Dual purpose canola – recent results from southern NSW

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Abstract
Canola crops were grazed during vegetative growth in three trials conducted in Wagga Wagga NSW in 2007. All experiments included various grazing periods and were combined with either 1) a range of cultivars, 2) sowing rate and row spacing, or 3) intensity of grazing. Due to seasonal conditions yields were low in all trials (maximum 1 t/ha) with grazing significantly reducing yields. Grazing for 18 days at 23 DSE (dry sheep equivalents) reduced biomass of Hyola 75 from 1793 kg/ha pre-grazing to 731 kg/ha post-grazing. This treatment yielded 69% of the ungrazed control despite dry conditions and flowering 11 days later than the control. Grazing intensity determined the magnitude of the delay in flowering. Heavy grazing (leaves and main stem) delayed flowering by 10-14 days while light grazing (removal of leaf only) delayed flowering by only 4 days. This delay was not due to delaying floral initiation, as this has already occurred by the 4^{th} leaf stage (pre-grazing). Canola will recover from heavy grazing as it is able to re-shoot from axillary buds, however, development will be significantly delayed. Choice of cultivar and sowing rate strongly influenced early biomass available for grazing. The hybrid cultivar (Hyola 75) produced much greater biomass than conventional and triazine tolerant (TT) cultivars. Increased sowing rate also led to higher early biomass production.

Keywords
Development, grazing, yield, cultivars

Introduction
Dual purpose canola is the practice of grazing canola during the vegetative stage while producing an economic seed yield. A small number of farmers have previously grazed canola crops without a noticeable effect on yield. Kirkegaard *et al.* (2008) conducted some initial studies demonstrating that with favourable spring conditions, timely grazing had little effect on seed yield. These trials were based in Canberra, using both spring and winter varieties and were generally crash grazed. Grazing reduces biomass and delays development (Kirkegaard *et al*. 2008), both of which are important in determining grain yield. The aim of these studies was to quantify the impact of grazing on crop biomass accumulation and developmental delay (in flowering time) and to relate both to final grain yield. The field experiments reported here were conducted in the farming belt of southern NSW using commercially available canola cultivars.

Methods
Three experiments were conducted in 2007, with two being located near Wagga Wagga and the third near Holbrook in the winter dominant rainfall zone of southern NSW. All three were designed in a similar manner with stock grazing all plots in common except for ungrazed control plots. Grazing treatments varied in length of the grazing period and/or stocking rate. The key features of each experiment were as follows.

Grazing x Cultivar
Located near Wagga Wagga, 2 lengths of grazing period (18 days, from 27/7/07 to 14/8/07, and 26 days, from 27/7/07 to 22/8/07) plus an ungrazed control; over each of 4 cultivars (Hyola 75 (mid-late hybrid), Skipton (mid conventional), Opal (early conventional), and Stubby (early TT)). Sowing was conducted on 9/5/07 and pre-grazing dry matter at 27/7/07 ranged from 449 kg/ha for Opal to 1793 kg/ha for Hyola 75, with leaf number varying from 7 to 9 leaves/plant. Grazing pressure averaged 23 DSE/day for both lengths of grazing.

Grazing management
Located near Holbrook, heavy (30 DSE) and light (20 DSE) stocking rates by 2 lengths of grazing period (early and late) compared to an ungrazed control. Grazing commenced on the same date with the treatments early and late relating to when sheep were excluded from the plot. Early and late lengths of grazing were linked to the stocking rate to make comparable DSE days between the heavy and light treatments. Grazing DSE days for the treatments were 420 heavy early, 630 heavy late, 420 light early and 560 light late. This

experiment was part of a paddock sown by the farmer on the 15/5/07. Stock were introduced on 15/8/07 with an average of 900 kg/ha dry matter across all plots. The dates that sheep were excluded from the treatments were 29/8/07 (heavy early), 5/9/07 (heavy late and light early), and 12/9/07 (light late).

Grazing x Density

Located near Wagga Wagga, 2 lengths of grazing (18 days, from 27/7/07 to 14/8/07, and 24 days, from 27/7/07 to 20/8/07) plus ungrazed controls for combinations of 2 row spacings (17 cm and 30 cm) by 2 seed rates (2.5 kg/ha and 5 kg/ha). Plots were sown on 9/5/07. Plant establishment was below expected as row width affected emergence rate, with narrow rows averaging 52 plants/m^2 compared to wide rows at 37 plants/m^2. Pre-grazing dry matter levels ranged from 278 kg/ha (low seed rate/wide row) to 870 kg/ha (high seed rate/narrow row). The 18 and 24 day grazing periods achieved similar stocking rates of 26 and 28 DSE/day respectively.

