Understanding the role of plant traits and their plasticity in N:P stoichiometry and competition

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Trait plasticity and the outcome of plant competition

We are investigating the effects of trait plasticity on plant competition and how this influences the plant biodiversity in Dutch grasslands. We are specifically focussing on the effect of the nitrogen: phosphorus ratio on these plant traits (Figure 1). To gain a better mechanistic understanding of this interaction, we carried out a greenhouse experiment in the Botanical Gardens of Utrecht University for two-years. This summer the second year harvest of the experiment was finished.

We chose six grasses and herbs that frequently occur in Dutch nature reserves: *Alopecurus pratensis* (Meadow Foxtail) and *Rumex acetosa* (Common Sorrel) as potential N-limited specialists, *Briza media* (Quaking Grass) and *Centaurea jacea* (Brown Knapweed) as potential P-limited specialists and *Knautia arvensis* (Field Scabious) and *Prunella vulgaris* (Selfheal) as potential opportunists. The species selection was based on the outcomes of exploratory fieldwork and the analysis of a large field database (database from Fujita et al., 2014).

Every pot contained four individuals, either four individuals of the same species (monoculture) or two opportunists and two specialists together (mixture). This allowed us to see what the effect of trait plasticity is - as measured in monoculture – on plant interspecific competition. The experiment had a full-factorial set-up, with an N:P ratio ranging from 1.67 (severe N-limitation) to 135 (severe P-limitation). To account for possible interaction effects between the N:P ratio and the total amount of nutrients, we also used three nutrient levels: low, intermediate and high. This resulted in 15 different nutrient treatments. The two-year experiment started with 2100 pots with 4 individuals each. Half of the pots were harvested in 2013, the other half in 2014. We measured many different plant traits and for both years it took a team of people to measure them all. The two harvests resulted in over 17,000 bags with dried plant roots, shoots, flowers etc. We are currently weighing these roots and shoots and analysing them in the lab for N, P and K content. We have already given a sneak preview of some of the outcomes at the Vegetation – Soil Interactions Symposium in Wageningen (held on 30 October 2014). As we are still gathering data, we hope to show you verified results at the next Biodiversity Works meeting.

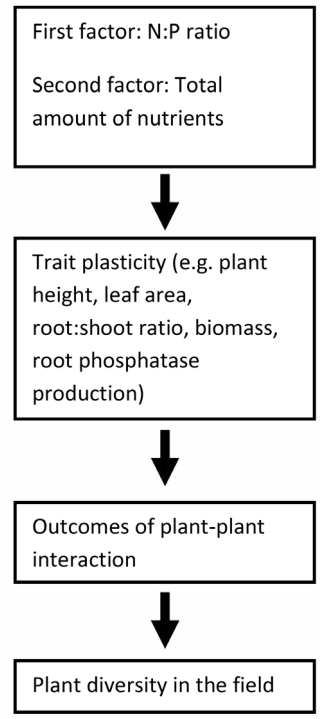

Figure 1 | Research outline.

Figure 2 | Alopecurus pratensis (Meadow Foxtail) vs. Knautia arvensis (Field Scabious). All three pots have received the same nutrient solution: a low N:P ratio (1.67; indicating severe N-limitation). The Alopecurus leaves are clearly taller in the monoculture (left pot) when compared to the competition pot (middle). On the other hand, Knautia growth in monoculture (right pot) is not visibly different from interspecific competition. *Photographs: Ineke Roeling (2013)*

Figure 3 | Top-left: Annick van der Laan is weighing and scanning the roots to determine the specific root length. Top-right: Ineke is measuring the root phosphatase production. Below: Inge Schrijver (right) is washing the plant roots for the second harvest cycle of the day after which the plants are prepared for leaf area measurements and root scans at the central table (Annick and Hans van Someren Gréve). In the background Martin Tegelaar is measuring the phosphatase production of the first harvest cycle of the day. *Photographs: Ineke Roeling (2013, 2014)*