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Study Suggests No Consistent Yield Benefit To Split N Fertilization

Manitoba's processing potato industry has undergone rapid expansion in recent years, contributing to significant increases in potato production in this province. In Manitoba in 2001-02, an estimated 12.8 million cwt of processing potatoes valued at $97.3 million were marketed.

Despite the growing importance of the processing potato industry in Manitoba, research directed at the development of economically and environmentally sustainable fertilizer management systems for irrigated potato production has been somewhat limited. As a result, much of the information currently available to Manitoba producers is based on research conducted in potato-producing areas outside of Manitoba. This information may not be directly applicable under local environmental conditions.

In 2003, a multi-year field study was initiated in southern Manitoba to assess N management in irrigated potato production systems in order to identify N management practices that optimize potato yield and quality while minimizing the potential for N losses from the plant/soil system. The following is preliminary information from this ongoing research project.

Field experiments were conducted from 2003 through 2006 in Manitoba's potato-growing region.

Tuber yield highest for the 4x split N treatments in one of four site-years in Manitoba.

Sites with low-to-medium soil NO_3 levels, which would have received a recommendation for N fertilization based on current criteria, were selected in all years of the study. Experiments were conducted on a loamy sand near Carberry in 2003, Winkler in 2004, Douglas in 2006, and on a clay loam near Carberry in 2005. Russet Burbank potatoes were grown under irrigation in all years. Growing season conditions included good growing conditions in 2003, cool and wet conditions throughout the 2004 growing season, unusually high levels of precipitation in the early part of the 2005 growing season, and generally good growing conditions but below normal rainfall in 2006.

Effect significant

Effects of N management on yield varied among years. In 2003, total tuber yield increased linearly with increasing N rate across the range of N rates applied, but was not affected by the timing of N application. In contrast, in 2004, N rate had no effect on total tuber yield, but preplant application of N resulted in a higher total yield than split application. In 2005, a comparison of all treatments revealed a significant effect of treatment on total tuber yield. Overall, N application increased total tuber yield compared to the control treatment, but where N had been applied, there was no significant difference among rates.

In 2005, the timing of N application also influenced total tuber yield but, unlike 2004, the 4x split treatments produced a total yield that was similar to the preplant treatment but greater than the 2x split. In 2006, treatments receiving N fertilizer had a higher total yield than a check treatment receiving no N fertilizer in any form. However, for treatments to which N was applied, neither rate nor timing of N application influenced total tuber yield.

Differences among years in the effects of timing of N application on total yield appear to be due, at least in part, to growing season conditions. In 2003 to 2006, which had generally good growing conditions and low-to-average rainfall, timing of N application had no effect on total yield. However, the difference in the effect of

SUMMARY

Nitrogen (N) application often increased total and marketable yield (greater than 3 oz) of irrigated potato compared to the control treatment for soils with low-to-medium soil test NO_3 levels. Control treatments receiving negligible amounts of N fertilizer typically yielded between about 85 to 90 percent of the highest N treatment, suggesting that mineralization of soil organic N may contribute significantly to the plant-available N supply in irrigated potato systems in Manitoba. Split-applying N fertilizer did not generally result in a yield benefit, except in 2005. In 2005, timing of N application influenced tuber yield and size distribution, with the 4x split producing a higher marketable yield than the other treatments. In that year, total tuber yield was also numerically the highest for the 4x split, but did not differ significantly from the treatment in which all the N fertilizer was applied preplant. The general trend in 2005 was for larger tubers where N applications had been split-applied. Above-average precipitation early in the growing season of 2005 likely contributed to N losses from treatments in which a high proportion of the N fertilizer was applied early in the growing season, contributing to higher yields where N applications had been applied later in the growing season. Although results of this study have not demonstrated a consistent yield benefit from split application of N, split-applying N fertilizer at planting and hilling may help to reduce the potential for N losses early in the growing season. Split-applying N may reduce the amount of N present in the soil as NO_3, a form of N that may be susceptible to loss through leaching and denitrification.

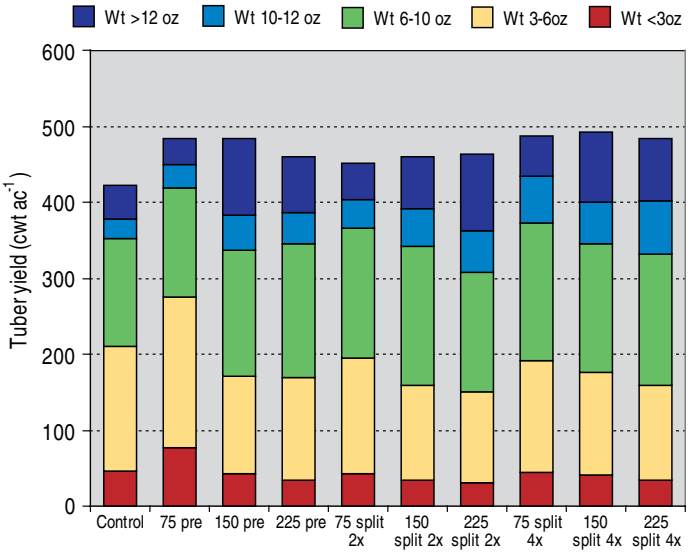

Figure 1. Effect of N fertilizer application rate and timing on yield of various tuber size fractions at Carberry, 2005.

