Optimum Nitrogen Fertilizer Rates for Hybrid vs Open-Pollinated Spring Canola in North America

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ABSTRACT

Hybrid canola is a recent addition to the cropping system in western Canada, where canola has established itself as a major contributor to farm profitability. Canola nitrogen (N) management has been evaluated in past field research trials, leading to fertilizer recommendations that are based on the yield response and potential of open pollinated (OP) varieties. The introduction of hybrid varieties in the region has seen average yields increase. The question of many growers and agronomists is whether these increased yields come solely with the new genetics, or is additional fertilizer N needed to optimize the returns with hybrids. Research results are presented which provide support for an increased use of N on the higher yielding hybrid types, but not to the extent suggested by several in the industry. In fact, there are examples where hybrid canola has been presented as the best cropping option when N supply is limited. Although the limited data is somewhat contradictory, it is our conclusion that hybrid canola may respond economically to 20 kg additional N per ha compared to OP varieties, and should be selected when yield maximization is desired.

INTRODUCTION

Nitrogen (N) fertilizer is one of the major input costs for canola producers in North America. Many growers rely on soil testing to determine optimal fertilizer rates. Questions have arose about the accuracy of N fertilizer recommendations for higher yielding hybrid *Brassica napus* canola, the predominate type of spring canola seeded now in North America. There are several factors that support a reassessment of N fertilizer response: soil test calibration curves were done many years ago on open-pollinated (OP), non-herbicide tolerant types (Soper, 1971; Nyborg et al, 1999); the calibration experiments often were onsummerfallow plots in contrast to the direct seeding systems that are popular now; and early calibration studies often used broadcast-incorporated fertilizer N placement whereas band placement now predominates.

The purpose of this paper is to briefly review the scientific evidence that compares the N fertilizer response between spring hybrid canola and open-pollinated varieties.

WESTERN COOPERATIVE FERTILIZERS (WESTCO) TRIALS

This western Canadian company conducted a series of experiments over 1999-2001 (14 site-years) to assess the N fertilizer response of canola hybrids (Karamanos et al, 2005) to conventional open-pollinated varieties. Hybrid cultivars produced 17% higher seed yield on average, but the yield advantage increased at higher fertilizer rates. They concluded that optimum N requirements are higher for hybrids than conventional canola cultivars. The hybrids tested included newer herbicide tolerant types, old non-herbicide tolerant types, and a synthetic (composite hybrid). The conventional cultivars included herbicide tolerant, non-herbicide tolerant, and specialty oil open-pollinated types. This range of other variety characteristics may have confounded the data. In a subsequent experiment conducted from 2002 and 2004, these researchers found no statistical difference in N response between hybrid and conventional canola (Karamanos et al, 2007). This company has developed Excel spreadsheet fertilizer recommendations that produce higher N recommendations for hybrid canola than OP.
Figure 1 shows this data summarized on a marginal yield increase basis using an optimal economic return of 6 kg grain per kg N fertilizer (based on canola and fertilizer prices during the winter of 2007 /08 and a 2:1 return cut-off). The hybrids show about a 20 kg N /ha higher optimum.

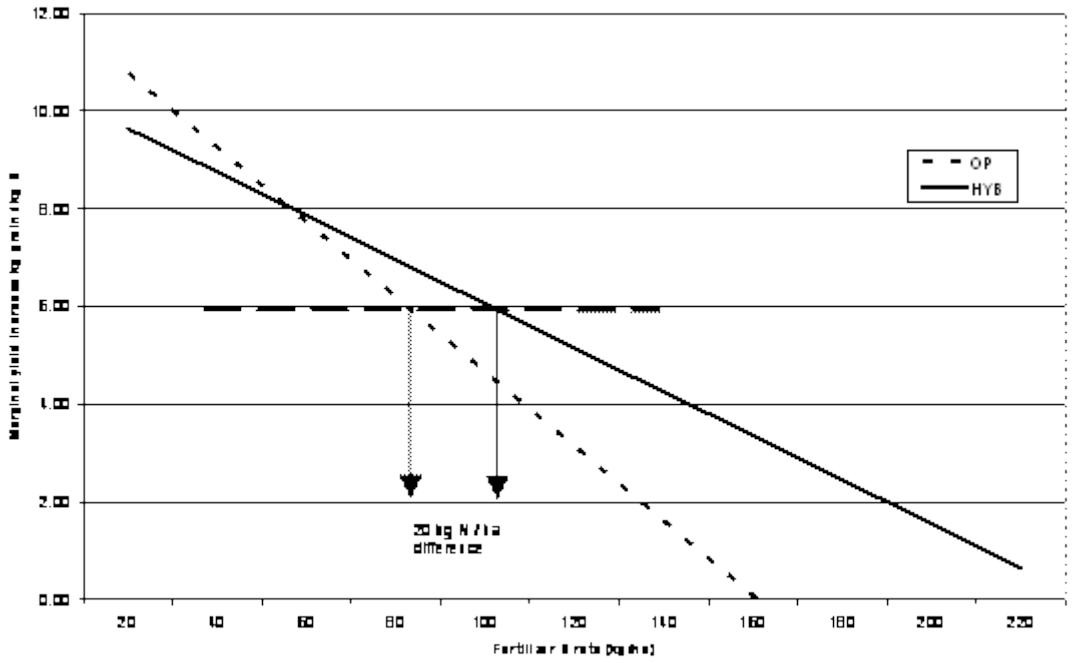

Figure 1. Marginal yield response in spring *Brassica napus* to incremental N fertilizer in western Canada based on trials conducted by Westco (Karamanos, 2005) OP – open pollinated; HYB – hybrid. Heavy dashed line is 6:1 optimal level based on current prices of crop and N fertilizer.

