

Pushing wheat stubble away lifts canola growth

CSIRO Plant Industry researchers Sarah Bruce, Megan Ryan and John Kirkegaard and Charles Sturt University researcher Jim Pratley have dispelled the theory that toxic compounds leached from wheat stubble are responsible for poor canola growth. This article explains the results of a three-year study and shows how modified sowing methods can improve canola seedling growth and yields.

Sowing methods which push wheat stubble away from the seeding row can reduce or even eliminate the negative impact of stubble on canola growth and yield.

CSIRO Plant Industry research shows surface-retained wheat stubbles of more than four tonnes per hectare can reduce the growth and yield of canola by more than 25 per cent.

Initially, it was suspected that toxic compounds leached from wheat stubble were responsible for poor canola crops.

But CSIRO research indicates poor growth is due to the physical presence of the stubble layer, the extra effort in stem growth required to achieve emergence above the stubble and cooler temperatures above the stubble layer.

Sowing using wider rows, narrow points and press wheels, which push wheat stubble 10–20 millimetres away from the seedbed into the inter-row, can alleviate lower canola growth rates associated with heavy stubbles.

This also ensures the benefits of stubble retention can be maintained.

Stubble retention

Stubble retention was initially adopted in cropping systems to reduce erosion.

At a glance

- CSIRO research shows retained wheat stubbles of more than four tonnes per hectare can reduce canola growth and yields by more than 25 per cent.
- Poor growth is due to the physical presence of the stubble layer, the extra effort needed by the canola plant to achieve emergence above the stubble and cooler temperatures.
- Sowing methods using wider rows, narrow points and press wheels which move the stubble off the sowing row will help prevent canola growth rate reductions.



Photos: CSIRO Plant Industry

CSIRO research shows heavy surface-retained wheat stubbles can reduce canola emergence, growth and yields by more than 25 per cent.

More recently, stubble has been retained to maintain organic matter, increase infiltration and reduce evaporation.

But in temperate Australia farmers have been slow to adopt stubble retention, particularly in southern New South Wales and Victoria.

In these areas, yield increases have led to cereal stubble loads of 7–10t/ha, which have caused physical problems during sowing. This is increased by slow rates of stubble decomposition, due to low summer rainfall.

Reports have also shown that wheat yields in southern NSW were consistently reduced by 0.3t/ha in the stubble-retained paddocks compared with the stubble-burnt systems.

There also has been increasing anecdotal evidence in the same area for poor canola growth and reduced yield when sown into surface-retained wheat stubble.

Crop establishment

The crops generally established satisfactorily but subsequent crop vigour was poor despite adequate nitrogen nutrition and no obvious disease.

Several factors could be responsible for the poor canola growth in wheat stubble.

These reasons include poor seed–soil contact, ineffective pre-sowing herbicide incorporation, resulting in increased weed competition, nitrogen immobilisation, reductions in soil temperature, increased incidence of root disease and insect and slug damage.

Another belief was that toxic compounds from the stubble were inhibiting canola growth (allelopathy).

Canola establishment trials

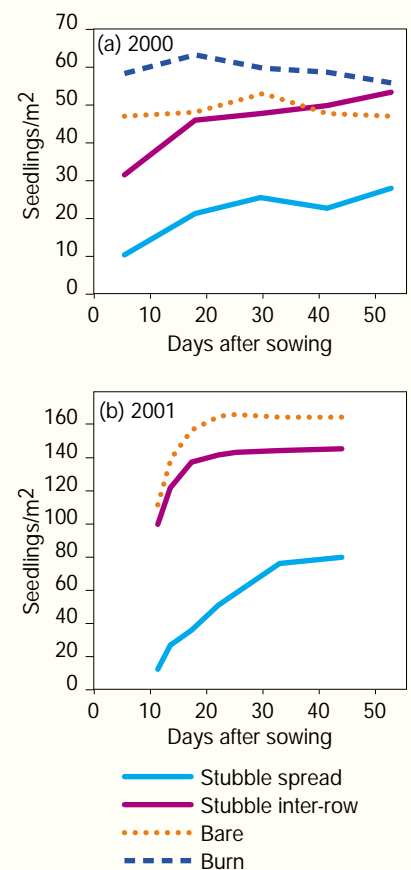
CSIRO Plant Industry carried out four paddock trials in southern NSW to investigate the effect of surface-retained wheat stubble on the emergence, growth and yield of direct-drilled canola.

