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D. Tennant
PLANT RESEARCH DIVISION
DEEP RIPPING EFFECTS ON CULTIVATION PANS, ROOT GROWTH, CROP GROWTH AND YIELD

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77WH17 Part of the planting systems programme. Some soil strength data are reported for this trial. Treatments, yields and cultural details are presented by R. Jarvis.

82WH2 Trial designed to examine the interaction of anticipated faster rates of root penetration to depth after deep ripping with N leaching and uptake. Trial details are presented by J.W. Bowden.

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82WH36 Trial designed to examine deep ripping effects on soil strength (cultivation pan), root growth, crop growth and soil water relations. Much of the data described in this summary comes from this trial.

Treatments - 82WH36

1. Direct drill.
2. Scarify 5-10 cm.
3. Agrow plow 15 cm.
4. Agrow plow 25 cm.
5. Agrow plow 35 cm.

Deep ripping was done 2 weeks before planting on June 16. All plots received 200 kg ha\(^{-1}\) superphosphate and 150 kg ha\(^{-1}\) Agran at seeding.

81M52 Trial aimed at examining the effect of several fallowing options on soil water conservation and yield. Several deep ripping treatments were included. Soil type was heavy Merredin clay loam.

RESULTS

A. Depth of cultivation effects on cultivation pans

Penetrometer data describing soil strength down the profile to 49 cm (Fig 1) clearly demonstrate cultivation pans at the 82WH36 and 77WH17 sites. Soil type at each site was Wongan loamy sand.

1. The cultivation pans were at different depths. At the 82WH36 site, highest soil strengths were recorded between 17 and 25 cm from the soil surface. These were between 12 and 18 cm at the 77WH17 site.
2. At the 82WH36 site, deep ripping to 25 and 35 cm depths significantly reduced soil strengths in the cultivation pan area. Some advantage to ripping to 35 than 25 cm depths was evident at depths below the pan.

B. Deep ripping effects on root growth

Data obtained at the 82WH36 (Fig 3) and 82WH2 sites confirm the expectation of faster root penetration to depth after deep ripping (DR) than conventional cultivation (CON) or direct drilling (DD).

1. The lag phase in root penetration to depth generally experienced over the 6 to 8 week period from planting is much reduced/non existent after soil loosening with deep ripping.

2. At 10 weeks from planting, roots on the DR plots were 50 to 60 cm deeper in the profile relative to CON or DD. Equivalent depths are reached as much as 3 weeks later with CON and DD.

3. Although there is some catch up towards the end of the growing season, final depths of rooting were 30 to 40 cm deeper with DR than with CON or DD.

C. Deep ripping effects on dry matter production

From measurements of soil water made at 20 cm intervals down the profile to 260 cm depths at approximately 2 week intervals, various computations were made to determine total and daily water use rates (Table 1), cumulative water use (Fig 5), availability of water in the soil profile (Fig 4) and water extraction patterns (Figs 6 and 7) of DD, CON and DR at the 82WH36 site. Dry matter production data were obtained (Fig 2) at the same time as the water profile data.

1. From inspection of soil water profile data, drainage beyond 260 cm from the soil surface did not appear to be a significant component of total water loss from the profiles.

2. Relative treatment patterns of water loss were similar to those described for 1981 data (1981 Summary). Water use between day 41 and day 105 (anthesis) from planting, when differences in dry matter production were attaining sizeable proportions (Fig 2) was greater with DR than CON than DD (Table 1). After anthesis, when availability of water was less with DR than CON than DD (Fig 4), water use was greater with DD than CON than DR.

3. Higher dry matter production (Fig 2), faster root penetration to depth and deeper final depths of rooting (Fig 3) are reflected in higher total water use with DR than CON or DD.

4. Soil water profile data at day 132 after planting (Fig 6) and water depletion data for each depth of measurement between day 105 and day 132 from planting reflect deeper rooting with DR than DD. Water extraction is greater at depth towards the end of the growing season with DR than CON or DD.
3.

5. Because of greater water use early on and despite deeper rooting, there is less available water for crop use after anthesis (day 105) with DR than CON than DD (Fig 4).

