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MANAGEMENT OF FLOWER THRIPS IN BLUEBERRIES IN FLORIDA

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ABSTRACT

Flower thrips are considered key pests in southern highbush (*Vaccinium corymbosum* L. × *V. darrowi* Camp) and rabbiteye (*Vaccinium ashei* Reade) blueberry fields in Florida. During 2005 and 2006, we evaluated the effectiveness of selected natural enemies (preventative and curative releases) for control of flower thrips in blueberries. Experimental designs were randomized complete blocks with 4 treatments and 4 replicates in 2005 and 3 treatments and 4 replicates in 2006. In 2005, treatments were evaluated as a preventative tactic and included the following biological control agents: (1) Thripor-I [*Orius insidiosus* Say (Hemiptera: Anthocoridae)], (2) Thripex-plus [*Amblyseius cucumeris* (Oudemans) (Acari: Phytoseiidae)], (3) combination of both *O. insidiosus* and *A. cucumeris* in 50% of standard dosages, and (4) untreated control (no natural enemies). *Orius. insidiosus* (Thripor-I) was released at 0.5 insects per m^2 and *A. cucumeris* (Thripex-Plus) at 0.5 sachets of 1000 mites per m^2. For the combination treatment, 50% of each standard dosage was released. In 2006, treatments were evaluated as a curative technique and included (1) Thripor-I (*O. insidiosus*) released at 10 insects per m^2, (2) Thripex-Plus, and (3) control [no natural enemies were released]. In 2005, the results indicated that thrips populations in the control were on average significantly lower than in treatments of *O. insidiosus* and *A. cucumeris* alone, implicating the potential for intraguild predation among natural enemies. In 2006, there were no significant differences among the treatments evaluated probably due to the short duration of time during which flower thrips are present in blueberry fields.

Key Words: *Frankliniella tritici*, *Frankliniella occidentalis*, southern highbush, rabbiteye blueberries, natural enemies, *Orius insidiosus*, *Amblyseius cucumeris*, biological control

RESUMEN

Se consideran los trips de las flores como una plaga clave de los arándanos "southern highbush" (*Vaccinium corymbosum* L. × *V. darrowi* Camp) y "rabbiteye" (*Vaccinium ashei* Reade) en los campos de arándano en la Florida. Durante los años 2005 y 2006, nosotros evaluamos la efectividad de enemigos naturales seleccionados (liberaciones preventivas y curativas) para el control de trips de las flores en arándano. Los diseños experimentales fueron bloques completamente aleatorizados con 4 tratamientos y 4 replicas en el año 2005 y 3 tratamientos y 4 replicas en el año 2006. En 2005, los tratamientos fueron evaluados como una táctica preventiva e incluyeron los agentes de control biológicos siguientes: (1) Thripor-I [*Orius insidiosus* Say (Hemiptera: Anthocoridae)], (2) Thripex-plus [*Amblyseius cucumeris* (Oudemans) (Acari: Phytoseiidae)], (3) una combinación de ambos *O. insidiosus* y *A. cucumeris* en 50% de la dosis estándar, y (4) un control no tratado (sin enemigos naturales). *Orius. insidiosus* (Thripor-I) fue liberado al 0.5 insectos por m^2 y *A. cucumeris* (Thripex-Plus) al 0.5 sobrecitos con 1000 mites por m^2. Para el tratamiento de combinación, 50% de cada dosis estándar fue liberada. En el 2006, los tratamientos fueron evaluados como una técnica curativa e incluyeron (1) Thripor-I (*O. insidiosus*) liberado unos 10 insectos por m^2, (2) Thripex-Plus, y (3) el control [sin enemigos naturales liberados]. En el 2005, los resultados indicaron que la población de los trips en el control por lo general fue mas baja que en los tratamientos con solo *O. insidiosus* y *A. cucumeris*, que implica el potencial de depredación entre los miembros de estos enemigos naturales asociados. En el 2006, no habían diferencias significativas entre los tratamientos evaluados probablemente debido a la corta duración del tiempo durante lo cual los trips de las flores están presentes en los campos de arándano.

