Abstract

Seed reproduction is a key part of the life cycle of the most plant species. It allows for the dispersal of species in space and time and, thus, significantly affects dynamics of plant populations and communities. Seed formation, germination and seedling establishment are subjected to selection pressures from the environment and lead to optimization of maternal investments (maternal care), manifested by the number of seeds and amount and composition of nutrients stored in individual seeds. The thesis aims to answer two questions: (i) whether maternal investments in terms of seed mass and seed nutrient stoichiometry is optimized according to the environmental conditions in which seedling development is expected and (ii) how nutrient availability, considering nutrients both stored in the seed by the mother plant and those available in the substrate, affects seedling growth and development.

To answer the first question, we focused on interspecific comparisons of seed nutrient stoichiometry linking it with data on seed mass and species niche along gradients of nutrient availability. We used a phylogenetically informed comparative approach to explore the ratio between phosphorus, nitrogen and nonstructural carbon in seeds from 510 wild herbaceous species. We analyzed seed nutrient stoichiometry with particular emphasis on the context of environmental conditions in which the species typically occur and on their seed mass. Despite strong phylogenetic constraints on seed nutrient stoichiometry, we showed that proportions of stored nitrogen and nonstructural carbon are also optimized according to environments in which the species occur and thus are expected to germinate. The result was similar for both carbon and nitrogen; i.e., plants preferentially store nutrients that are expected to be limiting in the environment of the future seedling. Further, we showed that seed phosphorus content is connected with seed mass. This results suggest that seed nutrient stoichiometry is under selection pressures of both seed mass and environmental conditions.

To answer the second question, we evaluated the impact of available nutrients, a pool stored in substrate versus a pool stored in a seed, on seedling root:shoot biomass partitioning and root system development. The pools of nutrients are not interchangeable as they affect seedling growth and development via different mechanisms. Better resource provisions from the seed allow the seedling to be more flexible and to more effectively use nutrients available in the environment. Growing seedlings in classical pots and rhizoboxes resulted in a final methodological study that allows us to validate results of our experiments.

In this thesis, we demonstrated that interplay between amount and ratio of nutrients stored in a seed, nutrients available in soil and fine-tuned biomass allocation in early ontogeny are crucial for successful seed reproduction and occurs both on evolutionary and ecological time scales. Our results underline the importance of maternal care for seedling establishment and consequently for population and community dynamics.

Key words: Biomass alocation · Nutrient stoichiometry · Root system development · Seeds · Seedlings