
Nitrogen Fertility of Canola Hybrids

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Introduction

The introduction of high yielding canola hybrids in the last few years has been extremely rapid. Consequently, very little work was initiated to assess the fertility requirements of these crops, since the normally accepted span of three years for fertility research in many cases exceeded the life of some of these varieties. Brandt and co-workers (personal communication) initiated a project in 1999 at three locations in Saskatchewan (Scott, Melfort and Indian Head). In general, herbicide tolerant canola hybrid varieties had a higher yield than open pollinated traditional varieties. Although, results so far are inconclusive, they provide a strong indication that higher yielding cultivars use nitrogen more efficiently, but also have a much higher maximum yield that may require more nitrogen to attain.

The objectives of this study were to assess:

1. Nitrogen requirement of hybrid compared to traditional canola varieties;
2. Interaction of nitrogen and sulphur (N:S) in hybrid canola ;
3. Interaction of nitrogen and phosphorus (N:P) in hybrid canola.

Materials and Methods

A series of experiments have been carried out over the last three years (1999 to 2001) to primarily assess the nitrogen fertility of canola hybrid varieties and at the same time ascertain whether the associated phosphate and sulphur fertility is influenced by nitrogen application.

This work evolved from a single experiment carried out in 1999 to number of diverse experiments carried out in 2000 and 2001. Although differences in individual canola hybrid variety behavior are significant in some cases, “hybrid” in this study does not pertain to the behavior of one specific variety, but to the group of hybrids tested.

The following experiments were carried out:

Effect of N Rates on Canola Yield

Irricana 1999: Twelve rates of nitrogen (0 to 200 lbN/acre) were side-banded as urea (46-0-0). Blanket applications of 27 lb P₂O₅/acre as 0-45-0, 45 lb K₂O/acre and 15 lb S/acre¹ as K₂SO₄ (0-0-50) were side-banded and broadcast and incorporated, respectively. Six-row plots with 9-inch spacing and 30-foot length were seeded with Invigor 2273 and 2153 and Innovator canola with an airseeder at a rate of 7 lb/acre on June 10 and were harvested on September 24.

Irricana 2000: Twelve rates of nitrogen (0 to 200 lbN/acre) as urea (46-0-0) and three rates of P₂O₅ (0, 18 and 36 lb/acre) were side-banded. A blanket application of 92 lb K₂O/acre and 30 lb S/acre as K₂SO₄ (0-0-50) was broadcast and incorporated. Six-row plots with 9-inch spacing and 30-foot length were seeded on April 30 with an airseeder at a rate of 7 lb/acre, for Invigor 2153, Hyola 401, SW Rider and Nexera 500, respectively and were harvested on September 13.

Effect of N and P rates on Canola Yield

Red Deer and Ellerslie 2001: Twelve rates of nitrogen (0 to 200 lbN/acre) as urea (46-0-0) and three rates of P₂O₅ (0,18 and 36 lb/acre) were side-banded. Blanket application of 45 lb K₂O/acre and 15 lb S/acre as K₂SO₄ (0-0-50) were broadcast and incorporated. Four-row plots with 9-inch spacing and 30-foot length were seeded with SW Rider or Q2 canola on May 4 at Red Deer and May 16 at Ellerslie with a hoeddrill at a rate of 6 lb/acre. The plots were harvested on September 17 at Red Deer and 25 at Ellerslie.

Effect of N and S rates on Canola Yield

Red Deer and Wetaskiwin 2001: Twelve rates of nitrogen (0 to 200 lbN/acre) as urea (46-0-0) and three rates of S (0,18 and 36 lb/acre) were side-banded. Blanket applications of 27 lb P₂O₅/acre as 0-45-0, and 200 lb K₂O/acre as 0-0-62 were side-banded and broadcast and incorporated, respectively. Four-row plots with 9-inch spacing and 30-foot length were seeded with SW Rider or Q2 canola on May 4 with a hoeddrill at a rate of 6 lb/acre at Red Deer and on May 16 with a double disk drill at a rate of 6 lb/acre. The plots were harvested on September 17 at Red Deer and 26 at Wetaskiwin.

