Plant-mediated effects of drought on predator-prey interactions

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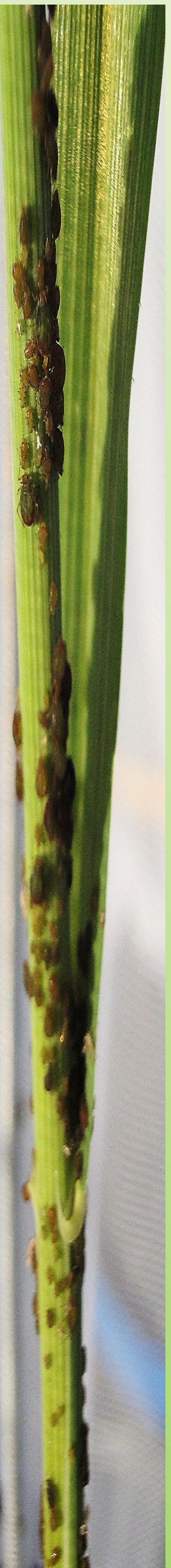
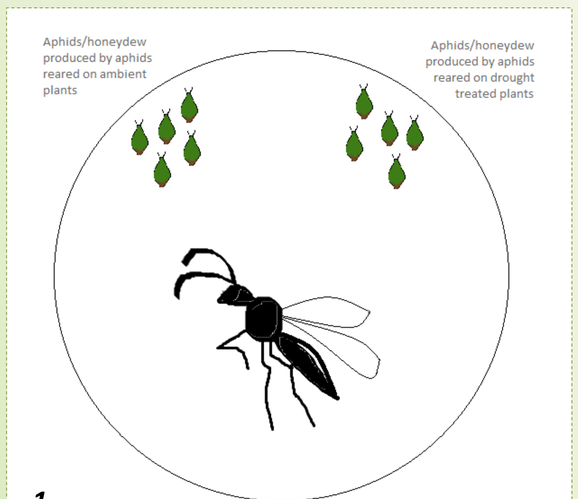


Summer drought is predicted to adversely affect crop production within the next 30 years, yet the impacts on subsequent trophic levels are understudied. In Scotland, barley (*Hordeum vulgare*) cultivation is likely to be hindered under predicted climate change scenarios, in terms of yields and quality.

The objectives of this study were to understand how plant-mediated effects of drought (plant height and mass; elemental and nutritional chemistry) affect the performance of the aphid *Rhopalosiphum padi* at the individual (aphid quality; individual mass) and population level (population growth; number of nymphs and winged aphids). We also investigated how such effects influenced the foraging behaviour of its parasitoid, *Aphidius ervi* (attack rate; host preference; foraging time).



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Methods

Experiment 1

- Using a randomized experimental layout, 60 identical *H. vulgare* plants (cv. Optic) comprising ten groups of six were grown under controlled glasshouse conditions. Each group of six plants were allocated to the following treatments:

Insect condition:	**Drought treatment:**
Control	Ambient
Aphid	50% rainfall
Aphid-parasitoid	

- Aphid and aphid-parasitoid treated plants were infested with two adult *R. padi* from a clonal culture after 21 days.
- Control and aphid treated plants were harvested and analysed using High Performance Liquid Chromatography (HPLC) and Elemental Analyser techniques after 42 days.
- A single mated female wasp was introduced to aphid-parasitoid treated plants and attack rate monitored over 30 minutes.

Experiment 2

- 20 *H. vulgare* plants were grown as previous and allocated to a drought treatment.
- Two adult *R. padi* were introduced and attached to leaf material in clip cages after 21 days. Honeydew was extracted after seven days and analysed using HPLC.
- Parasitoid choice assays were conducted using aphids and honeydew produced by aphids reared under differing drought treatments (Fig. 1).

Results

- Shoot growth (Fig. 2) and dry shoot mass (Fig. 3) decreased with herbivory and drought treatment. However, dry root mass decreased with herbivory only (Fig. 3).
- Drought treatment reduced percentage shoot nitrogen, while percentage root nitrogen decreased with drought treatment and herbivory by *R. padi* (Fig. 5).
- Free essential amino acid content contained in shoot tissue increased with herbivory and the interaction between drought and herbivory (Fig. 4).
- *R. padi* feeding on drought-stressed plants produced honeydew with a lower total amino acid content (Fig. 6a) and lower essential amino acid content (Fig. 6b).
- In a no-choice experiment, attack rate of *A. ervi* significantly decreased with 50% drought treatment (Fig. 7).

