Cultivation: does haste mean waste?

H M. Fisher

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Many farmers believe that increasing the speed of cultivation and seeding implements will cause deterioration of soils and reduced crop yields. In a three-year trial on clover ley land at Wongan Hills higher cultivation speeds tended to increase rather than decrease wheat yields. There was some deterioration in the physical structure of the soil.

IN MOST cereal growing areas of Western Australia methods of land preparation and seeding have a major influence on crop yields. Cultivation and seeding trials have emphasised the need to carry out the first workings when maximum destruction of emerging weeds is assured, and to sow as early as possible after a satisfactory control of weeds.

On unfallowed ley land in many wetter districts this means delaying the seeding for a week or two after the initial breaking-up to gain final weed control before sowing. The need to restrict cultivation to specific stages of weed emergence places greater emphasis on getting the job done quickly once "the time is ripe." Otherwise the tendency is to start too early and finish too late. So there is much more emphasis today on big plant and faster working to cover the ground as quickly as possible.

How fast the soil should be worked has become more and more a subject of controversy.

Most farmers operate within the generally accepted range of 4 to 5 m.p.h. Many exceed this and operating speeds of up to 9 m.p.h. are common.

Speed of working was investigated in a trial on clover ley land on the Wongan Hills research station. The soil was a sandy loam overlying clay and had not been cropped for five years.

The trial began in 1963 and for three years wheat crops were grown following a range of cultivation treatments, which included speeds of working.

**Treatments Investigated**

The following treatments were applied in all combinations, giving 18 treatments in all.

**A. THREE TYPES OF CULTIVATION**
- Scarifier 3 to 4 inches.
- Disc Plough 4 to 5 inches—broad setting (breast cut 10 ft.).
- Disc Plough 4 to 5 inches—narrow setting (breast cut 8 ft.).

**B. THREE SPEEDS OF CULTIVATION**
- Two m.p.h.
- Four m.p.h.
- Six m.p.h.

**C. TWO SPEEDS OF SOWING WITH A COMBINE**
- Four m.p.h.
- Six m.p.h.

Plots for harvest were two drill widths by three chains long. Each plot was separated by a buffer strip of one drill width sown with wheat. This was placed on the junction between adjacent cultivated areas to lessen any possible effect of nearby treatments on the areas from which yield assessments were made.
The treatments specified above were the only workings carried out, and were applied to the same plots each year, following weed emergence after opening rains. Cereal stubble was burnt during the summer.

**Implements**

A Chamberlain Countryman tractor, a Chamberlain 18-disc plough (21 in. discs), and a 16-tyne Sunduke scarifier (8 ft. cut) were used for cultivation. The plots were sown with a 12 run combine.

Tractor gears and throttle settings were chosen to give appropriate speeds and the speeds actually achieved were checked by timing the transit of the unit on each plot.

Significant variations in speed occurred according to the machine pulled and whether the work was up or down slope. Maximum desired speed was not achieved with the disc plough because of the development of bounce above 5½ m.p.h., particularly with the narrow setting.

An important feature of the treatments was the extent of soil displacement. This varied from almost no displacement with the scarifier at low speed to a lateral displacement of two to three feet, accompanied by inversion, with the disc plough.

At the higher speeds increased compression of the soil by the tractor tyres was noted. This caused uneven ploughing due to failure of the discs to cut as deep in the depressed areas as in unaffected areas.

**Yields**

Wheat yields were obtained from the plots for the three years 1963, 1964 and 1965. Although trial yields declined over the period the seasons were all above-average, as indicated by the overall wheat and oat yields for the bulk crops on this Research Station.

**BULK CEREAL YIELDS, WONGAN HILLS RESEARCH STATION.**

<table>
<thead>
<tr>
<th></th>
<th>Wheat</th>
<th>Oats</th>
</tr>
</thead>
<tbody>
<tr>
<td>1963</td>
<td>12.2*</td>
<td>28.0</td>
</tr>
<tr>
<td>1964</td>
<td>16.2</td>
<td>24.9</td>
</tr>
<tr>
<td>1965</td>
<td>28.1</td>
<td>34.1</td>
</tr>
</tbody>
</table>

* Affected by Rust.