Comparison of N Requirements by Parent-Daughter Pairs

Four parent-daughter pairs were grown under twelve rates of nitrogen (0 to 150 lb/acre) and blanket rates of 30 lb P₂O₅/acre as 0-45-0, 55 lb K₂O/acre and 18 lb S/acre as K₂SO₄ (0-0-51-17) that were side-banded and broadcast and incorporated, respectively. All canola cultivars were obtained from Agriprogress Inc., Morden, Manitoba and were seeded length on May 25 in four-row plots with 9-inch spacing and 30-foot length with a hoeddrill at a rate of 6 lb/acre and were harvested on September 3.

The results from all tests were subject to ANOVA and regression analysis using SYSTAT 8.0 (SPSS Inc. 1998).

Results and Discussion

Effect of N Rates on Canola Yield

Irricana 1999: The regression for Invigor 2273, 2153 and Innovator were statistically significant at P<0.01, 0.05 and 0.01 levels, respectively (Figure 1a). On average, Invigor 2273 yield approximately 35 percent higher than either Invigor 2153 or Innovator. However, the regression lines had almost identical slope (approximately 0.4 for the linear and -0.001 for quadratic portion), thus suggesting that the higher yield with Invigor 2273 was obtained with the same nitrogen rate. There was a gradual yield reduction which may be related to the N:S ratio of canola at nitrogen application rates of over 150 lb/acre. Linear plateau regressions were drawn (Figure 1b) after exclusion of the yields for highest rates of nitrogen application. These lines were fitted based on the technique described in the SYSTAT 8.0 (SPSS Inc. 1998) system and suggest that maximum yield with Invigor 2153 was attained at 105 lb N/acre, whereas the same for Invigor 2273 and Innovator at 125-130 lb N/acre in spite of the 14 bu/acre (30 percent) difference between yields. Thus the fertilizer nitrogen requirement for this study was 2, 2.3 and 2.7 lb N/bu for Invigor 2273, Invigor 2153 and Innovator, respectively.

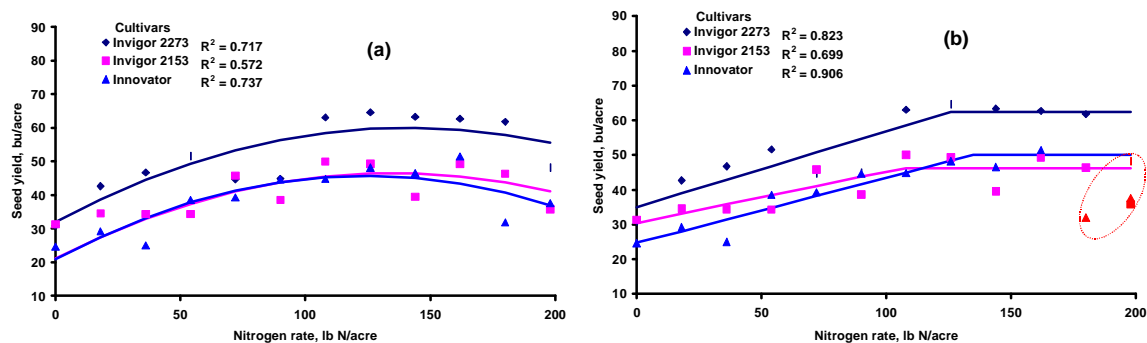


Figure 1. Effect of N rate on seed yield of Invigor 2273, 2153 and Innovator canola in 1999.

Irricana 2000: The nitrogen fertility of three canola hybrids was compared to that of a traditional canola variety. Maximum yield, depending on variety was attained with the application of between 70 and 110 lb N/acre (Figure 2).

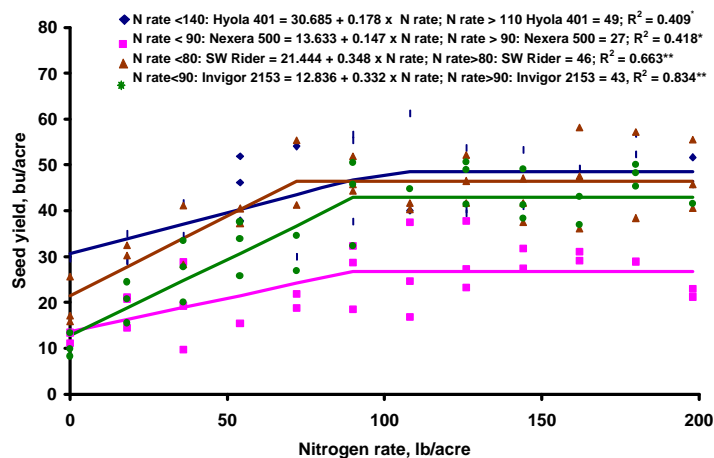


Figure 2. Effect of N and P on canola yield at Irricana in 2000.

