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Tanta University

Faculty of Agriculture, Kafr El-Sheikh

Horticulture Department

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STUDIES ON THE IMPROVEMENT OF CUCUMBER PRODUCTION IN THE SUMMER SEASON

By

Soliman Ahmed Ali Omran

B.Sc. (Agric.), Tanta University, 1991

Thesis

*Submitted in Partial Fulfillment of
the Requirements for the Degree of*

Master of Science

In

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INTRODUCTION

Cucumber is one of the important vegetables grown commonly throughout Egypt. It is used as a salad and pickle. It is also used as a cooked vegetable in India. The area of cucumber crop in Egypt occupied about 55,792 feddans in the year of 1996, which yielded 459,737 tons (according to Statistical Data of Ministry of Agriculture, 1996).

The cucumber is a warm season vegetable and it does not withstand even light frost. The cucumber growth best at temperatures between 18 °C and 24°C. High atmospheric humidity is conducive to the development of some diseases especially those affecting the foliage.

Certain environmental condition are perhaps more effective in modifying the flowering and sex expression habits in cucumber than in most other vegetable crops. A part from temperature (air and soil), light energy and photoperiod, is one of the paramount factors which influences reproductive development in cucumber. The efficacies of the previous factors in improving growth of the plants and increasing the yield are well documented.

There are some problems concerned with the production of cucumber in plastic greenhouse. For example, in the late summer season, the increase of air temperature, decrease of air relative humidity, high soil temperature and increase in soil salinity inside the plastic greenhouse which are the major problems. Therefore, the greenhouses remain without use during summer seasons.

The previous problems can be solved by using some treatments such as misting by water (for improving air temperature and relative humidity) and mulching by nature material which is available at low cost such as rice hulls. The rice hulls mulch is useful in soil moisture conservation, reducing the soil temperature, fertilizer leaching and evaporation, decreasing salt accumulation on soil surface and improving soil texture in subsequent crops (as reviewed and reported by **El-Sawy, 1993a**). Nevertheless, no research had been done on the effect of misting by the water and mulching by rice hulls on cucumber plants at late summer season inside plastic greenhouse under Egypt condition.

The main objective of the present research was to study the effect of misting and rice hulls mulch on the two cultivars, in addition, make good use of plastic greenhouse during the late summer season. The study included, vegetative growth, survival of plants, growth attributes, flowering, fruit set, fruit yield and quality, chemical analysis of the fifth leaf from the growing top and soil. Air temperature and air relative humidity were measured inside and outside the greenhouse. Also, soil temperature around the plants were recorded.

REVIEW OF LITERATURE

2.1. Cucumber heat requirements:

2.1.1. Germination:

Benzioni *et al.* (1991) found that the optimum germination of cucumber seeds was obtained between 20 and 30°C, but the germination was delayed at 12°C, inhibited at 8°C and greatly inhibited above 35°C. Also, they found that plants grown during the cold months (October and November) developed very slowly and leaves were chlorotic. **Jennings and Saltveit (1994)** working on cucumber cvs. Dasher II and Poinsett 76, found that the two cultivars seeds were imbibed and germinated at 10 to 30°C.

2.1.2. Vegetative growth:

Karlsen (1980) found that a maximum growth of the ground parts of cucumber plants was reached at air temperature of 30°C and roots temperature over the range from 16 to 25°C and minimum day temperature for fruit setting between 16 to 25°C. **Krug and Liebig (1980)** found that during vegetative growth of cucumber, stem extension rate and the development of leaf area is linearly dependent on the mean air temperature within the range of 19-26°C. **Slack and Hand (1980)** found that stem extension was closely related to day temperature and increased positively with each rise in day temperature over the range from 16 to 25°C and minimum day temperature for fruit setting between 16 to 25°C. **Cantliffe (1981)** studied the influence of air temperature on cucumber plants and showed that plant growth was ideal between 26 and 30°C. The plants in general were studied when grown at 16°C and normal growth continued till 34°C. **Kleinendorst and Veen (1983)** found that the optimum temperature for shoot growth tend to be higher than for root growth and temperature variation above-ground has more marked effects on productivity than below-ground variations. Moreover, **Krug and Thiel (1984)** indicated that stem length growth of cucumber plant cv. Pepinex 69 was significantly promoted by higher soil temperatures up to 23°C. **Tachibana (1989)** found that air temperature of 20-25°C and soil temperatures 23-25°C gave the best growth of cucumber. **Olympios and Hanan (1992)** found that highest growth rate of cucumber plant was showed under air temperature at 25/19°C (day/night).