Flower thrips belong to the family Thripidae within the order Thysanoptera. The majority of flower thrips belong to the genera *Franklinella* and *Thrips*. Flower thrips feed and reproduce within the floral structures of cultivated and wild plants and are pests of cultivated berries in Florida. To date, there is no evidence that flower thrips vector any viruses to berry crops in Florida, but they are known to reduce the quality and quantity of the fruit produced. The small size and cryptic nature of the eggs and larvae make thrips difficult to monitor and control in an agricultural system. The transportation of agricultural products such as whole plants, cut flowers, fruits, and vegetables facilitates regional and international dispersal of flower thrips. In addition, Parrella & Lewis (1997) explain that small insects such as thrips use the convective upper wind currents to disperse long distances. Natural dispersal occurs when plant quality decreases or local weather conditions are not conducive for population growth.

Flower thrips are considered key pests in southern highbush (*Vaccinium corymbosum* L. × *V. darrowi* Camp) and rabbiteye (*Vaccinium ashei* Reade) blueberry fields in Florida and southern Georgia (Arévalo 2006; Liburd et al. 2006) and a secondary pests in strawberries in Florida (Price et al. 2006; Rondon et al. 2005). In blueberries, flower thrips prefer to oviposit on the petals, but the damage to the berry occurs when they oviposit and feed on the ovaries (Arévalo & Liburd 2007a). In Florida, the dominant species attacking blueberries is *Frankliniella bispinosa* (Morgan), accounting for ~93% of the thrips captured on sticky traps or collected from within blueberry flowers (Arévalo & Liburd 2007a). In strawberries, an assemblage of species, *F. bispinosa* and *F. occidentallis* feed on the floral tissues causing Type 1 bronzing on the fruit (Rondon et al. 2005; Zalom et al. 2008).

In many crops, thrips populations are regulated by natural enemies including *Orius insidiosus* (Say), *Geocoris* spp, and Chalcidoidae parasitoids among others (Mossler & Nesheim 2007; Rondon et al. 2005). Fraulo et al. (2008) found that Chalcidoidae wasp populations were higher in plots with high numbers of thrips. Here we evaluate the potential of *O. insidiosus* and *A. cucumeris* alone, and in combination as biological control tactics to prevent or to reduce flower thrips populations in southern highbush blueberries in Florida.

Materials and Methods

In 2006, we evaluated the natural enemies as a curative technique for the control of flower thrips because attempts at preventative control for flower thrips were not effective in 2005. A new randomization of all 4 treatments was evaluated during the 2006 trials. In addition, we increased the release rates in an attempt to increase treatment effectiveness. The following treatments were evaluated in 2006: (1) Thripor-I (*O. insidiosus*) released at 10 insects per m^2, (2) Thripex-Plus (*A. cucumeris*) evaluated at 1.3 sachets of 1000 mites per m^2, (3) combination of both *O. insidiosus* and *A. cucumeris* in 50% of curative dosages, and (4) control in which no natural enemies were released. All treatments were released on 15 Feb when the number of thrips on sticky traps was above 100 thrips per trap. Biological control trials were located at a commercial farm in north-central Florida (N 28°54' W 82°14). This farm is planted with southern highbush blueberries, which consist of mixed varieties of Star, Jewel, Emerald, and Millennia. Bushes were ~1.5 m tall and spaced ~1 m apart. The experimental design to evaluate the effectiveness of selected natural enemies was a randomized complete block with 4 treatments and 4 replicates in 2005 and 3 treatments and 4 replicates in 2006. The farm was divided in 16 plots (each plot ~70 m^2) arranged in 4 blocks (283 m^2 per block) in 2005. In 2006, only 12 plots (same size as 2005) were used. There were buffer zones of 17 m between blocks and 5 m between plots within a block. During 2005, treatments were evaluated as a preventative tactic and included the following biological control agents that were obtained from Koppert Biological Systems Romulus, MI : (1) Thripor-I [*Orius insidiosus* Say (Hemiptera: Anthocoridae)],(2) Thripex-plus [*Amblyseius cucumeris* (Oudemans) (Acari: Phytoseiidae)], (3) combination of both *O. insidiosus* and *A. cucumeris* in 50% of standard dosages, and (4) untreated control. All dosages were recommended by the supplier (Koppert Biological Systems Romulus, MI). *Orius insidiosus* (Thripor-I) was released at 0.5 insects per m^2 and *A. cucumeris* (Thripex-Plus) at 0.5 sachets of 1000 mites per m^2. For the combination treatment, we released 50% of each standard dose. In 2005, natural enemies were released preventatively 1 week after flowering began and before thrips population begin to increase to form "hot-spots" (Arévalo & Liburd 2007b). *Orius insidiosus* and *A. cucumeris* are known to be able to survive in the absence of prey by feeding on pollen, mites, insects, and eggs and other secondary prey before thrips arrive to the system (Kiman et al. 1985; Van Rijn et al. 1993; Van Rijn et al. 1999).

