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FIELD DEMONSTRATIONS OF PHOSPHORUS LEVELS FOR VINE-RIPE AND MATURE-GREEN TOMATOES IN MIAMI-DADE COUNTY[1,2]

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Abstract. **Winter vegetable production in Miami-Dade County begins with plantings in early September and generally ends in mid- to late April. Early harvests tend to bring the highest returns surrounding holidays such as Thanksgiving and Christmas. The vegetable crop which is the most expensive to produce but which can also bring the highest per acre returns is tomatoes. Winter tomato production faces several challenges: potential cold weather events, overcast or rainy days which exacerbate gray wall, and various insect and disease pests. Trials during the 1995-96 and 1996-97 seasons examined the use of reduced levels of phosphorus in comparison with standard grower rates as one means of reducing gray wall. Fruit during the first year were harvested five times at the vine-ripe stage (Grower A trial) and twice at the mature-green stage (Grower B trial). During the second year, fruit were harvested two times at the mature-green stage (Grower C trial). None of the treatments had significant effects on marketable yield.**

Introduction and Review of Literature

The vegetable industry in Miami-Dade County has undergone changes due to several factors, most recently competition from Mexico, exacerbated by the passage of the North American Free Trade Agreement (NAFTA) (Degner et al., 1997). Despite this, tomatoes continue to have the highest value, 40% of traditional vegetables (Degner et al., 1997) as compared to 42% in 1988-89 (Moseley, 1990). Concurrent with the unfavorable changes in markets which occurred between 1988-89 and 1995-96, costs of production have risen from $7,992.78 per acre for Miami-Dade County in 1988-89 (Taylor and Smith, 1989) to $10,171.03 for 1995-96 (Smith and Taylor, 1996). Of these figures, fertilizer accounted for $329.50, or 9% of preharvest costs in 1988-98 compared to $284.00, or 5% of preharvest costs in 1995-96. There is no indication as to why fertilizer costs have been reduced, though reports for intervening years fluctuate widely for this figure.[3]

Since fertilizer costs represent such a small portion of total preharvest expenses, vegetable growers generally view expenditures on fertilizers as a necessary fixed cost, an "insurance policy" against low yields. On 22-23 Aug 1995, various aspects of tomato production in Miami-Dade County were discussed at a workshop held at the Tropical Research & Education Center and the Miami-Dade County Cooperative Extension Service. One of the discussion groups focused on fertilizer use, including results of trials using reduced rates of phosphorus. One of the participants convinced two local growers to participate in field demonstrations during the 1995-96 season using a blend of fertilizer with 50% of their normal rate of P, a 6-2.62-9.96 analysis rather than a 6-5.24-9.96. This demonstration was repeated during the 1996-97 season with one grower. Li et al. (1997) and Hochmuth et al. (1995) have reported on other work with fertilizer trials in Miami-Dade County. This is seen as an on-going effort to involve growers in trials to evaluate alternate fertilizer practices.

Materials and Methods

For confidentiality, growers have been designated as Grower A, Grower B, and Grower C. Growers A and B participated in the 1995-96 trials, while Grower C participated in the 1996-97 trial.

Grower A Trial: This was planted on a typical Krome very gravelly loam (a.k.a. "Rockdale" soil) using standard grower bed spacing of 36-inch wide beds planted on 6-ft centers. Dry fertilizer was applied in 2 bands along the top of the bed immediately prior to the application of methyl bromide on 6 Oct 1995. Fertilizer treatments included the standard grower rate of 1800 lbs./acre 6-5.24-9.96 (94.39 lbs P/acre) plus the treatment rate of 1800 lbs./acre 6-2.62-9.96 (47.2 lbs P/acre). The lower rate of P was achieved by blending white limestone rock as filler. Treatments were applied to two separate blocks, each of which were three beds wide and 0.25 mile long. Supplemental nitrogen was applied at the rate of 35 gal/acre of 4-0-6.64 per week. The cultivar 'Olympic' was transplanted on 20 Oct 1995. All harvesting was done by the grower's crew at the vine-ripe stage. Fruit were field packed into 1000 lb boxes which were graded at the packing house. Four field boxes were graded at each harvest, and yield was calculated based on the total number of boxes harvested per treatment. The grower harvested seven times, however research information was only collected from the first five harvests because of part of the field had been used for a U-pick operation before the last two harvests. Harvest dates were: (1) 24 Jan 1996, (2) 30 Jan 1996, (3) 2 Feb 1996, (4) 7 Feb 1996, and (5) 10 Feb 1996. Tomatoes were hand graded using rings to determine sizes[4]: jumbo, extra large: diameter ≥ 2 24/32 inches; large: diameter 2 16/32 inches to 2 25/32 inches, and medium: diameter 2 8/32 inches to 2 17/32 inches according to size standards established under the tomato marketing order (Fla. Tom.

