

Seed Coat Colour as a Driver of Antioxidant, Tannin and Morphological Variation in Portuguese Common Bean Germplasm

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Introduction



Common bean (*Phaseolus vulgaris*) is the most consumed legume in Portugal (3.1 kg/per capita/year in 2025, INE, 2026)

Beans are rich in phenolic compounds and other antioxidants, with dark-coloured seed coats generally associated with higher levels. However, the health-related potential of Portuguese bean accessions remains poorly characterised.



Portuguese germplasm includes ~1,405 landraces but only a few are commercially grown

Represent valuable genetic resources for climate resilience and sustainable agriculture

Methods

257 Portuguese common bean accession with the colours:



Common bean seeds were screened for:

- **Morphology** (pod per seed, seed per pod, seed weight, height, width, length)

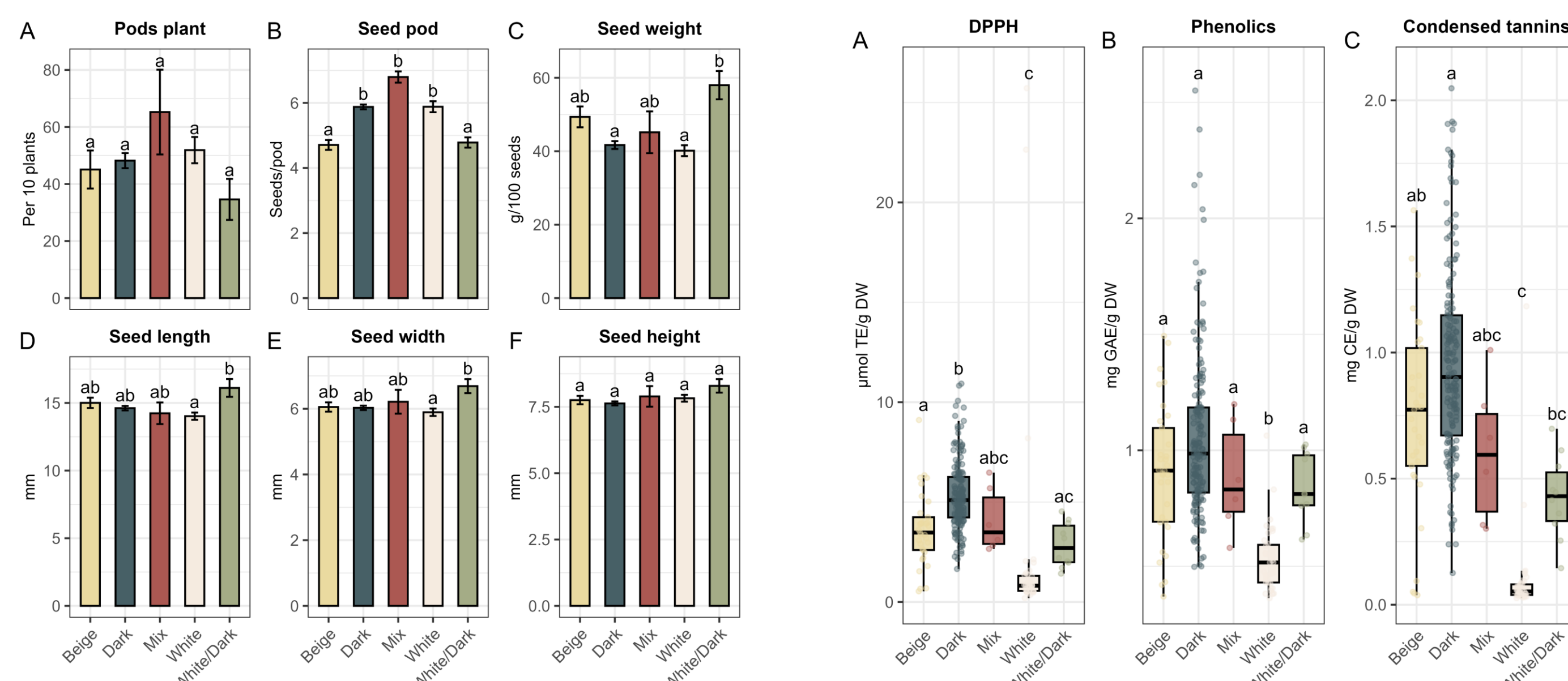
And milled for the analysis of:

- **Antioxidant capacity** (DPPH activity and total phenolic content) and **condensed tannins**



This work aimed to characterise the morphology, antioxidant and bioactive profiles of Portuguese common bean accessions and assess the influence of the seed coat colour on the profiles, revealing diversity patterns and supporting the selection of high-quality germplasm to promote its conservation, consumption and cultivation.