6. Water storage in the profile was 10 to 15 mm higher with DR than CON or DD at day 13 from planting (Fig 4). The data suggest faster infiltration of rainfall after deep ripping. A similar effect has been described in previous summaries for CON relative to triple disc drill direct drilling.

D. Yield data

Deep rip responses on light land

Table 2 lists a summary of yield data for relevant treatments in 77WH17, 82WH2 and 82WH36.

1. There was a 35% yield response to deep ripping at the 77WH17 site in 1981. In 1982, despite observation of faster root penetration to depth during early growth, there was no residual yield response to deep ripping.

2. Twelve per cent higher yields with DR than CON at the 82WH36 site were significantly lower than the 32% higher yields obtained at the 82WH2 site. Rates of root penetration and final depths of root penetration were almost identical at both sites. The 82WH2 site was ripped in December 1981 and the 82WH36 site ripped late May-early June 1982.

Detailed harvest data for 82WH36 are listed in Table 3.

1. Lowest yields with ripping to 15 cm only relative to DD and CON is difficult to understand.

2. Machine harvest yield data for ripping to 25 cm are not consistent with hand harvested yield trends and with the ratio hand harvested yield/machine harvested yield of the other treatments.

Deep rip responses on heavy land

1. At Merredin on heavy Merredin clay loam (Table 4) there was no advantage to deep ripping relative to chemical and conventional fallowing done 30/6/81 and 13/8/81, relative to conventional cultivation fallowing done December 1981 and relative to conventional cultivation at the break of the season of the cropping year (1982).

2. Water storage data have yet to be processed. Inspection of the raw data suggests that water storage was greater with chemical than conventional cultivation or deep rip fallows. Seed beds on the deep rip and conventionally cultivated fallows and on the deep rip at break of season treatment were cloddy relative to the chemical fallow and conventional cultivation at break of season treatments. Germination was poorer on the cloddy seedbeds.
3. Chemical fallow gave the best yields.

4. Yield advantage to fallowing ranged from 67% to just over 100% depending on fallowing option and time of fallowing.

### TABLE 1: Effect of Deep Ripping on total (mm) and daily (mm day\(^{-1}\)) water loss* from soil profiles to 260 cm depths. (Daily rates in parentheses)

<table>
<thead>
<tr>
<th>Measurement Interval</th>
<th>DD</th>
<th>CON</th>
<th>DR</th>
</tr>
</thead>
<tbody>
<tr>
<td>13-41 days + (27 days)</td>
<td>39.61 (1.47)</td>
<td>40.90 (1.51)</td>
<td>40.24 (1.49)</td>
</tr>
<tr>
<td>41-76 days (35 days)</td>
<td>51.51 (1.47)</td>
<td>54.63 (1.56)</td>
<td>60.22 (1.72)</td>
</tr>
<tr>
<td>76-105 days (29 days)</td>
<td>64.14 (2.21)</td>
<td>73.43 (2.53)</td>
<td>86.31 (2.97)</td>
</tr>
<tr>
<td>105-132 days (27 days)</td>
<td>70.22 (2.60)</td>
<td>68.68 (2.54)</td>
<td>63.28 (2.34)</td>
</tr>
<tr>
<td>132-162 days (30 days)</td>
<td>10.94 (0.73)</td>
<td>8.49 (0.57)</td>
<td>4.44 (0.30)</td>
</tr>
<tr>
<td><strong>TOTAL: 13-162 days</strong></td>
<td><strong>236.4</strong></td>
<td><strong>246.1</strong></td>
<td><strong>254.5</strong></td>
</tr>
</tbody>
</table>

* Evaporation + Transpiration + Deep drainage

+ Days after planting
TABLE 2:  Yield responses to deep ripping on 77WH17, 82WH2 and 82WH36 (kg ha⁻¹)

<table>
<thead>
<tr>
<th></th>
<th>CDD</th>
<th>CON</th>
<th>DR</th>
</tr>
</thead>
<tbody>
<tr>
<td>77WH17*</td>
<td>1998</td>
<td>2078</td>
<td>2089</td>
</tr>
<tr>
<td>82WH2⁺</td>
<td>-</td>
<td>1835</td>
<td>2431 (12%)</td>
</tr>
<tr>
<td>82WH36**</td>
<td>1974</td>
<td>1982</td>
<td>2204 (32%)</td>
</tr>
</tbody>
</table>

* Detailed yield results in R. Jarvis' report.
⁺ Detailed yield results in J.W. Bowden's report.
** Detailed harvest data in Table 3.

