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Monitoring and Emergence of Flower Thrips Species in Rabbiteye and Southern Highbush Blueberries

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Abstract

Several commercial colored sticky traps were evaluated for their effectiveness in monitoring flower thrips in rabbiteye, *Vaccinium ashei* Reade (syn. *V. virgatum* Ait.), and southern highbush, *V. corymbosum* L. × *V. darrowii* Camp blueberry plantings. Experimental designs were randomized complete blocks with 4 replicates per treatment. Four trap colors (treatments) were evaluated: 1) standard pantone yellow, 2) safety white, 3) walnut husk green, and 4) thrips blue. Traps were re-randomized weekly and hung within the canopy of blueberry bushes in a vertical position spaced approximately 10 m apart with 15 m between blocks. Significantly more flower thrips (*Frankliniella* spp.) were detected on blue and white traps compared with yellow and green in rabbiteye and southern highbush blueberry plantings. In a separate experiment, we compared three additional sampling techniques, dipping flower clusters into alcohol, tapping flowers over a flat white surface, and destructively sampling flower clusters, with the standard white sticky board trap for their ability to detect flower thrips. Significantly more flower thrips were detected on white sticky boards compared with the other techniques evaluated. The fewest number of thrips was recorded in the rabbiteye planting in the treatment where flowers were tapped over a flat white surface. Approximately, 95% of the thrips recorded in the blueberry plantings were *F. bispinosa* (Morgan). Other species of thrips included *F. fusca* (Hinds) 8%, and *F. occidentalis* (Pergande) 5%.

INTRODUCTION

Flower thrips belonging to the genus *Frankliniella* are well-documented pests of plants in the genus *Vaccinium*. In the Southeast, *Frankliniella bispinosa* (Morgan) [Florida flower thrips] *F. tritici* (Fitch), and *F. occidentalis* (Pergande) [western flower thrips] have been identified as pests of rabbiteye and southern highbush blueberries (Arévalo and Liburd, 2007, Liburd and Arévalo, 2005). These three species are known to have a wide host range and cause extensive damage to many different crop plants, with feeding primarily on tissues such as buds, flowers and young leaves (Kirk, 1995; Lewis, 1997). Flower thrips tend to aggregate in blueberry plantings forming hot spots in specific areas before dispersing throughout the field (Arévalo and Liburd, 2007). In blueberry, feeding on pollen, styles, and developing berries can initiate major yield losses. The development of an effective technique for monitoring flower thrips in blueberry plantings would enable growers to make informed management decisions and reduce the number of insecticide applications required for control.

MATERIALS AND METHODS

Experiments evaluating the effect of color for monitoring flower thrips using unbaited sticky traps were conducted in rabbiteye and southern highbush plantings in Windsor, and Inverness, Florida, respectively. Individual sites consisted of two-hectare blocks. Blueberry bushes in the rabbiteye planting were ~2.5–3 m tall and contained the following cultivars: ‘Beckyblue’, ‘Bonita’ and ‘Climax.’ Bushes in the southern highbush

planting were ~1.5–2 m in height and contained the following cultivars; 'Jewel', 'Misty', 'Sharpblue' and 'Star'. Bush spacing was 1.5 m apart and 2.4 m between rows in each planting.

In 2002, monitoring was conducted weekly from 5 March–12 April at the rabbiteye planting and 31 January–6 March at the southern highbush planting. In 2003, monitoring was conducted weekly from 4 February– 11 March at the southern highbush planting and twice per week from 6–21 March at the rabbiteye planting (five sampling dates).

Trap Evaluation

Various colors of commercially produced rectangular unbaited sticky board traps (treated area 394 cm^2, Great Lakes IPM) were used to monitor flower thrips in commercial blueberry plantings. Four treatments were evaluated: 1) standard pantone yellow, 2) safety white, 3) walnut husk green, and 4) thrips blue. Experimental design was randomized complete block with 4 replicates per treatment in each planting. Traps were hung within the canopy 30 cm from the top of the bush. Each trap was spaced 10 m apart and 15 m between blocks. Traps were re-randomized and replaced on each sampling date. During sampling, traps were removed from the field and covered with a layer of plastic wrap, then transported back to the laboratory for visual analysis. The total number of flower thrips per trap was determined with the aid of a 10-X dissecting microscope (Olympus America Inc., Melville, NY). The most effective trap color was determined based on the highest mean captures of flower thrips throughout the season based on our sub-sampling protocol. During the sampling operation, we did not distinguish between life stages or sex due to time constraints. Climatic conditions including temperature and rainfall were recorded throughout each of the sampling periods at both plantings in order to study thrips phenology.

Sampling Techniques

Experiments to evaluate different sampling techniques for detecting flower thrips were conducted in rabbiteye and southern highbush plantings in Windsor, and Inverness, Florida, respectively. Individual sites consisted of a one-hectare block and blueberry bushes were ~1.5–2 m in height.

Four techniques were evaluated for their effectiveness in detecting flower thrips populations: 1) use of unbaited white sticky boards, 2) dipping flower clusters into alcohol, 3) tapping floral clusters onto a white surface, and 4) collection of floral clusters for dissection. Experimental design was randomized complete block with four replicates per treatment in each cultivar. Treatments were blocked by cultivar. Each experimental unit consisted of approximately 15 bushes spaced 1.5 m apart and 2.4 m between rows in each planting.