During both years, SpinTor® 2SC (spinosad) (DowAgrosciences. Indianapolis, IN) was sprayed at 105 g a.i. / ha (using a backpack sprayer) in the buffer zones to discourage the movement of natural enemies between plots. Since the objective was to manage thrips populations and encourage natural enemy activity inside the research plots, these were not sprayed with insecticides. A white sticky trap (Great Lakes IPM, Vestaburg, MI) was placed in the center of each plot to monitor thrips activity. Each week the traps were collected from the field and brought to the University of Florida, Small Fruit and Vegetable IPM laboratory in Gainesville to count the number of thrips captured. In addition, a sample of 5 flower-clusters was collected weekly from each plot and processed by the "shake and rinse" method described in Arévalo & Liburd (2007b) to assess thrips population inside the flowers.

Statistical Analysis

In 2005, we compared the population of flower thrips on each of the sampling dates using one-way ANOVA (SAS Institute Inc. 2002). Treatment means were separated by LSD (α = 0,05) to determine differences (SAS Institute Inc. 2002). In 2006, we analyzed the growth rate (r) by comparing the increment of thrips population 1 week after the release, and 2 weeks after the release of natural enemies, with the initial population of thrips before the release.

Results and Discussion

The trials conducted in 2005 (preventative release), indicated that releases of *O. insidiosus* or *A. cucumeris*, as well as the combination of both treatments as a preventative tactic did not reduce thrips populations in blueberries during the flowering period (Fig. 1). Data collected from sticky traps indicated that thrips populations in the control were on average significantly lower than in treatments of *O. insidiosus* or *A. cucumeris* alone. However, no significant differences were detected between the control and the combination treatment during the first and second weeks after release (Fig. 1).

During the last week of sampling we captured significantly fewer thrips in sticky traps in the control treatment than in any of the other treatments (F = 7.95; df = 3, 9; P = 0.0067). The reasons why the control had less thrips than the areas treated with natural enemies is unclear; however, it may be related to the release of natural enemies before there was an abundance of thrips (< less than 10 thrips per trap or flower) in the field. The lack of prey (thrips) may have encouraged some level of intraguild predation, as well as feeding on other natural predators in the system and subsequently allowing for the increase of thrips populations in the treated area. Due to the low population of thrips in 2005, we were not able to collect enough thrips from inside the flowers to make a statistically robust analysis.

Data from the curative releases of *O. insidiosus*, and *A. cucumeris* did not show a significant effect on thrips population (Fig. 2). These results are consistent with observations made by Mound & Teulon (1995) and by Parella & Lewis (1997). These authors concluded that the biological characteristics of thrips overcome the attributes of natural enemies in such a way that the participation of natural enemies in the regulation of field populations of thrips is minor. Other authors argue that the use of natural enemies is enough to control thrips populations (Shipp & Wang 2003; Van de Veire & Degheele 1995). Our preliminary laboratory observations and other related studies published showed that *Orius* spp. and *A. cucumeris* are efficient in controlling flower thrips (Jacobson 1997; Shipp et al. 2003; Van de Veire et al. 1995). However, the observations related to the success of natural enemies controlling thrips have been conducted under greenhouse or laboratory conditions.

