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Fertigation Boosts Optimum Nitrogen Needs by Tomatoes and Peppers

Fertilizing vegetable crops requires a delicate balance between yield, quality and environmental impact. Fertigation, a practice that nutrients are applied through irrigation systems, increases crop response to nitrogen and provides greater opportunity to match fertilizer delivery to crop needs.

Tomatoes and green peppers are vegetable crops that provide huge nutritional benefits. Their production also demands good nutrition with a timely supply. Intensive production methods, including the use of fertigation, have helped to make their production viable in Ontario due to the high profitability. This has benefited Canadians by making nutrient-rich foods available under more environmentally sustainable conditions and with less need to transport over long distances.

La fertigation avec un apport adéquat de N et P augmente les rendements et la qualité des tomates et des poivrons.

Intensive production methods, however, may not conform well with the regulation of nutrient management as producers may need to use high rates of nitrogen (N) and phosphorus (P). Agriculture and Agri-Food Canada scientists at the Greenhouse and Processing Crops Research Centre in Harrow, Ontario have conducted research on various N and P rates for production of tomato and pepper. The focus of the research was 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 tomato and pepper crops included four delivery rates of N and three rates of P; in all 12 combinations. All of the P and 40% of the N requirement were applied pre-plant. The remaining N was supplied by fertigation. The soils were sandy loams or loamy sands, with organic carbon content of 1.7%, at the research station in Harrow, Ontario. Soil P and potassium (K) fertility was very high – generally above 60 ppm Olsen-P, and above 200 ppm exchangeable K.

Nitrogen rates

Over three growing seasons—2003 to 2005—optimum marketable yields required N rates of 202 to 240 kg/ha (180 to 214 lb/A) for green peppers, and 213 to 302 kg/ha (190 to 270 lb/A) for processing tomatoes (Figure 1). These rates exceed the current recommendations for these soils by two- to three-fold. These documented responses contribute toward the data required to make official changes to recommendation.

Removal efficiency (N in harvested fruit per unit of N applied) ranged from 50% to 80% for tomatoes fertilized at 269 kg/ha (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 224 kg/ha (200 lb/A), removal 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 unmaturated green tomatoes increased and soluble solids decreased. In some years, soluble solids decreased as petiole nitrate (NO_3) increased. In others, soluble solids increased with increasing stalk P concentrations. Phosphorus addition did not affect soluble solids.

Previous studies at Harrow (Warner and Zhang from 1999 to 2002) found that N rate did not affect

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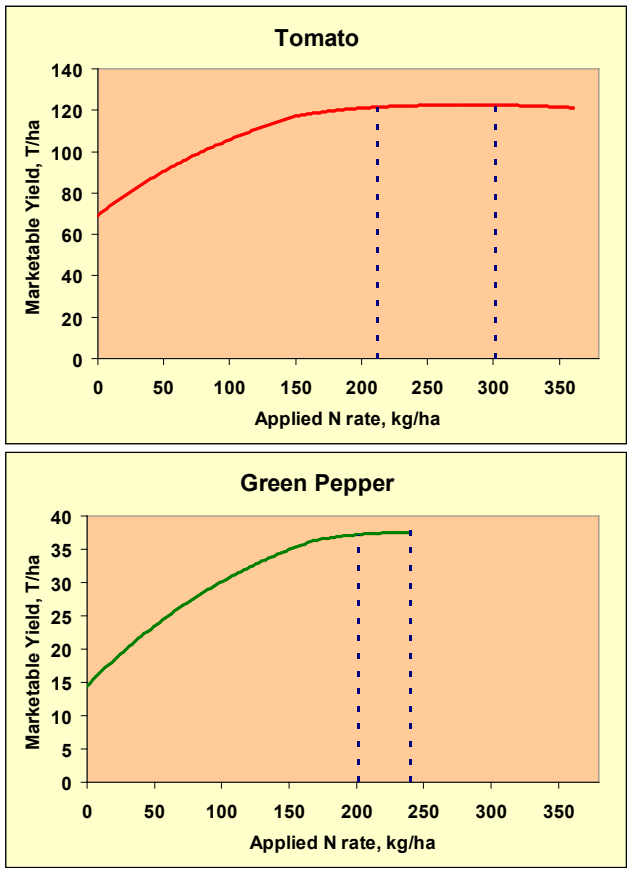

Figure 1. Responses to applied N (average over three years). Segmented vertical lines indicate the range of optimum rates.

soluble solids, firmness, size or color of marketable fruit of tomatoes.

Soil residual nutrient level

For both tomatoes and peppers, rates of N above optimum tended to dramatically increase residual soil nitrate (Figure 2). Reducing rates below optimum had much smaller effects. In order to minimize nitrate losses to groundwater, it remains important that N be managed carefully. Fertigation allows the producer to delay final decisions on N rates up to the last minute before crop needs, 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%. Drip 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 202 kg/ha (180 lb/A) of P_2O_5 substantially reduced residual soil nitrate 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

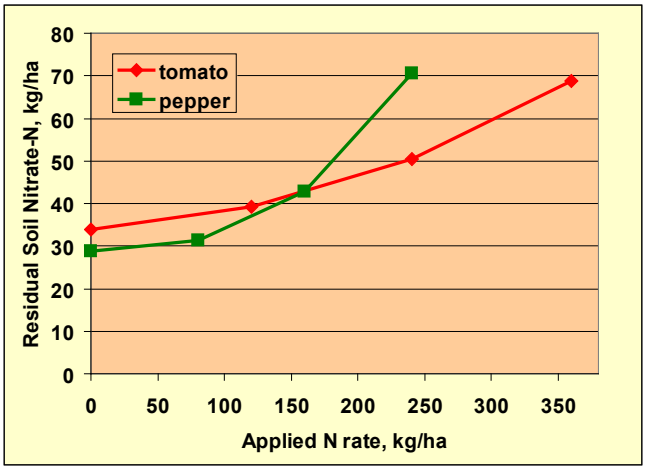

Figure 2. Residual soil nitrate-N to 1 m depth, following tomatoes and peppers (3-yr average).

84 kg/ha (75 lb/A) for tomatoes and 24 kg/ha (21 lb/A) for peppers.

After all, drip fertigated tomatoes and peppers require a lot more N than the rates currently recommended, while more studies are needed on their P needs.

Acknowledgments

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For more information contact:

Dr. Tiequan Zhang and **Dr. Chin Tan**
Research scientists
Environmental Health
Greenhouse and Processing Crops Research Centre
Harrow, Ontario, N0R 1G0
E-mail: zhangt@agr.gc.ca
www.agr.gc.ca/science/harrow

Collaborator:
Dr. Tom Bruulsema, Director Northeast Region
North America Program, International Plant Nutrition Institute, Guelph, Ontario, N1G 1L8

SCPS (N. Sangalli)

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