# Wheat variety response to dry sowing and seeding depth

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## Key messages

- Wheat can emerge from as deep as 120 mm on sandy soils, but emergence is reduced on loamy and clay soils.
- Reduced establishment due to deep sowing can reduce grain yield.
- Vigorous seed of a long coleoptile variety is best for deep sowing.
- Deep sowing offers no advantage when sowing dry.

## Aims

Early crop establishment is critical to maximising production in the WA wheatbelt. Dry sowing ensures that crops will germinate as soon as the first rains come, but in situations where the soil surface is dry but the subsoil is moist deep sowing onto the moist soil can also help. Wheat varieties differ in their sensitivity to deep sowing, the aims of the work described here were therefore to:

1. To test whether some wheat cultivars are better suited to dry sowing than others.
2. To characterise differences in wheat cultivar response to deep sowing.

## Method

The interaction between dry sowing and seed depth was studied in two trials at Mullewa and Merredin. These consisted of the factors time of sowing (dry or wet), seeding depth (normal or deep), and six cultivars laid out as split plot designs in four blocks, with sowing time in main plots. In another trial at North Miling seven cultivars were sown at three depths in a completely randomised block design with four replicates. Table 1 shows details of sites and treatments.

**Table 1 Details of two dry sowing trials at Mullewa and Merredin, and one seeding depth trial at North Miling in 2013. Figures given for seeding depth are measured; target depths were 30 mm (shallow), 50 mm (normal), and 90 mm (deep).**

| Trial | Soil type and rotation | Sowing date | Seed depth (mm) | Cultivars |
|---|---|---|---|---|
| Mullewa | Red shallow sandy duplex (fallow 2012) | 24 April (dry) | 69 (deep)<br>44 (normal) | Calingiri<br>Cobra<br>Corack |
| | | 9 May (wet) | 103 (deep)<br>51 (normal) | Emu Rock<br>Mace<br>Magenta |
| Merredin | Red shallow loamy duplex (field pea 2012) | 10 May (wet) | 74 (deep)<br>39 (normal) | Cobra<br>Corack<br>Emu Rock |
| | | 28 May (dry) | 72 (deep)<br>24 (normal) | Estoc<br>Mace<br>Magenta |
| North Miling | Yellow deep sand (lupin 2012) | 23 May | 28 (shallow)<br>52 (normal)<br>119 (deep) | Cobra<br>Corack<br>Emu Rock<br>Estoc<br>Mace<br>Magenta<br>Wyalkatchem |

## Results

### Environmental conditions

Seeding conditions varied between sites. At Mullewa soil moisture was well below crop lower limit at seed depth (50 mm) when the first dry sowing was planted, and close to the drained upper limit when the second wet time was planted the day after the opening rain of the season. At Merredin soil moisture at seed depth was also close to drained upper limit at seed depth for the first wet time of sowing, but around crop lower limit when the second dry time of sowing was planted. However, the soil was moist just below seed depth. At North Miling the volumetric moisture content at seed depth was much lower than at other sites, but because of the different soil type it was close to the drained upper limit. At all sites there was good spring rainfall, although total growing season rainfall was very low at Mullewa due to a very dry June (Table 2).

**Table 2 Growing season and spring rainfall and soil moisture profiles at seeding at each trial site.**

| Trial | Date of break | Rainfall (mm) | Volumetric soil moisture at seeding (%) | |
|---|---|---|---|---|
| | | | Early seeding | Late seeding |
| Mullewa | 8 May | May-Oct 126 | 0-6 cm 0.3 | 0-6 cm 19 |
| | | Sept-Oct 39 | 15-21 cm 10 | 10-16 cm 24 |
| | | | 24-30 cm 10 | 20-26 cm 20 |
| Merredin | 2 May | May-Oct 193 | 0-6 cm 22 | 0-6 cm 13 |
| | | Sept-Oct 63 | 10-16 cm 29 | 10-16 cm 27 |
| | | | 20-26 cm 29 | 20-26 cm 27 |
| North Miling | 8 May | May-Oct 224 | 0-6 cm 7.3 | |
| | | Sept-Oct 54 | 10-16 cm 8.2 | |
| | | | 20-26 cm 11.3 | |

### Crop establishment

Deep sowing reduced crop establishment in each trial but the extent of the reduction varied between sites and cultivars. At Mullewa and Merredin establishment was the same in both wet and dry sowings at normal depth (average 61 plants/m² at Mullewa 2 weeks after the second time of sowing, and 120 plants/m² at Merredin 3 weeks after the second time of sowing) but at Mullewa deep sowing reduced establishment by an average of 84% in the wet sowing compared to only 41% in the dry sowing. At Merredin the reduction was 28% when sown wet and 47% when sown dry. The greater sowing depth sensitivity when sown wet at Mullewa was probably due to seed being placed 40 mm deeper than the dry sowing treatments (Table 1). At Merredin where the seed depth was the same at both times sensitivity was greater when sown dry, presumably due to poor seed/soil contact as the seed bed was quite cloddy.