2.1.3. Flowering:

Sharma and Nath (1972) found that the sex ratio of melon plants (in summer season) decreased with a rise in air temperature as average from 28.9 to 34.5°C. **Hsiao and Hu (1973)**, on cucumber, found that temperature for maximum female flowers production in February to May were 25°C. **Matlob and Kelly (1973)** found that optimum temperature for pollen tube growth in vitro was 21°C for "Biet alpha" cucumber pollen from plants grown in the greenhouse at 27/21°C (day/night) during summer was the most vigorous, while plants grown at 38/27°C during the summer produced pollen with the poorest germination and

shortest pollen tubes. Also, they found that fruit set were failed during high temperature (July till September). **Takayama and Iwasaki (1978)** showed that the number of female nodes of cucumber significantly increased when the plants were planted at a high soil temperature (18°C) from the fifth true leaf stage. **Pashin and Krivonosova (1990)** reported that low relative humidity and high temperature tended to increase male sex expression in cucumber.

2.2. Effect of misting:

2.2.1. Climatic condition:

2.2.1.1. Air, soil and plant temperature:

There are some work researches on the effect of misting on air, soil and plant temperature in cucumber and other vegetable crops.

Bible et al. (1968) studied the effect of misting on some cultivars of cucumber, muskmelon and tomato, they found that the misting lowered plant temperature by more than 9°C. The temperature difference between misted and non-misted tissue reached a maximum of 8.3°C at 2.00 PM. The temperature of misted stems was 26.7°C and the temperature of non-misted stems was 36.1°C. The misted stems were at least 13.3 to 11.1°C cooler over a 6 hour period beginning of noon. The soil in the non-misted plot was 4°C warmer than the soil in the misted plots. **Pelletier (1989)** used the misting system on cucumber cv. Regina when the air temperature was reached the maximum (20-30°C). He found that the misting decreased the air temperature by 8°C. Moreover, **Van Gorp and Van Holsteijn (1991)** misted the cucumber plants cv. Ventura at mid-day, they observed that the misting lowered air temperature from 30 to 26°C.

Other studies on tomato, **Boulard et al. (1991)** found that misting and ventilation together significantly decreased the temperature degree of both air and tomato leaf. **Willits and Peet (1995)** found that the misting reduced maximum leaf temperature by 8.3%, compared with the control, also it reduced average ground temperature by 17.6%.

The effect of misting on the other vegetable crops were illustrated by many investigators. **Howell et al. (1971)**, on cowpeas, found that mist irrigation reduced leaf temperature by 4°C. **Tomatly (1988)**, on lettuces, found that ventilation, misting and shading each effectively lowered the temperature in summer. Also, **Kown (1992)** studied the effect of shading and misting on radish and Chinese cabbage under greenhouse, he found that shading and misting together lowed air and soil temperature, compared with the open field.

2.2.1.2. Air relative humidity:

Relative humidity very important for vegetative growth and fruit yield of cucumber. **Pelletier (1989)** found that misting system was operated when a minimum humidity 70%. **Pashin and Krivonosova (1990)** reported that low relative humidity and high temperature

tended to increase male sex expressions in cucumber. **Van Gurp and Van Holsteijn (1991a)**, on cucumber, found that the misting (at mid-day) raised the relative humidity from 40 to 80%. **Van Gurp and Van Holsteijn (1991b)**, on tomato, found that misting applied between 10.00 AM and 19.00 PM to maintain the relative humidity at 70%.

2.2.2. Vegetative growth:

Bible et al. (1968) reported that sprinkler irrigation at rates of 0.4 to 0.6 inches per hour during a period of high atmospheric stress helped regulate the growth and development of tomato. **Gubbels and Carolus (1971)** found that intermittent misting increased fresh weight of celery, but it decreased dry matter of plants. **Wang (1990)**, on golden pothos (*Pothos aureus*), found that leaves number and shoot length increased with increasing time of mist.

2.2.3. Flowering:

Cantliffe (1981) found that more staminate flowers of cucumber plants were produced under high temperature and light intensity, however, the highest number of pistillate flowers reached anthesis at 26 or 30°C. **Pashin and Krivonosova (1990)** found that low relative humidity and high temperature tended to increase male sex expression in cucumber.