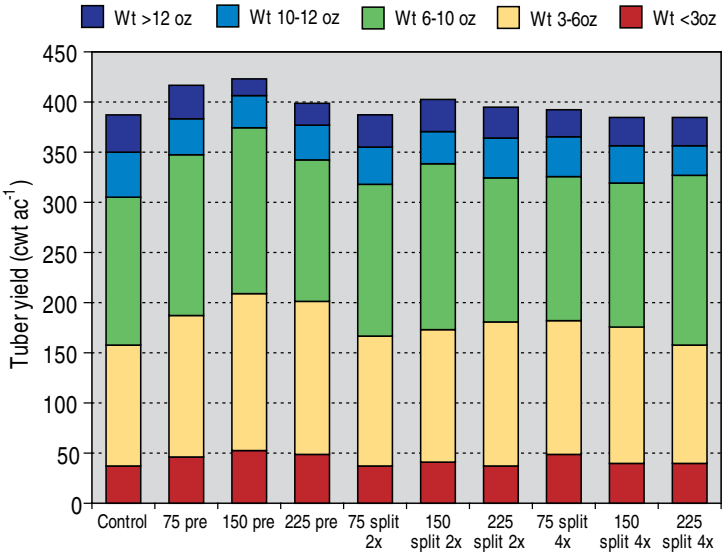

Figure 2. Effect of N fertilizer application rate and timing on yield of various tuber size fractions at Winkler, 2004.

split application among years is especially evident when comparing 2005 (Figure 1) to 2004 (Figure 2). In 2005, a wetter year that was subject to significant early-season N losses, the advantages of split N applications are more fully illustrated. In 2004, which was characterized by cool growing-season conditions and a lower accumulation of "physiological days" suitable for crop growth, split application was not advantageous.

The yield of marketable (greater than 3 oz) tubers was also assessed. In general, effects of N management on marketable yield were similar to those observed for total yield. In 2005, however, marketable yield was greater for the 4x split than for the other timing methods assessed, despite similar total yield in the 4x split and the preplant treatment (Figure 3). Contrasted to 2005, the 4x split in 2004 resulted in a lower marketable yield than the preplant treatment, and the 2x split was intermediate.

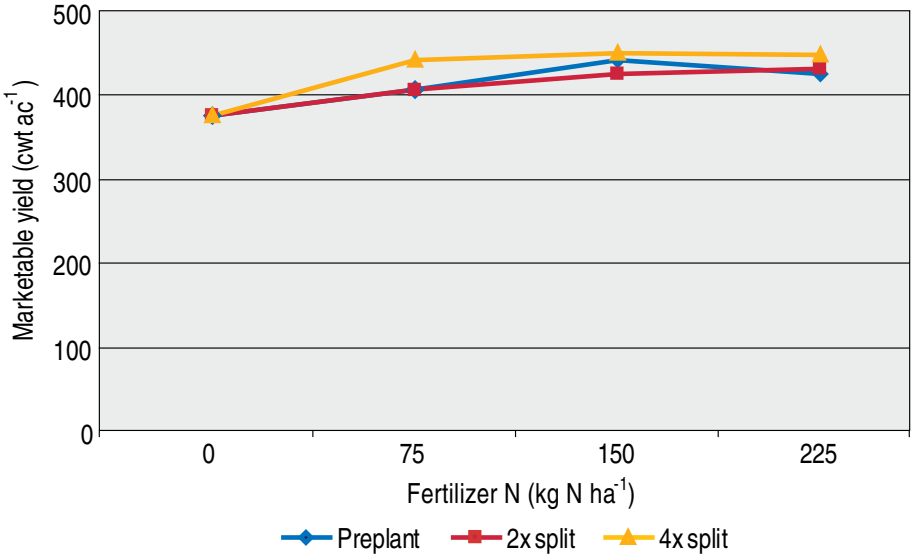

Figure 3. Effect of N fertilizer application rate and timing on marketable tuber yield at Carberry, 2005.

Although soil NO_3-N levels were relatively low at experimental sites in the spring prior to crop establishment (ranging among sites from 36 to 54 kg NO_3-N ha^{-1} to 60 cm), and only a small amount of N fertilizer (10 to 21 kg N ha^{-1}) was applied to the control treatment, total tuber yield in control treatments was usually 84 to 91 percent in the highest yielding treatment (Figure 1). These findings and previous studies in Manitoba have similarly pointed to the potential for significant contributions of N in irrigated potato production systems through mineralization of soil organic matter during the growing season.

Specific gravity was strongly influenced by N fertilizer management. Increasing N rate resulted in a significant linear decline in specific gravity in three of four site-years. Timing of N application

also influenced specific gravity in two site-years. In 2005, a higher specific gravity was obtained where N was applied as a 2x split at preplant and at hilling, than where it was applied either all preplant or at four times during the growing season. In contrast, a higher specific gravity was obtained in 2004 where N was either applied all preplant, as a 2x split application at preplant or at hilling, than where N was applied at four times throughout the growing season.

Preliminary results suggest that N fertilizer treatments had little measurable effect on fry color. However, in 2005 and 2006, N application reduced or tended to reduce the percentage of tubers with sugar ends and/or dark ends. Preliminary analysis indicates that, in most cases, the occurrence of hollow heart and brown center was greater in the control treatment than in N fertilized treatments, and that increasing N rate sometimes reduced the occurrence of hollow heart and brown center. However, N treatment did not consistently reduce actual losses in marketable yield due to hollow heart.

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