FINAL REPORT

GRDC
GRAINS RESEARCH & DEVELOPMENT CORPORATION

DAN00011

Best management practises for profitable oilseed production in low rainfall environments

PROJECT DETAILS

PROJECT CODE:	DAN00011
PROJECT TITLE:	BEST MANAGEMENT PRACTISES FOR PROFITABLE OILSEED PRODUCTION IN LOW RAINFALL ENVIRONMENTS
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Summary

Canola is considered a risky crop in low rainfall areas, restricting its use in crop rotations. This project combined existing knowledge with field research and modelling to produce canola management guidelines for low rainfall areas of New South Wales (NSW).

These include both the need to sow in April (mid April preferred) and for stored soil water to ensure satisfactory yields and oil contents. Early sowing allows root penetration to at least 1.7m depth and better access to stored water. Water use efficiency (WUE) is also higher with early sowing. Variety maturity group is not critical in the preferred sowing window but quick maturing varieties should be used if sowing is delayed beyond the end of April.

Conclusions

Guidelines for successful canola production in low rainfall areas have been developed and these should give growers confidence in canola as an alternative cash crop with benefits to subsequent cereal crops in the rotation. The guidelines, based on field trials and crop modelling, include the need to sow in April (with mid April preferred) and for sufficient stored (fallow) soil water to ensure satisfactory yields and oil contents. Early sowing allows root penetration to at least 1.7m depth and, therefore, better access to stored water. WUE is also higher with early sowing. The choice of variety maturity group is not critical in the preferred sowing window but quick maturing varieties should be used if sowing is delayed beyond the end of April.

Adherence to these guidelines will greatly increase the reliability and profitability of canola production in low rainfall areas. However, it will result in a significant number of years in which canola will not be sown in some areas. Farming systems need to be sufficiently flexible to allow projected canola paddocks to be sown to other crops when the guidelines above are not met.

Outcomes

This project has established clear guidelines for the growth of canola in low rainfall areas. Some increase in the area sown to canola is expected, but adherence to the guidelines will result in a significant number of years in which canola will not be sown in some areas. Growers will be able to benefit from canola as a cash crop in the appropriate years and from the rotational benefits of canola to subsequent cereal crops, but their farming systems will need to be flexible to respond to the seasonal conditions. Use of these guidelines will substantially reduce the risk of crop failure and enhance growers' confidence in canola.

Achievements/Benefits

Canola is a minor crop in many low rainfall areas, particularly when compared to higher rainfall zones. For example, cereal production in the Condobolin district occupies approximately 390,000ha while the canola area has usually been less than 7,000ha. It is common practice for growers to grow several wheat crops back to back despite the disease risks. A profitable oilseed crop would be welcomed by producers, particularly as research has shown that growing canola can benefit subsequent cereal crops. However, while preliminary research had indicated that good economic returns are possible from canola in low rainfall environments, many growers considered the risk of crop failure to be too high. This project aimed to increase growers' confidence in canola by combining existing knowledge with carefully targeted field research and modelling to produce a best management package for low rainfall environments of eastern Australia.

Field Trials

-Sowing Time
Two trials were conducted to determine the optimum sowing time for the region and to assess the degree of sowing date by maturity interaction, to help determine which maturity class is the most appropriate. Eight canola varieties differing in maturity (Ag-Outback(Þ), Rivette, Ag-Emblem, Rainbow, Ripper(Þ), Oscar, Hyola 60(Þ) and Dunkeld) were sown on three dates (April 22, May 17 and June 14) in 2002. In 2003, six canola varieties (Ag-Outback, Rainbow, Ripper, Oscar, Hyola 60 and Dunkeld) and two Indian mustard varieties (M887 and JN28) were sown on four dates (April 2, April 22, May 13 and June 6). Supplementary water was used to allow sowing on the specified dates in both years and to simulate a wetter season in both years.

The 2002 season was one of the driest on record in the central west and the 2003 season was also well below average, requiring supplementary irrigation to achieve results. In each year and for all varieties, yield was highest for the earliest sowing date and declined with each delay in sowing. The decline averaged 0.1t/ha/week over years and treatments. The high yield from the earliest sowing (April 2) was unexpected, given that many varieties began flowering in July, but apparently frosts were not sufficiently severe or frequent to seriously reduce yield. In a previous experiment, very early sowing had resulted in lower yields than mid-late April sowing. The results suggest that economic canola yields (>1t/ha) are achievable provided the crop can be established before the end of April. However, this criteria might only be met in about 50% of years. Seed oil concentration was also highest for the earliest sowing date. In 2002, the first two dates had similar values (41%), dropping to 39.3% for the June sown crops. In 2003, the early April crops averaged 40.3% and there was a near-linear decline with delay in sowing to 36.1% for early June.