The maximum yield for the three hybrids was similar (approximately 45 bu/acre, range 43 to 49 bu/acre) whereas that of the traditional canola was approximately 18 bu/acre lower. Thus, the fertilizer nitrogen requirement to obtain maximum yield of hybrid canola was approximately 2 lb N/bu of canola (range 1.7 to 2.3 lb N/bu), whereas that of traditional canola was 3.3 lb N/bu. This was similar to the values derived in 1999 for the same but different varieties. The only common variety in the two years was Invigor 2153 that yielded a maximum yield of 46 bu/acre in 1999 and 43 bu/acre in 2000 and had a fertilizer requirement of 2.3 and 2.1 N/bu, respectively. The nitrogen soil test level in this soil was in the 30 lb N/acre (0-24”) range.

Effect of N and P rates on Canola Yield

In two of the rate experiments carried out in 2001, the nitrogen rate experiment was carried out over three rates of P₂O₅. The hybrid canola variety behaved differently from the traditional canola variety. The Red Deer site is responsive to P₂O₅ applications and highly deficient as the

phosphorus soil test level is 4.1 ppm of Modified Kelowna (MK) extractable-P (Qian et al. 1994).

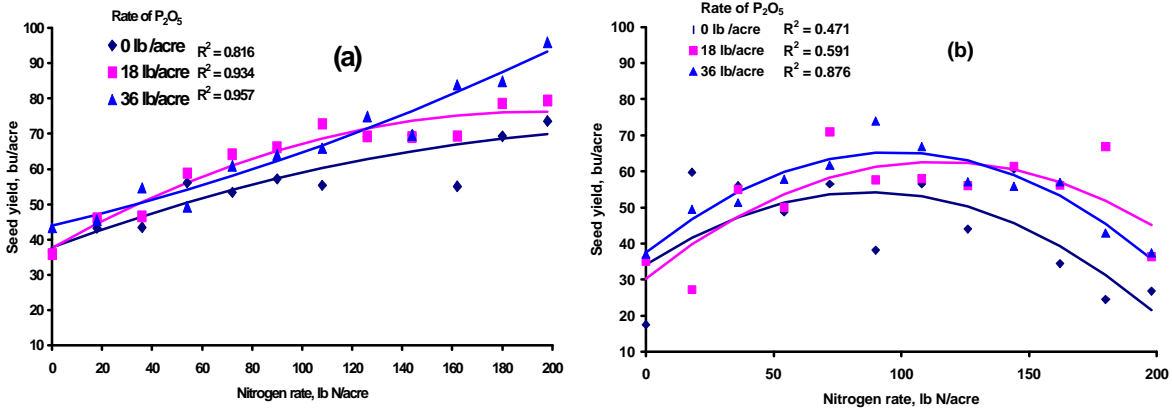


Figure 3. Effect of N and P on SW Rider (a) and Q2 (b) canola yield at Red Deer in 2001.

On average, 18 lb P₂O₅/acre resulted in 10 and 36 lb P₂O₅/acre resulted in 15 percent yield difference for SW Rider canola (Figure 3b). However, the differences between the 36 lb P₂O₅/acre and the control treatment grew from an average of 10 percent at lower than 125 lb N/acre rates to an average of 25 percent at N rates greater than 125 lb/acre. The yield of Q2 canola, on the other hand, became maximum between 90 and 100 lb N/acre and thereafter declined without any evidence of P₂O₅ interfering with nitrogen fertility, other than maximum yield for all N rates was obtained with 18 lb P₂O₅/acre.

Phosphorus soil test levels at the Ellerslie site were considerably higher (18 ppm MK-extractable P) and are considered marginal to sufficient. Although application of P₂O₅ did not appear to benefit SW Rider (Figure 4a) at this site, Q2 required the addition of 18 lb P₂O₅/acre in order to obtain maximum yield at all levels of nitrogen application (Figure 4b).

