Fertigation Boosts Optimum Nitrogen for Tomatoes and Peppers

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Fertilizing vegetable crops requires a delicate balance between yield, quality, and environmental impact. Fertigation increases response to nitrogen (N) and provides greater opportunity to control rates to optimum levels.

Tomatoes and green peppers are vegetable crops that provide huge nutritional benefits. Their production also demands good nutrition. Intensive production methods, including the use of fertigation, have helped to make their production viable in Ontario. This benefits society by making nutrient-rich foods available with less need to transport over long distances. Field tomatoes grown on 19,000 acres generated C$78 million for Ontario producers in 2005, while green peppers on 2,900 acres generated C$13 million.

Intensive production methods, however, may not conform well with the regulation of nutrient management. Producers use high rates of N and phosphorus (P). This research aimed to determine how changes to N and P rates would affect yield, quality, and potential losses to the environment under intensive management using drip fertigation.

The experiments on both crops included four rates of N and three rates of P in all 12 combinations. All of the P and 40% of the N requirement was applied preplant. The remaining N was supplied by fertigation. The soils were Granby sandy loams or loamy sands, with organic carbon content of 1.7%, at the research station in Harrow, Ontario. Soil P and K fertility was very high–generally above 60 parts per million (ppm) Olsen-P, and above 200 ppm exchangeable K.

Fertigation produces high yields of quality tomatoes.

Optimum yields and quality of peppers and tomatoes depend on adequate N and P nutrition.

Over three growing seasons—2003 to 2005—optimum marketable yields required N rates of 180 to 214 lb/A for green peppers, and 190 to 270 lb/A for tomatoes (**Figure 1**). These rates exceed current recommendations for this soil by two- to three-fold. These documented responses contribute toward the data required to make official changes to recommendations.

Removal efficiency (N in harvested fruit per unit of N applied) ranged from 50% to 80% for tomatoes fertilized at 240 lb/A, the mean optimum rate. At that rate, recovery efficiency (increase in N uptake compared to tomatoes grown without N fertilizer) ranged from 31% to 68%. Peppers were less efficient. Fertilized at their mean optimum rate of 200 lb/A, removal

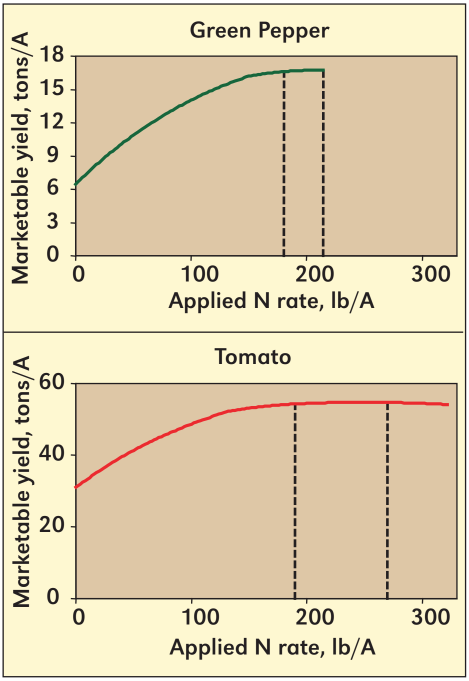

Figure 1. Response to applied N (3-yr. average). Segmented vertical lines indicate the range of optimum rates.

efficiencies ranged from 22% to 30%, and recovery efficiencies from 24% to 32%. While some vegetables show low efficiencies of nutrient removal and recovery, the figures for tomatoes are at least as good as typical values for corn.

When N rates exceeded optimum, the proportion of green tomatoes increased and soluble solids decreased. In some years, soluble solids decreased as petiole nitrate (NO_3^-) increased. In others, they increased with increasing stalk P concentrations. Phosphorus addition did not affect soluble solids. Previous research (Warner et al., 2004) from 1999 to 2002 found that N rate did not affect soluble solids, firmness, size, or color of marketable fruit of tomatoes.

