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Source: Florida Entomologist, 100(2) : 478-480

Published By: Florida Entomological Society

URL: <https://doi.org/10.1653/024.100.0212>

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Flower thrips (Thysanoptera: Thripidae and Phlaeothripidae) species complex on Florida blackberries and the effect of blackberry cultivar

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Blackberry production is a small but growing industry in the state of Florida. In 2007, 167 acres (67.583 ha) of blackberries and dewberries (*Rubus* species; Rosales: Rosaceae) were being grown in Florida (USDA 2009). Their numerous health benefits and relatively short shelf life make them suitable for “U-pick” and fresh-market operations in densely populated areas. In Florida, blackberries are typically harvested in May and Jun (Andersen & Crocker 2001). Little data are available on yield. Blackberries require a certain number of chill hours to begin flowering. This limits production to more northern areas of the state of Florida. Cultivars that can be grown in north Florida include ‘Apache’, ‘Arapaho’, ‘Chickasaw’, ‘Choctaw’, ‘Kiowa’, ‘Natchez’, ‘Navaho’, ‘Ouachita’, and ‘Shawnee’ (Andersen & Crocker 2001).

Several potential pest insect and mite species have been found on blackberries in Florida (Mizell 1993). The two most likely to become key pests are stink bugs (Brennan et al. 2013) and flower thrips (O. E. Liburd unpublished data). Stink bugs feed on blackberry fruits (Mizell 1993) and have the potential to directly reduce yields if numbers are high enough.

Flower thrips damage flowers in 2 ways. Both larvae and adults feed on all parts of the flowers including ovaries, styles, petals, and developing fruit. In blueberries, this feeding damage can reduce the quality and quantity of fruit produced (Liburd et al. 2005). Females also cause damage to fruit when they lay their eggs inside flower tissues.

Flower thrips are often highly polyphagous (Lewis 1997). However, thrips numbers can vary even among cultivars and varieties of a host plant. For example, more flower thrips were collected in ‘Emerald’ southern highbush blueberries compared with ‘Millenia’ and ‘Star’ (Rhodes et al. 2012). The cultivar ‘Jewel’ was intermediate. In crapemyrtle, flower thrips were found in higher numbers in white ‘Acoma’ flowers compared with cultivars having lavender, red, and pink flowers. Flower color in blackberry cultivars varies (Jia et al. 2007), and other factors might affect thrips distribution among cultivars.

The species complex of flower thrips can differ depending on host plant. *Frankliniella bispinosa* (Morgan) (Thysanoptera: Thripidae) is the predominant species found on blueberries (Liburd & Arévalo 2005). *Frankliniella bispinosa* and *Frankliniella tritici* (Fitch) (Thysanoptera: Thripidae) are more abundant in tomato, whereas *Frankliniella occidentalis* (Pergande) (Thysanoptera: Thripidae) is more abundant in pepper (Baez et al. 2011). It is not known which species, if any, predominate in blackberries.

The purpose of this study was to monitor flower thrips in blackberries to begin to determine their pest potential. Our main objectives were

1) to determine if numbers of thrips differed among blackberry cultivars and 2) to determine the species complex of flower thrips in blackberries.

The study took place at the Plant Science Research and Education Unit in Citra, Florida, over a 6 wk period from 17 Apr to 22 May 2010. The study site was approximately 0.2 ha consisting of 6 blackberry cultivars, Kiowa, Ouachita, Arapaho, Choctaw, Chickasaw, and Natchez. Half of the plot is managed conventionally, and the other half is managed organically. There is 1 row of each variety in each half of the plot.

