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Response of 'Fla. 8153' Tomato to Nitrogen Fertilization Programs and In-row Distances

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Two field studies were conducted to determine the most appropriate N fertilization program and in-row distances for 'Fla. 8153' tomato (*Solanum lycopersicum* L.). Six treatments resulted from the combination of three N fertilization programs and two in-row distances. Total N rates (204, 239, and 274 lb/acre/season) were the result of the combination of 50 lb/acre of N during prebedding plus each of the following drip-applied N rates: a) 1.5, 1.5, and 2.0 lb/acre/day during weeks 1 to 2, 3 to 4, and 5 to 12, respectively (154 lb/acre/season); b) 1.5, 2.0, and 2.5 lb/acre/day during weeks 1 to 2, 3 to 4, and 5 to 12, respectively (189 lb/acre/season); and c) 1.5, 2.5, and 3.0 lb/acre/day during weeks 1 to 2, 3 to 4, and 5 to 12, respectively (224 lb/acre/season). In-row distances and N fertilization programs had significant effects on early and total marketable yields of 'Fla. 8153' tomato, but the interaction between in-row distances and N fertilization programs was not significant. The results indicated that application of 50 lb/acre of N preplant plus 224 lb/acre through the drip lines (274 lb/acre/season of N) could improve early and total yields of 'Fla. 8153' in comparison with the other two tested programs (204 and 239 lb/acre/season of N). Therefore, it appears that the recommended rate of 200 lb/acre/season might not be enough to maximize 'Fla. 8153' yields. At the same time, this cultivar produced its largest yields per area when planted at 18 inches between plants in comparison with 24 inches, regardless of N fertilization rates.

'Fla. 8153' is a fresh market tomato hybrid that is being released for the premium tomato market. It has high lycopene content and an attractive, deep red interior color due to the crimson gene (Thompson et al., 1964). Fruit flavor is superior to most commercially available tomato cultivars based on the results of seven experienced sensory panels, a consumer panel, and numerous samplings from field trials. Environmental conditions have a large impact on tomato flavor and the strength of this hybrid is its ability to produce fruit with good flavor under a wide range of growing conditions. This feature, along with reliable yields of firm, marketable fruit, should allow for branding of vine ripe harvested fruit with consistent quality that will attract repeat purchasing in the supermarket. 'Fla. 8153' tomatoes should also be popular in upscale restaurants. The parents, 'Fla. 8059' and 'Fla. 7907', are both crimson types that should be useful for tomato breeders interested in developing crimson and more flavorful cultivars.

Studies need to be conducted to determine the most suitable production practices, such as N fertilization and in-row distances, to maximize yields of this cultivar. Besides the environmental benefits of using appropriate plant nutrient rates, fertilizer prices have significantly increased over the last two years, which forces the tomato industry to reevaluate current rates in an attempt to reduce production costs. N is the most applied nutrient in per weight basis for producing tomato, which is mostly injected daily through drip irrigation lines. Recent surveys throughout Florida have shown that N rates greatly vary across tomato farms depending on soil characteristics, irrigation scheduling, and production region, fluctuating between 250 and 400 lb/acre of N. Current recommendations suggest that N fertilization should be about 200 lb/acre for a 12-week season, using up to 70 lb/acre of preplant N and the rest applied through drip lines (Olson et al., 2006). The distribution during the season is split as follows: 1.5, 2.0, 2.5, and 2.0 lb/acre/day for weeks 1 to 2, 3 to 4, 5 to 11, and 12, respectively. However, this recommendation does not distinguish between cultivars for mature-green harvest (e.g., 'Florida-47' and similar types) and premium-market tomatoes, such as 'Fla. 8153', which might affect yields per fruit category.

Previous studies have discussed the different responses of tomato cultivars to spatial distribution and in-row distances. West and Peirce (1988), examining the effects of planting densities on the early and total yields, found that there was a significant density effect on each tested cultivar, where yields increased as densities decreased. Kemble et al. (1994) indicated that in-row distances between 12 and 30 inches caused no significant marketable yield differences of two determinate tomato cultivars. In contrast, Saglam and Yazgan (1995) determined that maximum tomato yields were reached with approximately 14 inches between plants. These diverse findings suggest that research needs to be conducted to determine the appropriate in-row distance to maximize 'Fla. 8153' yield potential. The objective of this study was to determine the most appropriate N fertilization program and in-row distances for 'Fla. 8153' tomato.

Materials and Methods

Two field trials were conducted between Fall 2006 and Spring 2007 at the Gulf Coast Research and Education Center of the University of Florida in Balm, FL. The soil was a sandy, siliceous, hyperthermic Oxyaquic Alorthod with 1.5% organic matter and pH 7.3. Planting beds were 32 inches wide at the base, 28 inches wide at the top, 8 inches high, and spaced 5 ft apart on centers. Finished beds were fumigated with methyl bromide plus chloropicrin (67:33 v/v) at a rate of 175 lb/acre to eliminate soilborne diseases, nematodes and weeds in the soil.

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Simultaneously, planting beds were covered with 0.0006 inch-thick silver on black mulch, and drip irrigation tubing (T-Tape Systems International, San Diego, CA) was buried 1 inch deep down on the bed center.

