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Evaluating nutrient effect on the *Orobanche* - red clover interaction

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Introduction

Parasitic plants grow by abstracting carbon, water and nutrients from their host. They are divided into holoparasites, which are completely dependent on the host, and hemiparasites, which are photosynthetic, but derive a benefit from host attachment. Parasites reduce the biomass of agricultural plants. However, relatively few studies have been done on the host-parasite relationship. *Orobanche minor*, the root holoparasitic angiosperm, is a strong resource sink for phloem resources. This study used *O. minor* as holoparasite and *Trifolium pratense* as a host plant.

A previous study in our group showed that host shoot mass was significantly reduced and parasite biomass increased approximately 2.5 times when nutrients were supplied to parasitized roots compared to when unparasitized roots were fed. This study aimed to investigate the effect of N supply to parasitized or unparasitized roots on the host-parasite relationship.

Material & Methods

T. pratense seeds were germinated for one week and then transplanted into split-root boxes **(Fig. 1)**. In the left chamber, *O. minor* seeds were mixed into the vermiculite, while the right chamber was without parasites. After a six-week establishment and attachment period, plants were fed 20 ml of nutrient solution to one chamber, and 20 ml of water to the other. Three N conditions were set, 1 mM as Low, 3 mM as Medium, and 5 mM as High. After six weeks, plants with parasites were separated into shoots, tap root, left and right roots, and parasites. The samples were dried and weighed. Statistical analyses were conducted using ANOVA.

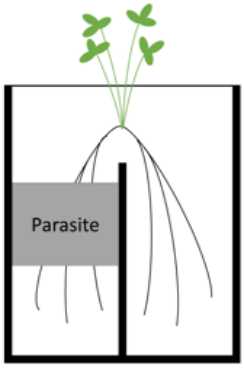

Fig. 1. Split-root box

Results

Host shoot mass increased with N supply (Fig, 2; $P<0.01$), although there was no fed root effect. Parasite mass decreased with increasing N supply, with a significant difference between Low and High (Fig, 3; $P=0.0092$). A negative relationship between parasite and host shoot mass was found.

At each N level, parasites on nutrient supplied roots were 1.2-1.3 times larger than those unfed roots. Fed roots were significantly heavier than the non-fed roots at all N levels ($P<0.05$).

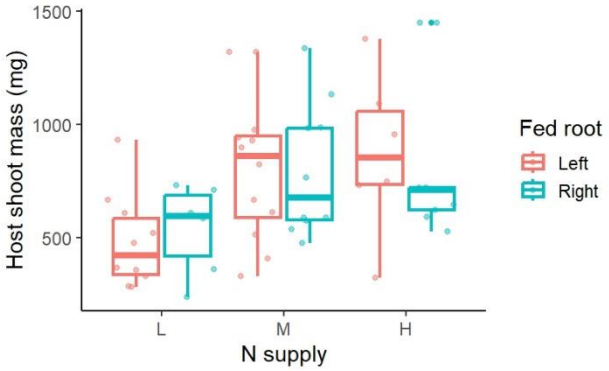

Fig 2. Host shoot mass with N supply

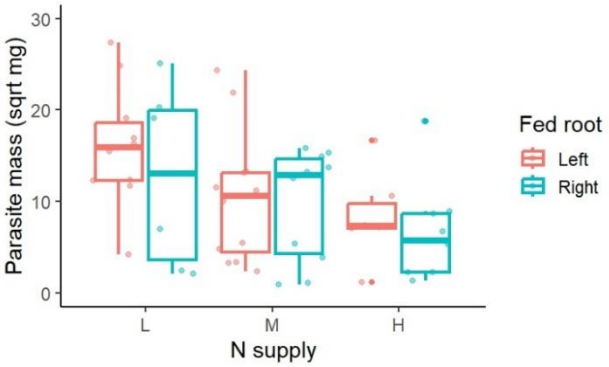

Fig. 3. *O. minor* biomass decreased as N supply increased.

Discussion

Hattori et al (2024) showed that nutrient supply to parasitized roots caused an increase in parasite mass, resulting in the suppression of host growth. However, in this study, the parasites became smaller and the hosts larger with increasing N supply, irrespective of whether the nutrients were supplied to parasitized or non-parasitized roots. This suggests that parasite growth may be limited by N supply, although the mechanism of this growth suppression is not clear.

Due to some issues with parasite establishment, both host and parasite mass data exhibit a high degree of variability. In future experiments, we aim to improve our plant establishment protocols and verify the results of this study.

Reference

Hattori et al. (2024). "Nutrient mediation of sink strength in the *Orobanche minor* – Red clover association." *Environmental and Experimental Botany* Vol. 228, Part B, 106041