Nutrient abstraction by the hemiparasite *Phtheirospermum japonicum* from attached and unattached roots

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Introduction

Despite their major impact on global crop yield, research on parasitic plants is limited. This is especially true for hemiparasites, plants which, in addition to independent photosynthesis, obtain nutrients such as N from parasitism. The traditional parasitic system illustrates N in the soil which is uptaken by a host to be stolen by the parasite which is attached with specialised cells modified for nutrient transfer, known as haustoria. However, hosts also have access to nutrients in roots which are not attached to the parasite, as nutrients in the soil are heterogeneous. Little is known about how hemiparasites benefit from nutrients in unattached host roots.

In this experiment, we aimed to find out whether the hemiparasite *Phtheirospermum japonicum* benefits from N taken up by host roots to which it is not attached, relative to that taken up by attached roots. We hypothesised that *P. japonicum* will benefit more from parasitizing hosts with N treated to attached roots than those on hosts with N to unattached roots, and that hosts with N in unattached roots will be less parasitized.

Materials & Methods

The grass host *Poa annua* and *P. japonicum* parasites were grown together in split-root boxes with two layers, the front and back sides (Figure 1). The parasite was grown in the right-chamber of the front side of the box. In control boxes, the parasite roots were prevented from attaching to the hosts in half of the boxes. Eight replicates were used in each of the six variable categories. Nitrogen (N) was supplied to the host as 5ml Hoagland's solution three times a week to either the front side (F), back side (B), or neither (-). Parasites received 5ml Hoagland's solution every three days. After parasite establishment, N treatment continued for six weeks before harvest and data collection.

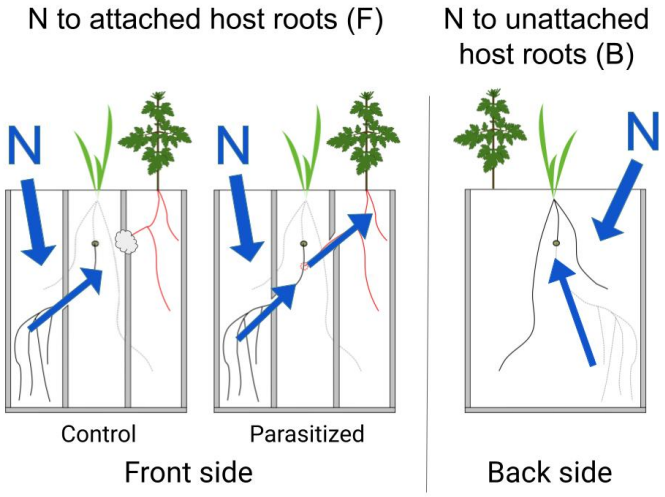

Figure 1. N was applied to the front side with attached host roots and back side with unattached host roots.

Results & Discussion

Parasite mass was significantly greater ($p<0.01$) in attached than in control boxes.

The effect of parasitism on host mass varied by treatment.

PF hosts with N in attached roots had a significant mass decrease by approximately 19% ($p<0.01$) relative to controls, while PB hosts had no significant mass difference relative to controls. Parasites may abstract less from N in unattached host roots, possibly due to both or stronger host defence systems. P- host mass was approximately 30% higher ($p<0.05$) relative to controls.

Relative to P- hosts, PF and PB hosts had significantly greater mass ($p<0.05$ and $p<0.01$ respectively). This indicates that the parasites cannot steal as much N from unattached roots as attached. This may be due to the majority of N in unattached roots being utilised for shoot growth before it is able to circulate through other roots, or that the proximity of N in attached host roots to the parasite allowed more efficient N abstraction during the experiment, or a combination of both.

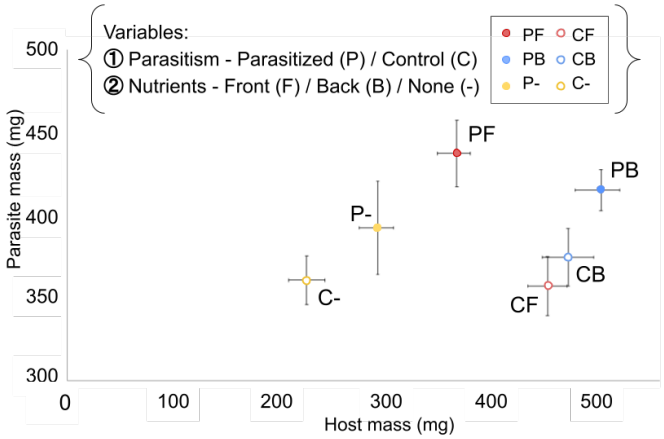

Figure 2. Biomass data from dried shoots.

Conclusion

Higher parasite mass was observed in the parasitized boxes, indicating parasitism. Parasite mass was the greatest with the N to attached roots treatment (F), while host mass was the greatest with the N to unattached roots treatment (B). The results suggest that *P. japonicum* does benefit from N in unattached host roots, but to a smaller degree than in attached host roots.