

Report on SSCR Project

Investigating invertebrate dynamics within a raspberry crop polytunnel environment



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INTRODUCTION

Over 80% of UK soft fruit sold through supermarkets is protected using polytunnels¹. The introduction of polytunnels (or Spanish tunnels) in 1993¹ has enabled higher grade fruit production and supplier consistency, both of which had been previously difficult to attain. Improved environmental conditions within tunnels have resulted in an extension to the soft fruit field season from May until mid autumn. Despite the extensive use of polytunnels throughout the UK, there is a surprising lack of detailed information regarding their impact upon invertebrate communities and population dynamics. In particular, the extended season provided by the tunnels may influence both pests which damage the crop (e.g. clay coloured weevils, raspberry beetles and spotted cutworm) and non-damaging invertebrates (e.g. earwigs and spiders) that contaminate the fruit.

A three year field experiment that involves recording vine weevil (*Otiorhynchus sulcatus*) densities at fortnightly intervals within the entomology polytunnels at SCRI is currently underway as part of my PhD research. This provided an attractive opportunity for incorporating a far more detailed survey of other invertebrates during 2008. The aim of collecting this additional information was to identify and quantify which invertebrates occur within a raspberry polytunnel environment, and how the community and population dynamics of these invertebrates changes throughout a field season.

METHODOLOGY

Sampling was conducted between May and August at a field site at SCRI, Dundee, UK (56°447'N, 3°012'W) within a polytunnel (1,056 m²) consisting of six adjoining tunnels (22 m x 8 m) covered with Luminance THB polythene film (BPI, London, UK). Each tunnel contained three raised beds of 24 raspberry plants covered with polythene mulch. Three of the tunnels were planted with the raspberry cultivar Glen Ample and the remaining three with Glen Rosa. Each row of plants had previously been physically separated using correx sheeting into six plot areas containing four plants (**Fig. 1**). The correx divides were erected as part of the weevil survey, but provided useful sampling plots for the insect survey.

As with the current protocol for the vine weevil experiment, sampling took place at night (usually between 10pm - 2am). A standardised sampling procedure² which dislodged insects from the plants onto collection trays was used. The middle two plants within each sampling plot were shaken backwards and forwards five times (approx.

20 s) which displaced insects onto two white beating trays (110 cm x 86 cm) (Watkins and Doncaster, Kent, UK.) (**Fig. 2**). Where it was possible to do so in the field, invertebrates were identified, counted and recorded within each sampling plot. Invertebrates not identified were collected in sample vials containing 40% ethanol and identified later in the laboratory using field guides. Temperature, humidity and light quality were also recorded inside the polytunnels.



Fig. 1. Individual sampling plot containing four raspberry plants and surrounded with correx sheeting.



Fig. 2. Night sampling of insects in the polytunnels using beating trays.

RESULTS

Preliminary data analysis has been conducted to highlight the species and abundances of both damaging and non-damaging invertebrates located within the polytunnels. Invertebrates were identified to species level where possible. However, in some instances grouping of invertebrates (e.g. spiders) was more appropriate than individual species. Insect counts were averaged over the number of plots sampled.

Earwigs (e.g. *Forficula auricularia*), caterpillars (e.g. *Pieris rapae*), spiders (e.g. *Pisaura mirabilis*), sawfly larvae (e.g. *Dolerus aerieus*) and raspberry beetles (*Byturus tomentosus*) were the most abundant invertebrates identified within the tunnels. *Byturus tomentosus* populations reached peak abundances at the end of June/beginning of July, with the abundances on Glen Rosa being consistently higher than that on Glen Ample until the population crashed to zero in the middle of August (**Fig. 3a**). Sawfly larvae also reached higher population levels on Glen Rosa than on Glen Ample, showing the maximum peak at the beginning of July (**Fig. 3b**). The spider population peaked on Glen Rosa at the end of June, but crashed quite dramatically at the end of July. A similar pattern can be seen on Glen Ample, however, the population maximum is considerably lower than on Glen Rosa (**Fig. 3c**). Earwig populations reached peak populations at the end of August (**Fig.3d**), with higher numbers being recorded on Glen Ample than Glen Rosa.

In addition, several other invertebrates were recorded within the tunnels, although frequently at insufficient numbers to provide information about insect abundances and populations. Clay coloured weevils (*Otiorhynchus*

singularis), raspberry moths (*Lampronia rubiella*), ladybirds (e.g. *Adalia bipunctata*), lacewings (e.g. *Chrysoperla carnea*), bees (e.g. *Bombus lucorum*) and wasps (e.g. *Vespa vulgaris*) were among some of the other insects recorded within the polytunnels. Large raspberry aphid (*Amphorophora idaei*) numbers were too high to record on several sampling dates, thus an accurate representation of their population dynamics is difficult to ascertain from the data.

