Row spacing and cereal crop yield

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Cereal growers in Western Australia have, traditionally, burned cereal stubbles. Burning stubble residues reduces weed seed populations and fungal pathogens, but its main purpose has been to eliminate straw which might cause blockages of seeding machinery and poor seed-bed preparation in the time-critical seeding operation.

Many cereal growers now wish to retain cereal stubbles. Recent research has demonstrated that there are many good reasons for doing so. Some of the more important include:

- protection from wind erosion on sandy surfaced soils.
- reduced brown leaf spot (Plasmodiophora) of lupins where stubble is retained in the wheat-lupin rotation, and
- conservation of moisture on heavy soils.

Grain growers usually prefer tined rather than disc-type seeding machinery because of its versatility. However sowing direct into crop residues with conventional tined machinery can cause stubble blockages, seeding delays and poor seed-bed conditions.

One solution to these problems is to increase the spacing between tines from the common 18 centimetres (seven inches) to 27 or even 36 cm. Research overseas and in eastern Australia has shown that cereal yields may be lower when row spacing is increased beyond 18 cm. Such losses must be offset against the benefits of easier trash handling, and the size of the loss will determine whether wider spaced rows or other stubble handling techniques should be adopted if stubble is to be retained.

In 1982, the Department of Agriculture began a project to determine whether wider spaced rows also depressed cereal yields in Western Australia. This article summarises some of the important results from that work.
Research programme

From 1982 to 1985, 23 field trials were conducted in Western Australia's central and eastern wheatbelt to define the effects of row spacings on crop yields. Trials with Gamenya, Gutha and Eradu wheats, Clipper barley and Yandee lupins were located on a range of soil types and in areas receiving on average from 210 mm to 390 mm of rain during the growing season.

Row spacings ranging from 9 cm to 54 cm were tested at several seeding rates. Trial sites were sprayed with herbicide, cultivated, topdressed with fertiliser, and sown. In-crop weeds were controlled with herbicides.

The 1984 and 1985 trials were sown using a seeder developed at the Department's Dryland Research Institute. This machine closely controlled seed distribution and placement along the row. A rigid tine/depth-control wheel arrangement was also used to give consistent and accurate control of sowing depth.

Crop emergence was recorded six weeks after sowing. In several trials yield was measured by hand-harvesting small areas before machine harvesting.

Effects on yield

Wheat

Rows more than 18 cm apart consistently reduced wheat yields in the 17 trials carried out between 1982 and 1985. Results of one trial (Figure 1) are typical of the effects observed. In this trial, crops planted in rows nine centimetres apart produced the highest yields, and grain yields decreased as the spacing between rows was widened. The effects of row spacing were the same at seeding rates of 30 and 60 kilograms per hectare.
Widening the row spacing from 18 cm to 27 cm decreased wheat yield by 6.1 per cent when averaged over the 17 trials (Figure 2). For rows 36 cm apart, yield fell by 7.3 per cent, and at 45 cm apart, 20.4 per cent, relative to the yield produced by the standard 18 cm spacing. The effects of row spacing on grain yield were consistent between trials and it appears from these results that yields will decrease with wider spaced rows, irrespective of environment, soil type or variety.

Nine centimetre wide row spacings—half the standard row spacing—were included in 12 trials. Mean grain yield was 17 per cent higher in rows 9 cm apart compared with 18 cm spacing. This result was influenced by a very high yield produced from 9 cm spacing in one trial, however even when this is allowed for, grain yields were 12 per cent higher with 9 cm wide spacing. This result is not unexpected as European and North American research has shown that rows 9 cm apart usually yield 5 to 10 per cent more than the yield produced from standard 18 cm spacings.

The trend of reduced yields from wider spaced rows was also not affected by the sowing rate used. Manipulation of sowing rates therefore does not overcome the negative yield effect of wider spaced rows.

Increasing row spacing decreased the number of productive tillers (ears) produced per square metre of crop. This probably resulted from reduced tillering early in the season caused by greater competition between the closely spaced plants within widely spaced rows. Row spacing did not influence kernel weight or ear size. Fewer tillers from wider spaced rows therefore resulted in lower yields.

These results suggest that wider tine spacings should not be used to improve stubble flow through seeders when sowing wheat. Machinery designers have suggested that relatively small increases in tine spacing will improve stubble flow significantly. However, it appears from these trials that any increase in row spacing will reduce yield, and that narrower spacings are desirable if they can be incorporated into practical machinery design.

Topdress sowing was evaluated in 1982 and 1985. This technique involved spraying the seed directly onto the cultivated soil surface, and trailing light harrows to cover the seed. Some growers use similar techniques to speed the sowing operation and to avoid sowing too deeply.

Yields were inconsistent from seven topdressing trials with wheat and averaged slightly below the yield from crops sown in

□ Wheat sown in rows 45 cm apart yielded 20% less than wheat sown in rows 18 cm apart.

□ Lupins sown in rows 54 cm apart.
rows 18 cm apart. Topdressing relies on sufficient soil moisture when sowing, and on adequate follow-up rainfall to ensure successful establishment. In two trials at Merredin in 1985, dry conditions after sowing delayed germination of shallow-sown, topdressed plots by as much as a week. Such delayed emergence appears to be the main cause of reduced yields from topdress sowing.

Barley

Poor seasons and failure of many of the barley row spacing trials resulted in only one successful barley trial; at Merredin on a red clay-loam in 1984. As with wheat, wider spaced rows depressed barley yields in that trial. This trend was not influenced by sowing rates of 25 kg/ha and 50 kg/ha.

Lupins

Four trials conducted in 1984 and 1985 compared row spacings for lupins. In three of these trials (Figure 3), row spacings of 18, 27 or 36 cm had little influence on seed yield. In these trials the crops were severely stressed by very dry weather in spring.

In the one trial where good conditions persisted throughout the season (Wongan Hills, 1985), seed yields decreased by 10 per cent as row spacing increased from 18 cm to 27 and 36 cm spacing. Thus, at this stage, it is uncertain whether lupins are less responsive than cereals to changes in row spacings, and it would be unwise to widen tine spacings for lupin sowings.

Conclusions

Field trials on cereals over four years have consistently shown that wider spaced rows reduce grain yields, and these effects are not influenced by the growing environment, soil type or variety. Wider spaced tines on seeders therefore do not appear to be a satisfactory way to overcome stubble blockage problems and still maintain production.

Stubble modification during the previous harvest by cutting low and using straw choppers, or reducing stubble levels by careful grazing or raking before seeding are perhaps better methods of overcoming the stubble problem than increasing tine spacing on seeders.

Wheat sown in rows 9 cm apart produced significantly higher yields than wheat sown at the conventional 18 cm spacing. This result confirms experimental work elsewhere. The development of commercial seeding equipment capable of sowing rows 9 cm apart is a major challenge for machinery manufacturers. Topdress sowing of wheat may approach the plant arrangement seen in rows 9 cm apart, but unreliable plant establishment has caused yields to be lower than with conventional 18 cm spacings.

A trial programme is continuing in an attempt to confirm the higher yield of wheat sown in rows 9 cm apart, and to define more clearly the response of lupins to changing row spacing.