Growing canola in wheat stubble – conservation cropping with increased yield

Sarah Bruce and John Kirkegaard, CSIRO Plant Industry; Megan Ryan, University of Western Australia; Jim Pratley, Charles Sturt University
Email: sarah.bruce@brs.gov.au

Key messages

- Surface-retained wheat stubble (4t/ha) evenly distributed can reduce canola yield by 25%
- The effect of wheat stubble on canola growth is through microclimate, not allelopathy.
- Using sowing techniques to push stubble off the row and onto the inter-row can alleviate the problem.

Background

During the 1990s growers in southern NSW observed poor growth and yield of canola grown in retained wheat stubble despite adequate plant populations and soil nitrogen, and good seasons. The common observation was one of small plants with very slow growth that often resulted in lower yield. As a result most growers burnt cereal stubble in order to avoid this costly problem. Allelopathy caused by toxins leaching from the stubble was thought to be one of the possible reasons for this effect, but there was no conclusive evidence. In this project we aimed to identify the cause of the problem and find ways to fix it.

Confirming grower observations

In 1999 we conducted experiments at 4 sites in the Harden district including the long-term site at Oxton Park, Cunningar and Galong. The experiments compared growth and yield of canola growing in retained wheat stubble (4.4 t/ha), or stubble burnt just prior to sowing (Fig. A). These experiments confirmed grower observations of slower seedling emergence, reduced plant populations, reduced seedling growth (Fig. 1B) and an average 24% yield reduction in canola yield (3.4 to 2.6 t/ha) when canola was sown into stubble. Seedlings also had elongated hypocotyls (stems) needed to emerge above the stubble. At the same time, laboratory experiments showed that leachates collected from wheat stubbles inhibited canola germination, but was this the cause of poor growth observed in the field?

Uncovering the mechanisms reducing canola growth – was it allelopathy?

A number of field and laboratory experiments were conducted to separate the possible physical, allelopathic or biological effects of wheat stubble on canola. In the field, yellow plastic drinking stubbles caused the same growth reduction as retained wheat straws, indicating that physical rather than chemical or biological effects were responsible. In the laboratory the stubble effects could be replicated without stubble by growing the seedlings in shaded tubes to elongate the hypocotyl. In addition stubble leachates collected under rainfall simulators in the field were not toxic to canola germination. Together the results suggested that reduced quality and quantity of light under the stubble led to extra investment of biomass in the hypocotyl to elongate it above the stubble layer. This reduced leaf area, and together with colder minimum temperatures above the stubble layer led to a reduction in growth rates. This understanding pointed to a possible solution.

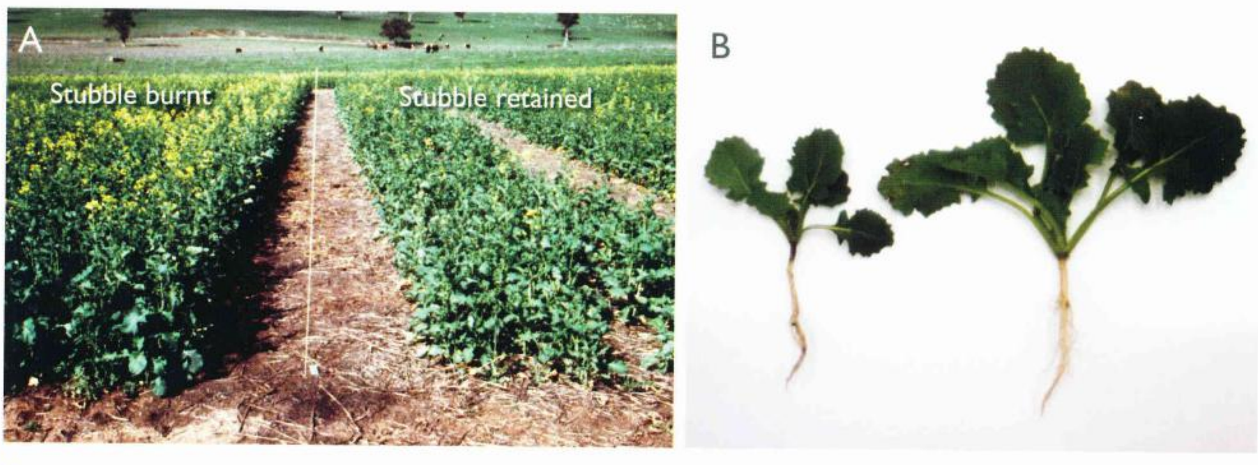


Figure 1. Effect of retained stubble on canola growth.

