The importance of wheat cultivar and seed size for deep sowing

Bob French, Department of Agriculture and Food Western Australia, Merredin

Key messages

- Establishment of Corack, Emu Rock and Wyalkatchem are reduced more by deep sowing than Cobra, Estoc, Mace or Magenta in moist soil or when chasing deep moisture. Despite this Corack still yielded very well when sown late May.
- Smaller seed is also more sensitive to deep sowing under these conditions. We recommend that growers only use seed larger than 35g/thousand when sowing deep to chase moisture.
- 158 of 173 random samples (more than 90%) of wheat delivered to CBH in the Merredin district in 2014 had seed larger than 35g/thousand. There should be no difficulty keeping large enough seed for sowing in 2015.

Aims

In order to establish crops early, wheat must often be sown into seedbeds that impose varying degrees of stress on emerging seedlings and young crops. This stress is often, but not always, water deficit. Another stress associated with water deficit is deep sowing because in some situations seed must be sown deeper than ideal so it is in contact with moist soil to initiate germination. In 2013 we investigated the response of wheat cultivars to deep sowing in moist soil but the effects we observed were confounded with seed source. In 2014 we used seed produced in a single environment to test 1) whether wheat cultivars differ in their ability to emerge from depth, 2) whether using larger seed is better under stressful conditions, and 3) whether responses to sowing depth are the same when the soil is moist throughout and when it is moist at depth but dry on the surface.

Method

Seed of 7 wheat cultivars adapted to Western Australian conditions was retained from a trial at Wubin in 2013 (average yield 3.05 t/ha). Seed of each variety was sieved to separate it into large and small seed fractions (Table 1). This seed was sown into moist soil approximately 40 mm deep or 80 mm deep at rates calculated to give 120 plants/m² at Merredin and at Buntine in late May. The same seed was sown at Mullewa in early August about 80 mm deep into soil that was dry in the top 50 mm but moist below this. All trials were given adequate fertiliser and weeds were controlled in line with commercial farmer practice. The properties of the seed used are shown in Table 1. Note the large and small size classes are not all the same size. In particular, the large Estoc seed was smaller than the small Corack seed. Also, seed size affected coleoptile length. The coleoptile lengths given here are predicted for a thousand seed weight (TSW) of 38 g. Coleoptile length was reduced by an average of 0.7 mm for each 1 g reduction in TSW.

Table 1. Characteristics of the seed used in experiments described this article.

Cultivar	Thousand seed weight (g)		Germination (%)		Predicted Coleoptile length (mm)
	Large	Small	Large	Small	
Cobra	36.7	21.2	97	97	74
Corack	43.0	34.6	95	100	82
Emu Rock	44.4	23.6	96	96	73
Estoc	32.5	21.8	100	96	90
Mace	37.7	30.0	100	98	74
Magenta	40.1	22.4	95	96	86
Wyalkatchem	43.7	32.0	100	98	73

Results

Seed depth trials

The average seed depths were 39 and 75 mm respectively for shallow and deep sowing at Buntine,

and 44 and 79 mm at Merredin. 5 weeks after sowing plant establishment in the shallow sowing was 87% and 107% respectively of the target 120 plants/m² at Buntine and Merredin, but only 50% and 74% of the target when sown deep. Figure 1 shows that while there were subtle differences between cultivars in establishment, small seed was much more sensitive to deep sowing than large seed.

