

Etman (1965), reported that N fertilization gave a higher rate of mint growth, oil content and oil yield compared to the unfertilized mint, K + N and P + N had better effects on the vegetative growth, oil content and oil yield, but oil content of N + K plants was consistently lower than N + P treated plants, He also added that the N P K treatment was superior to all fertilization treatments. It resulted in the highest rate of growth, oil content, and oil yield per plant.

Environmental Factors Affecting Production of Geranium Oil :

Geranium is cultivated under different climatic conditions. In France, it dies at temperatures below

+3°C, but in USSR, it stands at a temperature as low as -5°C, (Dimitrova, 1955). The air temperature is the major environmental factor controlling the percentage of oil, specially in the young leaves. The oil percentage being higher in October and November than in May and June owing to secondary factors of humidity, rainfall and sunshine. There was a parabolic relationship between a rise in air temperature and oil percentage, with a maximum yield occurring at temperatures of 28 to 29°C. With increasing sunshine, the oil percentage in young leaves increased by as much as 50 to 60%, but very little increase was found in older leaves, (Yoshida, 1959). The high air moisture content, also affected the growing of abundant foliage and unfavourably affected the percentage of oil specially under low temperature, (Ognyanov, 1958). The hot wind, and heavy rains also caused much damage to geranium fields, but if they were short, the plants might recover, (Guenther, 1961). Geranium is quite resistant to drought, but may wither under conditions of excessive drought. After a long spell of dry weather, the yield of oil diminishes greatly. Low soil moisture conditions caused delaying in flowering and maturity, (Reger, 1941). The growth rates of stem length,