The cultivars in which establishment was most affected by deep sowing were Calingiri and Mace at Mullewa; and Corack, Emu Rock and Mace at Merredin. The least affected were Cobra, Emu Rock and Magenta at Mullewa; and Cobra and Estoc at Merredin. There was little difference between wet and dry sowing in cultivar response to deep sowing at Merredin.

At North Miling establishment did not differ between shallow and normal sowing, but deep sowing reduced it considerably. This was more noticeable 2 weeks after sowing than 3 weeks later (Figure 1). The reduction in establishment due to deep sowing 5 weeks after sowing varied from 22% for Wyalkatchem to 45% for Cobra. The order of

cultivar sensitivity from least to greatest was Wyalkatchem, Estoc, Magenta, Corack, Emu Rock, Mace, and Cobra.

One of the cultivar characteristics most often associated with sowing depth response is coleoptile length. We measured coleoptile length on all seed lots used in these trials and found that cultivars with long coleoptiles tended to be less sensitive to deep sowing than those with short coleoptiles (data from North Miling are shown in Figure 2).. However other factors were also involved since having long coleoptiles did not guarantee good establishment after deep sowing. At North Miling there were clear differences between cultivars in how rapidly they emerged. For shallow and normal sowing the proportion of final emergence that occurring after 2 weeks, an estimate of emergence rate, ranged from 79% for Mace to 97% for Estoc, and was correlated more than coleoptile length with sensitivity to deep sowing, although the relationship was still poor (Figure 2).

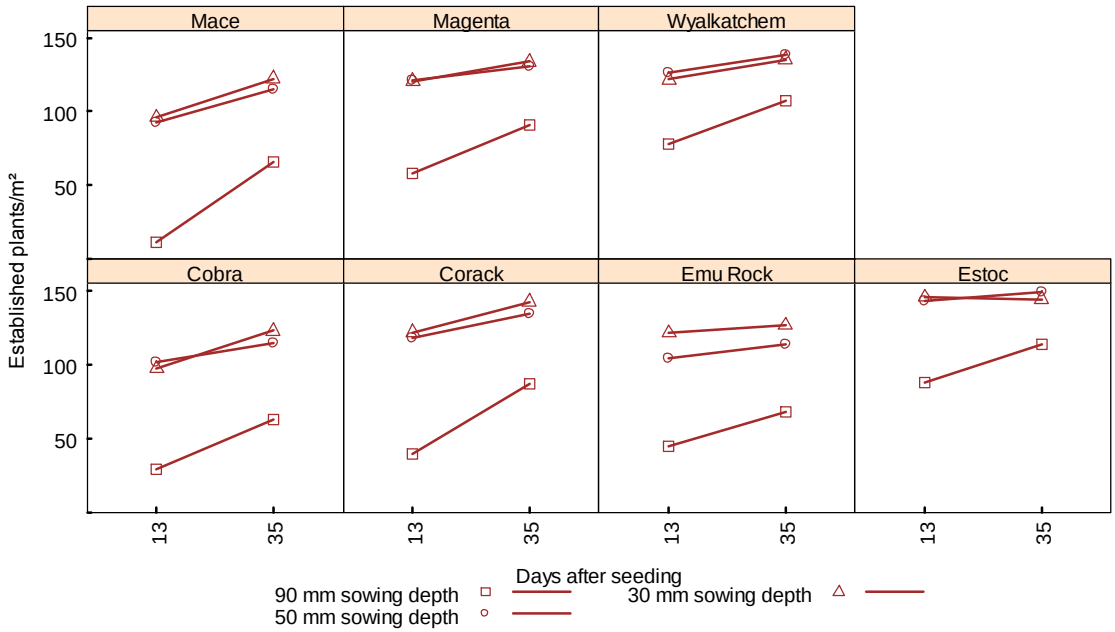


**Figure 1 Establishment of 7 wheat cultivars sown at different depths 2 and 5 weeks after sowing on a deep sand at North Miling in 2013.**

