Chapter 2

LITERATURE REVIEW

2.1. Effects of plant density on tomato

Tomatoes' yield and quality depend mainly on the variety, field management and post harvest handling (Wivutvongvana, 1987). Plant density, fertilizer and staking are the main factors of cultivation practices for getting high yields and good quality fruit of tomatoes. The effects of plant spacing, fertilizer application and staking on the yield and quality have been reported in a number of studies (Al-Maslani and Suwwan, 1989; Borrelli and Barbieri, 1984; Taha, 1984; Shibli and Suwwan, 1989; and AVRDC, 1985). Rumpel and Babik (1989) experimented with cultivar New Yorker from 1982 - 1984. The plants were grown at densities of 24,700, 29,600, 59,300 and 118,500 plants/ha. With an increase in plant density the total marketable yield amounted to 55.8, 53.2, 63.6 and 70.5 t/ha for the four levels of density respectively. An increase in plant population reduced the average weight of marketable fruits and increased to some extent the number of rotten fruits. Dry matter and pH of fruits were not affected by planting densities.

Taha (1984) reported that in the trial from 1979 to 1982, a high N rate of 180 kg/ha coupled with a low plant

population (22,130 or 16,660 plants/ha) delayed fruit set, thus reducing early yields. High plant population (66,640 plants/ha) led to high yields.

Candilo, et al. (1985) mentioned that the most satisfactory planting density tested appeared to be 74,074 plants/ha. Borrelli and Barbieri (1984) reported the highest yield from the density of 25 plants/m^2 in the experiments. The densely planted crops had a greater tendency to mature at the same time. Mohamed and Ali (1988) pointed out that 20 cm of plant spacing resulted in the highest yield, and also reduced the numbers of sun-scalded fruits.

Pimpini and Gianguinto (1990) indicated that by increasing plant density in the range of 3.7 - 18.3 plants/m^2, total yields were increased but individual fruit weights and numbers of fruits per plant were decreased.

In a two-year study, Shibli and Suwwan (1989) found that increasing the plant population from 20,000 - 160,000 plants/ha increased early yields of tomatoes but total yields were not significantly increased at populations above 53,000 plants/ha. The proportion of unmarketable fruits and fruit composition were not affected by plant population. The population density recommended is 53,000 to 80,000 plants/ha.

2.2. Effects of fertilizers on tomato

It is natural that the overall importance of nutrition and the relative importance of individual nutrients undergo dramatic change as yields change from 2 t/ha to 25 t, 50 t, and 150 t/ha. The yield potential of the tomato in the tropics is only slightly below that of temperate regions (with longer days and cooler nights). For a given yield, nutrient requirements will be similar (Uexkull, 1978).

Nitrogen affects vegetative growth and fruit yield more than any other nutrient. It promotes the set of flowers and fruit but tends to delay maturity and decrease fruit size. Adequate nitrogen will improve fruit quality. Fruit size, storage quality, color and taste are all decreased by excessive amount of water. Nitrogen tends to decrease the percent total solids in the juice and to increase titratable acidity (Uexkull, 1978).

Skrbic (1989) reported that N was applied at 0, 50, 100, or 150 kg/ha to soil supplied with 80 kg P and 120 kg K per ha as basal fertilizer. Yield and dry matter content were increased by N at the rate of up to 100 kg/ha, but at the higher rates they were depressed. N increased the carotenoid content of the fruit to a maximum at 150 kg N per ha. However, N also increased the nitrate content which at 150 kg, was double that of the control (P and K).

High levels of available P throughout the root zone are essential for rapid root development and for good utilization of water and other nutrients by the plant. Phosphorus (in combination with N and K) improves peel coloration, pulp coloration, taste, hardness and vitamin C content, and hastens maturity (Uexkull, 1978).

The effect of potassium on yield is usually not as pronounced as that of nitrogen. Where potassium has an influence, it tends to increase fruit size. Trudel and Ozbun (1970) concluded that K plays an important role in the process of tomato fruit pigmentation by increasing carotenoides, particularly lycopene, and decreasing chlorophyll.

Compared to potassium deficient plants, fruits setting from plants well supplied with K are generally higher in total solids, sugars, acids, carotene, lycopene, and have better storage qualities. Fruits from low K-plant tend to drop prematurely and the taste is flat. The effect of quality goes far beyond the level needed for higher yield. In many cases highest yields are obtained at 150 - 300 kg K_2O/ha, but highest quality was obtained at 600 - 800 kg K_2O/ha (Uexkull, 1978).

2.3. Effects of staking on tomato

Staking of fresh market tomatoes has been practiced in many areas to reduce diseases and increase harvesting efficiency. However, the low price of processing tomatoes inhibits growers from doing this unless there could be sizable yield gains (AVRDC, 1985). In some countries, tomatoes are usually grown with supports to obtain earlier, cleaner, and larger fruits as well as to make field operations more convenient. In developing countries, supports are used principally to keep the fruits above the ground and to keep the plants from being blown down by strong wind, especially during the rainy season. In the tropics, only in Colombia and the Philippines do growers use supports for extensive production of processing tomatoes (Villareal 1980).

Quinn (1974) indicated staking tomato plants increased stem branches and yield, and produced more fruits. It also improved the vertical distribution of the leaves, allowing more efficient use of intercepted solar radiation and thus increasing the photosynthetic surface. Staking has also been reported to increase leaf area index (LAI) of tomato plant, because of a better microclimate around the plants. (Adelana, 1976).

Olasantan (1985) reported that mulching and staking significantly increased vegetative growth, yields and yield

components of the tomato plant. AVRDC (1985) also reported using banking tillage and staking in two cultivars CL5915-153-D_4-3-3 and CL5915-93-D_4-1-0 for experiment; the highest stable yield for both cultivars were obtained with the banking-staking treatments. These yields were significantly higher than that of banking alone and that of the unbanked or unstaked treatments. Horvatich (1985) reported that highest marketable yields were obtained from plants supported by 1 m bamboo stakes in the trials. Percentage fruit rot was also the lowest in plants supported by bamboo stakes.