2.2.4. Fruit yield and quality:

Bible et al. (1968) studied the effect of mist on cucumber, muskmelon and tomato yields, they reported that misting increased yield of cucumber by 70% and muskmelon by 33%. Also, it increased marketable fruit yield of tomato by 50%. **Lindquist et al. (1987)** found that the total cucumber production was higher in misted greenhouse, the fruits percentage of grade I was not significantly affected by the misting. In addition, **Pelletier (1989)** observed that the misting increased the total fruit yield of cucumber from 33 to 43.3 kg/m². Furthermore, **Van Gurp and Van Holsteijn (1991a)** showed that the yield of cucumber plants receiving mist was slightly higher than that non-misted treatment (control).

There are several studies on tomato crop were carried out by many investigators. **Bauerle and Short (1977)** found that misting increased fruit size of tomato and reduced the incidence of fruits cracking by 15%, but the yield was not significantly affected. **Van Gurp and Van Holsteijn (1991b)**, on tomato, found that misting applied between 10.00 AM and 19.00 PM did not affect yield's fruit quality or crop development.

Other studies on vegetable crops, **Howell et al. (1971)**, on cowpeas, found that yield of green harvested pods was increased by mist, compared with the control. **Kown (1992)** studied the effect of shading and misting on radish and Chinese cabbage under greenhouse, he found that the highest yield for each crop was obtained with 40% shading and misting.

2.3. Effect of hybrids:

2.3.1. Vegetative growth:

Youssef *et al.* (1984) reported that the plants of cucumber cvs. Medina and Amara hybrids were the longest in stem length, compared with the ten studied cultivars. **Shaheen and El-Habbasha (1988)** evaluated ten cucumber hybrids under plastic house in Egypt, they found that the Medina hybrid gave the highest vine length leaves number and side shoots, as well as, the total plant dry weight and its different leaves and side shoots. Biet alpha hybrid CMVR (slvis) came to be in the second order. The poorest results of growth resulted from the TW 373 and Diyala XPH 1475 hybrids. **El-Shawaf *et al.* (1993)** evaluated some cucumber genotypes for general and specific combining ability, they found that the genotypes (Chinese long) was the best combiner in open field for plant height, while the line 1909 was the best combiner under greenhouse conditions. The cross 1909 x Biet alpha was the most promising one for plant height.

2.3.2. Flowering :

Hsiao and Hu (1973) reported that cucumber varieties of north Chinese type (Taipei 3, Taipei 4, SZU Yeh and Lichiv) were earlier differentiation of female flowers than south Chinese types (Kia-Liang-Ching-Pi) under high temperature, natural photoperiod and high light intensity. **Matlob and Kelly (1976)** found that high temperature and summer planting enhanced the production of staminate flowers. Snake cucumber, cv. Mosuli, produced more female flowers than cucumber, cv. Biet alpha under high summer temperature. Spring planting under short day conditions enhanced pistillate flowering in the cv. Mosuli. **Cantliffe (1981)** studied five pickling cultivars and a breeding line of cucumber. He found that agynoecious line, MSU 713-5, did not produce staminate flowers under varying light intensities. Few staminate flowers were produced when the plants were grown at constant 16 or 12°C, but all lines or cultivars produced some staminate flowers at 30°C. **Beyhan and Sen (1991)** studied some cucumber cultivars Biet alpha, Cengelkoy 432, Cengelkoy 5802, 5 local cultivars (M1, M3, M5, M13 and M17) and an Egyptian cultivar, Acur. They found that number of days from sowing to the appearance of first female flower was 54-58.6 days for most cultivars, but was 60 days for M5, M13 and Acur.

2.3.3. Fruit yield and quality:

Varietal cucumber trials in Egypt were carried out during winter and early summer seasons starting from 1976, in different locations. The first trial was in Kafr El-Sheikh and the other locations were in Ismailia, Tuh, Giza and Marsa Matrouh. More than 50 cvs. were used as the sources of these cultivars were different, most of them were Dutch and Hungarian cvs., among all cvs. evaluated the promising cultivars were: Budia Fellhoszu (7.3 kg/m²) K. 2744 (9.5), Maram (7.89), Vitomil (6.01) Daliva (6.05), Farbiola (11.06), K 1700 (9.03) Katia (6.89) Coroma (9.6), Dalibor (8.9), Picabello (8.8) Cordito (6.64) T.W 871 (8.5), Biet Alpha (8.3),