TABLE 3:  Effect of deep ripping on yield components and yields - 82WH36

<table>
<thead>
<tr>
<th></th>
<th>Direct Drill (DD)</th>
<th>District Practice (CON)</th>
<th>15 cm</th>
<th>25 cm</th>
<th>35 cm (DR)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Head number (per m²)</td>
<td>197</td>
<td>201</td>
<td>201</td>
<td>229</td>
<td>231</td>
</tr>
<tr>
<td>Dry matter (kg ha⁻¹)</td>
<td>5050</td>
<td>5270</td>
<td>4633</td>
<td>5614</td>
<td>6271</td>
</tr>
<tr>
<td>Grain yield (kg ha⁻¹)</td>
<td>2145</td>
<td>2156</td>
<td>2005</td>
<td>2243</td>
<td>2474</td>
</tr>
<tr>
<td>1000 grain weight</td>
<td>32.5</td>
<td>32.3</td>
<td>32.8</td>
<td>31.0</td>
<td>31.9</td>
</tr>
<tr>
<td>Harvest index (%)</td>
<td>42.7</td>
<td>40.8</td>
<td>43.2</td>
<td>40.0</td>
<td>39.4</td>
</tr>
<tr>
<td>Machine harvest yields (kg ha⁻¹)</td>
<td>1974</td>
<td>1982</td>
<td>1876</td>
<td>2204</td>
<td></td>
</tr>
</tbody>
</table>

.../6
### TABLE 4: Effect of fallowing options on yield - 81M52

<table>
<thead>
<tr>
<th>Treatment</th>
<th>Date</th>
<th>Yield (kg ha⁻¹)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Late June fallowing</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1. Agrow plow</td>
<td>30/6/81</td>
<td>1178</td>
</tr>
<tr>
<td>2. Agrow plow and scarify</td>
<td>30/6/81</td>
<td>1128</td>
</tr>
<tr>
<td>3. Chemical fallow</td>
<td>3/7/81</td>
<td>1254</td>
</tr>
<tr>
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<td>30/6/81</td>
<td>1103</td>
</tr>
<tr>
<td><strong>Mid August fallowing</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5. Agrow plow</td>
<td>13/8/81</td>
<td>1003</td>
</tr>
<tr>
<td>6. Agrow plow and scarify</td>
<td>13/8/81</td>
<td>1043</td>
</tr>
<tr>
<td>7. Chemical fallow</td>
<td>16/8/81</td>
<td>1206</td>
</tr>
<tr>
<td>8. Conventional cultivation</td>
<td>13/8/81</td>
<td>1032</td>
</tr>
<tr>
<td><strong>Summer fallow</strong></td>
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<tr>
<td><strong>Break of season</strong></td>
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<td>497</td>
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<tr>
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<td>600</td>
</tr>
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All treatments seeded 21/6/82
FIG 1: Penetrometer Data

a. 82WH36

kg force

Depth from surface cm

7 14 21

35 42 49

b. 77WH17

kg force

Depth from surface cm

7 14 21

35 42 49
FIG 2: Dry Matter Production - 82WH36

FIG 3: Depths of root penetration - 82WH36
FIG 4: Water in profiles to 260 cm depths - 82WH36

FIG 5: Cumulative water loss from profiles - 82WH36
FIG 6: Soil water profiles at 10/11/82 - 82WH36

FIG 7: Water depletion at each depth of measurement between day 105 and day 132 from planting - 82WH36
DEPARTMENT OF AGRICULTURE
Western Australia

SUMMARY OF EXPERIMENTAL RESULTS 1982

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**TOTAL:** 13-162 days 236.4 246.1 254.5

