# Effect of Wheeltracks on Yield in Controlled Traffic

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## Introduction

Controlled traffic is a crop production system in which the crop and traffic areas are permanently and distinctly separated. In Australia, this system has been shown, in general, to increase yield by 15.9% on non-wheeled cultivation (Tullberg 1997). The increased yield results from less compaction which allows greater water infiltration (80% for controlled traffic plots vs 76% for wheeled plots) for storage and crop availability (Tullberg 1997) and probably from greater porosity which facilitates more gaseous exchange of oxygen and carbon dioxide between the soil environment and the atmosphere (Eriksson *et al.* 1974). The effect of increased porosity on yield is more difficult to quantify.

If the main effect on yield is derived from increased stored water, then there is likely to be less response to controlled traffic in a season with favourable moisture than in a dry season. This may account for some of the variability in yield response to controlled traffic: 22.8%, 5.0%, 14.9% and 21.0% for wheat, sorghum, maize and wheat over a three year period (Tullberg 1997).

Comparison of yield on controlled traffic plots with non-wheeled plots needs to take account of the loss in crop production from wheeltracks. Obviously, this loss will be minimised for widely spaced, narrow wheeltracks. In conventional cultivation, the whole area is planted including the wheeltracks made by the planting rig.

Several other aspects of the effect of wheeltracks on yield need to be considered. Crop rows adjacent to wheeltracks may be subjected to at least two opposing factors. For a winter cereal crop planted at a conventional row spacing of 20 cm or less, these rows will receive more light especially during later growth stages when the canopy cover is complete. Thus it is common for plants in such rows to be shorter (due to less elongation) and to grow larger. The plants in these rows are potentially able to exploit a greater soil volume, and therefore water and nutrients, because of the reduced competition from the wider rows.

However, the opposing factor of soil compaction would be expected to reduce root growth and exploitation of the soil for water and nutrients. The extent of this reduction is largely unknown but So (1990) has suggested a productivity loss of 5 - 10% in field crops. The balancing forces of compaction and its effect on root growth, and reduced competition for light for top growth have not been determined.

For row crops planted at wider spacing (70 cm or greater), the situation is different in several aspects. There may be no loss of production area due to wheeltracks if these fit in the inter-row spaces. Theoretically, then, controlled traffic should produce higher yields in row crops than a closely planted crop because there is no area lost to production. This will, in turn, remove the competition effects from 'unguarded' rows. However, compaction will still occur in rows adjacent to the wheeltracks and these would be expected to be lower yielding.

In this paper, I will discuss the effect of row spacing on yield in wheat and relate this to the loss of production due to wheeltracks. I will then compare this loss with the gain expected from controlled traffic to arrive at an overall yield estimate.

**Row Spacing**

Doyle (1980) found that in trials conducted over 5 years at Narrabri in northern New South Wales that increasing the row spacing from 18 to 36 cm reduced yield in 3 of the years and was not significant for the other years (Table 1). Only in 1975 was yield reduced in the 27 cm spacing. There was no interaction of row spacing with plant population.

**Table 1**. Influence of row spacing on grain yield in kg/ha (after Doyle 1980)

| **Row Spacing (cm)** | **1974** | **1975** | **1976** | **1977** | **1978** | **Mean** |
|---|---|---|---|---|---|---|
| | **Grain Yield (kg/ha)** | | | | | |
| **18** | 3440 | 3230 | 3680 | 1600 | 3060 | 3002 |
| **27** | 3650 | 2980 | 3810 | 1560 | 3040 | 3008 |
| **36** | 3620 | 2940 | 3340 | 1440 | 2730 | 2814 |
| **lsd** | ns | 200 | 280 | ns | 190 | |

Thus averaging across years the maximum grain yield loss which can be expected for 36 cm rows would be 6%. Note that while 36 cm rows occupy only half the area that 18 cm rows occupy, the yield reduction was only 6%, indicating considerable yield compensation at the wider row spacing.

In extensive trials conducted in Western Australia, Burch (1986) found a similar reduction of about 6% grain yield reduction when row spacing was increased from the standard 18 cm rows to 27 cm or 36 cm rows (Table 2). Wider rows had a greater effect on yield.

In a sense, the wider row spacing of rows adjacent to the wheeltrack simulates the situation referred to above. However, there is likely to be additional yield reduction due to compaction from the wheeling though this only occurs on one side of the row. Thus the values for yield reduction from wider rows in the research by Doyle (1980) and Burch (1986) would be under-estimated for wide rows adjacent to wheeltracks.

Other researchers (Lamers *et al.* 1986 and Tullberg and Lahey 1990) showed that the yield of wheat from rows immediately adjacent to the wheeltracks was 150% higher than for inner rows.

Overall, research indicates that wider rows due to wheeltracks will yield higher than narrower rows and hence will compensate to some degree for the loss in area of production from wheeltracks.

**Table 2.** Wheat yields at different row spacing expressed as a percent of 18 cm yields; averaged over seeding rates and within years (after Burch 1986)

| **Row spacing** | | | | | | |
|---|---|---|---|---|---|---|
| **Year** | **9 cm** | **18 cm** | **27 cm** | **36 cm** | **45 cm** | **54 cm** |
| **1982 (4 trials)** | - | 100.0 | 98.9 | 96.9 | - | - |
| **1983 (5 trials)** | 101.0 | 100.0 | 90.8 | 89.0 | 71.6 | 72.2 |
| **1984 (5 trials)** | 125.2 | 100.0 | 100.0 | 92.5 | 82.8 | 78.1 |
| **1985 (3 trials)** | 133.0 | 100.0 | 82.6 | 99.5 | 86.3 | - |
| **Mean 1982-1985 (17 trials)** | - | 100.0 | 94.0 | 93.7 | - | - |

**Row Spacing and Controlled Traffic**

If we consider a bed with six rows at 20 cm spacing and 50 cm wheeltrack on either side, we effectively have four rows at 20 cm spacing and the two outside rows at 35 cm spacing (mean of 20 and 50 cm).

We can then consider the yield reduction due to the two wider rows:

From Doyle's work we conclude the maximum yield reduction would be approximately 6% for these rows.
If we consider the yield reduction for the whole plot, we have a 6% yield reduction in both of the outside rows and no reduction for the four centre rows.
Thus over the whole plot the yield reduction is (6x2)/6 = 2.0%

A 15.9% yield increase has been shown for controlled traffic plots compared with wheeled plots (Tullberg 1997). Because both treatment plots were bounded by wheeltracks, edge effects were common and hence treatments were strictly comparable.

Thus if we compare a controlled traffic plot (with bed arrangement described above) with a wheeled plot with a constant row spacing of 20 cm, a minimum net yield improvement of 15.9% - 2.0% or 13.9% can be calculated. This is the estimated gain from controlled traffic less the reduction due to the two wider rows.

For wider beds, the proportional loss from the two outside rows will be even lower. For example, a three metre bed will have 12 rows of 20 cm resulting in a yield reduction of (6x2)/12 = 1% and a net yield improvement of 14.9%.

The unplanted wheeltrack area is not wasted in that the rows adjacent to them can utilise, at least to some degree, the moisture and nutrients from this soil space. However, nutrient levels for this area will be lower because normally the wheeltrack area would not be fertilized.

More research is needed to separate the yield reduction due to compaction from that due to wider rows. It would also be interesting to separate the yield reduction from compaction due to reduced moisture availability and that due to lower porosity. Further research is needed to investigate the long term effects of compaction on yield. Is yield reduced by continued compaction season after season, or does the reduction stabilise after several crops?

**References**


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