Combining Optimal Agronomic Factors for Canola Production

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Abstract

Combining optimal agronomic factors improves the health, competitiveness, yield, and quality of canola (*Brassica napus*). In field experiments at Lacombe, Beaverlodge, and Lethbridge, we have studied the interaction between factors such as seeding date, seeding rate, fertilizer rate, fertilizer placement, herbicide rate, and time of weed removal. Combining these factors at optimal levels has implications for disease, insect, and weed management as well as crop yields. We often find that the failure to optimize a single factor can negatively influence other factors even at their optimal levels. Given the constraints of variability from year to year and site to site, there are some principles that emerge from our studies that can be applied in canola production systems.

Introduction

Canada produces more canola than any other country in the world. Average yields in Canada are similar to Australia, China, and the United States but substantially lower than yields in France, Germany, Poland, and the United Kingdom. While more optimal weather conditions and the production of winter canola probably explain most of the yield advantage in Europe, it is also apparent that there is potential for yield increases in Canada even with our inherent climatic constraints.

There are many agronomic factors that influence canola production. When managed at optimal levels, these factors can improve canola productivity and quality. Examples of these factors include seeding date, seeding rate, fertilizer rate, fertilizer placement, time of weed removal, and variety/cultivar choice. Combining several of these factors at optimal levels will improve canola production and increase the efficiency and profitability of canola growers (Clayton et al. 2000, Harker et al. 2000). For the last few years, we have been conducting multi-factor canola experiments and determining the impact of these factors on disease, insect, and weed management and general canola agronomics and productivity.

Materials and Methods

Direct seeding experiments were conducted at Lacombe, Beaverlodge, and Lethbridge, Alberta, Canada from 1997 to 2000. Prior to seeding, all plot areas were treated with glyphosate (450 g ai/ha) to control emerged weeds. Glufosinate-tolerant open pollinated 'Exceed' and hybrid 'Invigor 2153' were direct-seeded (direct drilled) with a knife opener ConservaPak at either 23- or 30-cm row spacings. Plot areas were fertilized with N, P_2O_5 and K_2O at 100% of the soil test recommendation unless specified otherwise. In most experiments wild oat (*Avena fatua*) was broadcast at 100 seeds/m^2 on the soil before seeding to supplement natural weed populations. Weed removal treatments were with glufosinate herbicide at the recommended application rate (500 g ai/ha) at the 2-, 4-, and 6-leaf canola stage. In all experiments a factorial arrangement of treatments were assigned in a randomized complete block design with four replications. Plot size was 4 x 15 m.

Results and Discussion

With the development of vigorous canola hybrids, substantial gains in crop competition with weeds and canola yields have been obtained. With InVigor hybrids (Aventis), and all else equal, we have come to expect a consistent yield advantage over other varieties. Early time of weed removal usually leads to higher canola yields (Figure 1) (Clayton et al. 1999, Harker et al 1999a, Harker et al. 1999b). However, canola variety interacted with weed removal timing (Figure 2), and was more critical with less competitive varieties ('Exceed') than with more competitive hybrids ('InVigor').

Canola seeding rate is an important agronomic factor that may influence crop establishment, disease, insect and weed management, yield, and canola quality. Higher seeding rates reduced dockage for both cultivars; the combination of a competitive cultivar ('InVigor 2153') with a higher seeding rate led to the lowest levels of dockage (Figure 3).

Canola variety influenced yield more than fertilizer rate, although yields tended to increase for each cultivar with increased fertilizer (Figure 4). Combining a competitive cultivar with a 100 or 150% of the recommended fertilizer led to low dockage (Figure 5). Dockage effects were more dramatic when higher seeding rates were combined with higher fertility regimes. From the lowest seeding rate and lowest fertility to the highest seeding rate and highest fertility, dockage was reduced from 16 to 7% (averaged over cultivars – Figure 6).

Placing fertilizer in the sideband was the optimal placement only when weeds were removed early (Figure 7). Therefore, the advantage of purchasing more expensive side-banding equipped seeders may be negated by poor management of a seemingly unrelated factor (time of weed removal).

The effect of canola seeding rate on root maggot damage has been reported previously (Dosdall et al. 1996, Dosdall et al. 1998); as seeding rates and canola stands increase root maggot damage decreases. Root maggot females appear to prefer large diameter stems in which to oviposit their eggs; large diameter stems are scarce at high seeding rates. In more recent studies we have determined that higher fertility (Figure 8) and early weed removal (Figure 9) both increase root maggot damage.