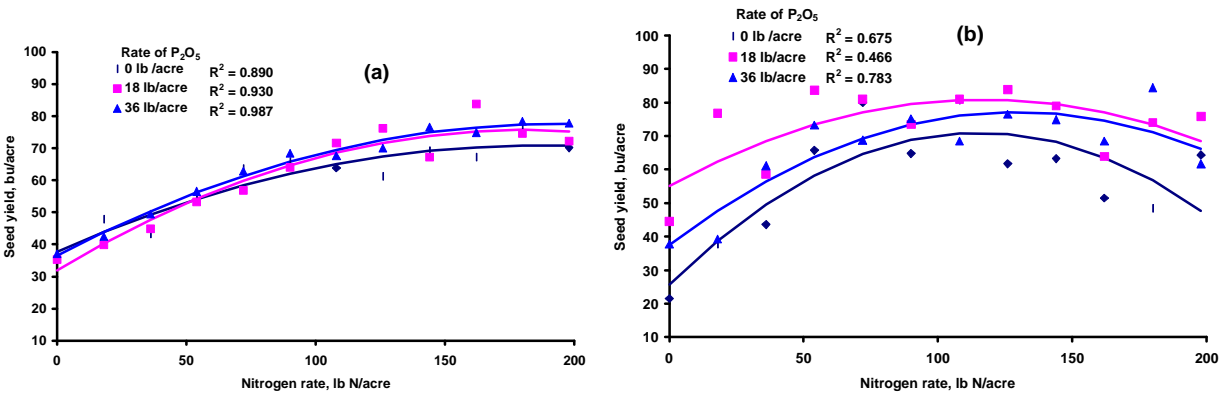


Figure 4. Effect of N and P on SW Rider (a) and Q2 (b) canola yield at Ellerslie in 2001.

At maximum yield, the fertilizer nitrogen usage was 2.1 lb N/bu of SW Rider at both sites. The maximum yield at Red Deer was 16 bu/acre higher than that at Ellerslie, reflecting extremely favorable conditions for canola growth. Soil test N in the 0-24" depth was 61 and 78 lb N/acre at Red Deer and Ellerslie, respectively. Fertilizer usage of Q2 was 1.7 and 1.3 lb N/bu, thus

indicating that Q2 utilized fertilizer nitrogen more efficiently than SW Rider, especially at Ellerslie, where yields of the two varieties were similar. However, at Red Deer the fertilizer nitrogen usage of SW Rider at the N rate for which maximum yield of Q2 was obtained was similar to that of Q2 (1.6 lb N/bu).

Effect of N and S rates on Canola Yield

In another two of the rate experiments carried out in 2001, the nitrogen rate experiment was carried out over three rates of S. The experiment at Red Deer was adjacent to that examining the N and P₂O₅ application rates. Sufficient P₂O₅ (27 lb/acre) was applied at all treatments. Yield results were identical to those obtained in the N X P experiment (Figure 5), except the yield reduction of the Q2 cultivar at high nitrogen rates was alleviated by application of 36 lb S/acre (Figure 5b). In the N X P study only 18 lb S/acre were used, which obviously was not adequate to provide maximum yield at high nitrogen rates. Although this observation is useful in explaining the reduction in the yield, it also points out to the fact that rates higher than 110 lb N/acre are unnecessary with Q2 as the yield potential is already reached with that rate. Thus, although application of S did result in alleviation of a N X S interaction, no yield benefit ensued and, therefore, this application represents an extra cost.

