1987

# Depth-controlled modified combine for direct drilling and Lupin row spacing.

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# EXPERIMENTAL SUMMARIES 1987

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## SUMMARY OF EXPERIMENTAL RESULTS 1987

<u>Trial Title</u>: Depth-controlled modified combine for direct drilling

<u>Trial number</u>: 87WH52

<u>Officers</u>: R.K. Belford, E.R. Harvey, D. Tennant, R. Thompson (with R. Jarvis, L. Butcher, L. Smith)

### Aim:

To compare soil penetration resistance, crop growth, water use, nutrient uptake and root development of wheat 1) sown after scarifying; 2) direct drilled with a combine; 3) direct drilled with the depth-controlled modified combine with loosening tines at 5, 9 or 13 cm; or 4) sown after deep ripping with an Agrowplow to 13 or 30 cm.

### Trial details

Details of site, methods and materials, and all treatments are given in Ron Jarvis' experimental summary. Detailed measurements were made on seven treatments only (Table 1).

### Crop growth

Early development and growth were influenced by seed depth and not by tillage method. The DDC, scarified and deep ripped treatments were each sown at about 2 cm depth; all the modified combine treatments were sown at around 5 cm depth (Table 1). Six weeks after sowing, both main stem leaf number (i.e. crop development) and dry weight per plant (i.e. growth) were closely related to original depth of seed placement, with $r^2$ values of ~ 0.7. After the end of July, patterns of dry matter accumulation, showed small differences between the non-ripped treatments, with DDC and modified combine (5 cm) treatments showing the slowest DM accumulation and the deeper loosening treatments the highest rates of growth. However, growth after deep ripping to 30 cm was much faster than on any other treament.

### Nutrient uptake

Soil and plant samples were taken fortnightly after emergence, for nutrient analyses. Analyses have not yet been completed.

### Root growth

Root growth was measured from video images taken with a colour TV camera inside transparent observation tubes installed at 30° to the vertical and 2 m deep. Tubes were installed on scarified (13 cm), modified combine (13 cm), DDC and Agrowplow (30 cm) treatments. Some tubes were damaged after installation. Data showed that root penetration to depth was most rapid after deep ripping, and slowest on the DDC treatment, as would be expected from soil strength profiles obtained with the penetrometer. Root distribution patterns showed the greatest proliferation of roots near to the surface (i.e. 0-20 cm) after DDC, and the greatest proliferation at depth (i.e. > 40 cm) in the Agrowplow (30 cm) treatment.

Water uptake

This was measured fortnightly using the neutron probe, via access tubes installed to 4 m depth. Total water use (i.e. rainfall plus change in moisture storage) was least for the shallow loosened, direct drilled treatments (i.e. DDC, modified combine 5 cm), and greatest after ripping with the Agrowplow to 30 cm (Table 1). Water extraction patterns also showed the Agrowplow (30 cm) treatment to have used most water below 40 cm; both total water use and the pattern of water extraction were consistent with the rates of root growth, and root distributions above.

Yields

Yields and yield components for 2 $m^2$ hand harvests are shown in Table 1. Yields of grain rank in the same order as those from 40 m machine cuts (R. Jarvis summaries).

Deep ripping to 30 cm gave the highest yield, whilst shallow loosening treatments (DDC, modified combine 5 cm) gave the lowest yields. Direct drilling with the modified combine increased grain yield with increasing depth of loosening, from 186 g $m^{-2}$ after 5 cm loosening to 217 g $m^{-2}$ after 13 cm of loosening. All treatments which loosened soil to 13 cm before or at seeding produced yields of ~ 220 g $m^{-2}$.

Variation in yield between treatments was associated with variation in ear numbers/$m^2$. Other yield components were not affected, with the exception of 1000 grain weight after deep ripping; this suggests that on this treatment only, the high pre-anthesis water use limited water availability to the crop during grain filling.

Water use efficiency was lowest (10 kg grain/ha/mm - Table 1) for the two shallow loosening treatments, which yielded least grain. All other treatments showed equivalent water use efficiencies (~ 11.0 kg grain/ha/mm) except the deep ripped treatment which had the highest WUE of > 12 kg grain/ha/mm.

Summary

On sandy soils, direct drilling using a combine modified to loosen soil below seeding depth increased yield above that obtained from 'conventional' direct drilling with a combine, to the level of yield obtained after pre-seeding scarifying. On the debit side, draft and fuel consumption at seeding is higher than for a DDC operation. Work in this and other trials suggests that the loosening tine on the modified combine should work at least 10 cm deep to give equivalent yields to scarifying before seeding.