Results and Discussion



Different letters indicate significant differences (Kruskal-Wallis + Dunn test, $p < 0.05$)

Seed morphology

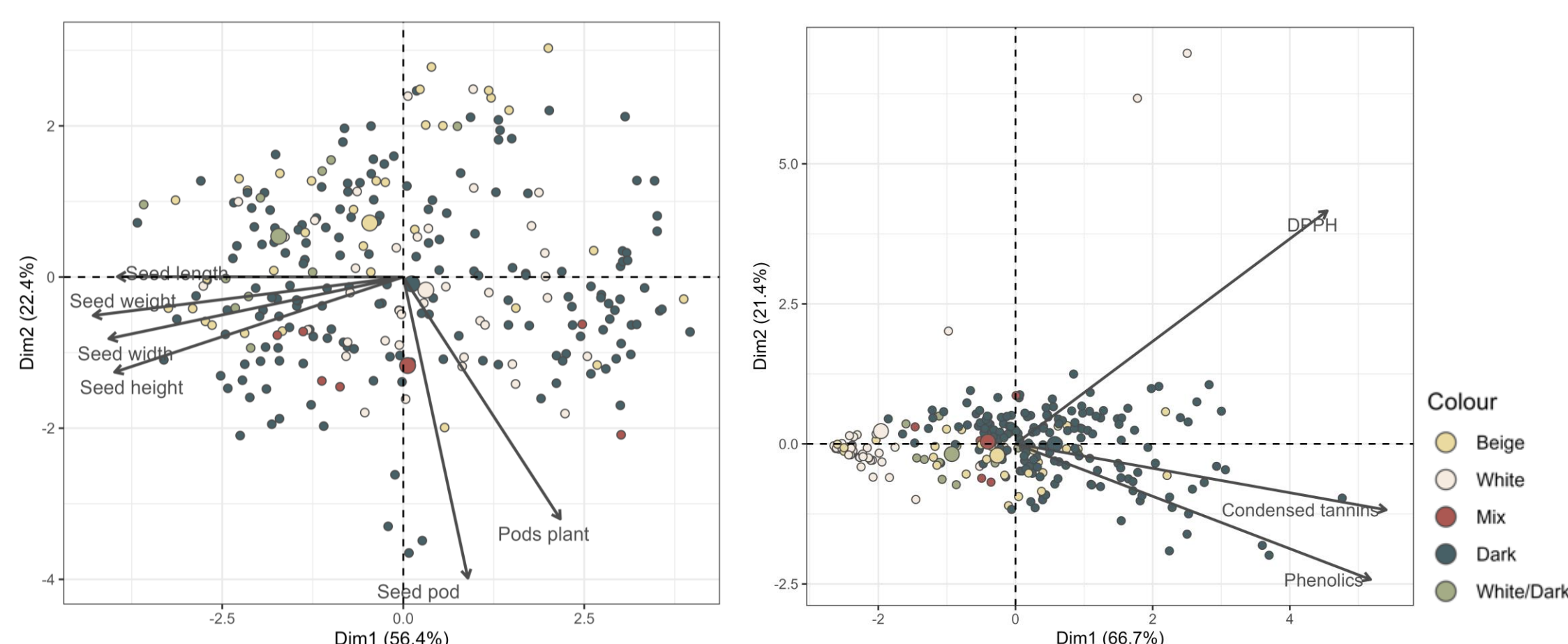
Seed coat colour had higher impact on the number of pods per plant and seeds per pod

Mix-coloured seeds produced ~ 65 ± 36.4 pods per plant and ~ 7 ± 0.4 seeds per pod

Antioxidant and bioactive compounds

Dark-coloured seeds have significant highest DPPH activity ($5.35 \pm 1.74 \mu\text{mol TE/g DW}$) and condensed tannins ($0.96 \pm 0.39 \text{ mg CE/g DW}$)

White-coloured seeds have significant lowest DPPH activity ($2.28 \pm 5.32 \mu\text{mol TE/g DW}$), phenolics ($0.53 \pm 0.14 \text{ mg GAE/g DW}$) and condensed tannins ($0.1 \pm 0.19 \text{ mg CE/g DW}$)



