EFFECT OF SOIL MOISTURE DEFICIT AND CYCOCEL ON GERANIUM

By

El-Toni Mohamed Aly El-Toni

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Faculty of Agriculture,
University of Ain Shams
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Name : El-Toni Mohammed Aly El-Toni

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This Thesis has been approved by:

S.Y. Metwally

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CONTENTS

1. INTRODUCTION

Most of the studies on irrigation requirement was extensively achieved on the field crop plants, as cotton, wheat and maize .... etc. However, little attention was scarcely directed to the study of the proper growth conditions for higher production of plants containing aromatic oils. Geranium species are one of the most important aromatic plants cultivated in Egypt, and occupied the largest area of aromatic and medicinal plants. The oil production of geranium comprised 80 % of the total production of essential oils in Egypt. Geranium essenial oil occurred in small glands distributed over the green parts of the plants, particulary the surface of the leaves. Therefore, the oil content of geranium should be expected to be affected by many environmental factors especially the availability of water for plant growth and transpiration.

As water is the limiting factor in agricultural expansion, the conservation of water for irrigation is important to increase the agricultural lands, especially in Egypt. One of the important trends for conservation of irrigation water is by calculation of the proper water requirement of the crop grown in various soil types under climatological conditions.

The present study aimed to reveal the interacting effect of varying irrigation intervals and different concentrations of cycocel on the evapotranspiration, the vegetative growth, the content and the yield of essential oil. Cycocel is a synthetic growth regulator which might increase drought resistance of the plants, reduced stomatal openning and lowered transpiration. Cycocel application may give a beneficial effect for water economy under soil moisture deficit conditions.

Determination of evapotranspiration for geranium was achieved using the soil moisture depletion method and the meteorological data throughout the growth season to determine the values of imperical constant for both Eagleman and Blaney-Criddle formulae.

2. REVIEW OF LITERATURE

Geranium oil is derived from several species. The most common varieties and strains of *Pelargonium*, are *P. greveolens*, *P. roseum*, *P. radula*, *P. capitatum*, *P. ordoratissimum*, *P. fragrans* and *P. trabinthinaceum* (Clifford, 1970). Buzinov (1961) considered that *Pelargonium greveolens* is grown as a perenniol crop, and the crop can be harvested 3 to 4 times per year. The oil content of the plant can be affected by many environmental factors prevailing during the growth especially soil moisture. In the present study, the combined effect of different levels of soil moisture and foliar spray with different concentrations of cycocel [(2-chloroethyl) trimethyl ammonium chloride] on the evapotranspiration, the growth and the yield of essential oil and efficiency of water use for geranium will be considered.

2.1 Acutal Evapotranspiration:

The application of water to increase the yields of crops already obtainable under rainfall conditions is traditionally known as "supplementary irrigation" whereas its application in semi-arid areas is known as "total irrigation". For much benefit of the limited amounts of water, irrigation policy must be based on the actual evapotranspiration, and its correct distribution throughout the growth season. El-Termini (1951) reported that the irrigation frequency for each crop depended on plant growth, climate and type of soil. Bahrani and Taylor (1961) found that the ratio of actual to potential evapotranspiration decreased curvilinearly with the soil matric potential. Most of the reduction occurred at high potentials (lower matric suctions).

Hallaire (1961) reported that the reduction of plant transpiration in drying soil was the result of the variation of moisture levels with time ($\Delta H/\Delta t$). If transpiration lead to low values of $\Delta H/\Delta t$, the transpiration proceeded at maximum potential level and soil moisture might be left to drop near the permanent wilting point before irrigating; if $\Delta H/\Delta t$ resulting from transpiration gave high values; transpiration would decrease before the water reserves were exhausted and irrigation should be applied so as to maintain soil moisture near to field capacity. Bennett and Doss (1963) found that daily evapotranspiration rates and total amounts of water used by some species of perennial forage species increased with increasing soil water potential. Soil moisture was extracted first from the soil surface than from successively lower depths, as soil-moisture increased near the surface. Grassi and Mihajlovich (1965) found that the relative evapotranspiration varied exponentially with plant hieght and dry matter production of wheat and linearly with depth of root zone. Furthermore, Grassi and Chambouleyron (1965) reported that the ratio of actual evapotranspiration to evaporation from a free water surface (class A pan) was 0.687 immediately after cutting lucerne, 0.835 at an intermediate stage, and 1.06 at full development.