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[3]Fertilizer costs were listed as $290.00 per acre for 1994-95 (Smith and Taylor, 1994) and $250.00 per acre for 1993-94 (Smith and Taylor, 1995).

[4]Jumbo: size categories 4 × 4 and 4 × 5; extra large: size categories 5 × 5 and 5 × 6; large: size category 6 × 6; and medium: size category 6 × 7.

Table 1. Effect of phosphorus rate on yield of vine-ripe tomatoes, Grower A, 1995-96.

P rate (%)[z]	Harvest	Fruit yield (25-lb ctn per acre) Jumbo	Large	Mkt. #1	Cull	Gray wall
50	1	12.3	18.1	16.8	3.0	n.a.
100	1	19.1	24.4	22.8	3.3	n.a.
significance		n.s.	n.s.	n.s.	n.s.	
50	2	106.6	113.3	110.0	8.3	n.a.
100	2	164.0	184.2	178.0	22.1	n.a.
significance		n.s.	n.s.	n.s.	n.s.	
50	3	183.8	277.6	252.7	31.8	n.a.
100	3	203.3	295.7	254.0	48.3	n.a.
significance		n.s.	n.s.	n.s.	n.s.	
50	4	155.6	168.0	164.0	8.3	38.6
100	4	206.3	220.4	214.8	19.8	42.4
significance		n.s.	n.s.	n.s.	n.s.	n.s.
50	5	5.4	102.1	52.9	17.7	7.4
100	5	9.5	105.9	68.1	23.9	9.4
significance		n.s.	n.s.	n.s.	n.s.	n.s.
50	TOTAL	463.7	679.1	596.4	69.1	46.0
100	TOTAL	602.2	830.6	737.7	117.4	51.8
significance		n.s.	n.s.	n.s.	n.s.	n.s.

[z]P rate expressed as % of grower rate.

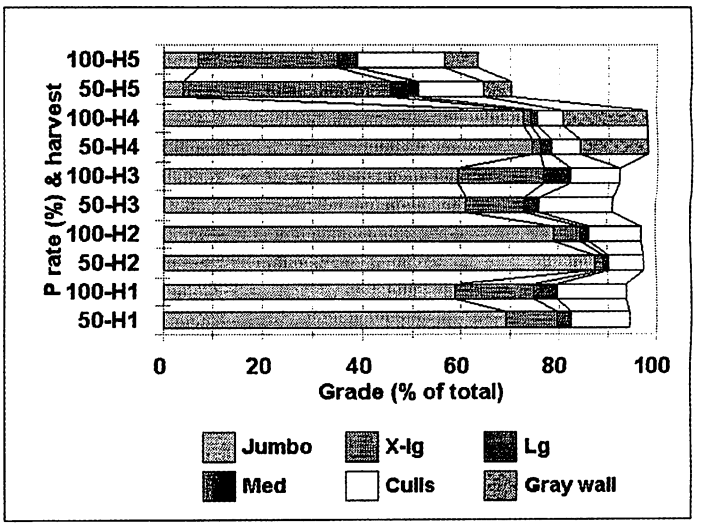

Figure 1. Effect of phosphorus rate on percentage of tomatoes per U.S. No. 1 Grade - Grower A, 1995-96.

Rev., 1997). They were also separated into marketable and cull fruit and also into U.S. No.1 and U.S. No. 2. Only data from U.S. No.1 and cull (including culls due to gray wall) fruit have been reported in this paper.

Grower B Trial: This was planted on a typical Krome very gravelly loam (a.k.a. "Rockdale" soil) using standard grower bed spacing of 36-inch wide beds planted on 6-ft centers. Dry fertilizer was applied in 2 bands along the top of the bed immediately prior to the application of methyl bromide on 26 Sept 1995. Fertilizer treatments included the standard grower rate of 1625 lbs./acre 6-5.24-9.96 (85.22 lbs P/acre) plus the treatment rate of 1625 lbs./acre 6-2.62-9.96 (42.61 lbs P/acre). The lower rate of P was achieved by blending white limestone rock as filler. Treatments were applied to two separate blocks, each of which were three beds wide and 0.25 mile long. Supplemental nitrogen was applied at the rate of 37 gal/acre of 4-0-6.64 per week. The cultivar 'Agriset' was transplanted on 10 Oct 1995. Harvesting was done at the mature-green stage, corresponding with dates when the grower harvested the rest of the field. Harvest data were taken from four 20' sections, one at either end of the three row block. The grower harvested twice. Harvest dates were: (1) 24 Jan 1996, and (2) 30 Jan 1996. Tomatoes were hand graded using rings to determine sizes: jumbo, extra large, large, and medium according to size standards established under the tomato marketing order (Fla. Tom. Rev., 1997). They were also separated into marketable and cull fruit and also into U.S. No.1 and U.S. No. 2. Only data from U.S. No.1 and cull fruit have been reported in this paper.