Six treatments resulted from the combination of three N fertilization programs and two in-row distances, and they were replicated five times. Treatments were arranged in a randomized complete-block design. Total N rates (204, 239, and 274 lb/acre/season) were the result of the combination of 50 lb/acre of N (NH_4NO_3 as N source) during prebedding plus each of the following drip-applied N rates: a) 1.5, 1.5, and 2.0 lb/acre/day during weeks 1 to 2, 3 to 4, and 5 to 12, respectively (154 lb/acre/season of drip-applied N); b) 1.5, 2.0, and 2.5 lb/acre/day during weeks 1 to 2, 3 to 4, and 5 to 12, respectively (189 lb/acre/season of drip-applied N); and c) 1.5, 2.5, and 3.0 lb/acre/day during weeks 1 to 2, 3 to 4, and 5 to 12, respectively (224 lb/acre/season of drip-applied N). These periods of fertilization approximately corresponded to the establishment, rapid growth, and flowering and fruiting stages of tomato growth and development. The drip-applied N source was $Ca(NO_3)_2$ and other nutrients were applied under non-limiting conditions following current fertilization recommendations (Olson et al., 2006).

Irrigation was supplied via subsurface irrigation at an approximate rate of 8000 gal/acre/day, and the soil was maintained at field capacity. The water table was maintained between 18 and 24 inches deep and constantly monitored with observations wells located in the fields. Experimental units had 15 tomato plants with a 5-ft-long non-treated buffer zone at the end of each plot. Marketable tomato fruit were harvested twice (10 and 12 weeks after transplanted) and separated on extra-large, large, and medium categories (Sargent et al., 2005). Resulting data was analyzed with the general linear model procedure to determine treatments effects (P=0.05) and treatment means were separated with Fisher's protected LSD test at the 5% significance level.

Results and Discussion

Data from the 2006 and 2007 seasons were combined because the season by treatment interactions for each variable were not significant. In-row distances and N fertilization programs had significant effects on early and total marketable yields of 'Fla. 8153' tomato. However, the interaction between in-row distances and N fertilization programs was not significant for those variables. Fertilization programs did not influence the early marketable yields of extra-large and medium fruit, with average values of 13.7 and 0.6 ton/acre (Table 1) However, application of the highest N rates increased early weight of large fruit and cumulative early yield by 43% and 6%, respectively. Early yields of large fruit and total fruit were also affected by in-row distances, with the highest values obtained in plots planted 18 inches apart (2.9 ton/acre).

Total marketable yields of 'Fla. 8153' extra-large and medium fruit were not affected by the N fertilization programs (Table 2). However, total weight of large fruit increased with the highest total N rate (6.4 ton/acre) in comparison with the intermediate N rate (4.5 ton/acre). Similarly, total marketable yields were the highest when 274 lb/acre of N were applied (32.6 ton/acre), which represented approximately an 8% increase in comparison with the other two N rates. A reduction in-row distance from 24 to 18 inches between plants increased total marketable yield by 21% and the yield of extra-large fruit of 'Fla. 8153' by 18%.

These results indicated that the application of 50 lb/acre of N preplant plus 224 lb/acre through the drip lines (274 lb/acre/

Table 1. Effects of N fertilization programs and in-row distances on the early marketable yields per fruit grades of 'Fla. 8153' tomatoes, 2006-07, Balm, FL.[z]

Preplant N	Drip-applied N	Total N rate	Extra-large[y]	Large	Medium	Total
lb/acre			ton/acre			
50	154	204	13.5 a	2.1 b	0.6 a	16.2 b
50	189	239	13.8 a	2.3 b	0.6 a	16.7 b
50	224	274	13.8 a	3.3 a	0.6 a	17.7 a
In-row distances (inches)						
18			13.7 a	2.9 a	0.7 a	17.3 a
24			13.6 a	2.1 b	0.4 a	16.2 b

[z]Fertilizer partitioning for each fertilization program was 1.5, 1.5 and 2.0 lb N/acre/day; 1.5, 2.0, and 2.5 lb N/acre/day; and 1.5, 2.5, and 3.0 lb N/acre/day from week 1 to 2, 3 to 4, and 5 to 12, respectively.
[y]Values followed by the same letters do not differ at the 5% significance level.

Table 2. Effects of N fertilization programs and in-row distances on the total marketable yields per fruit grades of 'Fla. 8153', 2006–07, Balm, FL.[z]

Preplant N	Drip-applied N	Total N rate	Extra-large[y]	Large	Medium	Total
lb/acre			ton/acre			
50	154	204	23.9 a	4.7 b	1.9 a	30.5 b
50	189	239	24.5 a	4.5 b	1.2 a	30.2 b
50	224	274	24.8 a	6.4 a	1.4 a	32.6 a
In-row distances (inches)						
18			26.7 a	5.4 a	1.4 a	33.5 a
24			22.0 b	4.9 a	1.5 a	28.4 b

[z]Fertilizer partitioning for each fertilization program was 1.5, 1.5, and 2.0 lb N/acre/day; 1.5, 2.0, and 2.5 lb N/acre/day; and 1.5, 2.5, and 3.0 lb N/acre/day from week 1 to 2, 3 to 4, and 5 to 12, respectively.
[y]Values followed by the same letters do not differ at the 5% significance level.

season of N) could improve early and total yields of 'Fla. 8153' in comparison with the other two tested programs (204 and 239 lb/acre/season of N). Therefore, it appears that the recommended rate of 200 lb/acre/season might not be enough to maximize 'Fla. 8153' yields. At the same time, this cultivar produced its largest yields per area when planted at 18 inches between plants in comparison with 24 inches, regardless of N fertilization rates.

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