CHALLENGES AND OPORTUNITIES WITH VEGETABLES BMP'S IN SOUTHWEST FLORIDA

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Abstract

Approximately 10,000 ha of staked tomato are grown each year in the winter-spring season in Southwest Florida. Tomatoes are produced with transplants, raised beds, polyethylene mulch, drip or seepage irrigation, and intensive fertilization. With the development of nutrient best management practices (BMPs) for vegetable crops and increased competition among water users, N recommendations must ensure economical yields, but still minimizing the environmental impact of tomato production. The current UF-IFAS N fertilization rate of 224 kg/ha of N (with supplemental fertilizer applications under specified conditions) may require adjustment based on soil type and irrigation system. Because growers should be involved in the development and implementation of BMPs, this project established partnerships with SW Florida tomato growers. Studies evaluated the effects of N application rates on yield, plant growth, petiole N sap, pests and diseases. Nine on-farm trials were conducted during the dry winter 2004-2005 season. Treatments consisted of N fertilizer rates ranging from 224 to 448 kg/ha, with each trial including at least the UF-IFAS rate and the traditional rate. Although total yields were comparable among N rates, there were differences in size category. Nitrogen rates had little effect on tomato biomass 30 and 60 days after transplanting. Changes in petiole sap NO_3-N and K concentrations were different between seepage and drip irrigation, but usually above the sufficiency threshold. It is important to consider the type of irrigation when managing tomato and determining optimum N fertilizer rates.

Introduction

Nitrogen (N) fertilizer management has become an issue of environmental concern for Florida vegetable growers under the adoption by the State of vegetables BMP. The BMP manual for vegetables endorses UF-IFAS recommendations of 200 lb/acre of N in tomatoes (*Lycopersicon esculentum* Mill.) plus provisions for supplemental fertilizer applications. The supplemental fertilizer applications are allowed (1) after a leaching rain (defined as 3 inches in 3 days or 4 inches in 7 days) for crops (including tomato), (2) under extended harvest season, and (3) plant nutrient levels (leaf or petiole) fall below the sufficiency range. Nutrient management in tomato production is not limited to the total amount of fertilizer found in the recommendation. Together with rate, the effectiveness of nutrient management depends on fertilizer placement, source, growing season, irrigation methods and application time.

Recent unpublished surveys by IFAS personnel indicate that most growers do not follow IFAS nutrient recommendations, particularly for N. Major growers' critique of current IFAS nutrient management includes the lack of large scale on-farm field research in southwest Florida, lack of N recommendation for drip irrigated tomatoes of more than 13 weeks, introduction of new varieties that support greater crop yields, a direct correlation between higher N rates and lower incidence of plant diseases. Many growers believe that UF-IFAS fertilizer recommendations are too low to produce economical yields, especially during wet years. On many operations, N rates are reported to be 150% of the UF- IFAS recommended rate. In some cases, N rates used may be as high as 200% of the UF-IFAS N recommendation. In addition, growers admit they tend apply irrigation in excess of crop evapotranspiration (ETc), which is the recommended water management practice. Although N runoff has not been identified as a widespread problem in south Florida, the environmental concern remains that the combination of over-fertilization and excessive irrigation may contribute to elevated nutrient concentrations in ground and surface waters.

Objectives

1) Establish partnerships with selected southwest Florida vegetable growers to evaluate the effects of N nutrient applications under commercial growing conditions.

2) Evaluate the effect of selected N application rates on plant growth, disease incidences, and production.

Table 1. Experiment number, irrigation type, N rates evaluated, plot size, planting date, number of harvest in the 2004-2005 N management trials in Southwest Florida.

Trial number	Farm	Season	Irrigation type	N rate (lb/acre)*	Plot size (acres)	Planting date	Number of harvest
1	1	Fall, 2004	Seepage	200, 240, 260, 260+BS†	0.33	28 Sept.	3
2	2	Fall, 2004	Seepage	195 and 255	0.83	5 Oct.	3
3	3	Fall, 2004	Seepage	200 and 300	0.83	5 Oct.	2
4	4	Fall, 2004	Drip/seepage	250 and 418	0.10	11 Oct.	3
5	5	Spring, 2005	Drip	260 and 300	25	22 Nov.	3
6	2	Spring, 2005	Seepage	195 and 255	0.83	3 Dec.	3
7	2	Spring, 2005	Seepage	195 and 255	0.83	28 Jan.	3

* based on 6-ft spacing or 7,260 linear bed feet per acre
† BS = biosolids

Table 2. Differences between higher and lower nitrogen rate (lb/acre), 5x6 yield (25-lb box/acre), and revenue ($/acre) in seven N fertilization trials conducted in 2004-2005 in Southwest Florida.

Trial		Difference Lower – Higher N rate		
1 Seepage/Fall 3-harvests	N rate (lb/acre)	36	60	60+BS
	5x6 Yield (boxes/acre)	415	348	98
	Revenue ($/acre)	$2,848	$1,191	$773
2 Seepage/Fall 3-harvests	N rate (lb/acre)	60		
	5x6 Yield (boxes/acres)	171		
	Revenue ($/acre)	$1,042		
3 Seepage/Fall 2-harvests	N rate (lb/acre)	100		
	5x6 Yield (boxes/acre)	17		
	Revenue ($/acre)	$1,064		
4 Drip/Fall 3-harvests	N rate (lb/acres)	168		
	5x6 Yield (boxes/acre)	388		
	Revenue ($/acre)	$3,104		
5 Drip/Spring 3-harvests	N rate (lb/acre)	40		
	5x6 Yield (boxes/acre)	187		
	Revenue ($/acre)	$3,567		
6 Seep/Spring 3-harvests	N rate (lb/acre)	60		
	5x6 Yield (boxes/acre)	-84		
	Revenue ($/acre)	$422		
7 Seep/Spring 3-harvests	N-rate (lb/acre)	60		
	5x6 Yield (boxes/acre)	134		
	Revenue ($/acre)	$2,064		

Figure 1. Petiole sap NO_3-N concentration for tomato grown with (a) seepage and (b) drip irrigation during the 2004-2005 seasons in Southwest Florida.

