The life cycle and management of *Echinothrips americanus* (Thysanoptera: Thripidae)

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ABSTRACT

The development times of *Echinothrips americanus* (Morgan) (Thysanoptera: Thripidae) on greenhouse peppers and cucumbers were determined, and commercially available predators of thrips were evaluated as potential biological controls for this pest. Development times on cucumber were 15.6 d ± 1.8, 3.6 d ± 0.8, 2.1 d ± 0.4, and 5.2 d ± 0.9 for egg, first-instar, second-instar and pupa, respectively. Development times on pepper were 15.0 d ± 2.1, 6.0 d ± 2.1, 5.5 d ± 1.2, and 5.2 d ± 1.0 for egg, first-instar, second-instar and pupa, respectively. Development from egg to adult took 26.5 d on cucumber and 31.7 d on pepper. The development time for the pest on pepper is about 20% longer than on cucumber. The predators, *Orius insidiosus* (Say) (Heteroptera: Anthocoridae), *Amblyseius cucumeris* (Oudemans) (Acarina: Phytoseiidae) and *Amblyseius degenerans* (Berlese) (Acarina: Phytoseiidae) were compared on *E. americanus*. *Orius insidiosus* significantly reduced thrips populations, but the two predator mite species did not. Our results indicate that *O. insidiosus* has the most potential as a biocontrol agent.

Key words: Life cycle, biological control, predators, British Columbia, greenhouse, pepper, cucumber, *Orius insidiosus*, *Amblyseius cucumeris*, *Amblyseius degenerans*.

INTRODUCTION

The greenhouse vegetable industry in British Columbia relies heavily on the use of beneficial insects and mites for biological control of arthropod pests (British Columbia Ministry of Agriculture, Fisheries and Food 1996). Control measures for new pests must be compatible with currently used biological control programs. Development of compatible programs requires knowledge of the biology of any new pest.

Echinothrips americanus (Morgan) (Thysanoptera: Thripidae) has a reported distribution from southern Quebec to Florida and west to central Iowa (Stannard 1968). It is an important pest of poinsettias in the Eastern United States (Oetting 1987).

Echinothrips americanus was first found in a commercial greenhouse cucumber crop in the Fraser Valley in 1994. Damage to plants was restricted to the foliage. The fruits

were not affected. *Echinothrips americanus* reappeared on cucumber plants in the same greenhouse in March of 1995, and the infestation was controlled with chemical insecticides. In July 1995, *E. americanus* was found in two different bell pepper greenhouses. Feeding by thrips damaged the leaves extensively and was severe enough in some areas of the greenhouses to kill the plants. Pepper fruits were damaged by feeding and had to be culled. The predatory mites, *Amblyseius cucumeris* (Oudemans) and *Amblyseius degenerans* (Berlese) (Acarina: Phytoseiidae), and the minute pirate bug, *Orius insidiosus* (Say) (Heteroptera: Anthocoridae), were present and may have been feeding on the pest.

The objectives of this study were to determine the development times of *E. americanus* on peppers and cucumbers and to assess and compare *O. insidiosus, A. cucumeris* and *A. degenerans* as predators on *E. americanus*. Development times were assessed:

1) To predict how fast the *E. americanus* population increases over the growing season.
2) To predict when susceptible stages of the pest are present in order to release natural enemies.
3) To predict when susceptible stages can be accurately predicted for the purpose of pesticide treatment.

MATERIALS AND METHODS

Development

We obtained thrips for this study from a colony reared on cucumbers at the British Columbia Ministry of Agriculture, Fisheries and Food (BCMAFF) greenhouse at Abbotsford. *Echinothrips americanus* has six developmental stages: egg, first-instar larva, second-instar larva, propupa, pupa, and adult. Identification of the stages was based on description of these stages by Stannard (1968), Vance (1974) and Oetting and Beshear (1993). Magnifying glasses (10x) were used to identify stages. In this study, we considered the propupae and pupae as a single stage, the pupae. Their short duration and the fact that development was only monitored every day or two made it impossible to distinguish the stages.