Pushing stubble away lifts canola growth

Demonstrating that stubble over the seeding row was the main cause of growth reduction meant that sowing methods that push stubble away from the seeding row and onto the inter-row might overcome the problem. Indeed, growers in the district were having success with canola growing in retained wheat stubble using wider rows, narrow points and press-wheels with no trailing harrows. Observations on their farms and further experiments at Harden and Canberra demonstrated the success of this approach. Growth and yield of canola in treatments where stubble was pushed onto the inter-row were similar to where stubble was removed or burnt (Fig. 2).

Practical implications

These studies have led to a practical solution which maintains productivity while eliminating the need to burn cereal stubbles. New GPS-guided seeding systems also provide options to sow canola between the rows of standing cereal stubble, an option used by farmers in Victoria on raised beds. Caution is still advised with canola sown into heavy stubble as it can fall back into the seeding row, or be pinned in the seeding row and can also harbour insect and other pests.

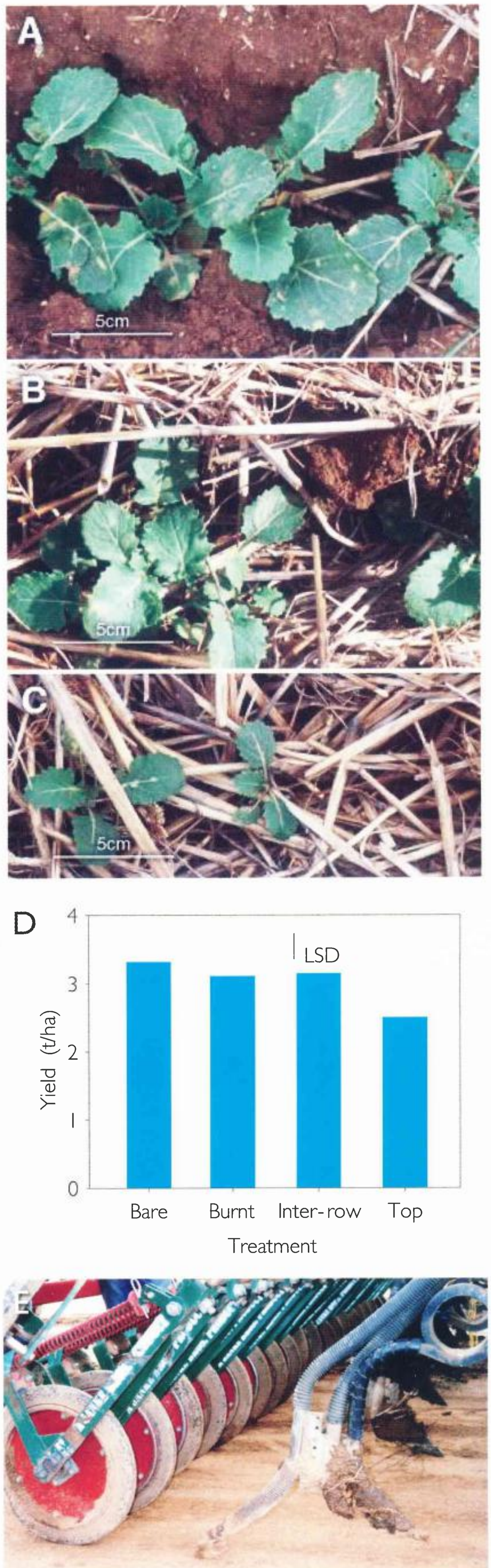
Further reading

Bruce, S.E., Kirkegaard, J.A., Pratley, J.E. and Howe, G.N. (2005) Impacts of retained wheat stubble on canola in southern New South Wales. *Australian Journal of Experimental Agriculture* 45: 421-433

Bruce, S.E., Ryan, M.H., Kirkegaard, J.A. and Pratley, J. (2006) Improving the performance of canola in retained wheat stubble. *Australian Journal of Agricultural Research* 57: 1203-1212

Bruce, S.E., Kirkegaard, J.A., Pratley, J. and Howe, G. (2006) Growth suppression of canola through wheat stubble I. Separating physical and biochemical causes in the field. *Plant and Soil* 281: 203-218

Bruce, S.E., Ryan, M.H., Hely, S., Kirkegaard, J.A. and Pratley, J. (2006) Growth suppression of canola through wheat stubble II. Investigating impacts of hypocotyl elongation using simulated stubble. *Plant and Soil* 281: 219-231.



> Figure 2. Efffect of stubble management on canola growth (A burn; B stubble retained on inter-rows and C stubble on top of row) and yield D. E shows the narrow points used in the farm experiment.