In the first year of cropping there was an overall tendency for yield to improve with faster speeds of cultivation. This trend was most pronounced in the case of the scarifier and with all machines tended to be more pronounced with the change from two to four m.p.h. than from four to six m.p.h. Where the disc plough was used yields were generally higher than with the scarifier. Observations on weed infestation indicated that differences in the degree of weed control achieved had a major influence on results.

In the second year the trial suffered from a general infestation of wild turnip. Although the plots were sprayed to control this weed no significant differences between treatments could be demonstrated due to high variability of yields over the trial as a whole.

**Effect of speed of cultivation with scarifier and disc plough on wheat yield, Wongan Hills Research Station, 1963-5**

<table>
<thead>
<tr>
<th></th>
<th>1963</th>
<th>1964</th>
<th>1965</th>
<th>Mean—All years</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Scarifier</td>
<td>Plough</td>
<td>Scarifier</td>
<td>Plough</td>
</tr>
<tr>
<td><strong>Speed—Two M.p.h.</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Two</td>
<td>22.3</td>
<td>37.9</td>
<td>21.3</td>
<td>19.6</td>
</tr>
<tr>
<td>Four</td>
<td>33.3</td>
<td>45.1</td>
<td>18.6</td>
<td>22.8</td>
</tr>
<tr>
<td>Six</td>
<td>39.4</td>
<td>46.2</td>
<td>18.1</td>
<td>22.5</td>
</tr>
<tr>
<td><strong>Means...</strong></td>
<td>31.7</td>
<td>43.1</td>
<td>19.3</td>
<td>21.6</td>
</tr>
</tbody>
</table>

Diff. for Sig. (0.05)—Treats. 7.5 N.S. 5.5

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In the third year the only significant effect was between implements. The scarifier gave a much lower yield than the plough at all speeds of working. There was a build-up of Wimmera rye grass in this year which neither implement handled satisfactorily, although ploughed plots were generally cleaner than scarified plots.

In all years the speed of the combine had no appreciable effect, although yields tended to be higher with the faster speed. There was likewise little difference between the two settings of the disc plough.

**Soil Structure**

In the last year of the trial, soil samples were taken from selected treatments for investigation of soil structure differences. The measurements suggested that soil structure deteriorated more with disc ploughing than with scarifying and more with higher speeds of working.

**Discussion**

Speeds of cultivation up to six miles an hour at least, had no detrimental effect on crop yields in this trial. Rather, there was a tendency for yield to increase, although this was less pronounced in the higher ranges of speed.

The effect tended to be more pronounced with the scarifier than with the plough. Over the three years of cropping using a plough rather than a scarifier increased yield by $7\frac{1}{2}$ bushels an acre or 40 per cent. Operation at six m.p.h. as compared with four m.p.h. resulted in 1.7 bushels increase where the scarifier was used and a negligible increase where the plough was used, reducing the superiority of the plough to 30 per cent.

Yield trends with different implements operated at three speeds. The yield increase with higher speeds was greatest in the first year of cropping and was more pronounced with the scarifier than the disc plough.
Observation suggests that different degrees of weed control played a major part in the results.

It is well documented that cultivation of any sort produces a marked deterioration in the physical condition of the soil. A decrease in the soil organic matter as an important structure-building agent is usually associated with this decline. Many plant nutrients originate from this source and it is possible that where crop growth is dependent on these nutrients some structure breakdown is inevitable if the best yields are to be realised.

Results of this trial suggest that some forms of cultivation could be more severe in this way than others. However it was apparent that after three consecutive years of cultivation on this soil type structure differences were not important enough to appreciably modify the direct effects of the treatments applied.

Further work is being carried out to assess the significance of soil structure changes with different cultivation treatments. Further work is also required to assess the effects of cultivation and seeding speeds under different conditions to those in the experiment described. In the case of new land, for example, it is possible that fast seeding could affect placement of seed and fertiliser to the detriment of the crop.

Other workers studying the power requirements of different forms of cultivation have found that increased speed calls for a more-than-proportionate output of power. Thus, costs per acre rise when cultivation is at a faster rate. It could be that higher costs may be justified if more timely and more effective cultivation results in increased yields as suggested by the results of this experiment.

Acknowledgments

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