Competition mediates the host‐hemiparasite relationship

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Introduction

Phtheirospermum japonicum is a hemiparasitic plant which steals growth resources from a host but is also capable of growing autotrophically in the absence of a host. Hemiparasites may attach to multiple hosts in the wild, deriving greater benefits from some hosts than others (Sandner and Matthies, 2018). However, the physiological basis of differences in host quality are poorly understood. In this research, we observe the effects of host species on *P. japonicum* performance, with the aim of understanding the importance of competition on the host – parasite relationship.

Materials & methods

Pot experiment

One *Phtheirospermum japonicum* was planted with one of four host plant species *Trifolium repens* (white clover), *Trifolium pratense* (red clover), *Cynodon dactylon* (Bermuda grass), or *Agrostis palustris* (creeping bentgrass) in a pot. For the control, two parasites were planted in a single pot without a host. The plant was regularly supplied with water and nutrients. The plant was grown in the pot for 2 months, then harvested.

Root box experiment

Phtheirospermum japonicum was planted in the middle compartment of a root box (Fig. 1), with *Trifolium pratense,* and *Trifolium repens* planted in the left and right chambers respectively. The parasite was allowed to connect to neither, one, or both of the hosts. Plants were regularly supplied with water and nutrients and grown for two months then harvested.

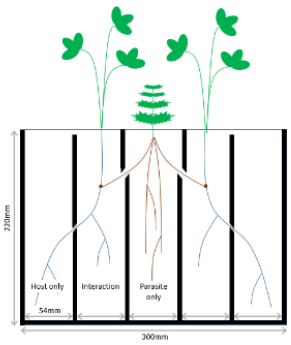

Fig 1. A root box system used in the root box experiment.

Result

Pot experiment

The parasite grown with red clover (*Trifolium pratense*) and *Agrostis* (*Agrostis palustris*) has a decreased biomass compared to the controls. While the parasite grown with white clover (*Trifolium repens*) and cynodon (*Cynodon dactylon*) had an increased biomass. (Fig. 2)

Root box experiment

The parasite attached to both hosts had the largest biomass (Fig. 3; P = 0.012). Parasites attached to only the white or red clover had a larger biomass compared to the control, although this was not statistically significant.

Discussion

In the pot experiment, white clover and *Cynodon* were good hosts, with attachment benefiting parasite growth. While red clover and *Agrostis* were poor hosts, with attachment causing a decrease in parasite biomass. However, in the root box experiment, the effect of red clover as a host was different, causing a slight increase in parasite growth. Our split root box controls for belowground competition, suggesting that the difference in the red clover – parasite relationship between experiments may be due to root competition. This implies that the poor performance of the parasite in the pot experiment was due to red clover acting as a strong competitor, rather than being an inherently bad host. This may suggest competition could mediate the host-parasite relationship. Similar to Frederica and Irving (2024), attachment to a second host caused an increase in parasite growth.

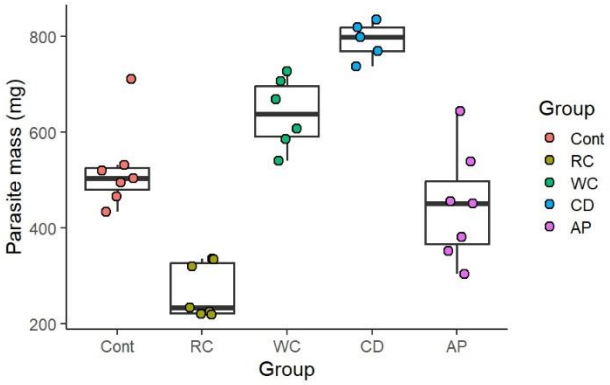

Fig 2. Graph of parasite mass and the host that they are grown with RC: red clover, WC: White clover, CD: *Cynodon dactylon,* AP: *Agrostis palustris*

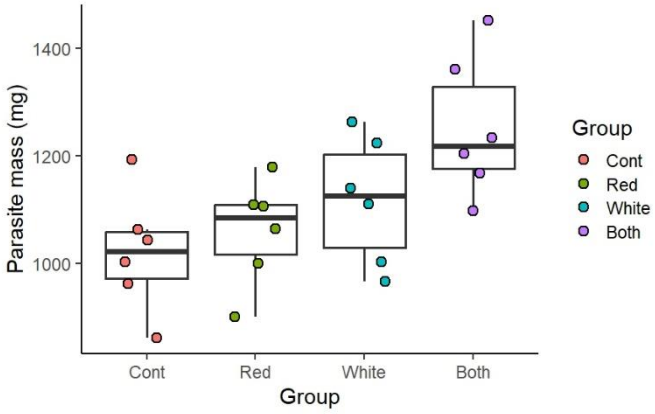

Fig 3.　Root box experiment. Parasite mass in relation to host availability. Control: no host, Red: red clover, White: white clover, Both: both hosts.

References

Frederica, C. F., & Irving, L. J. (2024). “Hemiparasite *Phtheirospermum japonicum* growth benefits from a second host and inflicts greater host damage with Exogenous N Supply”. Journal of Plant Physiology, 296, 154238. https://doi.org/10.1016/j.jplph.2024.154238

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