

Herbicide-Tolerant and Conventional Canola Production Systems Comparison

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Introduction

Spring canola (*Brassica napus* L.) has become a major crop in North Dakota with 1,400,500 acres sown in 2001 as compared to 15,000 acres seeded in 1991 (Hartwig and Meyer, 2002). This increase has been accompanied by a decrease in cereal production that has been problematic due to severe and ongoing head blight (*Fusarium graminearum* Schwabe) infestations. Along with rapid increases in canola production has come advanced technologies such as herbicide-tolerant (HT) canola introduced in 1999. Canola producers have rapidly adopted production of HT canola where production of HT cultivars has increased from approximately 35% of the acreage in 1999 to 75% of the acreage in 2002.

The objective of this research was to compare agronomic and economic performance of production systems associated with conventional and more recently introduced HT canola cultivars.

Materials and Methods

A replicated field study designed to evaluate 13 canola production systems was conducted, from 1999 to 2001, at research extension centers (REC) at Carrington, Hettinger, Langdon, Minot, Williston, and an off-station site, Prosper, associated with the North Dakota Agricultural Experiment Station at Fargo. The sites were widely spaced across North Dakota and represent distinct geographic environments within the state.

Four conventional and nine HT systems were selected to compare performance of conventional and HT cultivars with their corresponding weed control compliment in a randomized complete-block design with four replicates. Conventional cultivars included Hudson an open-pollinated (OP) cultivar, and Hyola 401, a hybrid cultivar. The herbicide compliment for these cultivars was a pre-plant incorporation of trifluralin (grass and small-seeded broadleaf herbicide) alone and with a post application of quizalofop (annual grasses and quackgrass, *Elytrigia repens* L.).

The three HT canola types – Roundup Ready, Liberty Link, and Clearfield – have different weed control spectrums with glyphosate controlling annual and perennial

grass and broadleaf weeds; glufosinate controlling annual broadleaf and suppressing annual grasses and perennial weeds; and imazomox controlling most annual grass and broadleaf weeds.

There were nine production systems with HT cultivars, with six of these involving Roundup Ready cultivars. Roundup Ready cultivars included, Minot an OP; SW Rider; a synthetic; and Hyola 357, a hybrid. Open-pollinated and hybrid Liberty Link cultivars were Phoenix and Invigor 2373, respectively. The Clearfield cultivar was 46A76. Herbicide rates and plant growth stage of application were in accordance with label directions.

Canola stands were solid-seeded at 600,000 pure live seed per acre at all sites in early to mid-May and within the seeding date range for optimum yield performance. Plots were approximately 4.6 by 7.6 m with data collected from a centralized area of 1.5 by 7.6 m. This provided plant border material to minimize herbicide drift from adjacent treatments onto the character determination area of each plot.

Character determinations included seedling vigor, flowering date, plant height and lodging, disease incidence, weed species, density, and control, seed oil content, and agronomic yield. Crop value was based on yield and current-season market value. Net return (NR) was determined by deducting seed and herbicide input costs from crop value. This paper will focus on agronomic and economic yield comparisons among the different canola production systems. The HT OP Minot RR system with two applications of glyphosate was not performed at all locations resulting in this treatment being deleted from the analysis. Herbicide system was considered a fixed effect and location a random effect in the statistical analysis (Steele and Torrie, 1980). Treatment means separation was performed with *F*-protected LSD comparisons at $P \leq 0.05$ level of significance for each evaluated character.

Results and Discussion

Yield was not greatly compromised by weed competition in this study because of moderate weed pressure and good weed control exhibited by all the herbicides utilized. Consequently, system yield differences emphasize the cultivar component more than the herbicide component of the systems. This study was conducted with the first HT cultivars available, and in the second study year improved cultivars were incorporated for each HT type. As expected, the location by treatment interaction was significant due to the diversity in geographies among the research sites that represented the entire state of North Dakota. The main effect of treatment (canola systems) was also significant and will be the focus of discussion.

Seed and herbicide costs for the canola systems were variable and showed hybrid seed approximately twice as expensive as OP seed irrespective of whether conventional or HT (Table 1). System herbicide costs ranged from \$6.25/acre for Systems 1 and 3, to \$27.48/acre for LL Systems 13 and 14. Production inputs (equipment, tillage, fertilizer, rent, etc.) that were constant across systems at a location were not determined.

Yield ranking of systems showed the five hybrid systems average 15% greater yield than OP systems irrespective of conventional or HT cultivar type (Table 1). Hybrids typically produce 10 to 15% greater yield than OP cultivars (D.R. Berglund, personal communication). Conventional hybrid Systems 3 and 4, and HT hybrid RR System 8 produced greater yields than the other conventional and HT systems, with the exception of HT RR System 9, which was in both the high and medium groupings for system yield. The low system grouping for yield included eight systems (11, 5, 7, 6, 12, 2, 1, and 10 in descending yield order) comprised of conventional and HT systems.

Yield influenced crop value and resulting NR and showed conventional hybrid Systems 3 and 4 and HT hybrid RR System 8 in the high group for system NR. These were the same systems that produced the greatest yield (Table 1). Yield for HT hybrid RR System 9 ranked fourth among systems for yield but fifth among systems for NR. Hybrid HT RR System 9 included two applications of glyphosate. This increased production costs for this system compared to hybrid HT RR System 8 with one glyphosate application and consequently reduced NR.

Further ranking of system NR indicated medium, and low groups. Hybrid systems generally produced in the high NR group with the exception of System 11. Although hybrid LL System 11 was in the medium yield group, the NR for this system was in the low group. High seed and herbicide costs for this system reduced NR (\$123/acre). Open-pollinated conventional System 1 showed the second to the lowest yield but produced a NR in the medium group. Although yield was low for this system, the seed and herbicide costs were low and resulted in a good NR (\$142/acre). Low yield and high input costs resulted in OP LL System 10 showing the lowest NR (\$117/acre).

Summary

Canola production system comparisons do not indicate a consistent yield superiority for conventional or HT production. Hybrid system yield performance was, however, greater than yield from OP systems and generally produced a high NR except where herbicide cost was high. Yields were generally similar among the conventional and HT hybrid systems within OP or hybrid systems. The location by system interaction for yield and NR indicates producers should consider cultivar adaptation and weed species and pressure when selecting systems for their production region. Although high yield contributes towards high NR, variable production costs among the conventional and HT systems should be carefully examined when deciding which production system will produce the greatest profit and also comply with existing crop rotations.

References

Hartwig, D., and B. Meyer. 2002. North Dakota Agricultural Statistics 2002. p. 11. North Dakota State Univ., Fargo.

Steele, R.G.D., and T.H. Torrie. 1980. Principles and procedures of statistics: A biometrical approach. 2nd ed. McGraw-Hill, New York.

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