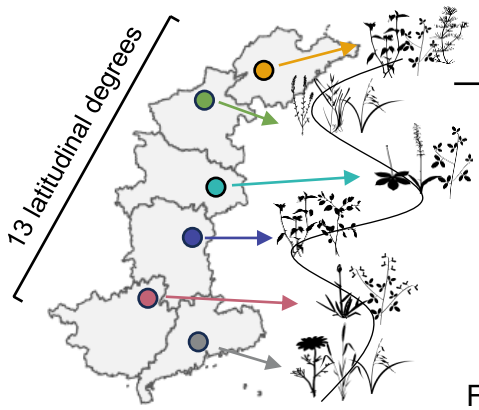
**Step 1**

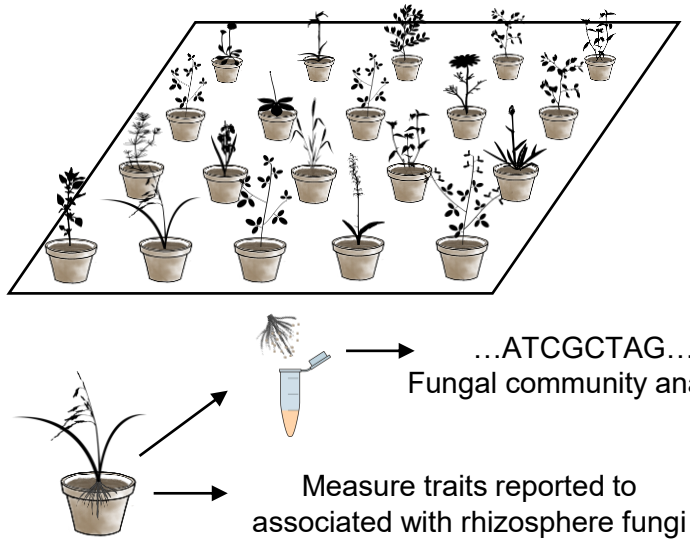
Field survey: variation in rhizosphere fungi among co-occuring plants in heterogeneous field conditions




**Q1** : What are the relative contributions of environmental factors, plant species identity, and their interactions in shaping rhizosphere fungal communities in the field?

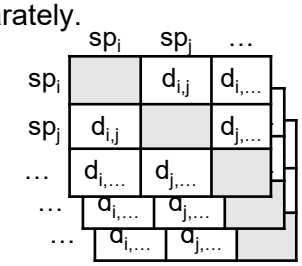
**Step 2**

Greenhouse expeirment: variation in rhizospehre fungi among species in a homogeneous condition




**Step 3**

For each species, we estimated its rhizosphere fungi compositional distinctiveness (Fungi-Dist) compared to that of all other species co-occurred at the same site and year, using the field (Fungi-Dist $_{\text{estimated in the field}}$) and greenhouse (Fungi-Dist $_{\text{estimated in greenhouse}}$) data separately.




$$\text{Fungi-Dist}_i = \frac{\sum_{j=1, i \neq j}^{N} d_{ij}}{N - 1}$$

*N* is the number of co-occurring plant species at a given site and year, $d_{ij}$ is the community composition pairwise distance between species *i* and *j*.

**Step 4**

For each species, we quantified the environmental effects on the compositional distinct of its rhizosphere fungi compared to that of all other species co-occurred at the same site and year.

$$\text{Environmental effects} = \text{Ln}\left(\frac{\text{Fungi-Dist}_{\text{estimated in the field}}}{\text{Fungi-Dist}_{\text{estimated in greenhouse}}}\right)$$

**At species level**: a positive and negative environmental effect means that the species recruits a more compositionally distinct or similar rhizosphere community in comparison to that of other species in the field versus in the greenhouse, respectively.

**At community level** (averaged across all co-occurring): a positive and negative mean environmental effect suggests that field environments increase and decrease compositional dissimilarity among co-occurring species rhizosphere communities, respectively.

**Q2** : What are the directions and magnitudes of the environmental effects on the compositional variation in rhizosphere fungal communities among co-occurring plant species in nature, in comparison with the greenhouse experiment?

**Q3** : What are the primary environmental factors and which kind of plant species within a plant community host rhizosphere fungal communities that are most sensitive to environmental variation?