* Evaporation + Transpiration + Deep drainage
+ Days after planting
### TABLE 2: Yield responses to deep ripping on 77WH17, 82WH2 and 82WH36 (kg ha\(^{-1}\))

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<tr>
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<th>CDD</th>
<th>CON</th>
<th>DR</th>
</tr>
</thead>
<tbody>
<tr>
<td>77WH17*</td>
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</tr>
<tr>
<td>82WH2+</td>
<td>-</td>
<td>1835</td>
<td>2431 (12%)</td>
</tr>
<tr>
<td>82WH36**</td>
<td>1974</td>
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<th>District Practice (CON)</th>
<th>Agrow plow 15 cm</th>
<th>25 cm</th>
<th>35 cm (DR)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Head number (per m(^2))</td>
<td>197</td>
<td>201</td>
<td>201</td>
<td>229</td>
<td>231</td>
</tr>
<tr>
<td>Dry matter (kg ha(^{-1}))</td>
<td>5050</td>
<td>5270</td>
<td>4633</td>
<td>5614</td>
<td>6271</td>
</tr>
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<td>2156</td>
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<td>2474</td>
</tr>
<tr>
<td>1000 grain weight</td>
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<td>39.4</td>
</tr>
<tr>
<td>Machine harvest yields (kg ha(^{-1}))</td>
<td>1974</td>
<td>1982</td>
<td>1876</td>
<td>2204</td>
<td></td>
</tr>
</tbody>
</table>

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*923*
<table>
<thead>
<tr>
<th>Treatment</th>
<th>Date</th>
<th>Yield (kg ha(^{-1}))</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Late June fallowing</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1. Agrow plow</td>
<td>30/6/81</td>
<td>1178</td>
</tr>
<tr>
<td>2. Agrow plow and scarify</td>
<td>30/6/81</td>
<td>1128</td>
</tr>
<tr>
<td>3. Chemical fallow</td>
<td>3/7/81</td>
<td>1254</td>
</tr>
<tr>
<td>4. Conventional cultivation</td>
<td>30/6/81</td>
<td>1103</td>
</tr>
<tr>
<td><strong>Mid August fallowing</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5. Agrow plow</td>
<td>13/8/81</td>
<td>1003</td>
</tr>
<tr>
<td>6. Agrow plow and scarify</td>
<td>13/8/81</td>
<td>1043</td>
</tr>
<tr>
<td>7. Chemical fallow</td>
<td>16/8/81</td>
<td>1206</td>
</tr>
<tr>
<td>8. Conventional cultivation</td>
<td>13/8/81</td>
<td>1032</td>
</tr>
<tr>
<td><strong>Summer fallow</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>9. Agrow plow</td>
<td>8/12/81</td>
<td>326</td>
</tr>
<tr>
<td>10. Conventional cultivation</td>
<td>6/12/81</td>
<td>388</td>
</tr>
<tr>
<td><strong>Break of season</strong></td>
<td></td>
<td></td>
</tr>
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<td>11. Agrow plow</td>
<td>15/6/82</td>
<td>497</td>
</tr>
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<td>15/6/82</td>
<td>600</td>
</tr>
</tbody>
</table>

All treatments seeded 21/6/82
FIG 1: Penetrometer Data

a. 82WH36

Depth from surface cm

kg force

10 20 30 40 50

7 7

14 14

21 21

28 28

35 35

42 42

49 49

DD
CON
DR 15
DR 25
DR 35

b. 77WH17

kg force

10 20 30 40 50

7 7

14 14

21 21

28 28

35 35

42 42

49 49

TDD
CDD
CON
FIG 2: Dry Matter Production - 82WH36

Days after planting

FIG 3: Depths of root penetration - 82WH36
FIG 4: Water in profiles to 260 cm depths - 82WH36

FIG 5: Cumulative water loss from profiles - 82WH36
FIG 6: Soil water profiles
at 10/11/82 - 82WH36

FIG 7: Water depletion at each depth
of measurement between day 105
and day 132 from planting - 82WH36