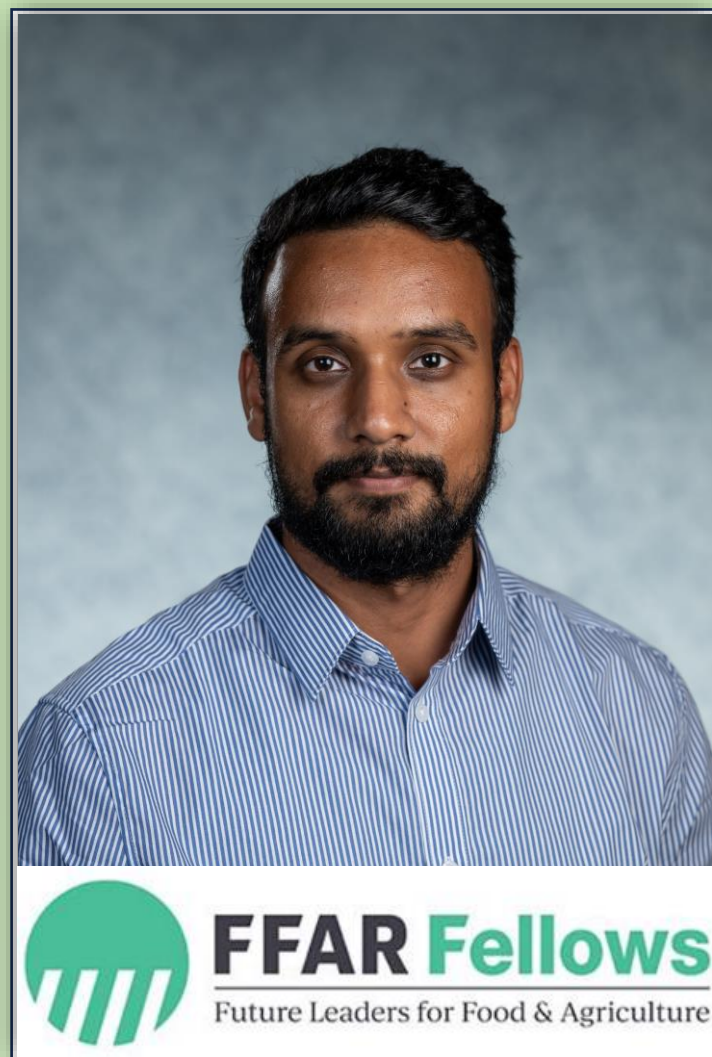




Vernalization Response and Freezing Tolerance of *Poa secunda*, a Promising Perennial Groundcover

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Background

- **Importance of *Poa secunda***
P. secunda, a native cool-season bunchgrass with early spring growth and summer dormancy, is a promising perennial groundcover (PGC) for providing ecosystem services in Midwest cropping systems.
- **Cultivar development using controlled hybridization in *P. secunda* is lacking**
P. secunda requires vernalization, an exposure to low temperatures and short-day length for flowering and seed production. The duration of vernalization required for flower induction in *P. secunda* is unknown.
- **Freezing tolerance in *P. secunda***
Excellent winter hardiness is an essential trait for an ideal PGC. Cool-season grasses acquire freezing tolerance with cold acclimation, an exposure to low temperatures and short-day lengths, a process similar to vernalization. Winter hardiness in *P. secunda* is poorly characterized.

Objective

- **Determine Vernalization Requirements**
Identify the minimum cold exposure needed to induce flowering across *P. secunda* genotypes and assess variation in flowering intensity and timing.
- **Evaluate Freezing Tolerance**
Quantify genotypic differences in freezing injury thresholds (LT₅₀) under non-acclimated and cold acclimated conditions using electrolyte leakage assay.

Materials & Methods

- **Plant Material**
Three *P. secunda* genotypes ('High Plains', 'Hanford', and 'Vale') were used for both experiments. *Poa pratensis* (Kentucky bluegrass, KBG) served as a winter-hardy control in the freezing tolerance assay.
- **Vernalization Experiment**
Design: Factorial with six vernalization durations (0, 3, 6, 9, 12, 15 weeks), 3 genotypes, and 3 replications.
Conditions: 5 °C, 8 h photoperiod during vernalization → transferred to 22 °C, 16 h photoperiod for flowering.
Observations:
 1. Days to first flowering (DOF)
 2. Number of flowering tillers (NFT)
- **Freezing Tolerance Experiment**
Treatments: Non-acclimated (NA) plants maintained at 20°C with a 12 h day length. Acclimated (CA) plants maintained at 5°C with an 8 h day length for 5 weeks.

