

A comparative analysis of dormancy and germination of arable herb seeds of different origins

David Gergő Csongor Árpád Szemes, Leonid Rasran

Hypothesis:

Horticultural, commercial or conservational cultivation of arable weeds affect or alter their germination behaviour and ability to form dormant seeds compared to wild plants: Demand on (cold) stratification for breaking dormancy is lower for cultivated populations than for wild ones.

Methods:

8 arable herb species: *Agrostemma githago* (**Ag**), *Anthemis tinctoria* (**At**), *Bupleurum rotundifolium* (**Br**), *Legousia speculum-veneris* (**Ls**), *Petrorhagia prolifera* (**Pp**), *Ranunculus arvensis* (**Ra**), *Scandix pecten-veneris* (**Sp**), *Silene noctiflora* (**Sn**)

3 origins:

- Wild:** Seeds collected manually in Germany and Austria (6 locations each) from native populations
- Conservation:** Populations that focus on conserving the species. From botanical gardens of BOKU (A1) and University of Vienna (A5), as well as an agricultural field in Germany established for the conservation of local endangered arable herbs in the region (D1) under organic crop management
- Cultivation:** Obtained from one Austrian and one German certified regional seed producer (A2 & D8) from populations with a focus on seed production

Germination experiments: 2 groups and phases: stratification and incubation

- 1. Stratification:** cold stratification for 22 days in a cold room at 5 °C.
- 2. Incubation:** germination chamber for 21 days. Day-night-cycle: 12 h illumination with fluorescent tubes at 15 °C (day) and 12 h darkness at 10 °C (night)
- Cold group underwent phases 1 and 2; normal group underwent only phase 2

TTC Test:

- After phase 2, testing cut seeds with 1 % TTC (triphenyl tetrazolium chloride) solution
- Used as proxy measure for dormancy, Assumptions: TTC positive -> seeds viable but not germinating => dormant ; TTC negative = non-viable

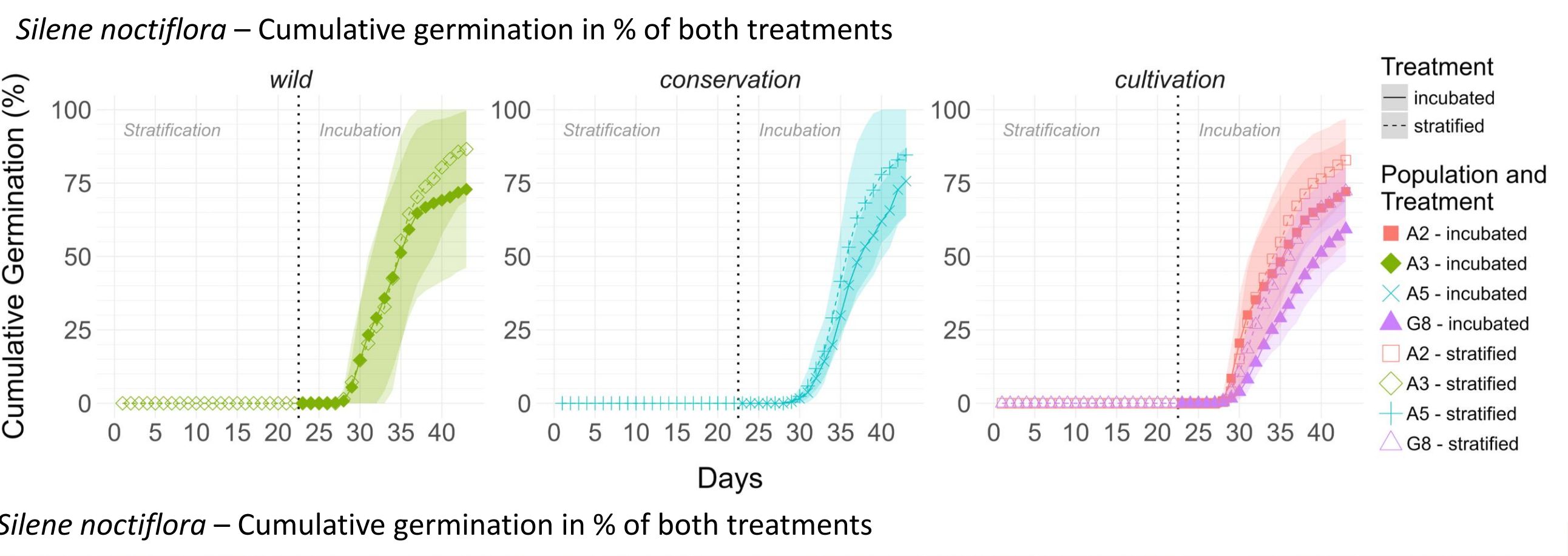
Results

Agrostemma githago:

- Quick germination, high germination ratio in all populations/treatments (**no dormancy!**), no differences between origins

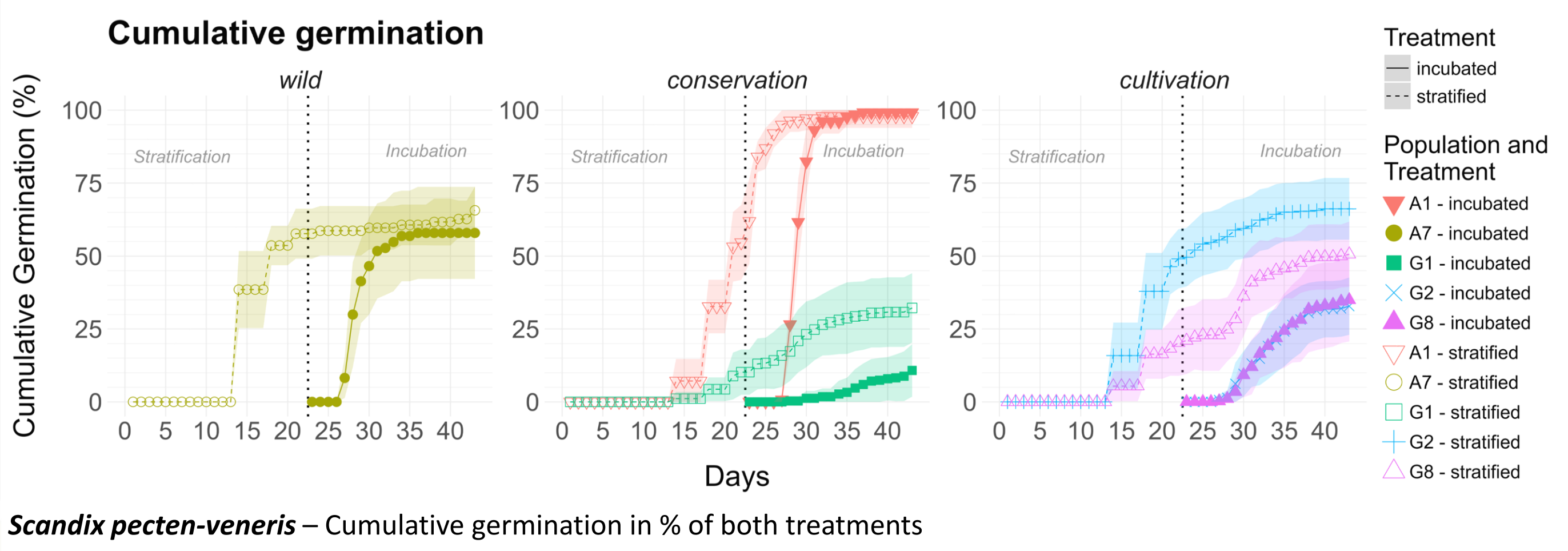
Silene noctiflora:

- Similar germination in all populations. **Dormancy** developed in all origins and could be broken by stratification.