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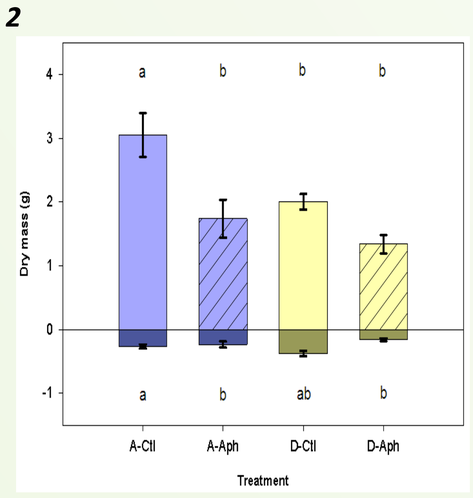

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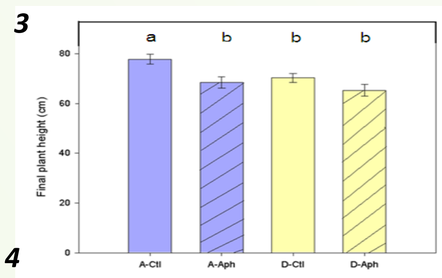

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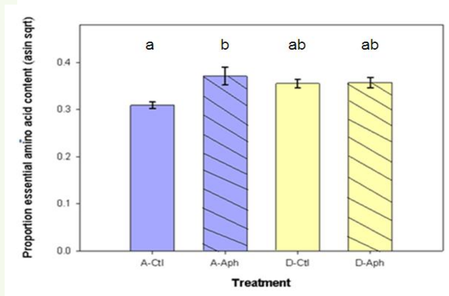

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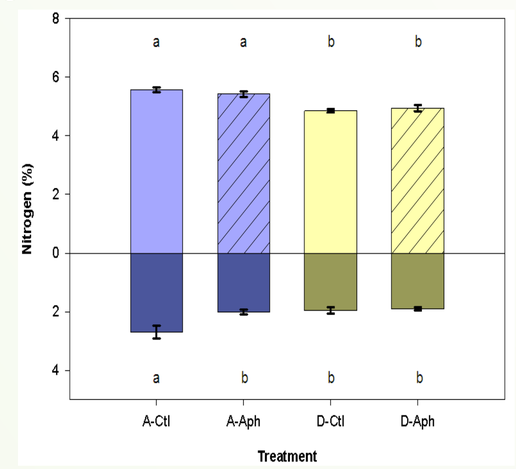

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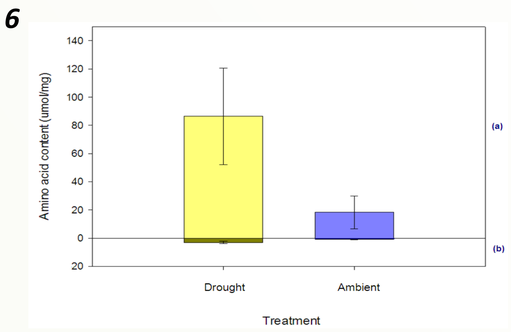

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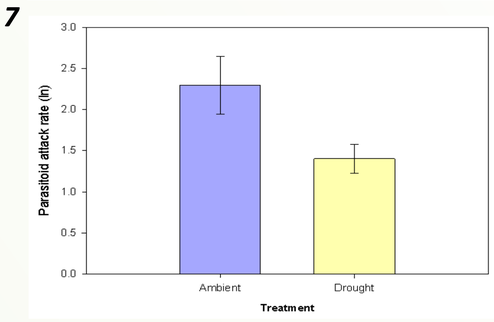

Key

- Shoot/Ambient treatment
- Shoot/Drought treatment
- Root/Ambient treatment
- Root/Drought treatment
- Herbivory

→ Barley production is likely to be hindered by summer drought through a reduction in total biomass production.

→ Our results support evidence of nitrogen remobilization under reduced rainfall regimes.

→ Further work needs to be conducted to assess drought-induced changes to aphid population demography.

→ Plant-mediated changes to prey quality may reduce the efficacy of parasitoid foraging under drought conditions.

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