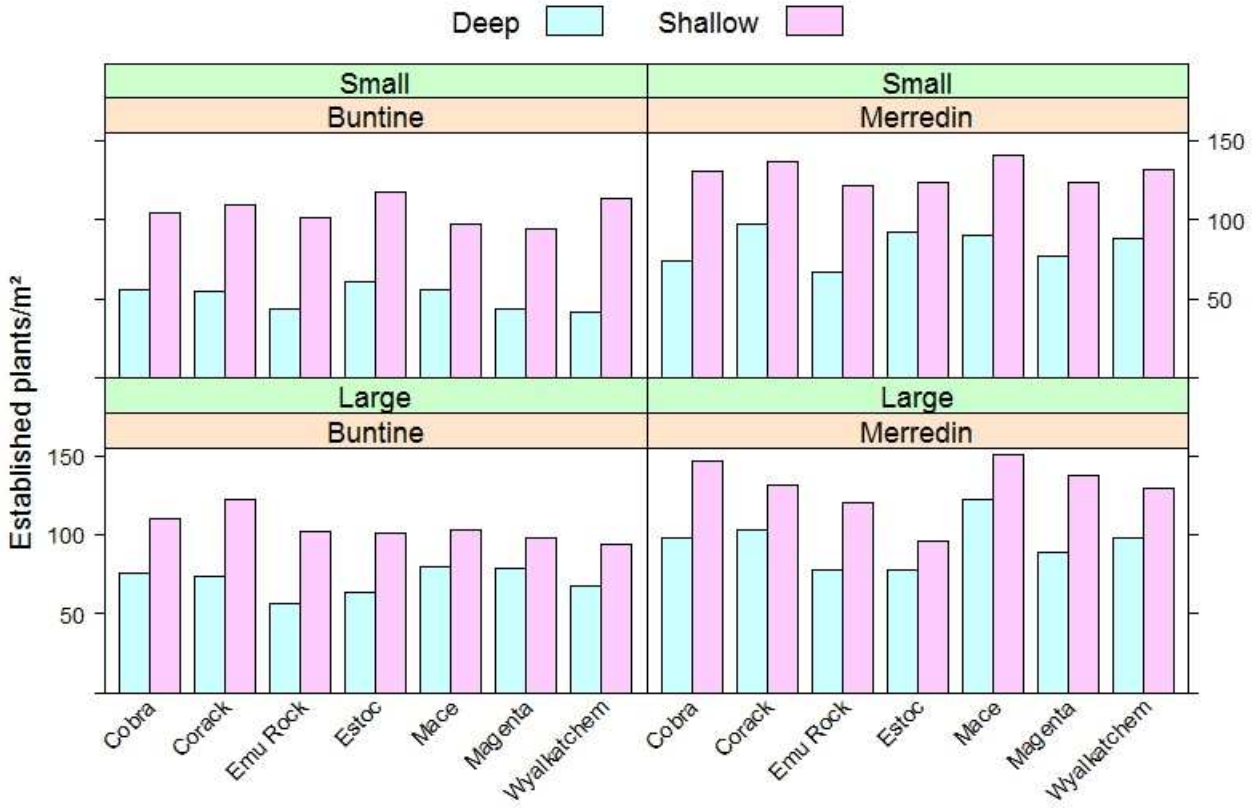

Figure 1. Establishment of 7 wheat cultivars when sown deep (75-79 mm) or shallow (39-44 mm) at Buntine and Merredin in 2014.