The sites near Wagga Wagga received 203 mm in-crop rainfall (April-October). The grazing x cultivar experiment also received 134 mm irrigation and the grazing x density experiment 72 mm. Holbrook received 225 mm April to October rainfall. Frost also had an impact on seed yields, particularly at Holbrook where no seed was harvested.

Results and Discussion

Grazing x Cultivar study

Seed yields were low due to prevailing dry conditions. All cultivars responded to grazing similarly thus only the main effects of grazing and cultivar were significant. Hyola 75 was more intensively sampled than other cultivars and for that reason it is reported here. Grazing for 18 days reduced final seed yield by 31% compared to the ungrazed control, whereas grazing for 26 days reduced yield by 63% (Figure 1). Harvest index averaged 12.5% across all plots with differences between cultivars and grazing but no significant interaction. The low harvest index was due to late frosts and high temperatures during seed filling. Seed yield corresponded strongly with seed number ($r = 0.88$, $P<0.01$), biomass at harvest ($r = 0.88$, $P<0.01$) and harvest index ($r = 0.81$, $P<0.01$).

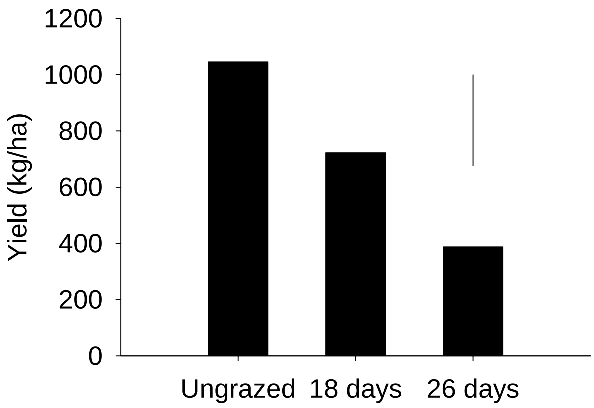

Figure 1. Seed yield of Hyola 75 following grazing treatments at Wagga, 2007. The bar represents the least significant difference (324 kg/ha) at P<0.05.

For the cultivar Hyola 75, grazing for 18 days decreased crop dry matter to 731 kg/ha from 1793 kg/ha and delayed flowering by 11 days (Figure 2). Subsequently, there was a rapid increase in regrowth when grazing ceased. In this experiment plots were heavily grazed leading to low residual dry matter and, as such, this practice is unlikely to be implemented on farm.

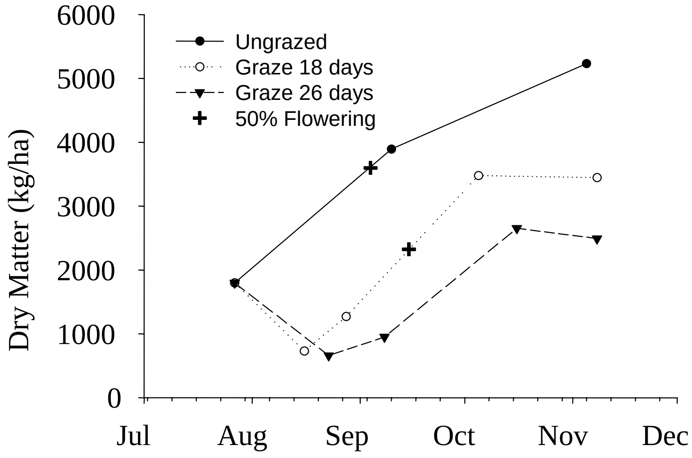

Figure 2. Dry matter of Hyola 75 over time in the Grazing x Cultivar experiment in Wagga, 2007.

One clear way in which early dry matter can be increased for grazing is by cultivar selection. There was significant variation between the cultivars in early dry matter production (Figure 3). The choice of using a hybrid greatly increased dry matter available at grazing over conventional and TT cultivars. While, Skipton is classed as having exceptional vigour, it produced significantly less dry matter than Hyola 75.

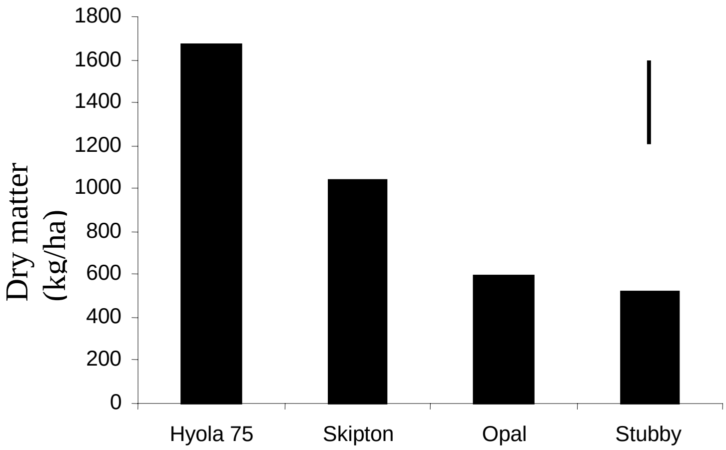

Figure 3. Crop dry matter at 79 days after sowing for four canola cultivars at 60 plants/m^2. The bar represents the least significant difference (393 kg/ha) at P<0.05.