We studied development times on three cucumber and three pepper plants. The plants were 6 weeks old and were grown in an *E. americanus*-free greenhouse at the Pacific Agriculture Research Centre - Agassiz. Cucumber plants were pruned to three leaves, and pepper plants were pruned to four leaves. Eight adult *E. americanus* were placed on each leaf of each plant and removed after 24 h. Each plant was then placed in a separate 50 cm x 50 cm x 37.5 cm mesh screen cage. The leaves were examined every 1 to 2 days and the number of individuals in each stage recorded. Because of the large number of first instar thrips on each cucumber leaf, the development of first instars was monitored on only six of the nine leaves. Larval development was monitored on all 12 pepper leaves. First and second instar larvae and pupae remained on the original leaf. The mean temperature was 23°C during the 14-h photophase and 19°C during the 10 h scotophase and mean RH was 45% during the experiment. The temperatures used are similar to those in commercial pepper greenhouses.

Assessment of natural enemies

Twelve, 9-week-old pepper plants of identical size and number of leaves were used in this experiment. Each plant was inoculated with 20 adult *E. americanus*, then placed in a cage. After 2 weeks, 20 more adults were placed on each plant. This was done to create two overlapping generations. The plants were then randomly divided into four groups of

three plants each. One group of plants was used as the control and the other three groups were treated with either *O. insidiosus, A. cucumeris* or *A. degenerans.* The predators were introduced at rates of four *O. insidiosus* per plant, 100 *A. cucumeris* per plant or 20 *A. degenerans* per plant. The predators were left to interact with the thrips for one month. The temperature, photoperiod, and RH were the same as for the development study. At the end of the experiment, leaves were washed to determine the number of *E. americanus* on the plants (Gillespie 1989). Analysis of variance (ANOVA) was used to test the differences in the number of *E. americanus* and the means were separated using the Tukey test (pairwise comparison of the three predator treatments against the control).

RESULTS AND DISCUSSION

Development times on cucumber were 15.6 d ± 1.8, 3.6 d ± 0.8, 2.1 d ± 0.4, and 5.2 d ± 0.9 (mean ± SD) for eggs, first-instars, second-instars and pupae respectively. Development times on pepper were 15.0 d ± 2.1, 6.0 d ± 2.1, 5.5 d ± 1.2, and 5.2 d ± 1.0 (mean ± SD) for eggs, first-instars, second-instars and pupae, respectively. Total development times from egg to adult were 26.5 d and 31.7 d on cucumber and pepper, respectively. On poinsettia, Oetting and Beshear (1993) found the total development time at 20°C was 33.9 d. Thrips took about 20% longer to develop on pepper than on cucumber. We therefore predict that populations of *E. americanus* will increase faster on cucumber than on pepper. However, the thrips used to determine development time originated from a colony maintained on cucumber. Insects and mites adapt to host plants on which they are reared, and this may affect their life history on other host plants (Fry 1989, Gillespie and Quiring 1994). Nonetheless, this is the first record of the development time of *E. americanus* on host plants other than poinsettia.

Table 1.

Number of *Echinothrips americanus* found on pepper plants in the presence of different predators. Means followed by same letter not significantly different (Tukey test, $p > 0.05$)

TREATMENT	REP 1	REP 2	REP 3	MEAN
No predator	36	44	249	109.7 *a*
Amblyseius cucumeris	93	18	15	42.0 *a*
Amblyseius degenerans	37	23	--	30.0 *a*
Orius insidiosus	0	10	3	4.3 *b*

Predators had significant effects on the number of *E. americanus* after 1 month (Table 1; F=4.99, df=3, p = 0.037), but only *O. insidiosus* reduced their populations significantly relative to the control (Table 1; $p < 0.05$). Neither mite species reduced *E. americanus* numbers significantly relative to the control, but the counts were highly variable, and further replication would have been appropriate. This was not possible because the *E. americanus* colonies had to be destroyed before the 1996 growing season to prevent the risk of contaminating commercial greenhouses. In the course of the experiment, plants were not damaged extensively. We note that *E. americanus* is considerably larger than *Frankliniella occidentalis*, the most common pest thrips in vegetable greenhouses in British Columbia. *Amblyseius cucumeris* cannot prey successfully on second-instars of *F.*

occidentalis, partly because the thrips defend themselves against attack (Riudavets 1995). It is possible that neither predatory mite can successfully attack the larger *E. americanus* for similar reasons. We observed *O. insidiosus* attacking all stages of *E. americanus*, but saw no predation by either mite species. Our results indicate that, of the predators presently being used for biological control of thrips in British Columbia, *O. insidiosus* would be the most appropriate to use in a biological control program for *E. americanus.*

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