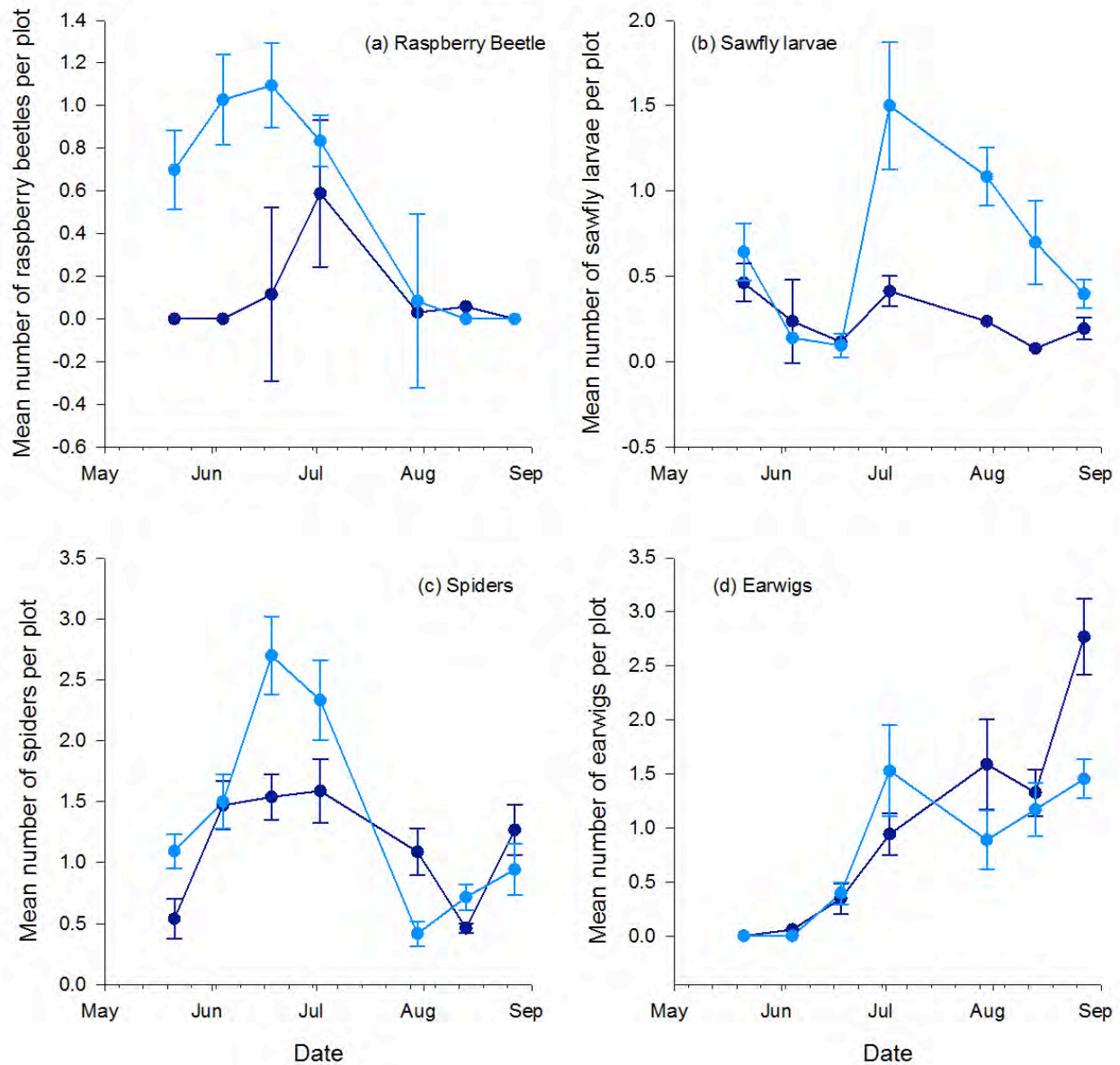


Fig. 3. Invertebrate population dynamics within raspberry polytunnels over a field season with mean (\pm S.E.) number of insects per sampling plot: (a) Raspberry beetle, (b) Sawfly larvae, (c) Spiders and (d) Earwigs • with solid line represents insects sampled on Glen Ample plants, • with a dotted line represents insects sampled on Glen Rosa plants.

CONCLUSIONS and OUTPUTS

- Peak population abundances for both damaging and non-damaging invertebrates were higher on Glen Rosa than Glen Ample, occurring mid June to August.
- Different invertebrates showed peak abundances at different points in the growing season, for instance raspberry beetle numbers peaked in mid June whereas earwigs were most abundant in September.
- Raspberry beetle were recorded as having higher numbers on Glen Rosa than Glen Ample until the very end of the sampling period, when they became equally distributed.
- These data will be used in a paper describing the population dynamics of the vine weevil, “Determination of vine weevil (*Otiorhynchus sulcatus*) population dynamics within a protected cropping system using capture mark recapture” illustrating the typical identities and abundances of invertebrates within protected cropping systems.
- It is intended that the findings of this work will be presented in a poster at Ento’09 (University of Sheffield, 15th - 17th July 2009) one of the leading entomological research meetings in the UK.

¹ Anon, Why polytunnels are used. Fact sheet produced by British Summer Fruits, Available at: <http://www.britishsummerfruits.co.uk>, (2005).

² T. R. E. Southwood and P.A. Henderson, *Ecological Methods*, 2nd ed. (Blackwell Science, Oxford, 2000).