Limits to Achieving Potential Yield of Canola in Southern NSW

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Abstract

Canola yielded to its water-limited potential (12 kg/ha/mm) in field experiments at three sites in southern NSW in 2001 when N nutrition was adequate, Blackleg severity was low and Sclerotinia was controlled using fungicides applied during flowering. Yields in excess of 4 t/ha were achieved under these conditions. The results suggest that Sclerotinia is causing significant yield loss (~20%) in the area and reliable, economic control strategies for the disease are required.

Key Words

Sclerotinia, blackleg, disease, nitrogen, sowing date, fungicide

Introduction

In southern NSW concern has been growing that canola is not reaching its water-limited potential (12 kg/ha/mm) and in some areas yields are declining. Under the high rainfall in the area (550-600mm) potential average canola yields are considered to be 3.5-4.0 t/ha while farmer yields are declining from an average of 2.0 – 2.5 t/ha in recent years. The Best Bet Canola Management Project, funded by NSW GrainGrowers and managed by The Harden District Rural Advisory Service was established in 2001 to identify factors causing poor canola performance. In 2001, field experiments focussed on the impacts of disease (Blackleg and *Sclerotinia*) and included seed and fertilizer fungicide treatments, foliar sprays for *Sclerotinia*, three sowing dates and two varieties (Rainbow and Hyola 60). Simulation using a model validated in the area and soil and climatic data from the field experiments was used to estimate crop performance in relation to its potential, and to provide context to the 2001 results in relation to expected seasonal variation in the region.

Methods

Field experiments were established in 2001 at Galong, Harden and Wallendbeen representing the range of soil and site variation experienced in the region. The treatments included three sowing dates (30 April, 15 May, 30 May), two varieties (Hyola 60 (Blackleg resistant), Rainbow), six seed and/or fertiliser fungicide treatments (Untreated Control, Jockey, Impact, Jockey+Impact, Thiram, Rovral) and two (+/-) *Sclerotinia* control treatments involving three fungicide applications applied as three overhead sprays 10-12 days apart to one half of each plot from 20% flowering. At each site, the experiment consisted of an un-replicated block design split into three adjacent blocks according to sowing date, with each block allowing for random allocation of 12 fully factorial variety x fungicide treatment combination subplots with three replicates. Each sub-plot measured 16 m x 1.44 m and was split in half to allow for the two levels of *Sclerotinia* treatment. Pre-sowing soil water and mineral N measurements were taken at each site and the crops were managed to ensure N, other nutrients and weeds did not limit growth. Plant measurements included establishment counts, assessment of Blackleg leaf lesions during the seedling stage, numbers of plants with canker at flowering, seed yield and harvest index from a plot header (whole plot harvested) and 1m^2 bordered hand cuts, *Sclerotinia* incidence and severity from counts of infected

stem bases following harvest, and seed oil and protein content. Water-use efficiency (WUE) was calculated as yield (hand cut)/April-November rainfall. The soil data obtained at sowing, daily rainfall collected at the sites and historic climatic data from the nearest weather stations were used as input variables for the APSIM canola model (Robertson *et al.* 1999). APSIM was then used to estimate the range in potential yield expected at each site using the historic climatic data (1957-2001) to determine long-term yield response assuming similar starting soil conditions to those measured in 2001.

Results

The 2001 season was characterised by high levels of pre-sowing stored water, good autumn and spring rain, a warm and dry winter and a long, cool spring. As a result, sowing date had little impact on yield (although this cannot be statistically assessed). The seed/fertiliser fungicide treatments influenced the incidence of Blackleg lesions during early vegetative stages but had no impact on yield (data not shown). There was a consistent yield advantage of ~ 0.4 t/ha to Hyola 60 over Rainbow at the sites but few interactions between variety and other treatments. The yield advantage of Hyola 60 did not appear to be related to it's Blackleg resistance, but to its higher yield potential under the favourable seasonal conditions in 2001. In view of the lack of sowing date and fungicide effects and few varietal interactions, data have been summarised in Table 1 to show the key impacts of *Sclerotinia* across the sites. Data for cv. Rainbow were chosen as the model has been previously parameterised for this variety and it is widely grown. *Sclerotinia* emerged as the major yield-limiting factor in 2001 reducing yields by 0.2 to 0.9 t/ha depending on site, sowing date and variety. The average yield loss associated with *Sclerotinia* was 15-23% across the three sites (Table 1). The header yields are higher than hand cuts in some cases presumably due to the unaccounted border effects related to harvesting the whole plot. The calculated WUE values are higher than the suggested limit of 12 presumably due to the large amount of stored water at sowing.

Table 1. Measured hand-cut and header yields (t/ha) for +/- *Sclerotinia* control treatments for 15 May sowing of Rainbow at three sites and simulated yields estimated using APSIM canola model.

	Wallendbeen	Galong	Harden
- Sclerotinia control			
Hand harvesting	4.4	3.6	2.9
Header harvesting*	4.6	3.8	3.0
+Sclerotinia control			
Hand harvesting	5.2	3.6	3.8
Header harvesting	5.7	4.5	na
LSD (Header)	0.4	0.3	na
% Yield loss	19	15	23 (hand)
WUE (kg/ha/mm)	14.3	9.1	14.0
Model simulation (2001)	5.1	3.8	3.4
Long-term Average	4.6	3.7	3.7
Decile 1	2.8	2.0	1.8
Decile 9	5.3	4.9	5.0

* Header harvest included the whole plot potentially overestimating yield due to unaccounted border effects

At all sites, simulated yield was close to that harvested by hand in the +*Sclerotinia* control plots (Table 1). This suggests that crops were growing according to their potential in the sprayed treatments. The long-term simulations indicated that the experimental yields in 2001 were greater than the long-term average expected at Galong and Wallendbeen and just below average at Harden. The Harden site has a sandier soil with lower water holding capacity that results in lower long-term yield potential than the other sites. The model analysis suggests that water and N limitations in the 10% poorest seasons (Decile 1) would

limit yields to less that 3 t/ha, while in the 10% highest yielding seasons (Decile 9) yields close to 5 t/ha should be achievable (the simulation model cannot account for effects other than water and N such as disease, pests, weeds or other nutrient deficiencies). The consistently high yields in 2001, both measured and simulated (>3.5 t/ha) indicate that canola can yield to potential in southern NSW with adequate attention to nutrition and disease control.

Conclusions

In these experiments, canola yielded to its water-limited potential when nutrition was adequate and major diseases controlled. The results indicate that *Sclerotinia* is currently causing significant reductions in yield, and cost effective control measures will need to be developed for the disease in this region. The low yields in farmer paddocks in southern NSW may also involve other as yet unidentified factors that are under further study.

References

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