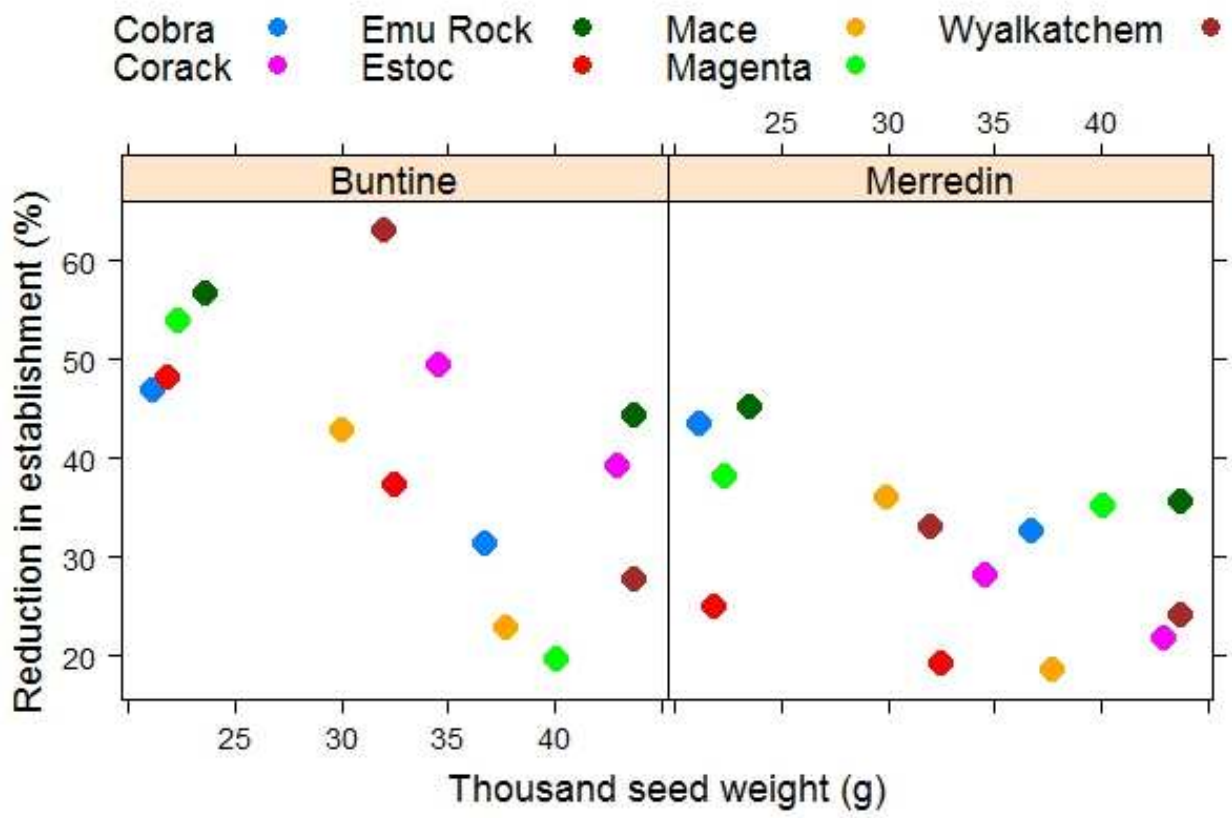

Figure 2. Small wheat seed is more sensitive to deep sowing (75-79mm) than large seed.

The importance of seed size in the sowing depth response is clearer in Figure 2. Regression analysis (not shown) suggests that, although the slope of the relationship between TSW and sensitivity to deep sowing differed between

Buntine and Merredin, it did not differ between cultivars. Corack, Emu Rock and Wyalkatchem were more sensitive to deep sowing than other cultivars after adjusting for the effects of seed size.

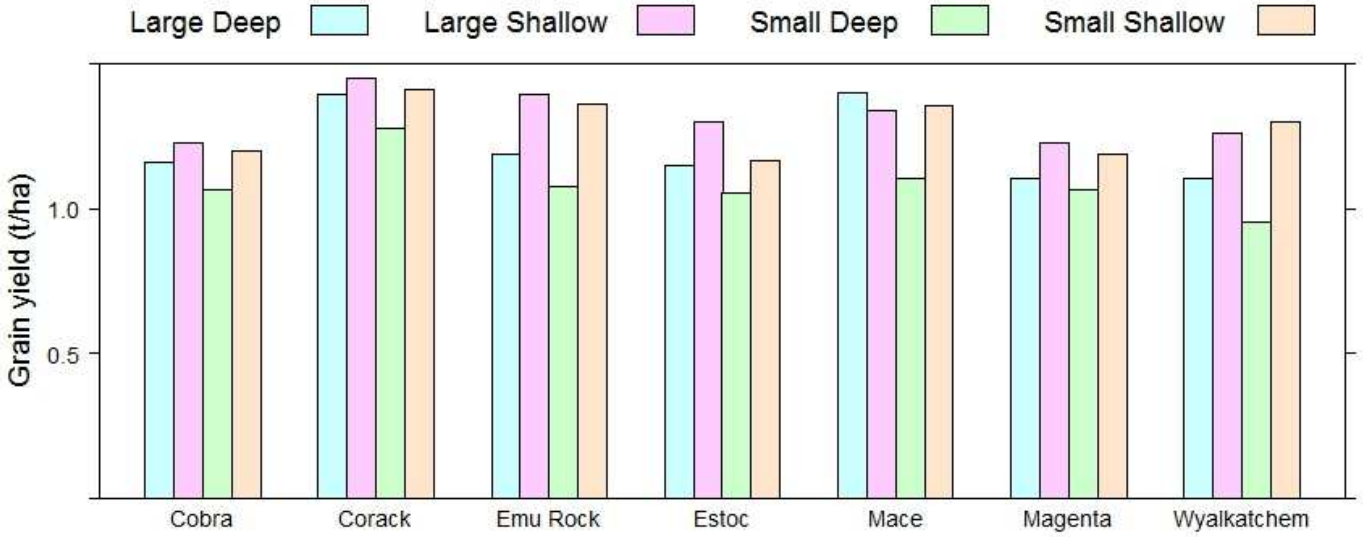

Figure 3. How deep sowing and seed size affected grain yield of 7 wheat cultivars at Buntine in 2014 (lsd 0.12).