For both tomatoes and peppers, rates of N above optimum tended to dramatically increase residual soil NO_3^- (**Figure 2**). Reducing rates below optimum had much smaller effects. In order to minimize NO_3^- losses to groundwater, it remains important that N be managed carefully.

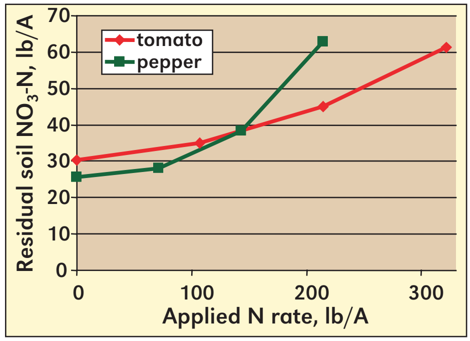

Figure 2. Residual soil NO_3-N to 40 in. depth, following tomatoes and peppers (3-yr. average).

Fertigation allows the producer to delay final decisions on N rates, and thus provides for more careful control.

On-farm trials comparing surface and sub-surface irrigation, with or without fertigation, showed that any form of irrigation increased tomato yields by 20% to 45%. Fertigation did not boost yields relative to drip irrigation. However, it offers the flexibility to adjust rates mid-season to account for weather and condition of the crop, since only 40% of the total fertilizer requirement is applied at planting.

In the first year of this study, P fertilizer increased the marketable yield of peppers, despite soil test levels so high that it would not have been recommended. In that year, the increased growth from P fertilization at 180 lb/A of P_2O_5 substantially reduced residual soil NO_3^- after harvest, keeping soil concentrations below 10 ppm. However, in the last 2 years, neither peppers nor tomatoes responded to P.

Considering that the soil test levels were in a range where no P is recommended, this indicates that response frequency may be sufficient to justify applying at least as much P as the crops remove, even at such high soil test levels. Crop removals of P_2O_5 averaged 75 lb/A for tomatoes and 24 lb/A for peppers. BC

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Research Notes

Chlorophyll Meter Readings Can Predict Corn Nitrogen Need and Yield Response

Earlier research indicated that chlorophyll meters (CM) can indicate nitrogen (N) stress in corn, but did not address whether the amount needed can be predicted. Based on 66 N rate experiments over a 4-year period in seven northcentral states, CM are highly significant predictors of economically optimum N rate (EONR). Predictions were stronger when based on relative readings, on readings made later in the growing season, and where N fertilizer had not been previously applied. Soil nitrate (NO_3^-) or soil N indices were much weaker predictors of EONR.

In irrigated corn, there are repeated opportunities to apply needed N during the growing season with irrigation water. In rainfed systems, the opportunity is more limited. The CM will only be useful in guiding N application rate if it can be the basis for a single quantitative rate recommendation.

The objective in this study was to develop calibrations to predict corn N need and yield response based on CM readings over a wide range of environments and growth stages to improve N rate recommendations and inform management decisions. Minolta SPAD chlorophyll meters were used to take the readings. All readings were taken midway between the stalk and tip of the appropriate leaf. A relative CM value was calculated as: *Relative CM value = (CM value/reference value)*. The reference CM value was specific to each experimental location and growth stage. It was calculated by averaging all readings from a group of high N treatments, instead of just the highest N rate.

The experiments included here are part of a cooperative regional research project, based on a shared experimental protocol… one of which was to evaluate the utility of CM both for predicting corn yield response to N and assessing N supply related to mineralization. The 66 N rates experiments were conducted in seven states: Illinois, Kansas, Michigan, Minnesota, Missouri, Nebraska, and Wisconsin. BC

Source: Scharf, P.C., S.M. Brouder, and R.G. Hoeft. 2006. Agron. J. 98:655-665.

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References:

Warner, J., T.Q. Zhang, and X. Hao. 2004. Effects of nitrogen fertilization on fruit yield and quality of processing tomatoes. Can. J. Plant Sci. 84: 865–871.