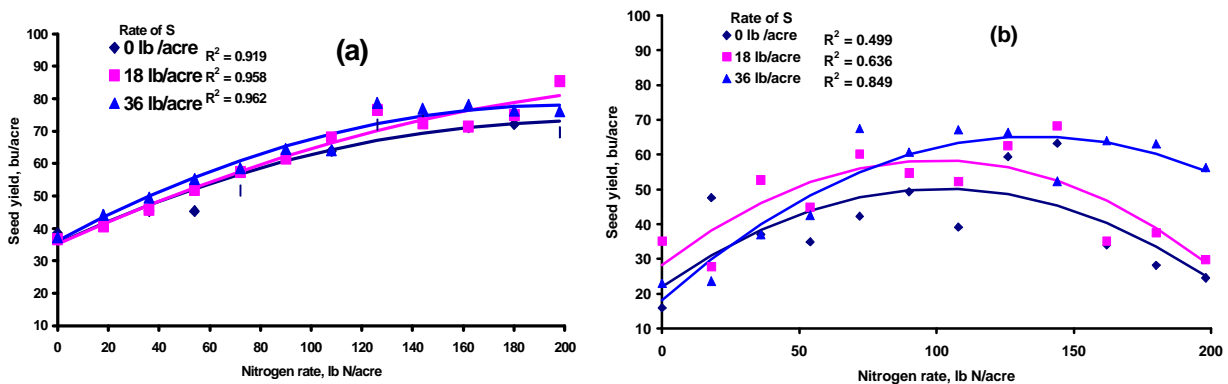


Figure 5. Effect of N and S on SW Rider (a) and Q2 (b) canola yield at Red Deer in 2001.

There was no response of either SW Rider or Q2 canola to sulphur at the Wetaskiwin site, therefore the data from all three rates of S for both varieties are presented together (Figure 6). In contrast to the results obtained at the Red Deer and Ellerslie sites, SW Rider canola yielded considerably higher than Q2 with. Maximum yield was 70 bu/acre for SW Rider and 60 bu/acre with Q2 and were obtained with a fertilizer nitrogen rate of 165 and 145 lb N/acre, respectively. Thus, at maximum yield the fertilizer usage was 2.4 lb N/bu for both varieties, however, at 60 bu/acre yield the fertilizer usage for SW Rider was 1.8 lb N/bu. Thus this experiment would support the findings from 1999 and 2000 that hybrid canola varieties produce higher yields with the same rate of fertilizer nitrogen under optimum P and S levels. Furthermore, their maximum yield potential is reached at higher fertilizer nitrogen rates than those required for traditional varieties. The exceptions noted in Red Deer and Ellerslie are probably associated with the extremely favorable conditions observed in 2001 and the high organic matter level of these soils (7 to 9 %) that would induce higher mineralization of nitrogen.

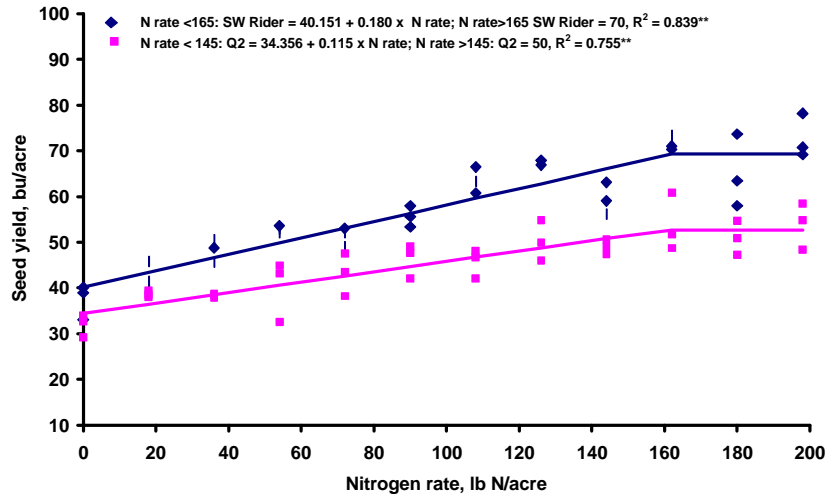


Figure 7. Effect of N and S on SW Rider (a) and Q2 (b) canola yield at Wetaskiwin in 2001.

Comparison of N Requirements by Parent-Daughter Pairs

The results of the parent-daughter are shown in Figure 8.