Seeding date affected a variety of factors. Sclerotinia damage in canola was highest in 2000 in fall-seeded canola (Figure 10), but lowest in fall-seeded canola in 1999 (Figure 11). Weather patterns and inoculum availability probably explain differences between years more than a particular seeding date. Fall-seeded canola not only provides opportunities for higher yields (Figure 12), but also helps growers diversify their farming operation and spread out their work-load. The operational diversity inherent in fall-seeded canola may have important weed management benefits. Weeds that adapt and proliferate in repeated spring-seeded crops may be less competitive in earlier emerging fall-seeded crops. In addition, at the end of the growing season, weeds that have adapted to late fall harvests may not undergo sufficient seed-rain before harvest to substantially increase the soil weed seed bank in earlier harvested fall-seeded crops (Figure 13).

Combining agronomic factors at optimal levels leads to optimum canola productivity. The failure to optimize a single factor can negatively influence other factors and decrease their cost and production efficiency. It is common practice for growers to focus on one or two agronomic factors that are popular or receiving emphasis at the time. Here we have shown that the most efficient production occurs when several factors are simultaneously combined at optimal levels.

Literature Cited

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Figure 1
TWR Effects on Yield - 1997

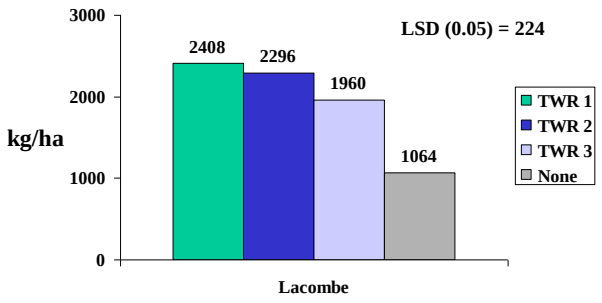

Figure 2
Variety and TWR Effects on Yield

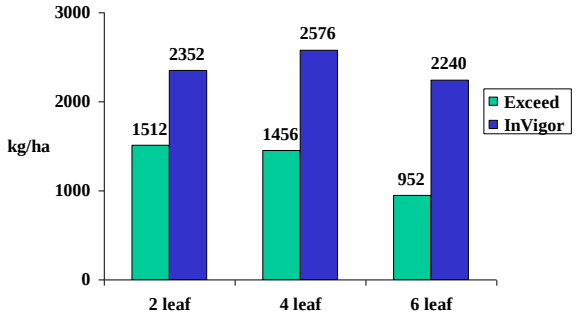

Figure 3
Variety and Seeding Rate Effects on Dockage

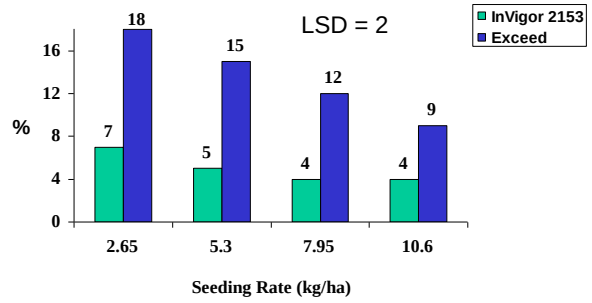

Figure 4
Variety and Fertility Effects on Yield

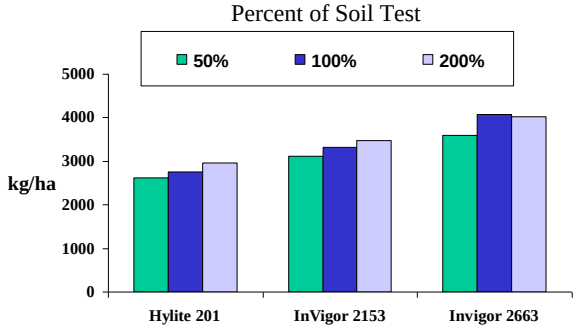

Figure 5
Variety and Fertilizer Rate Effects on Dockage

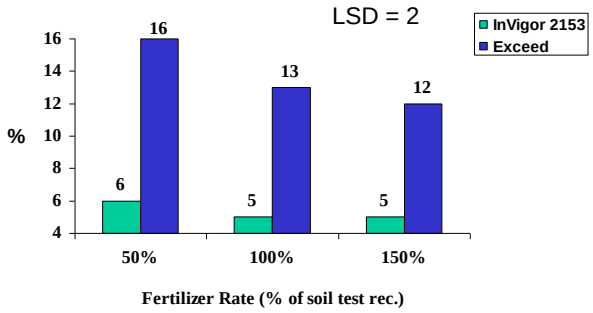

Figure 6

Fertilizer Rate and Seeding Rate Effects on Dockage

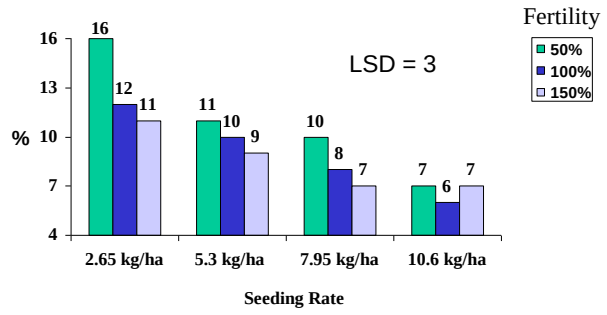

Figure 7

TWR and Fertilizer Placement Effects on Yield

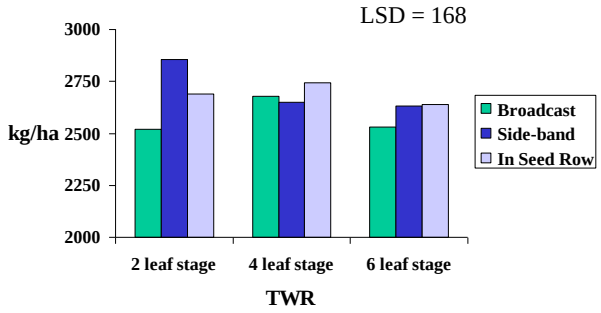

Figure 8

Fertility Effects on Root Maggots

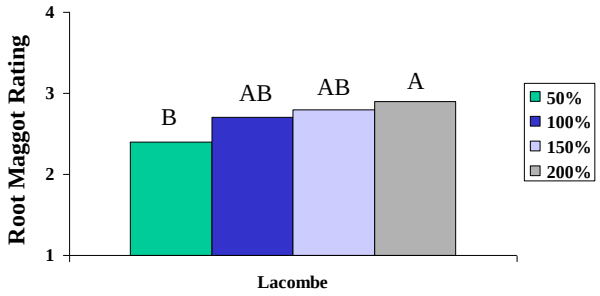

Figure 9
TWR Effects on Root Maggots

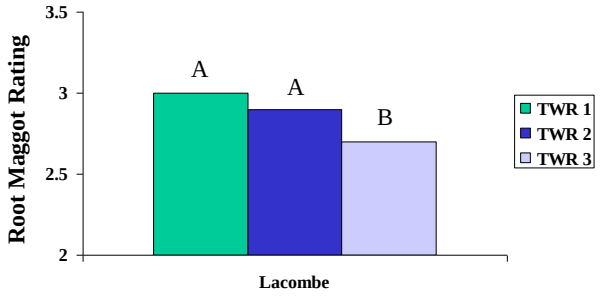

Figure 10
Seeding Date Effects on Sclerotinia - 2000

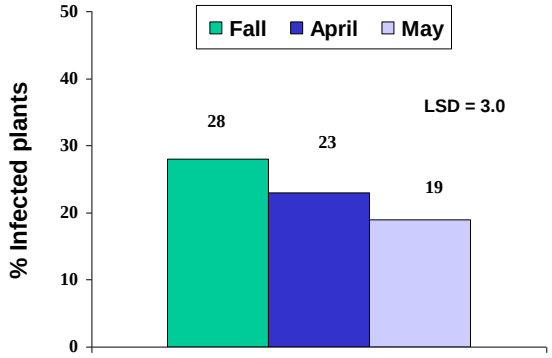

Figure 11
Seeding Date and Variety Effects on Sclerotinia - 1999

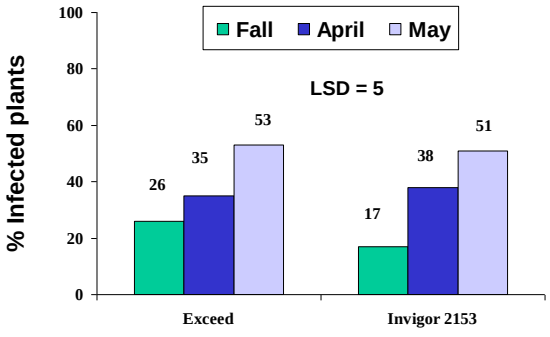

Figure 12
Seeding Date Effects on Yield - 1999

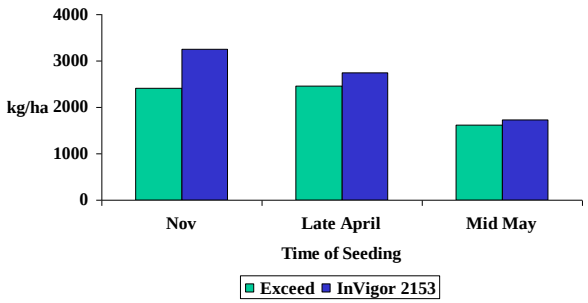

Figure 13
Seeding Date Effects on Maturity - 1999