Grower C Trial: This was planted on a typical Krome very gravelly loam (a.k.a. "Rockdale" soil) using standard grower bed spacing of 36-inch wide beds planted on 6-ft centers. Dry fertilizer was applied in two bands along the top of the bed immediately prior to the application of methyl bromide on 12 Dec 1996. Fertilizer treatments included: (1) the standard grower rate (100% rate) of 100.51 lbs P/acre preplant plus 30.15 lbs P/acre starter fertilizer, (2) (63% rate), which was calculated by using 56.81 lbs. preplant plus the starter fertilizer, and (3) (37% rate), which was calculated by using 56.81 lbs preplant without the starter fertilizer. Each treatment was applied to two separate rows, each of which was 0.25 mile long. Supplemental nitrogen was applied at the rate of 37 gal/acre of 4-0-6.64 per week. The cultivar 'Sunbeam' was transplanted on 30 Dec 1996. Harvesting was done at the mature-green stage, corresponding with dates when the grower harvested the rest of the field. Harvest data were taken from three 20-ft sections, evenly spaced along of each of the two beds. The grower harvested twice. Harvest dates were: (1) 31 Mar 1997 and (2) 14 Apr 1997. Tomatoes were hand grad-

Table 2. Effect of phosphorus rate on yield and average size of mature-green and vine-ripe tomatoes, Grower B, 1995-96.

		Mature-green						Vine-ripe					
		yield (ctns per acre)[y]			size (oz.)[x]			yield (ctns per acre)			size (oz.)		
P rate (%)[z]	Harvest	No. 1	Mkt	Lg	No. 1	Mkt	Lg	No. 1	Mkt	Lg	No. 1	Mkt	Lg
50	1	1442	1508	1293	6.09	6.06	6.51	311	354	348	8.61	8.72	8.79
100	1	1522	1617	1367	5.99	6.02	6.48	237	274	267	8.12	8.16	8.47
significance		n.s.	n.s.	n.s.	n.s.	n.s.	n.s.	n.s.	n.s.	n.s.	n.s.	n.s.	n.s.
50	2	641	772	424	4.38	4.41	5.11						
100	2	589	706	346	4.48	4.55	5.50						
significance		n.s.	n.s.	n.s.	n.s.	n.s.	n.s.						

[z]P rate expressed as % of grower rate.
[y]25 lb carton.
[x]weight of an average fruit.

Table 3. Effect of phosphorus rate on yield and average size of large mature-green and vine-ripe tomatoes, Grower C, 1996-97.

P rate (%)[z]	Harvest	Mature-green Yield (ctns per acre)[y]	Mature-green Size (oz.)[x]	Vine-ripe Yield (ctns per acre)	Vine-ripe Size (oz.)
37	1	405.9 a[w]	4.60 a	54.0 a	8.21 a
63	1	480.2 a	5.46 a	64.0 a	8.42 a
100	1	542.9 a	5.91 a	97.1 a	7.92 a
37	2	248.5 a	4.83 a	228.7 a	6.52 ab
63	2	171.2 a	5.32 a	222.9 a	5.75 b
100	2	137.2 a	4.61 a	316.9 a	6.67 a

[z]P rate expressed a % of grower rate.
[y]25 lb cartons.
[x]Weight of an average fruit.
[w]Means followed by the same letter are not significantly different, Duncan's multiple range test, 5% level.

ed using rings to determine sizes: extra large, large, and medium according to size standards established under the tomato marketing order (Fla. Tom. Rev., 1997). They were also separated into marketable and cull fruit and also into U.S. No.1 and U.S. No. 2. Only data from U.S. No.1 and cull fruit have been reported in this paper.

Results and Discussion

Grower A Trial: Reducing phosphorus rate from the grower rate (100%) to one-half the grower rate (50%) had no significant effect on any of the measured fruit parameters at any of the five harvest dates (Table 1). Phosphorus rate did not have any significant effect on the percentage of fruit per grade over any of the seven harvests (Fig. 1).

Grower B Trial: Phosphorus rate did not have a significant effect on either yield or size of mature-green tomatoes over either harvest. Phosphorus rate did not have a significant effect on either yield or size of vine-ripe tomatoes at the first harvest (Table 2).

Grower C Trial: Phosphorus rate (37%, 63%, or 100%) did not have a significant effect on yield of either mature-green or vine-ripe tomatoes at either harvest. Size of mature-green tomatoes was not affected at either harvest, nor was size of vine-ripe tomatoes for the first harvest. For the second harvest, vine-ripe tomatoes which received the 100% rate were significantly larger than those which received the 67% rate, but neither group was significantly different from the 37% rate (Table 3).

Conclusion

Changes in phosphorus fertilizer ranging from cutting grower rates in half to studies where they were at 63% and 37% of the grower standard did not have any significant effect on yield, size, or quality of fruit. As production costs continue to escalate, growers may want to be aware of even small changes to their total costs which can save money without sacrificing crop quality.

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