Grazing management study

Grazing generally delays flowering and this was more clearly demonstrated in this experiment. Heavy grazing removed apical meristem of the plant which led to re-shooting from axillary buds at the base of the plant and flowering 10 to 17 days later than the ungrazed controls. Lighter grazing removed leaves only and delayed flowering by 4 days. The length of the grazing (early or late) had less impact on flowering date then the intensity of the grazing as it depended more on which parts of the plant are grazed. Leaf removal at this stage (leaf 8) would not affect floral initiation which generally occurs at about the 4th leaf stage in similar cultivars (McCormick, unpublished data).

Grazing x Density study

Severe moisture stress during flowering and pod fill led to very low seed yields, which are therefore not reported here. However the experiment did reveal a strong relationship between early dry matter production and plant density (Figure 4). As indicated earlier, row spacing affected the seedling emergence and therefore these treatments cannot be compared directly. This resulted in a wide range of plant densities to demonstrate the strong correlation between density and early dry matter production.

Although the seasonal conditions prevented an accurate assessment of post-grazing recovery, it is speculated that cultivar choice and plant density will influence the ability of canola to recover and thus reduce the impact on yield. Biomass may be recovered rapidly if faster growing cultivars are chosen and increased plant densities might potentially capture more available light.

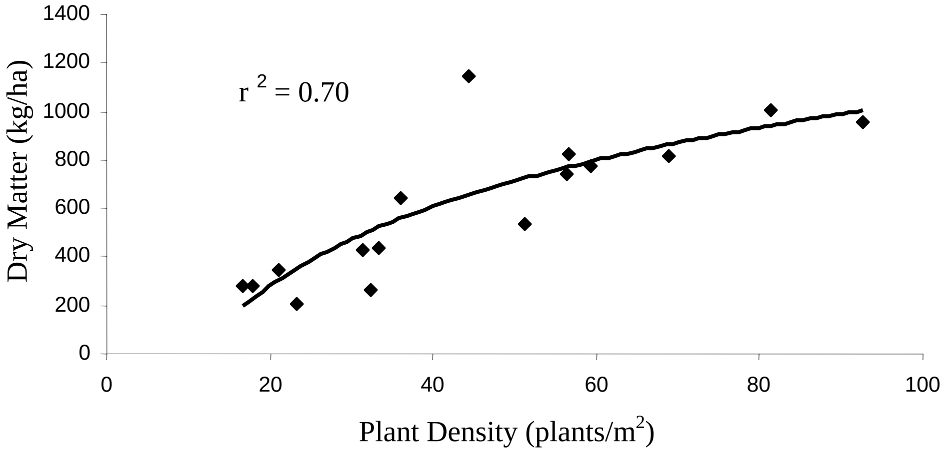

Figure 4. Effect of plant density on dry matter production at 77 days after sowing for canola cv. Skipton.

Conclusion

Grazing significantly reduced canola seed yields in these experiments. However, the relevance of these results is questionable due to the unseasonable lack of rainfall from August onwards, which coincided with the recovery time for the grazed plots. The data does provide some evidence that canola is able to rapidly increase dry matter after grazing leading to yield recovery. Despite the poor season and heavy grazing pressure, the crop was still able to yield, in the case of Hyola 75, 69% of the ungrazed control yield. It is likely that the seed yield reduction would be smaller in more favourable seasons and under less intense grazing regimes. Managing grazing will be an essential step for success when grazing canola. Removal of the growing point will delay development by 10 to 14 days, thereby increasing the risk of finishing in dry conditions. Although the crop can recover from harsh grazing and produce some seed yield, it is more vulnerable to seasonal conditions. The ability to increase early dry matter production by selecting appropriate cultivars and/or increasing crop density should also be incorporated into management strategies for grazing canola. It may be assumed that increased vigour and higher plant densities will improve crop recovery and final seed yield, but there are no data from these experiments to support this view.

References

Kirkegaard JA, Sprague SJ, Dove H, Kelman WM, Marcroft SJ, Lieschke A, Howe GN, Graham JM (2008) Dual-purpose canola – a new opportunity in mixed farming systems. *Australian Journal of Agricultural Research* **59**, 291-302.