These trials also examined the interaction between sowing time and variety to help growers decide on the most appropriate variety maturity group. In 2003, the early maturing AG-Outback and Hyola 60 gave the highest yields from late (June) sowing but these were still below 0.4t/ha. For the preferred April 22 sowing, a range of maturity groups performed well with the highest yielders being Rivette and Hyola 60. A generally similar pattern was observed in 2003, although Rainbow and Oscar were the highest yielding from a 22 April sowing. These two varieties were also the highest yielding from the very early (April 2) sowing in 2003, ahead of the later maturing Dunkeld. It appears that the selection of variety maturity type is not critical in the preferred sowing window, but quick maturing varieties should be used if sowing is delayed beyond the end of April. There was little evidence of variety by sowing time interaction for oil content, reflecting the strong genetic control of this character. Some varieties (Rivette, Hyola 60) produced both high yields and high oil contents. Both yield and oil contents of the two Indian mustard varieties were generally below the values for canola in all comparisons, although they performed relatively better in the late sowings.

Detailed soil moisture measurements were taken at about three week intervals under a number of varieties at each sowing time to quantify water use and the effective root zone. April sown canola was able to extract moisture from down to 1.7m, whereas the limits for May and June sown crops were 1.3m and 1.0m, respectively. Based on water extraction, the rate of root penetration was 1.18cm/day for April sowing and 0.96cm/day for the May sowing. This information is critical for understanding canola performance and for successful crop modelling, and also shows the ability of canola to access stored water from depth, particularly when sown in April.

Early sown crops had considerably greater total water use, a result of less direct soil evaporation (which occurred before emergence of the later crops) and of greater soil water extraction. In 2002, water use dropped from 160mm for April sown crops to 140mm for May crops and just 100mm for June crops. Values were similar in 2003, dropping from 180mm for the early April sowing down to 140mm for the May and June sowings. In each year, WUE for seed production also decreased with delay in sowing, from values of about 8kg/ha/mm for April sown crops to as low as 4kg/ha/mm for June sowings.

-Importance of stored soil moisture
The second area requiring field work was quantifying the value of stored water. This information is required to assist growers in selecting paddocks for canola (e.g. after long fallow or an annual crop) and for deciding between canola and a cereal, if stored moisture can reduce the risk of canola failure and give growers confidence that the extra investment in canola is worthwhile. Two canola varieties (Ag-Outback and Ripper) were sown into a paddock which had previously had lucerne for a number of years and so had little stored soil moisture. Drip irrigation was used to generate plots with three levels of stored water and the crop response and soil water use were measured.

Stored soil water had a large effect on crop growth, increasing seed yield from 1.20t/ha at the lowest level to 1.59t/ha and

2.11t/ha as stored water levels increased. These results confirm the importance of stored water in increasing yield and reducing the risk of canola growing. Model outputs suggest that stored water is likely to be important in a high percentage of years, the exceptions being when growing season rainfall is very high (greater than 270mm) or is too low to allow sufficient crop growth to access deeper moisture.

Crop modelling
Simulation modelling can be valuable in placing research outcomes in a long term context and in examining variability. This can be done using a validated crop model and long term weather records. The Agricultural Production Systems Simulator (APSIM)-Canola model was tested by comparing model outputs to the field measurements of crop growth and water use. Agreement between the two was somewhat variable, possibly because of differing phenology. However, there was general agreement between the two for the effects of sowing time and soil moisture on canola yield. This gives some confidence in extending the research outputs across a wider time scale. Further work to better understand and improve the model performance would be valuable.

Outputs
A best management guide for canola growing in low rainfall areas has been prepared, in conjunction with Mr Nathan Border, district agronomist, Condobolin. This will be published as a Primefact in 2007.

Results from this project will also contribute to the Canola Best Management Practice Guide for SE Australia being prepared by the Canola Association of Australia (CAA). In NSW, this is expected to replace the 1992 Canola Agfact as the key reference on canola growing.

It is anticipated that several scientific papers based on this work will be published after Ms MacKinnon's PhD thesis is finalised. A number of conference papers and extension articles have already been published and these are listed in Additional Information.

Other extension activities conducted include field days in 2002 and 2003 (total attendance approx. 160 people) and pre-season grower meetings in both years.

Other research

This project concentrated on canola but other oilseeds might be better suited to this region. While the performance of the two Indian mustard varieties trialled in 2003 was not exceptional, there was some indication that they may be competitive with canola from May sowings. They also appear better suited to direct heading, thereby reducing production costs. It is suggested that further development of mustard for low rainfall areas should be encouraged.

Additional information

MacKinnon, G. C. Fettell, N. A. (2003). The effect of sowing time, supplementary water and variety on yield and oil concentration of canola (Brassica napus). Thirteenth Biennial Australian Research Assembly on Brassicas. Tamworth, New South Wales, September 2003. 40-42.

McCallum, R.J., Cornish, P.S., Fettell, N.A. (2003). Model applications in farming systems - the Condobolin experience. Proceedings, 1st Australian Farming Systems Conference, 7-11 September 2003, Toowoomba, Queensland.

MacKinnon G, Fettell NA, Freeman, J. (2004). The effect of sowing time and variety on yield and oil concentration of canola (Brassica napus). CWFS Research Compendium 2004.

MacKinnon GC. (2006). Strategies for growing canola in low rainfall environments of Australia. PhD Thesis submitted to University of New England (UNE).