Yield penalties with delayed sowing of canola

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KEY MESSAGE
Canola yields are highly variable in the Mediterranean climate of Western Australia. Both yield and oil content decrease with delay in sowing date. A canola growth model has been calibrated for Western Australian adapted cultivars and, together with long-term weather data, is a useful tool to study the probabilities and risks of canola yields associated with different sowing dates.

INTRODUCTION
Canola is becoming an important crop in farming systems in Western Australia. Over 900,000 ha were grown in 1999. Sowing date is an important determinant of yield in canola. Decreasing yields with delayed sowing date have been reported in previous studies (Mendham et al., 1981; Robertson et al., 1999). Sowing date depends on the onset of significant rainfall in autumn and therefore, in the Western Australian environment, varies considerably from year to year. In such a variable environment, a large number of experiments would be required to obtain the information needed to improve canola management. However, field experiments are time consuming and costly. An alternative option, therefore, is the use of crop simulation modelling. A crop model, together with long-term weather data has been used to study yield decline and its variability in response to delay in sowing date.

METHOD
The APSIM-Canola model had been previously tested in eastern (Robertson et al., 1999) and Western Australia growing regions (Farre et al., 2001). The model was used in simulation experiments with long-term weather data from 1900 to 1999. Five sowing dates were established at 20 day intervals between 5 April and 24 June, at two contrasting locations, Kojonup (high rainfall, long season) and Mullewa (low rainfall, short season). The following settings were selected for the simulations: cultivar Karoo; duplex soil; 2 cm sowing depth; 80 plants/m^2; 150 kg N/ha split in 2 applications. Soil water content at each sowing date was estimated by the model using the soil water balance. The soil water profile was re-initialized at the lower limit at 1 January of each year. Simulations were also run for 2 possible sowing dates for Kojonup and Mullewa using the year 2000 weather data. The sowing dates for 2000 were based on a small rainfall event of about 10 mm in mid May and the real break of the season with more than 20 mm rainfall in mid June.

RESULTS AND DISCUSSION
Canola yields were highly variable because of their dependence on growing season rainfall (Fig. 1). Delay in sowing date affected both long-term average yield and yield variability (Fig. 2). The long-term average yields from the first to the last sowing date ranged from 2.6 to 1.9 t/ha in Kojonup and from 1.6 to 0.6 t/ha in Mullewa (Fig. 2). The decline in yield caused by delayed sowing was due to reduction in growth duration and an increased chance of a more severe water deficit during grain filling. The relative long-term average yield decline, resulting from a delay in sowing date, was 4.8 % per week for Mullewa (low rainfall location) and 2.4 % per week for Kojonup (high rainfall location). The greater decline in yield with delayed sowing in a lower rainfall location, as compared to a higher rainfall location, agrees with studies by Robertson et al. (1999). Fig. 2 shows the long-term average yields with the upper and lower 10%-percentile, indicating that the yield variability in Kojonup was higher for late sowings whereas in Mullewa the variability was higher for early sowings. Simulated yields for the year 2000 for the two sowing dates are close to the lower 10%-percentile for both locations, indicating the extremely poor growing conditions caused by low rainfall in the year 2000.

Crop growth simulation together with long-term weather data offers a powerful tool with which to examine the risks of canola yields associated with different crop management strategies. The model can be used to optimize combinations of location x cultivar x sowing date with the aim of increasing farming profitability. Simulation studies enable the construction of probabilities and hence the calculation of risk associated with management decisions. It is impossible to achieve this with field experiments limited to a few seasons. However, the optimum sowing date also depends on the risk attitude of the grower. Information on probability distributions for simulation experiments allows the various risks to be assessed.
In Western Australia, late sowing often results in unfavorable grain filling conditions with high temperatures and terminal drought. This can reduce canola yields and depress seed oil content and hence crop profitability (Walton et al., 1999). More work is required to include the simulation of seed oil contents in the model.

CROP SIMULATION RESULTS

Fig. 1. Simulated canola yields from 1950 to 1999, Mullewa, for the sowing date of 15 May.

Fig. 2. Long-term simulated average canola yields (-▲-) with upper and lower 10%-percentile (- - -) for Kojonup and Mullewa for 5 sowing dates. Predicted yields for 2 sowing opportunities in 2000 (●).

CONCLUSION

Large variability exists in canola yields in the Mediterranean climate of Western Australia. Canola yields decline with delay in sowing date. The relative yield reduction with delay in sowing is greater for a low rainfall location, but the variability around the average long-term yield is larger for a high rainfall location. Simulation analysis using long-term weather data can incorporate the effect of a variable climate and can be used to evaluate the risks in canola yields associated with different sowing dates.

KEY WORDS
Canola, simulation model, yield, sowing date

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REFERENCES