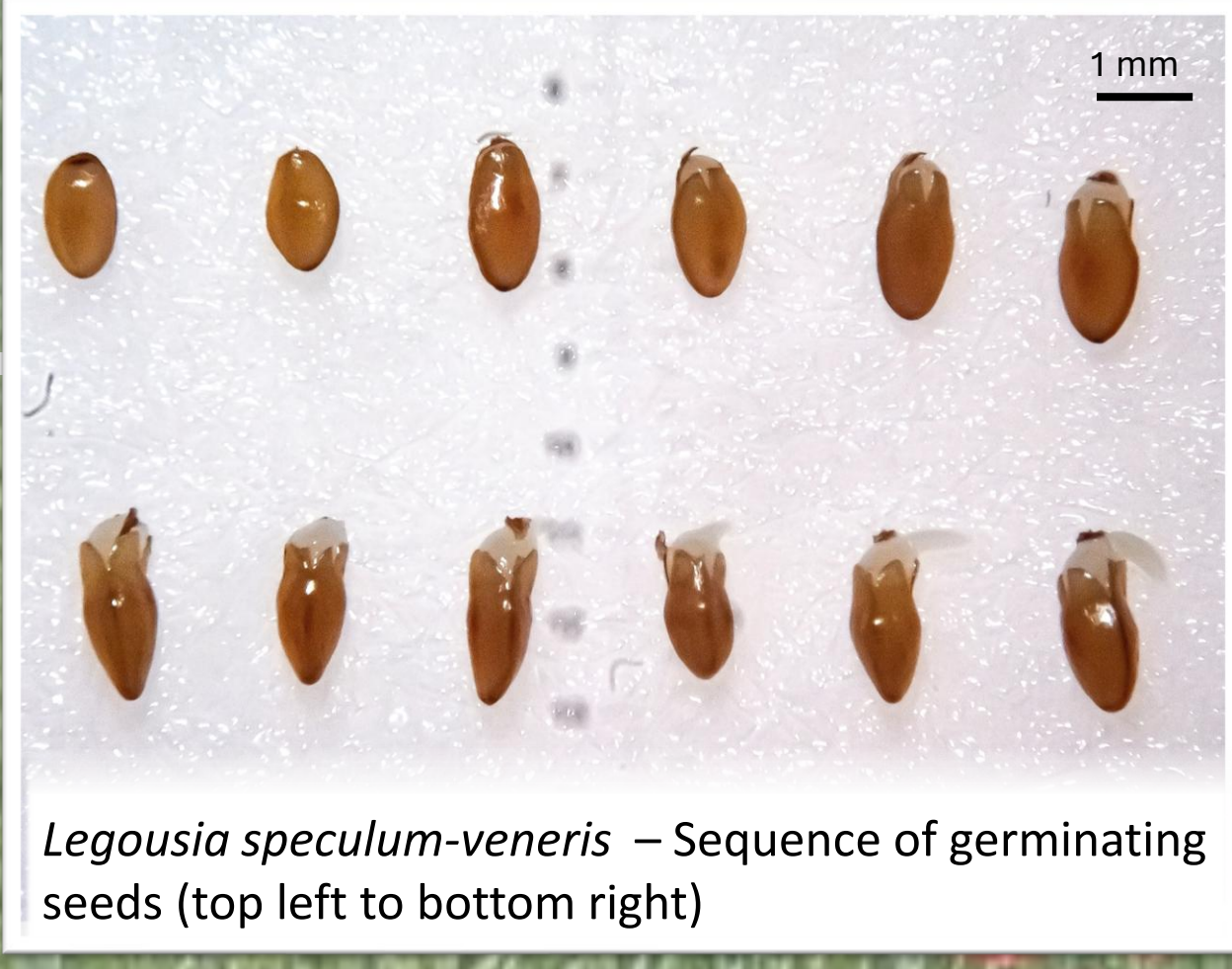
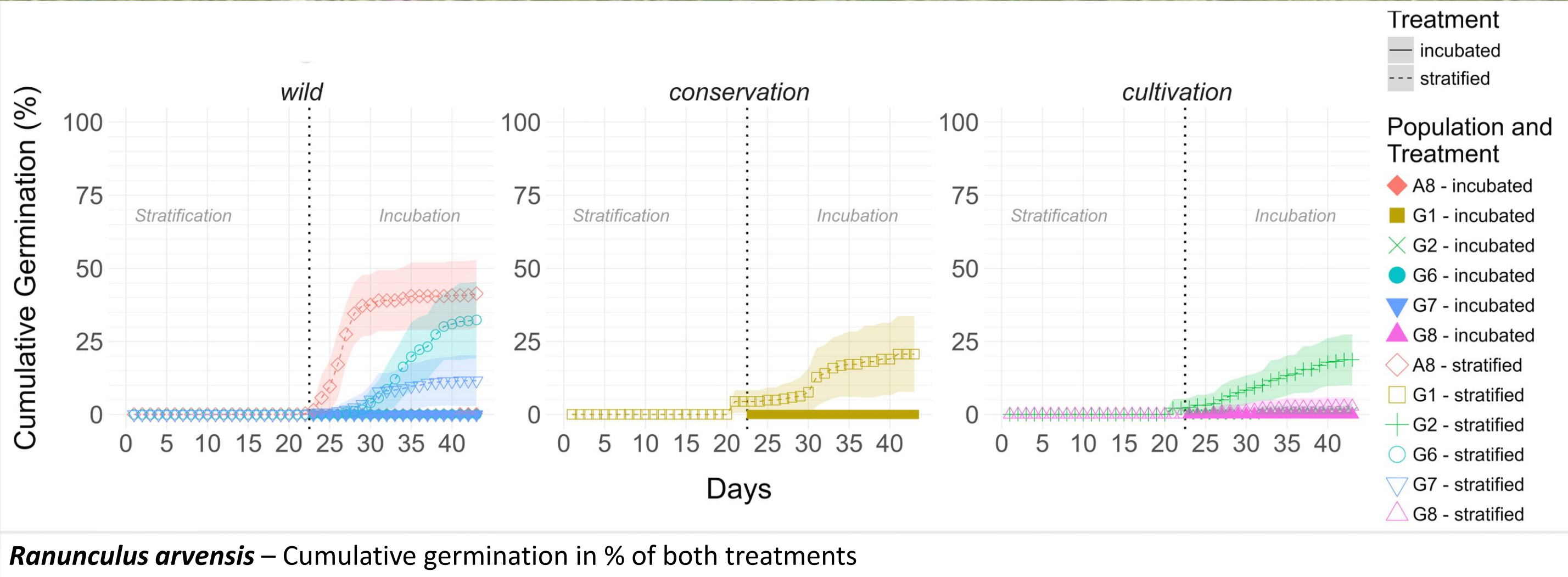
Scandix pecten-veneris:

- Germination behaviour differed strongly between all populations. The biggest discrepancy was observed between populations A1 and G1 (both considered as “conservation”). Higher dormancy in cultivated populations than in wild ones. **→ opposite to the expectation.**



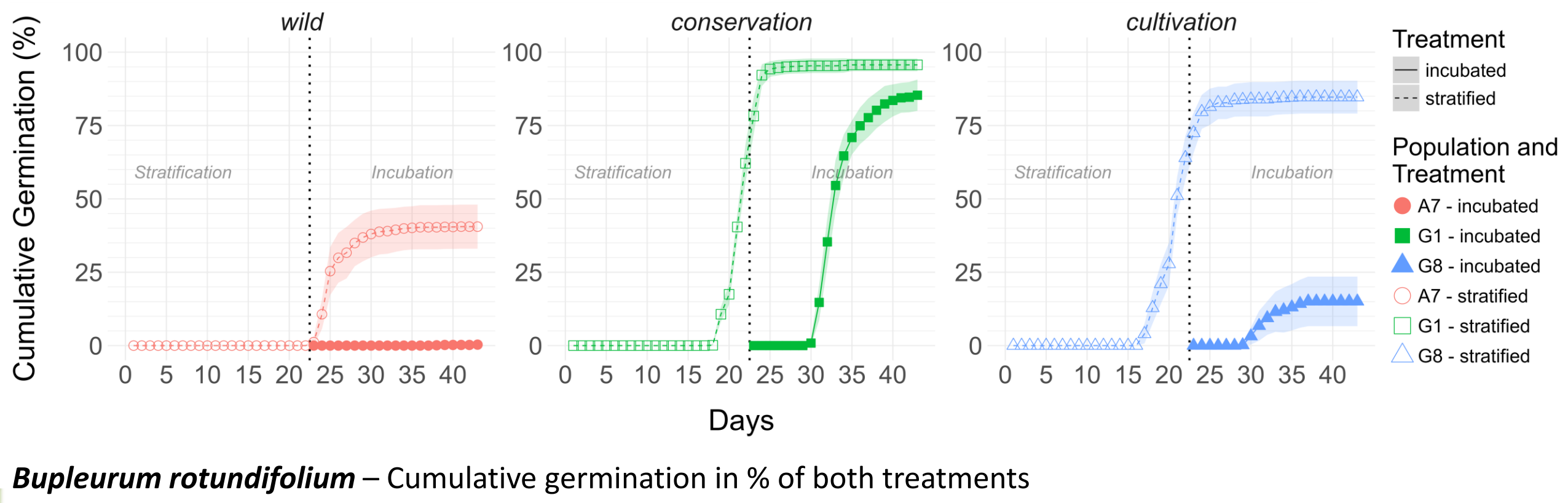
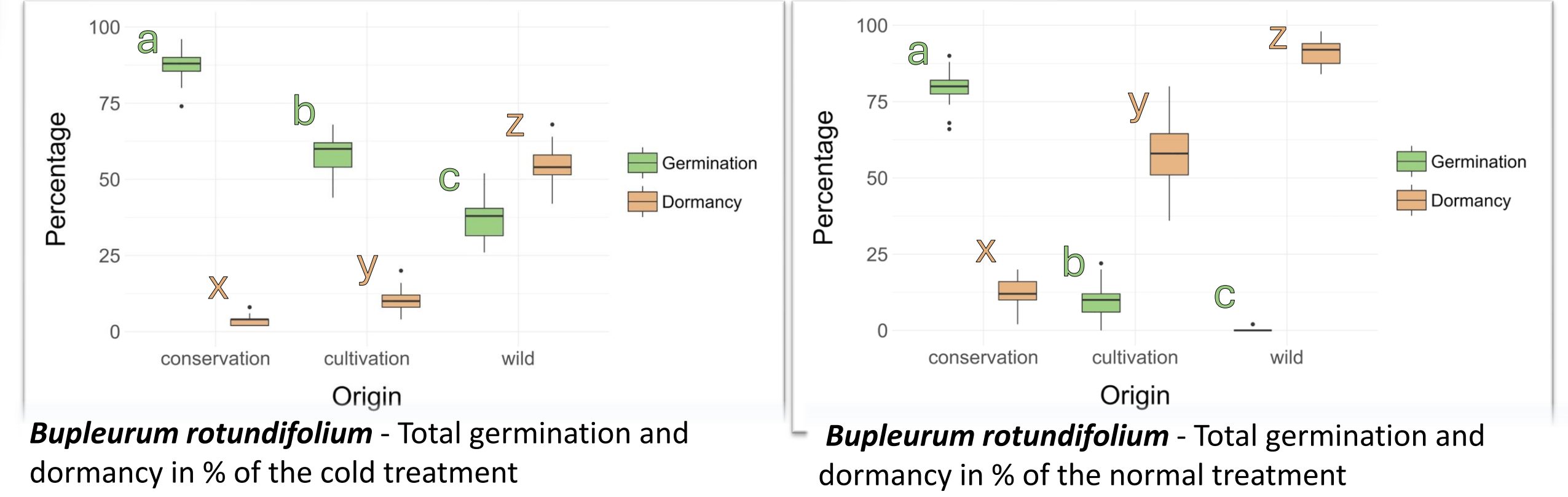
Ranunculus arvensis:

- Nearly no germination without stratification. Higher dormancy percentage in conservation and cultivation populations compared to wild. **→ opposite to the expectation.**



Bupleurum rotundifolium, *Cota tinctoria*, *Legousia speculum-veneris* and *Petrorhagia prolifera*:

- Significantly higher and faster germination and lower dormancy in cultivated seed compared to wild. Cold stratification clearly increased the germination rate, especially in wild populations. **→ Hypothesis confirmed.**



Discussion & Conclusions

Half of the studied arable herb species are affected by dormancy loss (*Br*, *Ct*, *Ls*, *Pp*) and change germination behaviour under conservation and cultivation management, while others (*Ag*, *Sn*) remain indifferent or even display increased dormancy (*Ra*, *Sp*). We also observed a notable variability in dormancy and germination rates between different populations, as well as between populations of the same origin in several species.

Therefore, wild and non-wild populations may have developed specific dormancy and germination patterns causing them to react in different ways and to varying degrees to ex-situ cultivation. This highlights the need for further research of the mechanisms controlling dormancy and germination behaviour in arable herb populations. Such knowledge is essential to better understand the processes involved in the natural balance of soil seed banks and their seasonal fluctuations in germinability, as well as how they are affected by anthropogenic influences. This is particularly relevant for long-term re-establishment of target species, as it remains highly uncertain whether dormancy related traits that have been lost during ex situ cultivation can be recovered through natural selection after re-introduction into nature.

For more details: Szemes, D. G. C., Bernardini, L. G., & Rasran, L. (2026). A Comparative Analysis of Dormancy and Germination of Arable Herb Seeds of Different Origins. *Plants*, 15(3), 485.

Acknowledgements: BOKU Colleagues: Nora Stoeckl, Roman Tumpold, Susanne Scheffknecht, Karin Fohringer; Austrian experts of the REWISA network: Karin Böhmer, Harald Schau, Erich Bangerl, Rudolf Schmidt; Authorities: Office of the Burgenland State Government, Department 4 – Agriculture, Nature and Climate Protection- Department of Nature Conservation Law, Office of the Lower Austrian Government – Group: Spatial Planning, Environment and Transport – Department: Nature Conservation; Help in population monitoring and seed collection: Emma Szemes