Comparing coleoptile length in wheat varieties

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Key Findings

- Varieties with the longest coleoptiles on average were Cutlass and Yitpi with 81 mm and 80 mm, respectively.
- Varieties with the shortest coleoptiles on average were Cobra and Wedgetail with 61 mm and 62 mm, respectively.
- Increasing soil temperature had a negative impact on coleoptile length with an average length of 67 mm recorded at 21°C, compared to 72 mm at 16°C.

Why do the trial?

The coleoptile is the protective sheath of tissue surrounding the stem of seedlings. The length of the coleoptile is an important characteristic when considering the seeding depth of cereals, especially during drier conditions when sowing deeper to reach soil moisture. If a variety is planted deeper than the potential length of the coleoptile, this can cause poor plant establishment as the shoot will emerge underground where it may never reach the soil surface.

The length of the coleoptile is influenced by a number of factors including variety, seed size, seed dressing, soil moisture and temperature. Genes found in many commercial semi-dwarf wheat varieties have also been associated with shorter coleoptile length, while taller varieties will have longer coleoptiles. However, the genetic variation for coleoptile length within Australian semi-dwarf wheat varieties is still considerable.

The aim of this experiment was to measure the coleoptile lengths of 12 wheat varieties under different soil temperatures according to average soil temperature data in late March and early May at Hart.

How was it done?

The experiment was a split-split plot design with three replicates of 12 varieties germinated in two soil types at two temperatures (Table 1).

Firstly, the base of individual seedling pots were filled with either Hart soil or Mallee sand and lightly compacted. Five seeds of each variety (in the size range of 25 - 28 mg) were placed on top of the compacted soil at the base of the pots. The pots were then filled loosely with the appropriate soil and firmly compacted so a one centimetre gap remained at the top of each pot. The soil was wetted to a field capacity and allowed to drain, the pots then placed on a tray, covered and placed inside an opaque plastic bag. The trays were then placed in growth rooms with temperatures set at 16°C and 21°C. After approximately 14 days the trays were removed from the growth rooms and the length of individual seedling coleoptiles was recorded.

Table 1. Wheat varieties, soil types and temperatures chosen for the coleoptile experiment.

Wheat Varieties	Soil Types	Temperatures
ADV08.0008	Hart Soil	21°C
ADV11.9419	Mallee Sand	16°C
Cobra		
Cutlass		
Kittyhawk		
Longsword		
LPB14-0392		
Scepter		
Trojan		
V09150-01		
Wedgetail		
Yitpi		

Results and discussion

Coleoptile length differed between varieties in this experiment ranging from 61 mm to 81 mm (Figure 1). The varieties with the longest coleoptile on average were Cutlass at 81 mm followed by Yitpi at 80 mm. At the other end of the scale Cobra, Wedgetail, LPB14-0392 and ADV08.0008 produced the shortest coleoptiles averaging 62 mm. There was no correlation between a varieties developmental type (spring, facultative or winter) and coleoptile length with the developmental types producing a range of coleoptile lengths.

The results show there were small variations in coleoptile length among the varieties trialed. If choosing to sow early with a winter variety (e.g. pre-Anzac day) and deeper into soil moisture the results show Longsword and Kittyhawk produced the longest coleoptile lengths.

