Stacking Optimal Agronomic Practices in Canola

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ABSTRACT

Experiments were conducted at Lacombe, Beaverlodge, and Lethbridge, Alberta, Canada to determine optimal combinations of agronomic factors for canola cropping systems. All experiments were direct-seeded on cereal stubble. Experiments were designed to study 3-way interactions of agronomic factors such as cultivar, seeding date, seeding rate, fertilizer rates, and time of weed removal. Optimal combinations were evaluated not only from a seed yield standpoint, but perhaps more importantly, from a standpoint of seed quality, seed uniformity, and maturity date. Agronomic factor interactions were also evaluated from a weed, disease, and insect management perspective. For example, it was determined that combining a competitive hybrid cultivar with higher than normal seeding rates and early weed removal led not only to higher yields, but also to lower variability in weed populations from year to year. It was not always possible to combine factors that optimized management in all three pest disciplines (weeds, diseases, and insects). Early weed removal benefited weed management more than insect management, and, whereas higher seeding and fertilizer rates could lead to higher disease risks, the same factors usually benefited seed yield and weed management. Optimal combinations of agronomic factors can be attained when crop health is the major study focus.

Key Words: digital photos – competition – fall-seeding – growth analysis

INTRODUCTION

Implementing a favourable agronomic practice often enhances canola production. Research has documented that canola production can be improved by the manipulation of agronomic factors such as cultivar, seeding date, seeding rate, fertilizer rates, weed control. Combining several optimal practices may further increase production, and, given greater crop health and competitiveness, could also improve weed control. However, the interactive effect of several factors in combination has not been reported in canola. Such multi-factor experiments support more sustainable, integrated crop management strategies with less dependence on non-biological inputs. Our objective was to determine optimal combinations of the agronomic factors mentioned above with respect to weed management, canola yield and canola quality.

MATERIALS AND METHODS

Several experiments were conducted at Lacombe, Beaverlodge, and Lethbridge, Alberta (1998-2001). All plots were direct-seeded into wheat or barley stubble. Factorial combinations of cultivar, seeding date, seeding rate, fertilizer rates, and time of weed removal were randomized in complete blocks with four replicates (maximum of three factors at two or three levels per experiment). Target seeding dates were fall, late April, and mid May. Fertilizer rates ranged from 50 to 200% of soil test recommendations. Canola cultivars were usually hybrid ('InVigor

2153') and open-pollinated ('Exceed') glufosinate-tolerant cultivars. Crop seeding rates were 100, 150 and 200 seeds m^{-2}. Weed removal timings were at the two-, four-, or six-leaf stage of canola. Plot size was 4 by 15 m at Lacombe and Beaverlodge, and 2 by 6 m at Lethbridge. All plots received the same fertilizer (except those with fertility regime treatments), herbicide and fungicide/insecticide treatments.

Canola seedlings were counted prior to herbicide application. In some experiments, grassy and broadleaf weeds were counted and weighed (later in the season) in each plot. Dockage (defined as extraneous plant, insect, or other material in the harvested seed) was determined from a sample of the harvested seed. Oil and protein concentration from a smaller cleaned sample were determined by near infrared spectroscopy. Disease and insect were also monitored in most experiments.

Data were analyzed by ANOVA and subjected to mean separation using LSD (0.05). Box-whisker plots of weed biomass included medians and means to characterize central tendency and variability and are bounded by the first and third quartiles.

RESULTS

Fall seeded canola reduced the height of all cultivars. Consequently, the first branch to pod started lower on the main stem in fall seeded canola. Therefore, taller varieties that are susceptible to lodging can be manipulated by fall seeding and potentially reduces disease problems associated with these varieties.

Fall seeding was a rather risky practice. In some cases fall seeding led to yield gains, but not in most cases. When fall temperature trends reversed and become mild, given adequate soil moisture, substantial seedlings germinated prematurely and were killed over the winter. More importantly, fall seeded stands of canola were often compromised by repeated spring frosts. Weak stands of fall-seeded canola often led to greater dependence on herbicides for weed management.

Canola yield and weed management were favoured by optimal fertilizer combinations with other factors. Percent dockage in harvested canola seed was substantially reduced when banded fertilizer was combined with a competitive cultivar, or when relatively high fertilizer rates were combined with a competitive cultivar.

Combining higher seeding rates, early weed removal and the use of a competitive cultivar led to high levels of canola production and weed management (Harker et al. 2003). Indeed, yields of this "best combination" exceeded yields of the worst combination by 41%.

An interesting interaction was discovered when root maggot (*Delia* spp.) egg laying and damage was monitored. Egg deposition and damage to canola taproots via root maggot feeding declined as weed removal was delayed from the two- to six-leaf stages of development.

DISCUSSION

Combining some optimal agronomic variable levels seems intuitive. Combining higher seeding rates with early weed removal and competitive cultivars may help increase net returns, reduce herbicide dependence and favour the adoption of more integrated weed management systems. Of particular importance was the reduction in the variability of weed biomass when all three of these factors were employed at their optimal levels.

Predicting an optimal combination of agronomic factors is not always straightforward; interactions among pest species can be complicated. For example, early weed removal favours higher yields (Clayton et al. 2002), but leads to higher levels of root maggot egg-laying and damage (Dosdall et al. 2003). Heterogeneous environments, like weedy backgrounds in canola plantings, minimize opportunities for root maggot females to complete the behavioral sequence required for oviposition, leading to reduced infestation levels in weedy systems. However, yield improvements achieved with early weed removal exceeded the yield benefit derived by lowered root maggot pressure when weeds were removed later. In some situations it may then be appropriate to ameliorate root maggot damage by allowing a few more weeds to grow in canola. Other complications in canola could arise when seeding rates that favour weed management predispose the crop to greater disease infection. These interactions require careful empirical study rather than theoretical predictions from past experience.

Future studies could focus more on the interaction of different pest groups and on making pest management strategies compatible. Crop health must be the focus of these interactive studies. If agronomic factors are combined to ensure a high level of crop health, then optimum yield, pest management, and returns will be more likely. Determining the feasibility of optimal factor combinations from an economic as well as an agronomic perspective should also be a priority.

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