Is inflorescence preformation in overwintering buds linked to changes in plant phenology and plant functional traits?

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Introduction

Inflorescence organs inside overwintering buds (inflorescence preformation in buds (IPB)) in the year before the plant growth are widespread in herbaceous plants (Schnablová et al. 2021) varying however in development (Figure 1). As plants start their spring events earlier and autumn later with warming climate, the stage of IPB might play a role in the species-specific ability to respond to climate change. Here, we test the influence of IPB on plant phenology and its variability against the documented impact of plant functional traits such as specific leaf area (SLA) or leaf nutrients.

Methods

In total, we studied 83 plant species from eleven gardens across the Northern Hemisphere in multiple years. Buds were harvested in late autumn in the Botanical gardens of Prague and Jena and analysed under a light microscope (Figure 1).
Plant phenology was observed weekly following the PhenObs protocol. We focus on the stages “peak flowering”, “beginning of fruiting” and “peak senescence”. We study the timing and the variability of four years and eleven gardens.
We analysed the impact of plant functional traits namely leaf N, C and C/N content, leaf dry mass, plant height, seed weight and SLA from the TRY database (www.try-db.org).
We analysed data using boosted regression trees which were simplified.

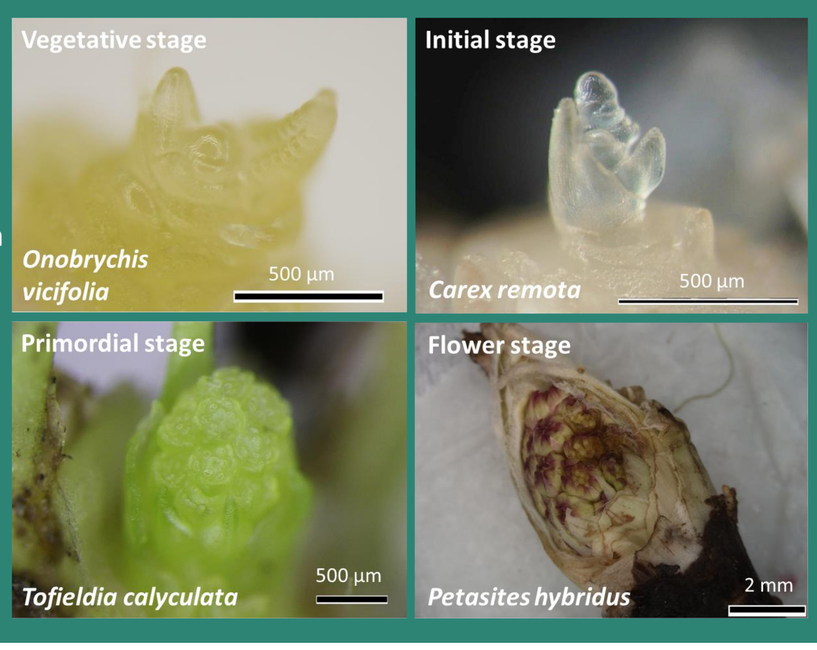

Figure 1: IPB classification:
0 - only vegetative meristem
1 - initial stage
2 - primordial
3 - primordial advanced
4 - full primordial
5 - flower stage