Flower samples were used to monitor thrips and their natural enemies. Flower samples were collected weekly beginning at the onset of flowering in each variety. Kiowa, Choctaw, and Chickasaw began flowering first, with the 1st sample taken on 17 Apr. Natchez began flowering 1 wk later, and the 1st sample was taken on 21 Apr. Ouachita and Arapaho began flowering 2 wk after the first 3 cultivars, and samples were taken on 1 May. Three flower samples were taken from each row of blackberries: 1 from a bush near the center of each row and the other 2 from bushes near either end of each row. Each sample consisted of 5 flowers randomly collected from a single bush. Each sample of 5 flowers was placed in a 50 mL centrifuge tube containing 20 mL of 70% ethanol. Flower samples were processed by the “shake and rinse” method developed by Arévalo & Liburd (2007). Numbers of thrips adults, thrips larvae, and natural enemies were counted with the aid of a dissecting microscope. A subsample of 20 thrips adults per sample was identified to species. If there were 20 or less thrips adults in a sample, all of the thrips adults in the sample were identified to species.

Thrips adults per flower, thrips larvae per flower, and *Orius* sp. (Hemiptera: Anthocoridae) individuals per flower data could not be normalized even with transformation, so nonparametric statistics were used. Total numbers of thrips adults, thrips larvae, and *Orius* sp. individuals per flower were analyzed with the Kruskal–Wallis test (Hollander & Wolfe 1999). Means were separated according to Dwass, Steel, Critchlow–Fligner multiple comparisons tests. The same procedures were used for weekly data.

Overall, we found no significant difference in numbers of thrips adults per flower among cultivars (Fig. 1a; $H = 8.67$, $df = 5$, $P > 0.1$). There were significantly fewer thrips adults per flower in Choctaw compared with all the other cultivars on 1 May (Fig. 1b; $H = 16.4$, $df = 5$, $P = 0.005$) and significantly greater numbers of thrips adults per flower in Choctaw compared with Arapaho on 15 May ($H = 12.2$, $df = 5$, $P = 0.03$). We found no significant differences among cultivars on any other sampling date (all $H \leq 9.9$, $df \leq 5$, $P > 0.1$).

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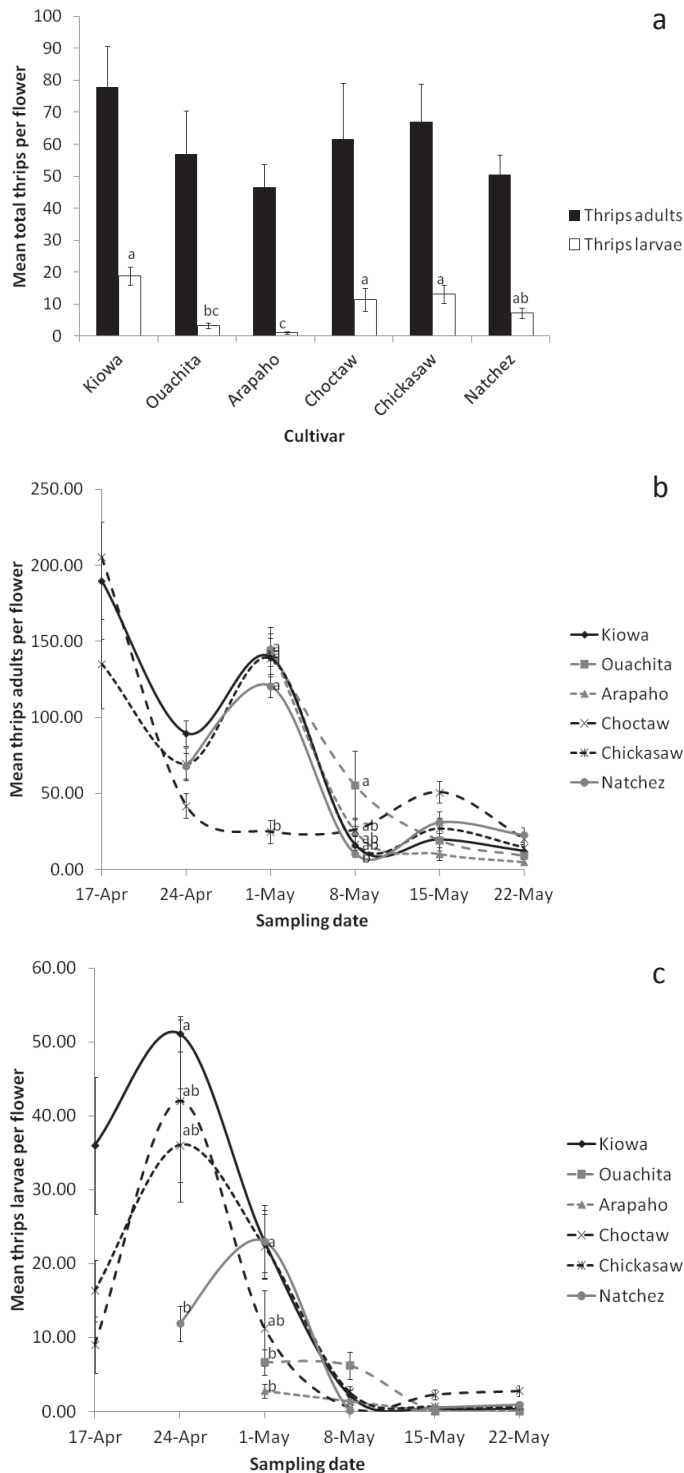