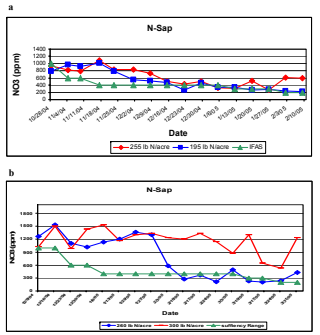
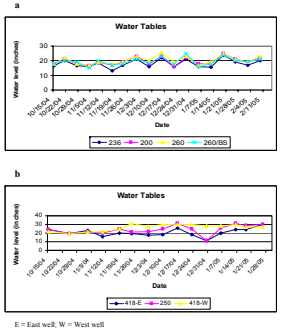


Figure 2. Water table depth (inch) below the top of tomato beds in fields irrigated with drip (a) and seepage (b) irrigation during the 2004-2005 season in Southwest Florida.



E = East well; W = West well

Figure 3. Incidence of Fusarium crown rot (caused by *Fusarium oxysporum* f.sp. *radicis-lycopersici*) on tomato plants in trial 1 between 12 Jan. and 2 Feb. 2005 in Southwest Florida. (1 plot= 10 plants).

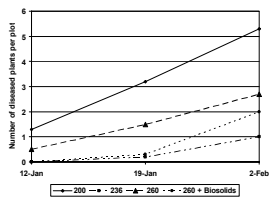
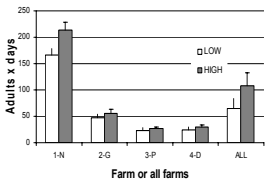


Figure 4. Cumulative mean adult whiteflies x days with standard error bars on 4 farms in southwest Florida, fall/winter 2004-2005.



Materials and Methods

Nine fertility trials were conducted during the 2004-2005 growing season on farms that not only included 16,000 acres or 80% of staked tomato production in Southwest Florida (Collier County), but also well represented the diversity of growing conditions in the area: six trials were done with seepage and three with drip irrigation. Six trials were conducted in the fall 2004 and four in the spring 2005. Trials also included different varieties (mostly 'Florida 47' and 'Sebring'), plant densities (in-row spacing of 18 to 24 inch/plant; 5 or 6 ft bed centers), soil type (Immokalee fine sand), and farm size (500 to 5,000 acres). Treatments consisted of N fertilizer rates ranging from 200 to 418 lb/acre, with each trial including at least the UF-IFAS rate (200 lb N/acre) and the grower's rate (typically higher than the UF-IFAS rate). Plots size varied from 0.1 to 50 acres (Table 1).

Data collection: Plant biomass 30 and 60 days after transplanting (DAT), fresh petiole sap NO_3-N and K concentrations, ground water table depth, number of plants showing symptoms of Fusarium crown rot (caused by *Fusarium oxysporum* f.sp. *radicis-lycopersici,* adult whiteflies counts *(Bemisia argentifolii),* marketable tomatoes were graded in the field according to USDA specifications of number and weight of extra-large (5x6), large (6x6), and medium (6x7) fruit. The economic section of this paper calculates a monetary value by fertilizer treatment for each farm site. The values compare projected total revenues gained by fertilizer treatment utilizing yield data and market prices reported at the date of each harvest (USDA-AMS, 2005). Southwest Florida tomato growers harvest mature-green tomatoes in two market windows - fall/winter and early spring. It is important to realize that grower prices for the fresh tomato are set on a daily basis and are sensitive to total market supplies. Tomatoes imported from Mexico, Europe and Canada, compete with those from Southwest Florida for the same market windows.

Results and Discussion

Nitrogen rates had little effect on tomato biomass 30 and 60 DAT (data not shown). Changes in petiole sap NO_3-N and K concentrations were different with seepage and drip irrigation, but tended to be above the IFAS sufficiency threshold for all treatments and at all stages of plant growth (Fig. 1a and b). Overall, the water table depths among different treatments were relatively stable (Fig. 2a and b). Preliminary data showed on one farm, an association between the increasing incidence of Crown Rot (*Fusarium* sp.) and decreasing N rates (Fig. 3). Higher whitefly counts were observed in fall on plants receiving the higher N rate in spite of low pest pressure in 2004-2005 (Fig. 4).

In this relatively dry season (after the hurricanes), significant yield differences in early yields were found in 2 out of 7 trials ($P<0.05$), whereas differences in total yield were significant only in 1 trial.

Table 2 summarizes for each trial the impact of N rate differences within a trial on 5x6 yields and total revenue. In all trials except trial six, total production of extra larges (5x6) cartons was greater under the higher grower N rate. Total revenue was greater on all trials, even in trial six. While the IFAS rate on trial six produced more total cartons of 5x6s, 5x6 yields from the grower standard plots were greater during the third harvest when the market price exceeded $19 per carton. Even if the experimental design of this study does not allow for the discernment of statistical differences, a trend has already appeared within the first year data. That is, higher fertilization rates from the various "grower-standard" treatments produce more total revenue. It is a trend that reinforces the economic reasoning behind the observed behavior of tomato growers pushing for higher N fertilization rates.