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Seasonal Influences of Greenhouse Climate on the Effectiveness of Biological Control Agents in Greenhouses

Over 95% of the greenhouse tomato acreage in Canada uses biological control for pest management. However, it is well known that during late fall and winter, some biological control agents (BCAs) such as *Encarsia formosa*, are often not as effective in controlling their target pests compared to the rest of the year. A similar situation is recognized for augmentative releases of *Neoseiulus cucumeris* against western flower thrips (*Frankliniella occidentalis*) during the winter months in northern temperate regions. The reasons for this reduced effectiveness are not understood, but it is speculated that low light intensities, short daylengths or cooler temperatures during this period may reduce their effectiveness.

A team of Agriculture and Agri-Food Canada (AAFC) scientists at the Greenhouse and Processing Crops Research Centre in Ontario are conducting research to determine the influence of seasonal (summer vs winter) light intensity, daylength, and temperature on the efficacy of several BCAs including two parasitoids, *Encarsia formosa* and *Eretmocerus eremicus* used to control greenhouse whitefly (*Trialeurodes vaporariorum*) and the predatory mite, *N. cucumeris* for control of western flower thrips.


Encarsia formosa


Eretmocerus eremicus


Trialeurodes vaporariorum, adult greenhouse whitefly.


N cucumeris feeding on immature western flower thrips.

Effect of light and photoperiod on parasitism and host feeding at 24°C

Both *E. formosa* and *E. eremicus* parasitized more whitefly hosts at high light intensity/long daylength (summer light conditions) than low light intensity/short daylength treatment (winter light conditions). *Eretmocerus eremicus* parasitized about twice as many whitefly hosts than *E. formosa* at 24°C under all treatment combinations (Fig. 1).

Effect of temperature on parasitism and host feeding

As in the previous experiment, *E. eremicus* parasitized more whitefly hosts than *E. formosa* in all treatment combinations (Fig. 2). More dead whiteflies were recorded in the leaf cages with parasitoids than the no parasitoid control, indicating that host feeding occurred. *Eretmocerus eremicus* killed more whitefly hosts through host feeding than *E. formosa* at 20°C at the low light intensity/short daylength treatment (winter condition) (Fig. 3).

Effect on predation and oviposition

Neither light intensity (high summer or low winter) nor photoperiod (long versus short) had any effect on the number of first instar western flower thrips killed by *N. cucumeris* (Fig. 4). However, light intensity had an effect on the number of eggs laid by *N. cucumeris*, but not photoperiod (Fig. 5). In addition, there was no significant difference in hourly predation rate on western flower thrips between the scotophase (night) or photophase (day) when *N. cucumeris* is reared under 16 hour light:8 hour dark or 8 hour light:6 hour dark photoperiod. *Neoseiulus cucumeris* only laid eggs during the photophase, regardless or whether they were reared under short or long day conditions.

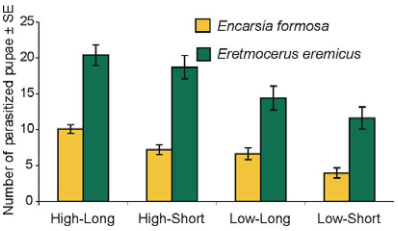

Fig. 1. At 24°C, *E. eremicus* parasitzes more whiteflies than *E. formosa*. Both parasitdoids parasitize more whiteflies at high light intensity/long daylength (summer) than low light intensity/short daylength.

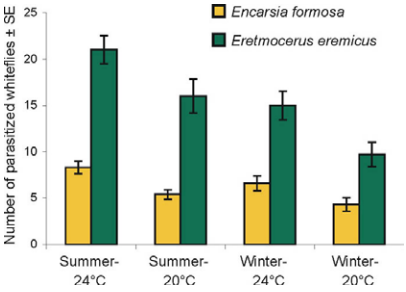

Fig. 2. *E.eremicus parasitizes* about twice as many whiteflies than *E. formosa* at all treatment combinations.

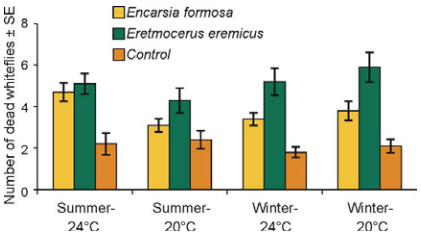

Fig. 3. *E. eremicus* kills more whitefly hosts through host feeding than *E. formosa.*

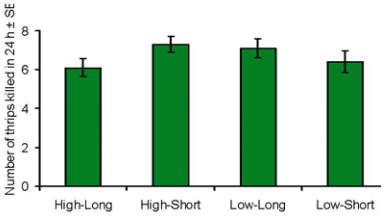

Fig. 4. At 24°C, the number of western flower thrips killed by *N. cucumeris* is not affected by light intensity or daylength.

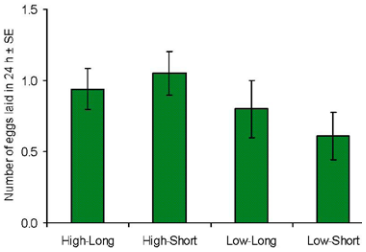

Fig. 5. *N. cucumeris* lays less eggs under low light intensity/ short daylength compared to high light intensity/long daylength at 24°C.

Conclusions

- *Eretmocerus eremicus* kills more whiteflies through a combination of parasitism and host feeding than *E. formosa* under both winter and summer conditions.
- These findings are particularly useful for the winter months where *E. formosa* has been reported to have reduced efficacy.
- *Eretmocerus eremicus* is recommended as a year round biological control agent for greenhouse whitefly.
- Higher release rates of *N. cucumeris* are needed during the winter months to decrease establishment time for *N. cucumeris* and thus, decrease the time to achieve effective biological control of western flower thrips.

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Collaborators

Dr. Gabriella Zilahi-Balogh – AAFC, Harrow, ON; Dr. Conrad Cloutier – Université de Laval, Québec, QC; Dr. Jacques Brodeur – Université de Montréal, Montréal, QC.

For more information please contact:

Dr. Les Shipp
Research Scientist – Greenhouse Entomology

Agriculture and Agri-Food Canada
Greenhouse and Processing Crops Research Centre
Harrow, ON N0R 1G0

Tél. :(519)738-1235
Fax : (519) 738-2929

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