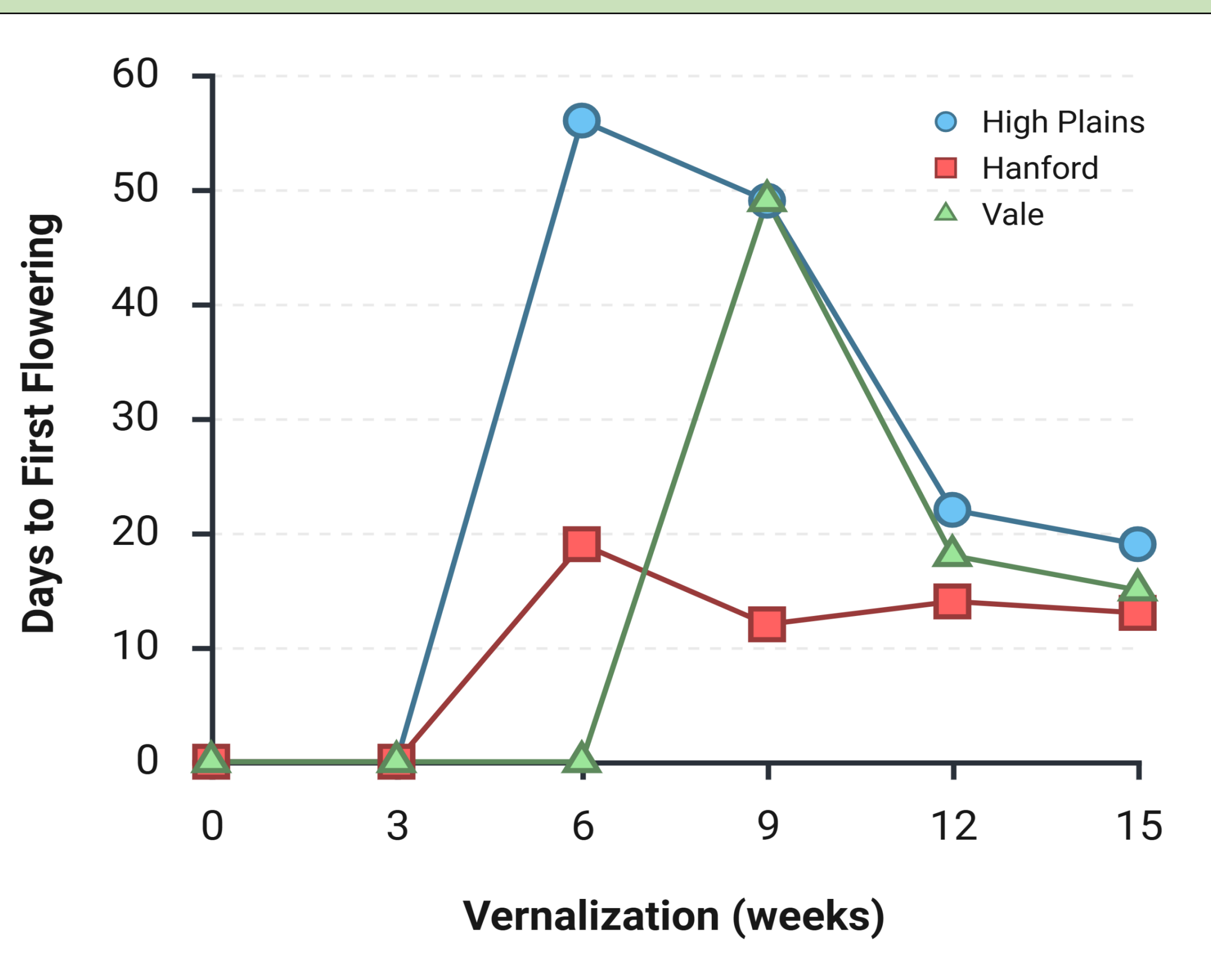


Fig 1. Effect of vernalization duration on the days to first flower in 3 *P. secunda* genotypes