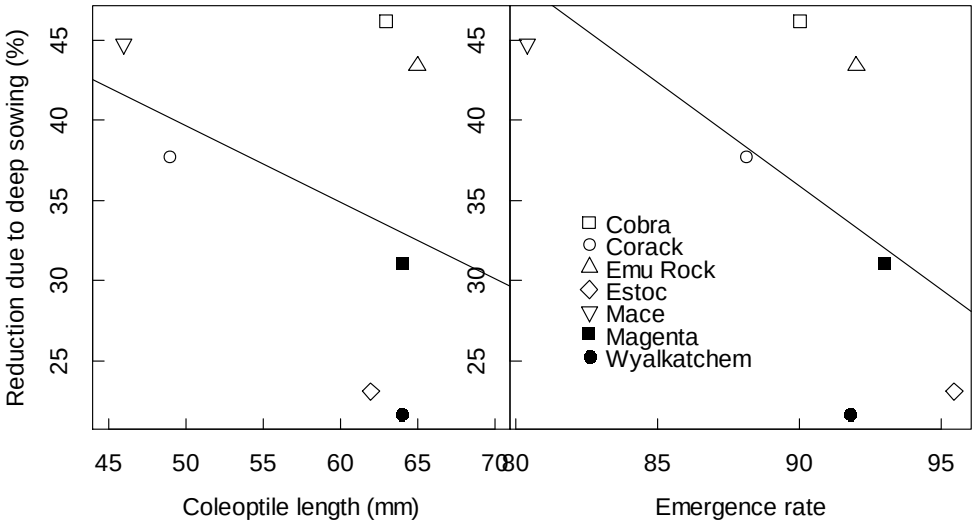

**Figure 2 Coleoptile length and emergence rate affect establishment reduction due to deep sowing at North Miling. Emergence rate is estimated as the proportion of total emergence (5 weeks after sowing) that occurred in the first 2 weeks.**

### Grain yield

Grain yield responded differently to deep sowing at each site. At Merredin (site mean yield 2.62 t/ha) there were no significant grain yield differences. At Mullewa cultivar yield differences were consistent when sown dry at either depth or wet at normal depth (mean yields were 2.24, 2.29, and 2.19 for dry deep, dry normal and wet normal treatments respectively). Magenta was the highest yielding cultivar in these treatments (2.5 t/ha) and Emu Rock the lowest (1.9 t/ha). Yield was substantially reduced in the deep wet sowing, with Cobra suffering the greatest reduction (43%) and Magenta the least (19%) in relation to the normal wet sowing. However, this was not related to the observed reduction in crop establishment. At North Miling yield was reduced by deep sowing and in this case there was a significant correlation between the reductions in yield and establishment (Figure 3). Averaged over the shallow and normal sowing depths Magenta was highest yielding (3.4 t/ha) and Estoc lowest (2.8 t/ha).

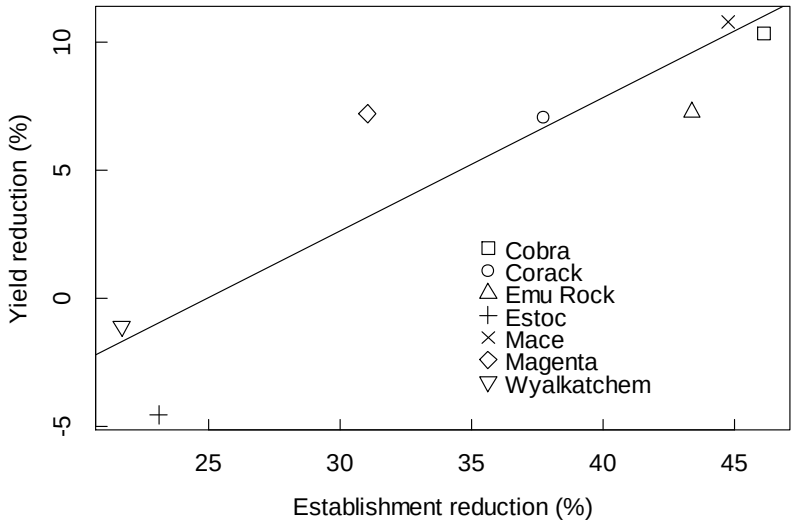


**Figure 3 Relationship between reductions in crop establishment and grain yield due to deep sowing at North Miling.**

## Conclusion

### Sowing depth

Wheat can emerge even when sown deeper than 100 mm under favourable circumstances. We suggest that soil type is important: deep sowing reduced establishment much more on a loamy soil at Mullewa than on deep sand at North Miling. Cultivars differed significantly in their sensitivity to deep sowing. Varieties with short coleoptiles did not emerge well when sown deep, but neither did some long coleoptile varieties. There were also inconsistencies between sites: Cobra (long coleoptile) was good at Mullewa and Merredin but not at North Miling. Another factor affecting sowing depth response was seed vigour. This may be more a characteristic of individual seed lots rather than cultivars, so using good quality seed is more important for deep than normal sowing. Reduced establishment due to deep sowing also reduced grain yield at North Miling, but not so clearly at Mullewa or Merredin.

Dry sowing

Dry sowing did not affect grain yield at either Mullewa or Merredin when sown at normal depth. At Mullewa it actually improved yield when sown deep but this is misleading because of differences in the actual seed depth between wet and dry sowing. At Merredin establishment was more sensitive to deep sowing when sown dry because of the cloddy seedbed. This is unlikely to happen on sandier soils, but in any case deep sowing offers no advantage when sowing dry.


## Key words

Sowing depth, dry sowing, wheat, cultivars, crop establishment

## Acknowledgments

Laurie Maiolo and Salzar Rahman (DAFWA, Merredin), the Liebe Group, and DAFWA RSU staff at Geraldton, Wongan Hills, and Merredin,

**GRDC Project No.:** DAW218

**Paper reviewed by:** Mohammad Amjad and Christine Zaicou