Project Title: **Agronomic And Environmental Consequences of Applying Fertilizer Nitrogen And Phosphorus to Processing Tomatoes and Green Peppers Under Drip Fertigation**
(Report of the first year)

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## Executive Summary

Processing tomatoes and green peppers are high nutrient demand crop, and the requirements can be further increased with increased yield potential due to the improved water supply. Irrigation has been increasingly used in southern Ontario for processing tomatoes and green peppers to overcome the frequent incidences of drought stress. However, excessive nutrient supply can have adverse impacts on water quality through surface runoff and leaching (nitrogen and phosphorus) and to air quality through gaseous emissions. New fertilization techniques must be developed for irrigated processing tomatoes and green peppers to maximize farmers' profits and sustain or improve the environmental quality. Nutritional information is also essential to establish database for Ontario nutrient management legislation.

The long-term objectives of this study are 1) to develop optimum rates of fertilizer nitrogen and phosphorus which are both economically and environmentally sound, 2) to determine the amounts of nitrogen and phosphorus required for each ton increase of processing tomato and green pepper yield, and 3) to determine the threshold values of petiole $NO_3$-N and K for Ontario conditions. The short-term objectives for 2002 were 1) to determine the relationships between fertilizer nitrogen and phosphorus rates and yield and quality of processing tomatoes and green peppers under drip fertigation; 2) to evaluate the relationships between petiole $NO_3$-N and K and yields; 3) to determine crop N and P removals; and 4) to evaluate the potential leaching losses of soil $NO_3$-N and P.

The experiment was conducted in a Granby sandy loam soil at the GPCRC, Harrow, ON. Treatments for processing tomatoes included 4 fertilizer nitrogen rate (0-258 kg N $ha^{-1}$) and 3 fertilizer P rates (0-200 kg $P_2O_5$ $ha^{-1}$). For green peppers, treatments included 4 fertilizer N rate (0-198 kg N $ha^{-1}$) and 3 fertilizer phosphorus rates (0-200 kg $P_2O_5$/ha). Fruits pf green peppers were harvested once a week (7 times of harvests during the season) and ranked as marketable and non-marketable yields. Fruits (from 2 harvests at this stage) and stover were sampled and analysed for moisture, nitrogen and phosphorus contents. Total nitrogen and phosphorus uptake and removals were calculated in combination with fruit and stover yields. Nitrogen and phosphorus requirements for each ton production of green peppers were calculated. For processing tomatoes, fruits from the central rows of each plot were harvested at the 80% fruit ripening stage and graded into marketable, green and cull. Fruit soluble solids were measured. Fruit and stover were sampled and to be analysed for N and P contents when funds available. Total N and P uptake and removals will be calculated in combination with fruit and stover yields. Leaf petiole nitrate ($NO_3$-N) and potassium measurements were conducted using Cardy nitrate and potassium metre from each plots once in a week. For both processing tomatoes and green peppers, soil profile samples (0-100 cm depths) were taken before planting and shortly after harvesting and analysed for $NO_3$-N and $NH_4$-N to evaluate the leaching potential of soil N as a function of fertiliser rates.

Total yield of green peppers was only affected by fertilizer nitrogen when phosphorus was added at a rate above 100 kg $P_2O_5$ $ha^{-1}$. The highest total yield was produced with 74 kg N $ha^{-1}$ fertilizer nitrogen plus 200 kg $P_2O_5$ $ha^{-1}$ fertilizer phosphorus. Marketable yield responded to fertilizer nitrogen only when fertiliser phosphorus was added at the rate of 200 kg $P_2O_5$ $ha^{-1}$. A 83 kg N $ha^{-1}$ nitrogen (OMAF recommendation: 70 kg N $ha^{-1}$ ) was required to produce the maximum yield of 29.4 ton $ha^{-1}$. Obviously, green pepper production under drip irrigation requires more nitrogen fertilizer. The high yield production of green peppers can only be achieved with the combination of optimum fertilizer nitrogen and adequate application of phosphorous fertilizer.

Green pepper stover uptakes of nitrogen ranging from 53 to 88 kg N $ha^{-1}$ increased linearly with fertilizer nitrogen added. Stover phosphorous uptake ranged from 10 to 13 kg P $ha^{-1}$, and increased exponentially with fertilizer nitrogen added. However, nitrogen removal by fruits responded quadratically to fertilizer nitrogen rate only when fertilizer was added at 200 kg $P_2O_5$ $ha^{-1}$, with a maximum removal of 81 kg N $ha^{-1}$. Fruit phosphorus removal increased with increases in nitrogen rate, with the maximum of 13.5 kg P $ha^{-1}$. Total nitrogen uptake ranged from 108 to 149 kg N $ha^{-1}$ and total phosphorus from 22 to 25 kg P $ha^{-1}$, and both increased with increases in fertilizer nitrogen rate. The calculated values for the amount of nitrogen required for each ton production of green peppers increased linearly with increased fertilizer nitrogen rate, ranging from 2.7 to 3.6 kg N $ha^{-1}$, and for the amount of phosphorus required increased exponentially with added fertilizer nitrogen, ranging from 0.55 to 0.60 kg P $ha^{-1}$. By considering the fertilizer nitrogen required for the maximum marketable yield of green peppers, the amount of nitrogen and phosphorus required for each ton production can be 3.1 and 0.53 kg $ha^{-1}$, respectively. Soil profile $NO_3$-N after harvest increased with fertilizer nitrogen rate, with majority of the soil $NO_3$-N remained at the soil depth of 0-40 cm. Certain amount of soil $NO_3$-N was leached down up ro 100 cm when fertilizer nitrogen rates were above 62 kg $ha^{-1}$, which was corresponding closely with the fertilizer nitrogen rate (83 kg N $ha^{-1}$) required for maximum green pepper production found from this study.

There were significant interactions between fertilizer nitrogen and phosphorus on processing tomato yields. With fertilizer P added above 200 kg $P_2O_5$ $ha^{-1}$, marketable yield responded quadratically to fertilizer nitrogen rate, with the maximize marketable yield produced at 133 kg N $ha^{-1}$, However, marketable yield was not affected by added fertilizer nitrogen when fertilizer phosphorus was below 100 kg $P_2O_5$ $ha^{-1}$. Increased fertilizer phosphorus rate increased the ratio of marketable yield to total yield. In addition, increased fertilizer phosphorus rate increased soluble solids contents, with 5.5% of percent Brix increase when at the phosphorus rate of 200 kg $P_2O_5$ $ha^{-1}$, while increases in nitrogen rate decreased linearly the soluble solids contents, with 8% of percent Brix decrease when at the nitrogen rate of 260 kg N $ha^{-1}$. It seems that phosphorus plays a significant role in the accumulation of soluble solids of processing tomatoes. Balanced fertilization with optimized combination of nitrogen and phosphorus is essential to the production of processing tomatoes, if both yield and quality are to be maximized.

Increased nitrogen fertilizer rate increased petiole $NO_3$-N concentration of processing tomatoes, and the effects were largely enhanced with high rate of fertilizer phosphorus, 200 kg $P_2O_5$ $ha^{-1}$.

Similar to green peppers, soil profile $NO_3$-N after harvest for processing tomatoes increased with fertilizer nitrogen rate, with majority of the soil $NO_3$-N remained in the soil depth of 0-40 cm. Added fertilizer nitrogen at 258 kg N $ha^{-1}$ significantly increased the amount of soil $NO_3$-N. The maximum soil depth affected was only by 60 cm, shallower than the green pepper field, due to the short-lasting growing season with drip fertigation.