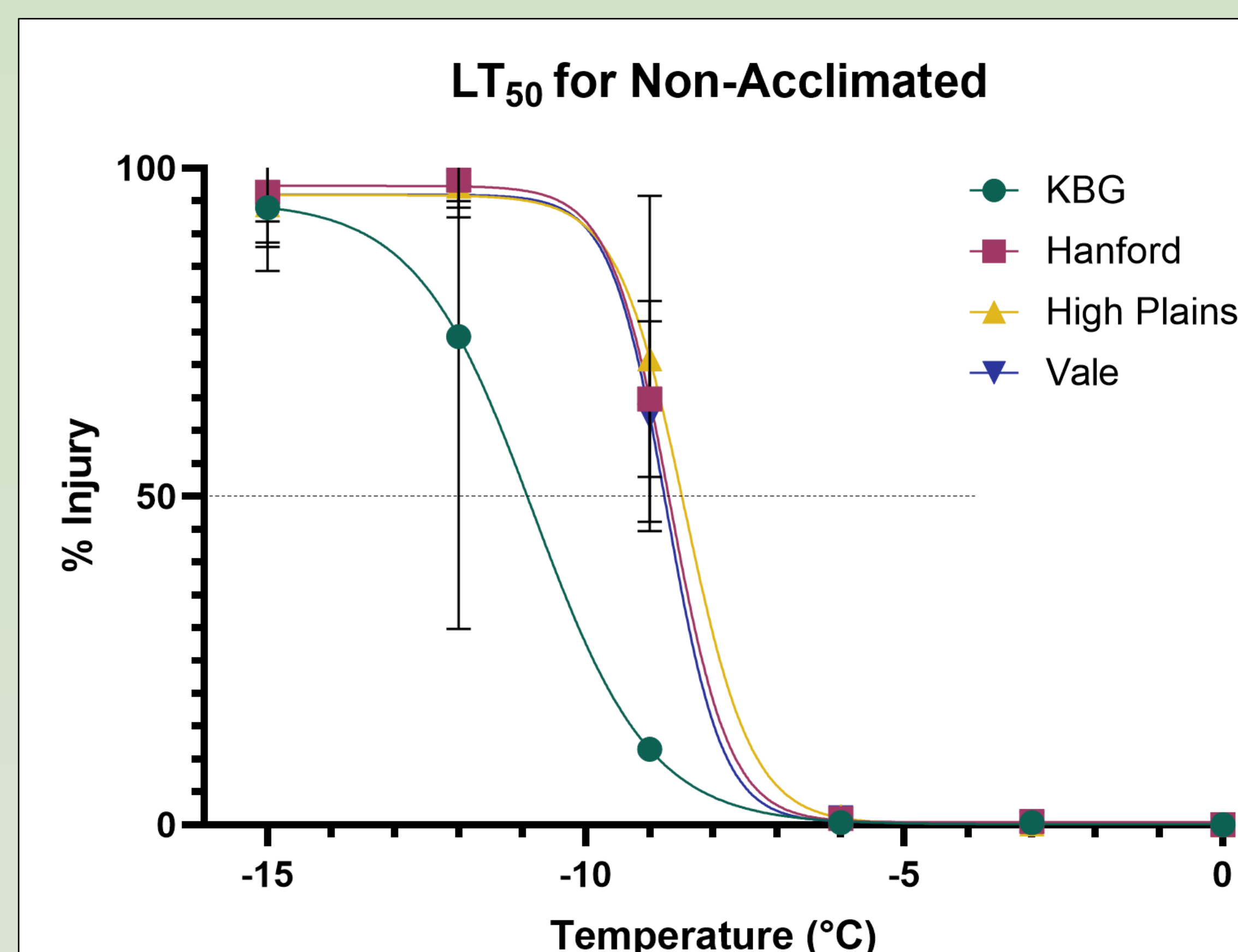


Fig 2. Genotypic variation in freezing tolerance (LT₅₀) under non-acclimated conditions