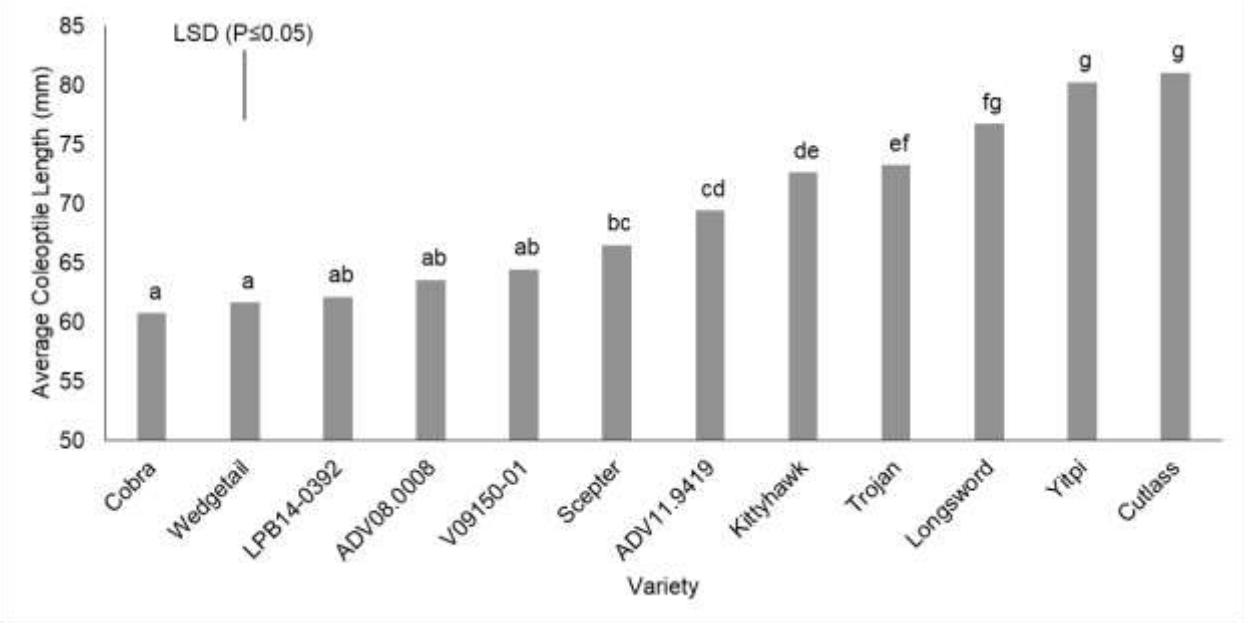

Figure 1. Average coleoptile length of varieties grown in two soil types and at two temperatures.

Coleoptile length also differed between temperatures used in this experiment (Figure 2). The results show a maximum average coleoptile length of 72 mm was recorded at 16°C, compared to a shorter coleoptile of 67 mm at 21°C. This is consistent with previous research of Australian commercial wheat varieties which has indicated coleoptiles can reach their optimal length at soil temperatures around 15°C, but shorten linearly when approaching temperatures around 35°C (Radford, 1987).

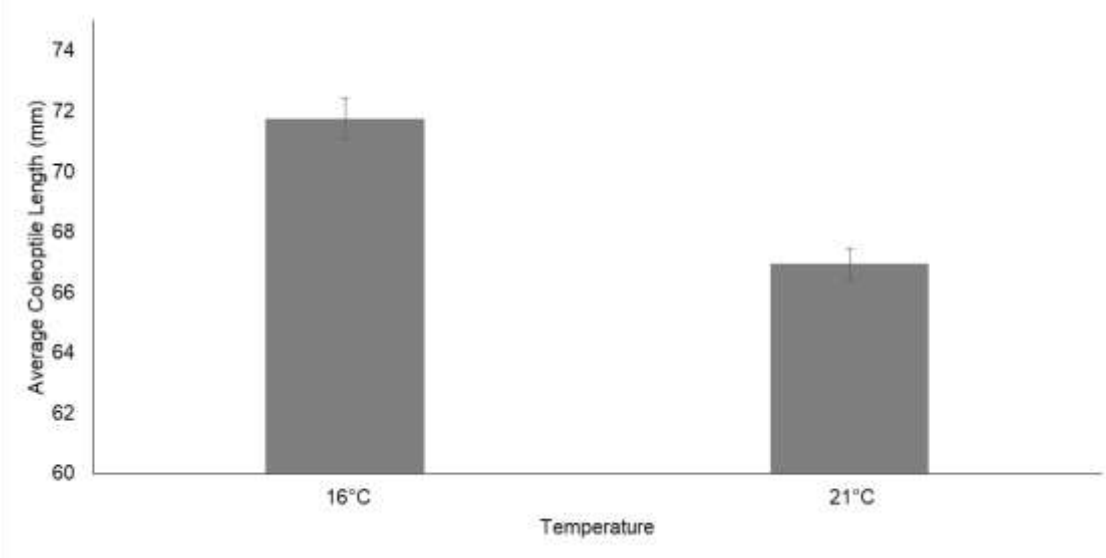

Figure 2. Average coleoptile length of wheat varieties grown at two temperatures based on soil temperatures in late-March (21°C) and early-May (16°C) at Hart.

Summary / implications

The varietal differences in coleoptile length were significant with Cutlass and Yitpi recording the longest coleoptiles at 81 mm and 80 mm, respectively. An increase in soil temperature had a negative effect on coleoptile length and soil types (clay loam v sand) did not affect coleoptile length.

Wheat varieties that have longer coleoptiles can be sown deeper to access stored moisture from summer rainfall events. These varieties would be better suited to capturing yield benefits associated with early sowing opportunities compared with shorter coleoptile varieties, especially when sowing into warmer soils. Special attention also needs to be given to incorporated herbicides and seed treatments. However, a greater evaluation of commercially available and developing wheat varieties under a variety of treatments and growing conditions needs to be taken to determine their suitability to early sowing conditions in Southern Australia.

References

Radford BJ (1987) Effect of constant and fluctuating temperature regimes and seed source on the coleoptile length of tall and semi-dwarf wheats. *Australian Journal of Experimental Agriculture* 27, 113–117. doi:10.1071/EA9870113.