Three treatments were established during 2000–2001 and included stubble spread evenly across the plot (stubble-spread) and stubble pushed off the sowing row onto the inter-rows leaving about 20 millimetres of bare ground around the seed row.

The aim was to mimic farmer practice where sowing machinery achieved a similar effect by using narrow points, press wheels and no prickle-chain (stubble-inter-row).

The third treatment was stubble burnt or raked off the plots (burnt or bare).

FIGURE 1 Seedling emergence



Source: CSIRO Plant Industry.

All treatments had 6t/ha equivalent of wheat stubble, which was removed from the plots just before sowing and replaced as required after the sowing operation.

All trials were direct-drilled.

Several measurements were taken including seedling emergence, insect damage, plant and soil nitrogen content, seedling characteristics, temperature and light measures and canola plant biomass (number of leaves).

Poor seedling emergence

Seedling emergence was reduced by between 40–60% in the presence of evenly spread stubble compared with no stubble (see Figure 1).

Despite demonstrating leached wheat stubble compounds were toxic to canola seeds in the laboratory, this effect could not be reproduced in the paddock.

Instead the slower emergence of the canola seedling above the straw layer was due to a reduction in the quality and quantity of light beneath the straw layer leading to extra investment of dry matter in hypocotyl (stem) needed to emerge above the straw layer.

The colder minimum temperatures experienced by the growing tip above the stubble layer also damaged seedlings, particularly on frosty mornings, contributing to reduced growth rates.

Nitrogen concentrations

Although, nitrogen immobilisation by retained residues was thought to cause poor canola growth, this was not the case in the trials.

While soil nitrogen content was lower in stubble-retained treatments 10 days after sowing, this did not affect seedling nitrogen concentration.

So, it seems unlikely that nitrogen immobilisation will be a problem for canola sown into surface-retained wheat stubble where recommended fertiliser rates are applied.

Reduced crop yields

The effect of stubble on canola growth was consistent among the trials.

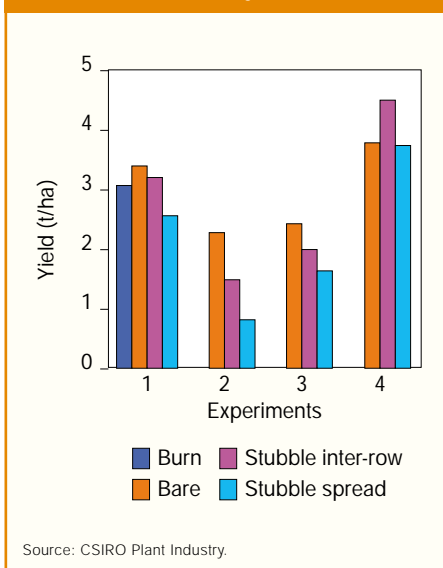
Biomass at flowering was 65–90% lower where the stubble was evenly spread across the row compared with no stubble.

Growth responses to clearing stubble from the sowing row were consistent between trials and were intermediate between bare-burn treatment and stubble-spread.

Stubble on the inter-rows caused an initial reduction in seedling growth but this had diminished by flowering.

Yields were either similar to the bare treatment or were between the bare and evenly spread stubble results.

FIGURE 2 Canola yields



Evenly spread stubble led to, on average, a 38% yield reduction in three of the four trials (see Figure 2).

Improved sowing approach

Sowing methods using wider rows, narrow points and press wheels (in the absence of a prickle-chain) which move stubble 10–20mm away from the seeding row and into the inter-row could eliminate the negative effects on canola growth associated with 5t/ha surface-retained wheat stubble.

The presence of stubble on the inter-row will maintain the benefits of stubble cover.

Such an approach could be made easier by increasing seeding row width.

At lower rates of stubble (less than 2t/ha) most sowing processes adequately push the straw off the sowing row, reducing the impact on canola growth.

Take care with stubble

It is possible that allelopathy could remain a problem if wheat stubble is pinned into the sowing row at sowing or if large amounts of stubble are incorporated immediately (1–2 weeks) before sowing.

Under these circumstances, rotting stubble in close proximity to germinating seeds may have a toxic effect on seedlings.

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Further reading

For more information on stubble, see *Farming Ahead* No. 118, page 38; No. 95, page 55; and No. 50, page 49.

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