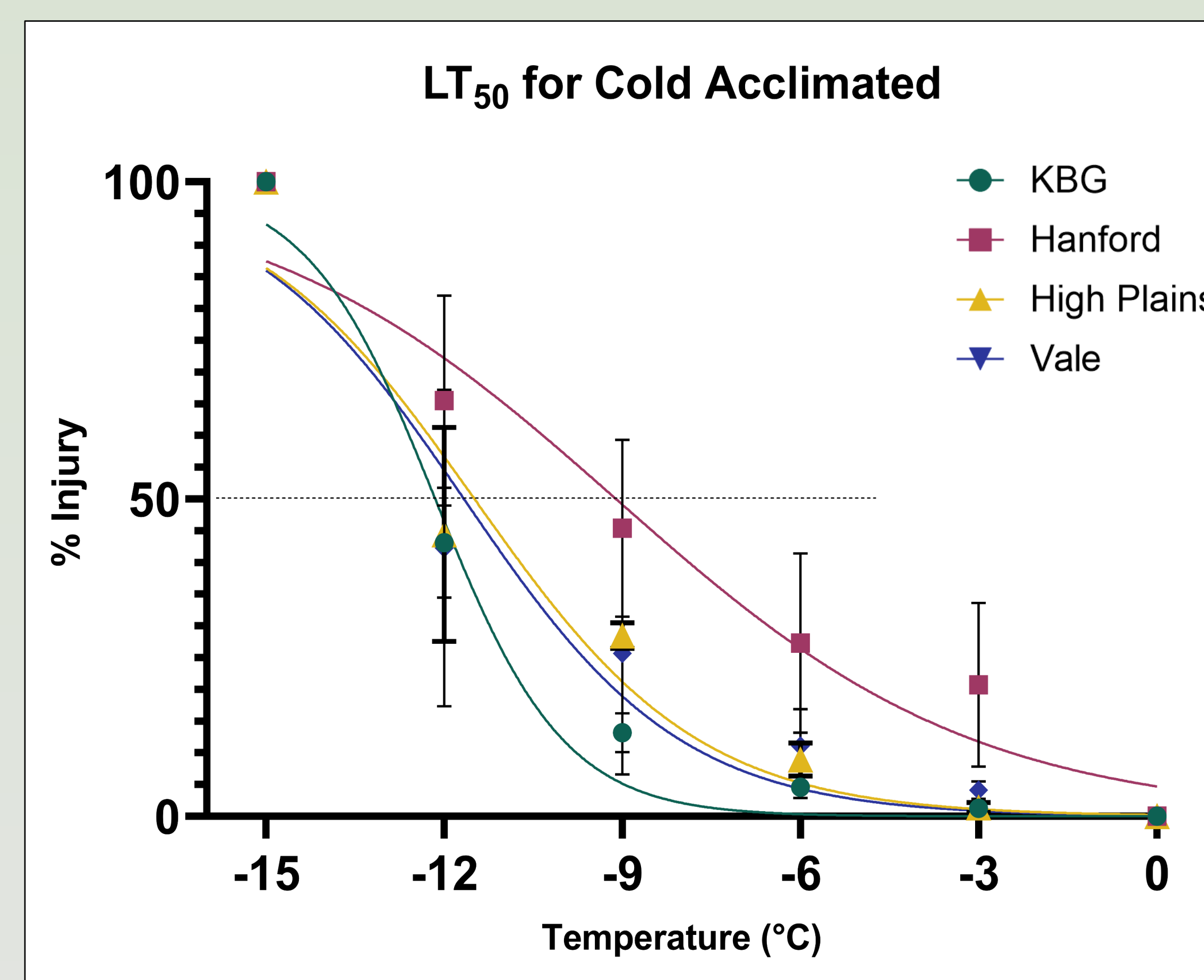


Fig 3. Genotypic variation in freezing tolerance (LT₅₀) under cold-acclimated conditions

Procedure: Leaf samples cooled from 0 °C to -15 °C in a programmable freezer; injury assessed via electrolyte leakage at 0, -3, -6, -9, -12, and -15 °C.

Results

- **Vernalization Requirement**
 1. No flowering occurred without vernalization or with only 3 weeks of vernalization.
 2. 'Hanford' requires the shortest vernalization duration (6 weeks) and fewest days to first flowering (20 days).
 3. 'Vale' required the longest vernalization (≥ 9 weeks) and flowered the latest.
 4. Increasing vernalization duration consistently reduced days to flowering and increased number of flowering tillers across all genotypes.
- **Freezing Tolerance**
 1. NA plants showed little variation among *P. secunda* genotypes, and all were less freezing tolerant than KBG.
 2. CA plants revealed genotypic differences, with KBG most tolerant (-12.2 °C), 'Vale' and 'High Plains' intermediate (~-11.6 °C), and 'Hanford' least tolerant (-9.1 °C).

Genotypes	NA-LT ₅₀	CA-LT ₅₀
KBG	-10.82	-12.2
'Hanford'	-8.68	-9.1
'High Plains'	-8.45	-11.5
'Vale'	-8.73	-11.7

Conclusion

- *P. secunda* genotypes showed significant variation in vernalization requirement and freezing tolerance, indicating useful genetic diversity for adaptation traits.
- NA plants exhibited moderate freezing tolerance (LT₅₀ ≈ -8.5 °C) with little genotypic variation, whereas CA increased tolerance and revealed differences among genotypes, with 'Vale' and 'High Plains' approaching the winter hardiness of KBG and 'Hanford' remaining less tolerant.
- These results highlight the importance of evaluating both flowering response and cold hardiness when selecting *P. secunda* germplasm for breeding climate-resilient perennial groundcover cultivars.