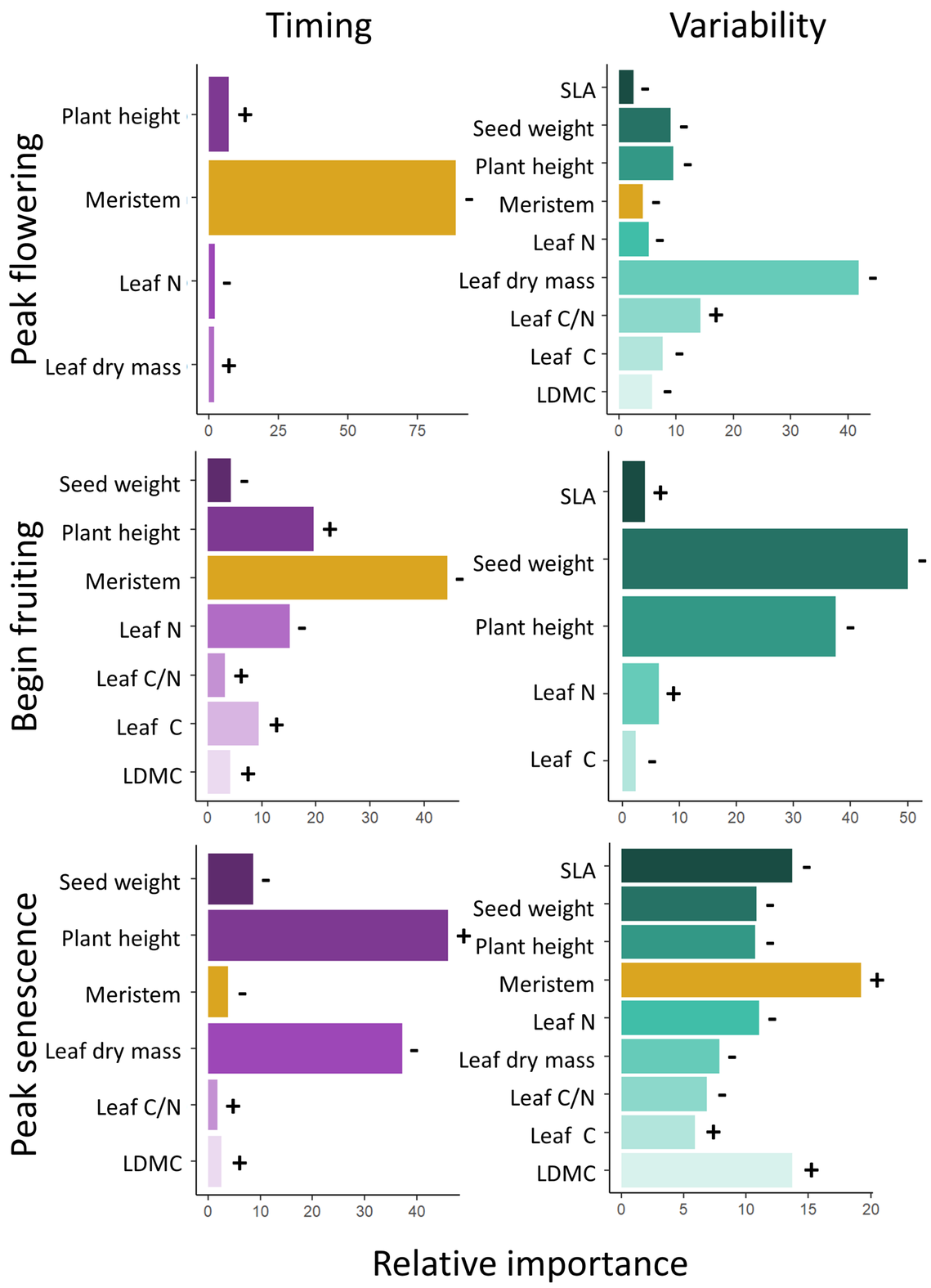

Figure 2: Boosted regression trees describing the timing and variability of phenological stages. “+” indicates positive relationships, i.e., higher values lead to later onset or higher variability, “-” to lower.

Results

More advanced meristems led to earlier flowering, earlier fruiting, and earlier senescence. IPB was more important for the timing of generative phenology than plant functional traits.
IPB had little influence on the variability of phenology unlike traits; plants with highly preformed buds showed little variability in between years and gardens. IPB had a high impact though on the variability of senescence with well developed species being more variable (see Figure 2).

Conclusions

The impact of the stage of IPB on the timing of reproductive phenology and the variability of senescence is higher than the one of traits (Sporbert et al. 2022). This has implications for the adaptation of plant phenology to changing climate.

Schnablová, R., L. Huang, J. Klimešová et al. 2021. Inflorescence preformation prior to winter: a surprisingly widespread strategy that drives phenology of temperate perennial herbs. New Phytologist 229:620-630.
Sporbert, M., D. Jakubka, S.F. Bucher et al. 2022 Functional traits influence patterns in vegetative and reproductive plant phenology - a multi-botanical garden study. New Phytologist 235:2199-2210.

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