One of the few successes in control of flower thrips under field conditions was reported by Funderburk et al. (2000), who showed that field peppers that were untreated or treated with spinosad had a significantly higher population of *Orius* spp. and lower population of flower thrips than fields treated with acephate and fenopropathrin, which excluded predators, mainly *O. in-*

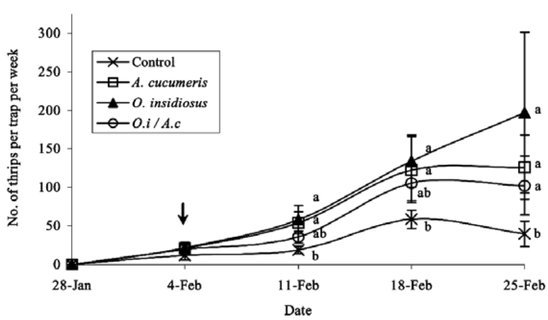

Fig. 1. Average number of thrips captured per week after the release of natural enemies, as a preventive measure, in white sticky traps located inside the blueberry bush in 2005. Treatments followed by the same letter are not significantly different when compared by LSD (α = 0.05). The arrow represents the date of release. 4 Feb 2005 (F = 1.52; df = 3, 9; P = 0.62), 11 Feb 2005 (F = 7.13; df = 3, 9; P = 0.016), 18 Feb 2005 (F = 2.83; df = 3, 9; P = 0.0988), 25 Feb 2005 (F = 7.95; df = 3, 9; P = 0.0067)

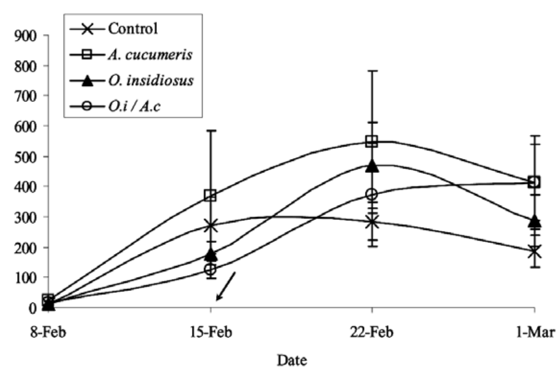

Fig. 2. Average number of thrips captured per week after the release of natural enemies, as curative measure, on white sticky traps located inside the blueberry bush in 2006. The arrow indicates the date of the release of natural enemies. No significant differences among treatments when compared by LSD (α = 0.05). 15 Feb 2006 (F = 0.95; df = 3, 9; P = 0.4549), 22 Feb 2006 (F = 0.54; df = 3, 9; P = 0.6639), 1 Mar 2006 (F = 1.79; df = 3, 9; P = 0.2185).

sidiosus. However, in these studies the reduction in the thrips population due to the presence of natural enemies was observed from 55 and 60 d after transplanting, approximately 10 d after the first sampling. These periods of time allowed the natural enemies to build-up their population, and have a significant effect on the thrips population. The situation in blueberries is different. Flower thrips arrive to the fields after the winter when the flowers are opening and insect activity in the foliage is limited. Thrips are only present for an average for 20 to 25 d, which correspond to the flowering period in blueberries. This short period of time may not be long enough for the natural enemies to establish and reach a significant level of control.

Under these experimental conditions we found that inundative releases of *O. insidiosus*, *A. cucumeris,* both preventatively and curatively, do not appear to play a significant role in regulating flower thrips populations in the blueberry system in Florida. The use of trade names in this publication is to provide specific information. UF/IFAS does not guarantee or warranty the products names, and the references in this publication do not signify our approval and exclusion of other products of suitable composition, nor the endorsement of any of the products here included.

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