Fig. 1. Numbers of flower thrips sampled from 6 blackberry cultivars. a) Mean total numbers of thrips larvae and adults per flower. b) Mean numbers of thrips adults and c) mean numbers of thrips larvae per flower on each sampling date. Error bars represent SE. Treatments with the same letter are not significantly different at $P < 0.05$. Significant differences for the last 3 sampling weeks in (c) are described in the text.

Overall, we found significantly greater numbers of thrips larvae per flower ($H = 30$, $df = 5$, $P < 0.01$) in Kiowa, Choctaw, and Chickasaw compared with Ouachita and Arapaho (Fig. 1a). Numbers of thrips larvae were significantly greater in Natchez than in Arapaho. We found significant differences among the numbers of thrips larvae per flower

on every sampling date (Fig. 1c) except for the first one, 17 Apr ($H = 0.8$, $df = 2$, $P > 0.1$). On 24 Apr, numbers of thrips larvae per flower were significantly greater in Kiowa than in Natchez ($H = 9.1$, $df = 3$, $P = 0.03$). On 1 May, numbers of thrips larvae per flower were significantly greater in Kiowa, Chickasaw, and Natchez compared with Ouachita and Arapaho ($H = 20.5$, $df = 5$, $P = 0.001$). On 8 May, numbers of thrips larvae per flower were significantly greater in Chickasaw than in Natchez ($H = 18.6$, $df = 5$, $P = 0.003$). We found significantly greater numbers of thrips larvae per flower in Choctaw compared with Ouachita on 15 May ($H = 14.2$, $df = 5$, $P = 0.015$) and with Ouachita and Arapaho on 22 May ($H = 21.0$, $df = 5$, $P = 0.001$).

We found no significant differences in the numbers of *Orius* sp. individuals per flower either overall or on any sampling date (all $H \leq 9.3$, $df \leq 5$, $P \geq 0.09$). The *Orius* sp. population peaked approximately 1 wk after the thrips population (Fig. 2).

The most abundant thrips species collected in the blackberries was *F. bispinosa*. Almost all (99.8%) of the thrips sampled were identified as *F. bispinosa*. The sex ratio was 1.7 females to 1 male. Several specimens of *Haplothrips graminis* Hood (Thysanoptera: Phlaeothripidae), *Microcephalothrips abdominalis* (Crawford) (Thysanoptera: Thripidae), and *Thrips hawaiiensis* (Morgan) (Thysanoptera: Thripidae) were collected. This is similar to the thrips species complex in blueberries in Florida, where *F. bispinosa* dominates (Arévalo & Liburd 2007).