AGRICULTURE AND AGRI-FOOD CANADA TRIALS

A study conducted by Agriculture and Agri-Food Canada at three Saskatchewan locations in 2000 and 2001 reported that target N fertilizer rates for optimum seed yield and economic returns were similar for one hybrid and OP variety (Malhi et al, 2007). Although the cultivar X N interaction was not statistically significant overall, there was a significant C X N interaction at 2 of 6 individual site-years. Summarizing their data on the marginal response approach in Figure 2 using a best fit curve, there appears to be a 20 kg N/ha difference again between hybrid and OP canola.

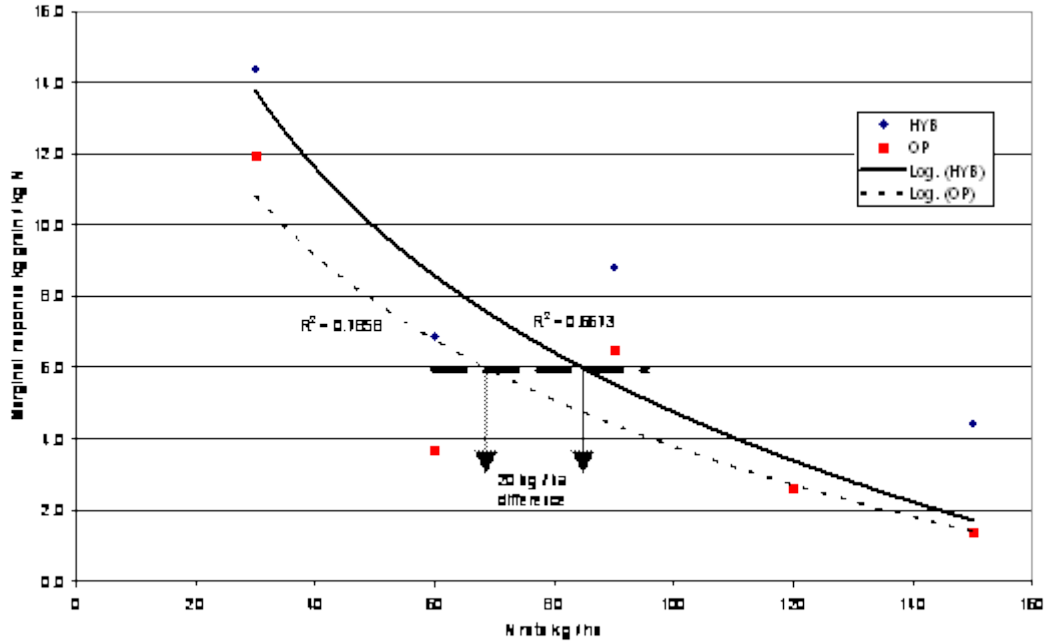

Figure 2. Marginal yield response in spring *Brassica napus* to incremental N fertilizer in Saskatchewan based on trials conducted by Agriculture and Agri-Food Canada (Malhi et al,, 2007) OP – open pollinated; HYB – hybrid. Heavy dashed line is 6:1 optimal level based on current prices of crop and N fertilizer.

NORTH DAKOTA STATE UNIVERSITY TRIALS

A third set of N response trials for hybrid and OP canola was conducted in North Dakota (USA) at six locations in 2003 and 2004. This research has not been published yet but was described in an article by Barry Coleman in the January / February issue of the U.S. Canola Digest in 2006. In this article, this research indicated that "hybrids usually require about 15 to 20 pounds per acre (lbs/a) less nitrogen (N) for economic yields than open-pollinated (OP) varieties". Although a few graphs of net returns at a few sites have been posted on the North Dakota State University website (Franzen and Lukach, 2007), the full data has not been obtained to conduct a marginal response analysis. Interestingly, a close look at their Figure 1 shows that the N rate where the hybrid plateaus for maximum net

returns is less than the open-pollinated at the Hettinger site. In other words, the hybrid had a lower economic optimum N fertilizer rate than the OP. However, the authors state that "the optimum N rate is similar for a lower producing variety compared with a more productive, N-efficient variety".

CONCLUSIONS

The contrasting results from these 3 different research groups about the relative N response of hybrid compared to OP spring canola reveals that more research is needed. However, the suggested change in recommended N rates for hybrid cultivars are relatively small (+/- 20 kg N /ha) compared to the uncertainty of varying weather conditions and its impact on optimal N rates. A canola grower in the Great Plains of North America can experience growing seasons ranging from very dry to very wet – such conditions would warrant drastic changes in fertilizer N requirements but unfortunately, this can't be predicted at the time when fertilizer needs to be applied!

Much of the above work has documented higher canola yields and N removal with hybrids compared to OP varieties. Research is beginning to measure the impact on residual soil N fertility and subsequent crop yield and quality (Karamanos et al, 2007). Hybrids do appear to be better scavengers of soil N, which could explain how higher yields are achieved without requiring more fertilizer N in soils with moderate residual nitrate.

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