Willis and Balasubramaniam (1968) found that illumination of geranium plants not under water stress was followed by rapid openning of the stomata and thus caused a rapid increase in the rates of transpiration and a fall in leaf resistance. During long periods of illumination water deficits developed, leaf resistance increased, and the rates of transpiration declined. Leaves with small water deficits gave a slower stomatal response to illumination than did well-watered plants. Water stress accelerated stomatal closure in response to darkening. Changes in the rates of transpiration was closely related to those of leaf resistance in all conditions. Petrasovits and Bela (1970) found that the correlation between evapotranspiration and leaf surface of maize was particularly high at optimum level of soil moisture. Moreover, Ritchie and Burnett (1971) showed that when the leaf area index was greater than 2.7, evapotranspiration was practically independent of plant factors and was equal to potential evaporation as estimated from daily net rediation, until evapotranspiration was limited by soil-water availability.

Vasilcik and White (1971) made a study on seedlings of the Geranium crimson grown in 4-in plastic pots and irrigated at different frequencies (between 1 and 6 times daily) according to plant size and the average daily solar energy. They found that younger plants required approximately half the amount as frequent irrigation compared with that for the older plants. White and Vasilcik (1972) reported that water losses as large as 264 g/pot/day and as small as 24 g/pot/day were recorded for seedlings of geranium during the growth period Vasilcik and White (1974) found that highly significant differences in evapotranspiration (E T) from well watered geraniums at stages ranging from seedling transplants to early and late vegetative growth and flowering. Moreover, these differences were related to variations in plant weight, leaf area and maturity. Correlations of ET and SR were lower when SR was measured at the same hour as ET than when SR was measured at the previous hour. The values of ET per unit changed due to environmental parameter and plant growth were the lowest for the older growth stage and the highest for the younger growth stage.

Talha (1974) studied the effect of varying soil moisture at the root zone of Vinca and found that the average daily evapotranspiration rate increased as irrigation frequency increased reaching its maximum value during August. Hamdi et al. (1974) found that the average daily, monthly and seasonal evapotranspiration rate decreased as soil moisture depletion at the root zone of sugar-beet increased. Talha and Osman (1975) found that the soil moisture potential at the root zone of sunflower was highly affected by the system of irrigation regime and the stage of plant growth. He also added that the average daily rate and seasonal evapotranspiration of sunflower were increased as irrigation amount, or frequency increased.

Concerning the effect of CCC on evapotranspiration, little is known about it especially for the medicinal and aromatic plants. Plaut *et al*. (1955) found that CCC applied at optimal concentration reduced transpiration rate per unit leaf area of been plants especially when applied to the soil. Halevy and Kessler (1963) reported that bean plants treated once through the soil with the growth retardants (CCC and phosphon) remained turgid and survived longer than the control plants when irrigation was withheld and the growth of treated plants exceeded that of the untreated ones.

2.2 Calculated Evapotranspiration:

More attention has been focused on the meteorological equation for calculating evapotranspiration rate depending on saturated vapour pressure, relative humidity, temperature, day-time hours, wind speed and actual bright sunshine hours .... etc. (Thornthwaite, 1948 & 1954; Blaney-Criddle, 1950; Penman, 1956 and Eagleman 1967). Fritschen and Shaw (1961) reported that Pan evaporation might be used for estimating evapotranspiration and irrigation requirements, provided that the relationship between the irrigation requirement and pan evaporation was established for a given area. The empirical coefficient for annual or during the growth season for such equation could be calculated for any crop, using the actual measured evapotranspiration and specific climatological data. These coefficients were useful for calculation of potential evapotranspiration for each crop. Bermudez (1961) reported that the formulae of Blaney and Criddle, "U" was the total consumption (evapotranspiration for the period) and "F" was the sum of the monthly factors of consumption (functions of temperature and day time hours). He found that k was 2.97 compared to that of Blaney and Criddle's. The same author found that the monthly coefficients appeared more suitable than the seasonal coefficient as indicators of irrigation requirements. Camargo (1962) showed that potential evapotranspiration was highly correlated with values computed by the methods of Thornthwaite (0.95), Blaney & Criddle' (0.93) & the Penman-Bavel nomogram (0.89). He added that a modified Blaney & Criddle equation, adapted to local conditions, gave results very similar to those from the Thornthwaite method.

The climatological conditions have a pronounced effect on evapotranspiration, Wilcox (1963) reported