At Buntine deep sowing reduced yield by 13% (148 kg/ha) on average. Seed size did not affect yield when sown 40 mm deep, but reduced it by an average of 12% (128 kg/ha) when sown 75 mm deep (Figure 3). Wyalkatchem and Emu Rock were the most sensitive cultivars to deep sowing in terms of yield, but small seeded Mace was also quite sensitive. Regression analysis showed effects on yield were closely related to effects on establishment. Very dry winter and spring conditions at Merredin meant yields were very low and meaningful yield data could not be collected.

Moisture chasing trial

When this trial was sown on 5 August soil volumetric moisture content was less than 5% at 50 mm depth, 10% at 100 mm and 14% at 200 mm. We estimated wilting point for this soil was 0.066, and field capacity was about 12%. After sowing volumetric soil moisture content in top 50 mm was 0.048, and in 50-80 mm was 0.091. The seed was placed 78 mm deep on average. There were no depth treatments in this experiment.

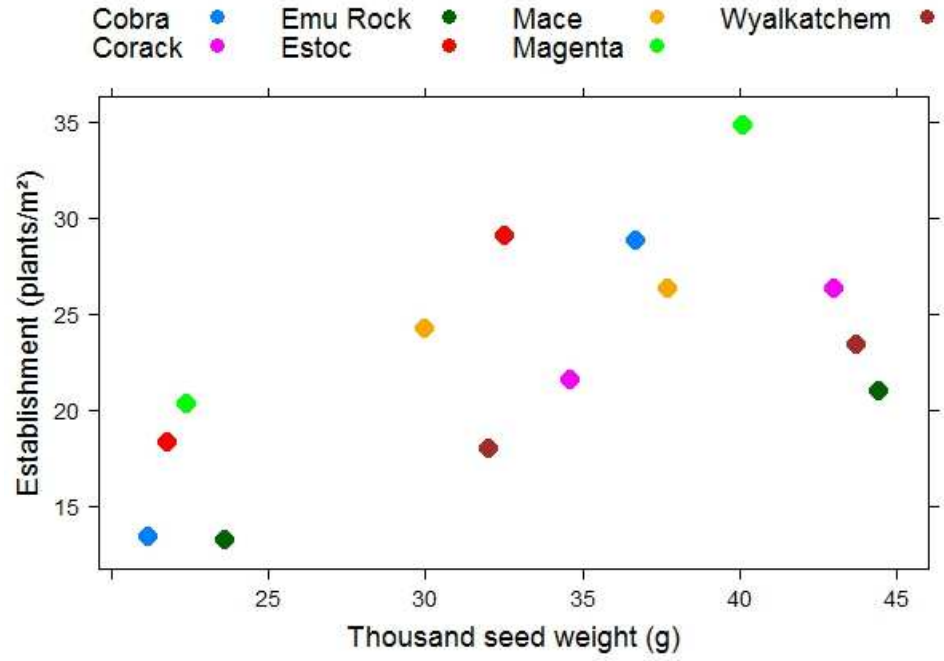

Figure 4. How seed size affected establishment of 7 wheat cultivars when sown deep into moist soil underneath a dry surface.

Establishment was much poorer than in the two sowing depth experiments, the best treatment only establishing 29% of the target density of 120 plants/m². However there was a clear advantage to larger seed. Regression analysis indicates that there were cultivar differences after adjusting for the seed size effect. The cultivars with poorest establishment were Corack, Emu Rock, and Wyalkatchem, the most sensitive to deep sowing in the other trials.

What size is farm produced seed?

The seed used in these trials covered a very large size range. How relevant are these sizes to seed farmers use? We measured seed size on 173 samples of wheat from the 2014 harvest delivered to CBH receival points in the Merredin district. 80 of these samples were Mace, but other cultivars with more than 10 samples were Calingiri, Magenta, Stiletto, and Wyalkatchem. Mean thousand seed weights were 35g or higher for each cultivar, except for Justica which, based on 3 samples, had a mean of only 29g. Most cultivars had means in the range 37-39 g, but Calingiri, Corack, Spear, Stiletto, and Yitpi all had mean thousand seed weights greater than 40g. Some individual samples had quite small seed (Figure 5) but these were not common. Of the 173 samples only 15 had thousand seed weights less than 35g.