Because adult thrips have wings, it is not surprising that we found few differences among cultivars in the blackberry plot on the research farm. Either there is no effect of flower color in this case or the plot size is too small for such differences to emerge.

In contrast, we found greater numbers of thrips larvae per flower in Kiowa, Choctaw, and Chickasaw, which began flowering 2 wk before Ouachita and Arapaho. Natchez, which flowered in between, had an intermediate number of thrips larvae. One possibility is that the females laid more eggs in the flowers of the cultivars that flowered earlier. Alternatively, the *Orius* sp. population may have lowered the survival of thrips larvae on the later flowering cultivars. The *Orius* sp. population peaked the week after the 2 later flowering cultivars began to flower.

It appeared that the thrips population responded in a density dependent manner to the *Orius* sp. population. Shirk et al. (2012) found this to be the case on both Queen Anne's lace, *Daucus carota* L. (Apiaceae: Apiaceae), and false Queen Anne's lace, *Ammi majus* L. (Apiaceae: Apiaceae), where *F. bispinosa* populations were initially large and then declined rapidly as *Orius* sp. populations increased. Funderburk et al. (2015) found a similar trend on crapemyrtle.

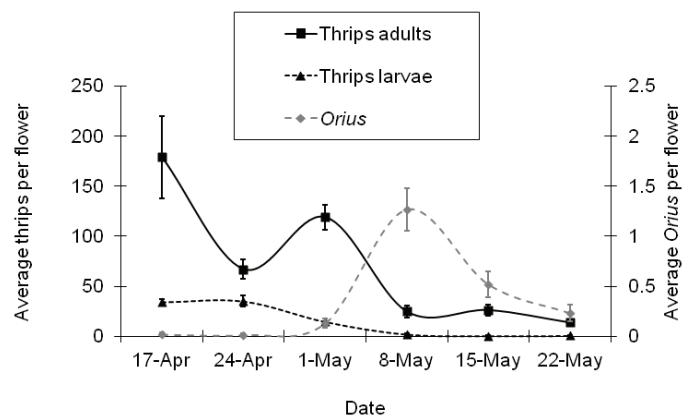


Fig. 2. Mean total numbers of flower thrips and *Orius* sp. individuals per flower.

In conclusion, it appears that flower thrips have a high pest potential in blackberries in Florida, especially in early flowering cultivars. *Orius* sp. appears to be an important natural enemy. Therefore, management tactics should be implemented that have minimal impact on *Orius* sp.

We thank Sara Brennan, Craig Roubos, and Elke Weibelzahl for their help with collecting and processing samples. We also thank the staff at the Citra PSREU for maintaining the blackberry plot.

Summary

Blackberries are a relatively new crop to Florida, and little is known about which pests will become key pests in the system. This study was conducted to determine the pest potential of flower thrips in blackberries in Florida. Flower thrips were present in large numbers, particularly in early flowering cultivars. *Frankliniella bispinosa* Morgan (Thysanoptera: Thripidae) was the dominant species found in blackberries. Flower thrips populations behaved in a density dependent manner with *Orius* sp. (Hemiptera: Anthocoridae) populations, so *Orius* sp. may be an important predator of flower thrips in this system.

Key Words: *Rubus*; *Frankliniella*; cultivar

Sumario

Las moras son un cultivo relativamente nuevo para la Florida, y poco se sabe sobre cuales plagas se convertirán en plagas clave en el sistema. Se realizó este estudio para determinar el potencial de plagas de los trips de flores en moras en la Florida. Los trips de flores estaban presentes en un gran número, particularmente en variedades de floración temprana. *Frankliniella bispinosa* Morgan (Thysanoptera: Thripidae) fue la especie dominante en moras. Las poblaciones de trips de flor se comportaron en una manera dependiente de la densidad de *Orius* sp. (Hemiptera: Anthocoridae), por eso *Orius* sp. puede ser un depredador importante de trips de flores en este sistema.

Palabras Clave: *Rubus*; *Frankliniella*; cultivar

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