Much of the improvement in crop growth and yield is associated with a lowering of soil strength, thereby helping root penetration at early stages of growth; the two experiments studied in detail (86M56 and 87WH52) have both shown a close relationship between yield and soil penetration resistance integrated over 30 cm. Other factors such as nutrient supply, particularly the availability and mobility of nitrogen, are likely to be involved in determining crop response to modified combine direct drilling on specific sites and in differing seasons.

Table 1. 87WH52 - Depth controlled modified combine trial

| Treatment | Scarified 13 cm | DDC | Modified combine 5 cm | Modified combine 9 cm | Modified combine 13 cm | Agrowplow 13 cm | Agrowplow 30 cm | LSD |
|---|---|---|---|---|---|---|---|---|
| Depth of seeding cm | 1.6 | 2.3 | 5.2 | 5.0 | 4.5 | 2.1 | 2.8 | 0.74 |
| Plants $m^{-2}$ | 116 | 131 | 127 | 128 | 123 | 131 | 128 | |
| Heads $m^{-2}$ | 209 | 202 | 195 | 178 | 193 | 213 | 272 | 31.7 |
| Grains $head^{-1}$ | 28.9 | 26.9 | 25.9 | 29.7 | 30.4 | 29.6 | 31.2 | 3.39 |
| 1000 g wt, g | 36.4 | 36.4 | 37.4 | 37.0 | 36.6 | 36.2 | 31.3 | 1.34 |
| Grain wt $gm^{-2}$ | 220 | 198 | 186 | 198 | 217 | 228 | 265 | 37.7 |
| Total DM $gm^{-2}$ | 486 | 448 | 413 | 435 | 486 | 498 | 602 | 70.9 |
| Water use (mm) (change in storage and rainfall) | 197 | 192 | 186 | 180 | 197 | 204 | 218 | |
| Water use efficiency (kg grain $ha^{-1}$ $mm^{-1}$) | 11.2 | 10.3 | 10.0 | 11.0 | 11.0 | 11.1 | 12.2 | |

EXPERIMENTAL SUMMARY

Trial No.: 87M82

Title: Lupin row spacing

Trial location: Merredin Research Station paddock T6 south

Sowing date: 11/5/87

Variety: Danja 60 and 100 kg/ha

Fertilizer: 200 kg/ha plain super
a) topdressed rep 1 and 1/2 rep 2 on 8/5/87

b) topdressed rest on 11/5/87 after rain on the 8/5/87

100 g/ha sodium molybdate 19/6/87

Sprays: Brodal 150 ml/ha on 22/6/87
Fusilade 250 ml/ha on 30/6/87

Harvest date: 6/11/87

Estimated harvest loss: 9 seeds/0.1 $m^2$ or 150 kg/ha

Plant emergence table of means

| Row spacing | Plants/$m^2$ | | Mean |
|---|---|---|---|
| | 60 kg/ha | 100 kg/ha | |
| topdressed normal harrow | 32.7 | 60.7 | 46.7 |
| topdressed Phoenix harrow | 45.3 | 58.7 | 52.0 |
| 9 cm | 42.0 | 68.7 | 55.3 |
| 13.5 cm | 42.7 | 56.3 | 49.5 |
| 18 cm | 39.3 | 71.7 | 55.5 |
| 27 cm | 37.3 | 57.7 | 47.5 |
| 36 cm | 36.3 | 60.0 | 48.2 |
| mean | 39.4 | 62.0 | 50.7 |

L.S.D. ($p < 0.05$) : Spacing: n.s.
Rate: 6.08
Spacing x Rate: n.s.

Grain yield table of means

| Row spacing | Yield kg/ha | | Mean |
|---|---|---|---|
| | 60 kg/ha | 100 kg/ha | |
| topdressed normal harrow | 539 | 553 | 546 |
| topdressed Phoenix harrow | 731 | 622 | 677 |
| 9 cm | 1161 | 1099 | 1130 |
| 13.5 cm | 1040 | 906 | 973 |
| 18 cm | 947 | 913 | 930 |
| 27 cm | 905 | 994 | 949 |
| 36 cm | 920 | 921 | 920 |
| mean | 891.7 | 858.3 | 875 |

L.S.D. ($p < 0.05$) : Spacing: 142
Rate: n.s.
Spacing x Rate: n.s.

Comments:

The spraying treatments heavily damaged the smaller plants but only white tipped the larger healthier plants. The crop grew out of these early effects.

The topdressed rep 1 on the 8/5/87 significantly outyielded rep 3 which was topdressed after the rain by 28%.

The 9 cm row spacing yielded the highest ($p < 0.05$). This may, in part, be due to the narrow plot width giving an edge effect. There was no significant change ($p < 0.05$) in yield between 13.5, 18, 27 and 36 cm row spacings. Both seed topdressing treatments followed by harrowing yielded poorly although the plant counts were similar to other treatments.