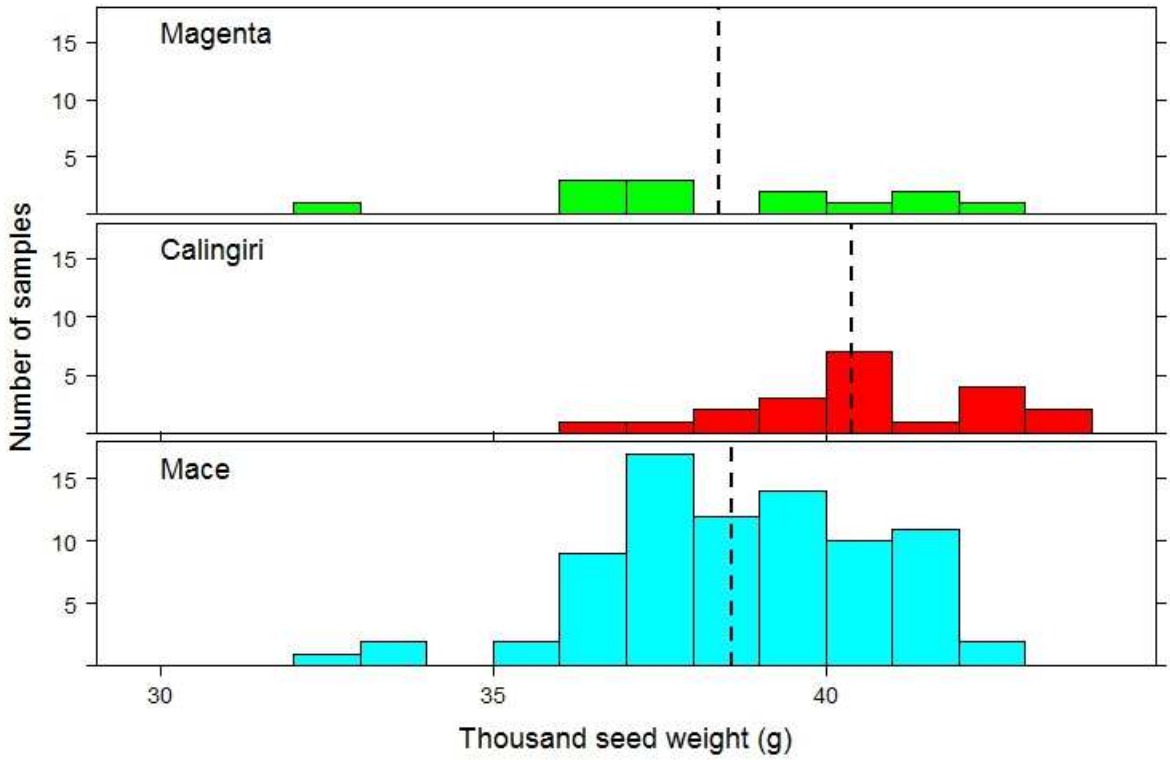

Figure 5. Distribution of seed sizes for Mace, Calingiri, and Magenta wheat delivered to CBH in the eastern wheatbelt in 2014 Dotted line shows the mean of each distribution.

Conclusion

Corack, Emu Rock, and Wyalkatchem were more sensitive to deep sowing than Cobra, Estoc, Mace, or Magenta when assessed on the basis of how much crop establishment is reduced. Small seed increased sensitivity to deep sowing as well, particularly when it was smaller than 35 g/thousand seeds. This was true both in moist soil and in when sown deep to chase moisture in soil with a dry surface. Differences in establishment translated into differences in grain yield, although Corack was the highest yielding cultivar at Buntine despite being sensitive to deep sowing in terms of establishment.

On the basis of our data we recommend that growers only use seed larger than 35 g/thousand seeds must be sown deep to chase moisture. Most wheat grown in the Eastern Wheatbelt in 2014 satisfied this criterion although there were some crops with smaller seed. This seed should be avoided for sowing in 2015.

Key words

Wheat varieties, seed size, deep sowing, soil moisture

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