Seed morphology, antioxidant and bioactive compounds

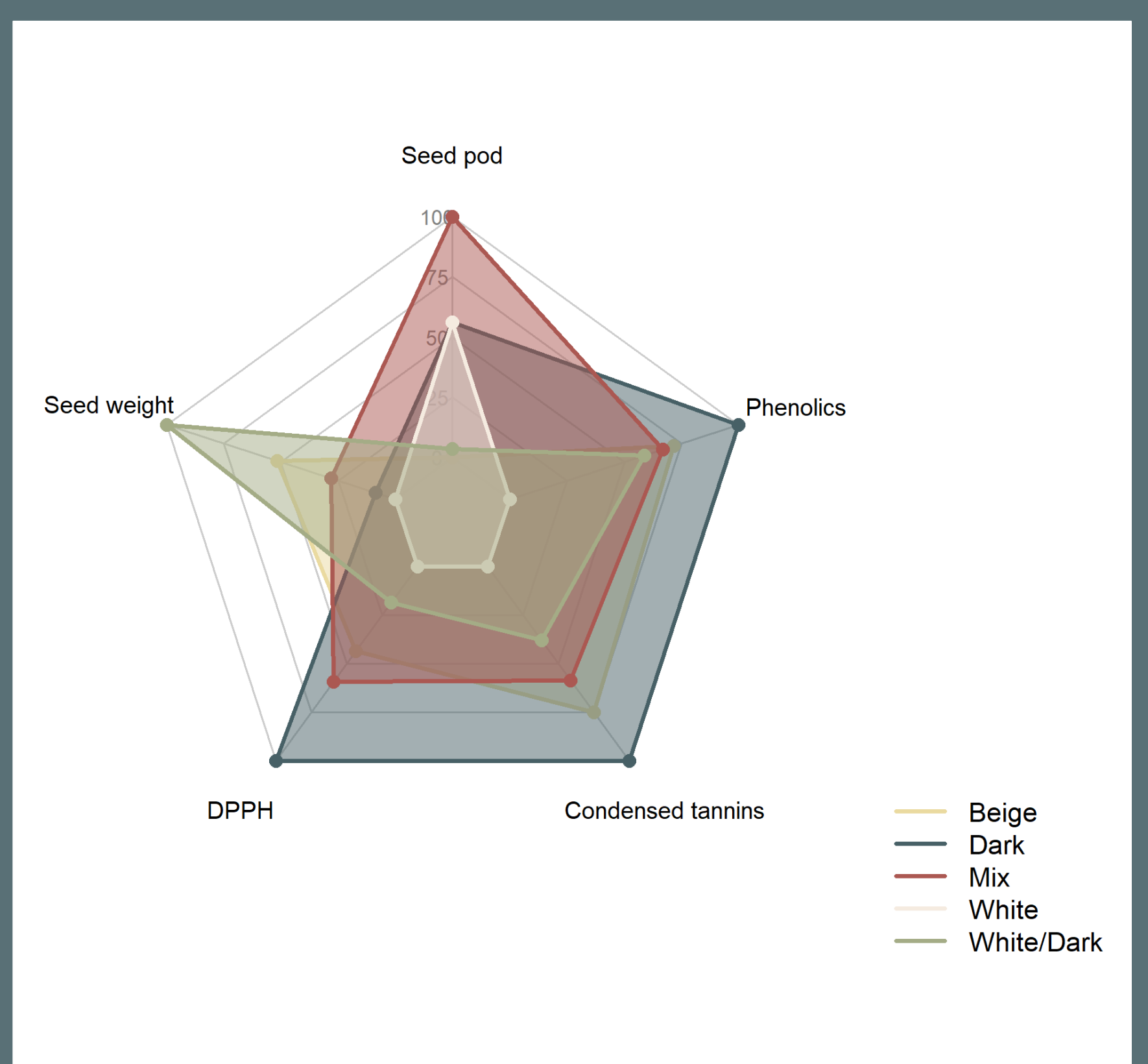
Beige and white with dark spots coloured seeds cluster towards seed size traits while mix-coloured seeds to reproductive traits

Dark-coloured seeds have stronger correlation with higher phenolics, condensed tannins and DPPH, while white-coloured seeds have weaker correlation

Higher antioxidant capacity and condensed tannins can be linked to bigger morphology, while reproductive traits to lower capacity and tannins

Conclusion

- White-coloured seed coats show **greater allocation to reproduction** than to oxidative stress defence.
- Dark-coloured seed coats have **higher allocation to antioxidant activity and bioactive compounds** than to seed size and reproduction.
- Beige-coloured seed coats replicated dark-coloured seeds patterns
- Mix-coloured seed coats had **moderate oxidative stress defence and higher seed reproduction**



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