EARLY PRODUCTION OF STRAWBERRY USING SOILLESS CULTURE SYSTEMS

By

ENASS NABIL MOHAMED EISSA
B.Sc. Agric. Cooperative Sc., Higher Institute for Agric. Cooperation, 2003
M. Sc. Agric. Sc. (Advanced Agricultural systems for Arid Land), Arid Land Agricultural Graduate Studies and Research Institute,Ain Shams University, 2010

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ABSTRACT

Enass Nabil Mohamed Eissa: Early Production of Strawberry Using Soilless Culture Systems. Unpublished Ph.D. Thesis, Arid Land Agricultural Graduate Studies and Research Institute, Faculty of Agriculture, Ain Shams University, 2016.

This study was divided to two experiments: First experiment was carried out at the experimental site of Arid Land Agricultural graduate studies and Research Institute (ALARI), Faculty of Agriculture, Ain Shams University, Qalyobia Governorate. While, the second ones was carried out at Central Laboratory for Agricultural Climate (CLAC), Agriculture Research Center (ARC), Giza Governorate.

The experiments were carried out during the two successive seasons of 2013/2014 and 2014/2015. Fresh bare root strawberry (*Fragaria x ananassa*) transplants cv. Festival were used in these two experiments.

The aim of this study was to determine the best irrigation scheduling and better strawberry density to get the best early production and quality of strawberry fruits grown in soilless culture systems (A-shape 'NFT system', substrate system 'Bed system).

For first experiment, five irrigation schedules (24 hours (control), ¼ / ½ hour (Sched 1), ¼ / 1 hour (Sched 2), ¼ / 2 hours (Sched 3), ¼ / 3 hours (Sched 4) and two plant density per square meter (21 plants / m^2 "PD-1", 32 plants / m^2 "PD-2") and the combinations among them were tested in this experiment. Second experiment, two irrigation schedules (¼ / 2 hours, ¼ / 3 hours), and two plant density per square meter (12 plants / m^2 "PD-1", 18 plants / m^2 "PD-2") and the combinations among them were tested in this experiment.

The EC of the nutrient solution was adjusted at the range of 2.0 – 2.5 $m.mhos^{-2}$ and pH was maintained at the range of 5.5-6.0 throughout the experimental time.

The measurements recorded were as follows: vegetative growth measurements include number of leaves, leaves total chlorophyll, leaves

fresh weight, leaves dry weight, root fresh weight and root dry weight. Productivity measurements include number of flowers/plant, number of fruits/plant, % of fruit set, early yield (g/plant), total yield (g/plant), mean fruit weight (g), marketable yield (g/plant), marketable yield (%), un marketable yield (g/plant) and unmarketable yield (%). Quality measurements include total soluble solids (TSS), ascorbic acid (mg/100g) and titratable acidity. Chemicals measurements include macro and micro-nutrient contents in the leaves. Water measurements include water consumption.

Results indicated that, First experiment: irrigating plants for 15 min every ½ hour (Sched 1) increased plant productivity (mean fruit weight (g), early yield (g/plant) and total yield (g/plant)) and quality (TSS) with significant differences but reduced vitamin C and fruit acidity of strawberry. However using plant density of 32 plant/m^2 recorded higher number of strawberry leaves, total chlorophyll of leaves, early and total yield, vitamin C and titratable acidity but recorded the lowest water consumption (L/plant). Second experiment: results illustrated that irrigating plants for 15 min every 2 hours (Sched 1) increased vegetative growth parameter (number of strawberry leaves and total chlorophyll of leaves), productivity parameter (early yield (g/plant), total yield (g/plant) and mean fruit weight (g) and quality parameter (titratable acidity). However using 18 plants/m^2 recorded higher number of strawberry leaves, total chlorophyll of leaves, total yield, vitamin C and lower water consumption (L/plant). Regarding the interaction between irrigation scheduling and plant density.

Key Words:

Soilless culture, NFT, Substrate, Strawberry, Irrigation scheduling, Plant density

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1. INTRODUCTION

Strawberry (Fragaria × ananassa) is a perennial, low-creeping, stoloniferous herb belonging to the family Rosaceae. It is basically a temperate fruit crop, widely distributed due to its genotypic diversity, high heterozygous nature and broad range of environmental adaptations **(Sharma and Sharma, 2004)**. It is perishable crop which is exceedingly in demand for its taste, profitability, high yield and good quality. It has a unique, highly desirable taste and flavor and is one of the most popular fruits around the world **(Sturm *et al*., 2003)**. It is a rich source of vitamins and minerals with delicate flavors **(Sharma, 2002)**. It also contains a higher percentage of phenolic and flavonoids compounds **(Hakkinen and Torronen, 2000)**.

Strawberry is one of the most important crops for export in Egypt, and is produced in open fields, with heavy harvesting occurring mostly in the winter months of the year. This allows Egyptians strawberry growers to take advantage of the high fruit prices when other states do not have production due to cold weather. In spite of this competitive advantage, increasing competition from international markets has prompted growers to seek alternative production systems that could enhance crop yield and quality, as well as fruit earliness. Soilless culture may be an alternative to fulfill those goals.

Soilless plant production has been practiced for several millennia and it permits crops to be grown where no suitable soil exists or where the soil is contaminated in some manner or other. Maximum yields are possible and this makes the system economically feasible in high-density and expensive land areas. According to **Takeda (2000)**, future growth of soilless culture will depend on the development of production systems and substrates that are competitive in costs and returns with conventional agriculture.

Poor timing or insufficient irrigation could result in crop stress and reduced yields, whereas excessive watering may diminish yield and

quality and increase the risk of nutrient leaching **(Simonne and Dukes, 2009). Kruger *et al*. (1999) and Kirnak *et al*. (2003)** showed a positive influence of proper irrigation on strawberry yield, fruit size and quality in comparison to non-irrigated plants. Another report found that there is a significant effect of irrigation on strawberry flavor **(Hoberg *et al*., 2002)**.

Planting density plays an important role in achieving high productivity per unit area. High planting density resulted in highest yield, largest berries, and the best quality fruit **(Petersen, 1998)**. In strawberry, marketable yields were higher at narrower spacing than wider spacing **(Legard *et al*., 2000)**. Growth and yield per plant were increased by increasing plant spacing from 20 to 30 cm and also resulted in a greater leaf area and leaf area index, but the highest harvest index and yield per square meter were obtained at the closest spacing **(De-Camacaro *et al*., 2004)**. Planting density also greatly influence production and fruit quality of strawberry plants that are grown from cuttings **(Jansen, 1997)**. Improper selection of plant population density limits the productivity and acreage of strawberry.

This study was conducted to investigate the impact of irrigation scheduling and plant densities on yield and quality of strawberry fruits in strawberry plants grown under soilless culture systems (A-shape 'NFT system', substrate system 'Bed system').