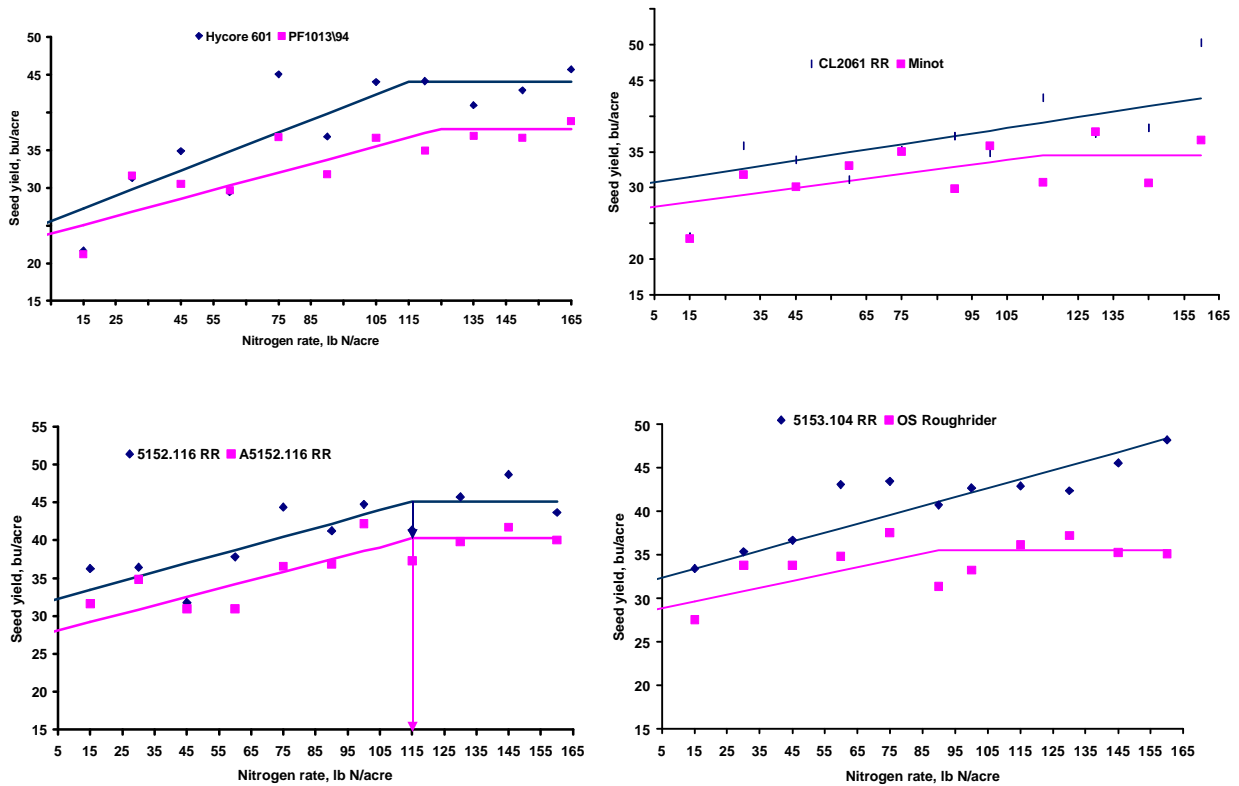


Figure 8. Effect of N rate on seed yield of canola parent-daughter pairs

All daughter (hybrid) canola varieties yielded higher compared to the corresponding parent variety at all nitrogen application rates. In two of the four cases maximum yield of both hybrid

and parent variety was obtained with same nitrogen rate. In the remaining two cases the maximum yield of the hybrid was beyond the maximum rate of nitrogen application (150 lb N/acre). At the parent maximum yield the fertilizer usage for the parent varieties was 3.1 lb N/bu, whereas that of the hybrid 2.6 lb N/bu, thus suggesting that the hybrids are more efficient users of soil nitrogen.

Conclusions

Hybrids produced higher yields than traditional or parent varieties, but there was no consistent trend as far as determining optimum rate for maximum yield. This is because an apparent N:S interaction observed with traditional varieties was not evident with hybrids. Further higher rates of phosphate fertilization in some instances resulted in higher yields for hybrids only. A general statement can be made that “on average canola hybrids yielded 25 percent higher yield than traditional varieties with approximately the same nitrogen fertilizer rate”. This would indicate that canola hybrids are more efficient “scavengers” of soil nutrients and certainly has implications on the fertility of following crops.

Current N recommendations need be revised for both hybrid and traditional canola varieties.

Reference

SPSS Inc. 1998. SYSTAT 8.0. Chicago, IL.