Pilot Study

White sticky boards were sampled using the sub-sampling protocol that was developed from the pilot study (Finn, 2003). Briefly, a cumulative frequency distribution determined that sampling 15 of the 63 quadrats on the sticky boards provided an optimum sub-sample size to effectively estimate thrips population (Fig. 1). These data were used to create the sub-sampling protocol for the main study.

In the latter three treatments, 40 flower clusters per treatment (10 flower clusters per replicate) were collected at random and sampled for the presence of flower thrips. Sampling was conducted in the early afternoon when thrips activity was presumed to be high. In our alcohol dip technique, clusters were immediately placed into 237 ml white polyethylene jars (B & A Products, Ltd. Co., Bunch, Oklahoma) containing ~80 ml of 70% ethanol alcohol and returned to the laboratory for further analysis. Jar contents were separated using a funnel with a 2 mm screen. The remaining plant material was rinsed with ~200 ml water to recover any remaining thrips. The total number of thrips in alcohol and water aliquots was counted and recorded using a high-powered dissecting microscope

(Olympus America Inc., Melville NY). In our floral tap technique, individual clusters were tapped 5 times (50 taps of 10 flower clusters per replicate) over a 12 x 12-cm white cardboard surface, and the total number of thrips collected on the cardboard was counted and recorded. In our floral dissection technique, 10 clusters per replicate were immediately placed into 60 ml plastic containers and returned to the laboratory for dissection. Overall, the total number of thrips in each sample was determined by counting the number of thrips per 10 clusters during dissection. In addition, we inspected floral organs (n = 40 clusters), including ovaries, pistils, and stamens, to determine which floral organs were most susceptible to flower thrips damage. Treatments (monitoring techniques) were rotated among experimental plots on a weekly basis. The most efficient sampling technique was determined based on the ability and ease for detecting flower thrips. Again, no effort was made to distinguish between life stage and sex due to time constraints.

Data Analysis

Data from both studies were square root transformed to account for deviations from normality and then subjected to an analysis of variance (ANOVA) followed by mean separation using least significant difference (LSD) tests (SAS Institute, 2001). Data were also subjected to repeated measures analysis (using PROC MIXED, SAS Institute 2001) to examine interaction effects between treatment and time (sampling date) throughout the duration of each experiment. When significant interaction effects were noted, further analysis was conducted to determine the order of treatment efficacy for each sampling date. Means were considered significant when P values were ≤ 0.05. The untransformed means and standard errors are presented in tables and figures.

RESULTS

In each of our studies, *F. bispinosa* was the most abundant species of flower thrips we encountered, comprising more than 95% of the total thrips in our samples. Although other species were observed, including *F. tritici* and *F. occidentalis*, their presence was insignificant (less than 5% total thrips).

Pilot Study

Based on variance estimates as well as standard equations for sample size estimation, we determined that counting 15 of the 63 quadrats per sticky trap would provide adequate precision for estimating total thrips per trap (Fig. 1). As the number of quadrats to sample increased beyond 15, there was very little reduction in the variance component for among quadrat sampling.

Overall, thrips populations were higher in 2002 than in 2003 (Figs. 2 and 3). In 2002, thrips were a serious pest in our rabbiteye planting for three weeks, with peak density (2270±540 thrips per trap) occurring on 12 April (Fig. 2). In 2003, peak thrips density (125±10 thrips per trap) occurred on 21 March, approximately three weeks earlier than in the previous year in the same planting (Fig. 2). By contrast, in our southern highbush planting, thrips populations peaked approximately three weeks later in 2003 (22±5 thrips per trap) than in 2002 (130±30 thrips per trap) (Fig. 3). The number of days between peak thrips densities in our southern highbush and rabbiteye plantings was 40 in 2002 and 10 in 2003 (Figs. 2 and 3).

Unbaited Colored Traps

In 2002, white and blue sticky boards captured significantly ($F = 6.34$; df = 3, 9; $P = 0.01$) more *F. bispinosa* compared with yellow and green boards in our rabbiteye planting (Table 1). Similar results were recorded in our southern highbush planting, where white and blue boards captured significantly ($F = 41.2$; df = 3, 9; $P < 0.01$) more *F. bispinosa* compared with yellow boards, which captured more than green boards (Table 1). Overall, blue appears to be most the most effective color for monitoring *F. bispinosa*, followed by white, yellow, and green, respectively. There were significant interaction

effects between treatments and sampling dates in the rabbiteye planting, where yellow was the most effective trap color early in the season (5 and 13 March) when populations of thrips were low. However, as the season progressed and thrips populations increased (22 March through 12 April), blue and white were the most effective trap colors.

In 2003, white, blue, and yellow sticky traps captured significantly ($F = 10.3$; df = 3, 9; $P < 0.01$) more thrips than green in our rabbiteye planting (Table 2). Similar results were recorded in our southern highbush planting, where white, blue, and yellow sticky traps captured significantly ($F = 13.9$; df = 3, 9; $P < 0.01$) more thrips than green traps (Table 2). Again, there were significant ($F = 6.9$; df = 16, 45; $P < 0.01$) interaction effects between treatment and sampling dates in our southern highbush planting. As before, yellow was the most effective trap color for monitoring thrips when populations were low (5 March in the southern highbush planting and 6–18 March in the rabbiteye planting), but when thrips populations peaked (11 and 21 March in the southern highbush and rabbiteye plantings, respectively), blue and white traps were more effective.

Sampling Techniques

In our rabbiteye planting, white sticky boards were significantly ($F = 33.6$; df = 3, 9; $P < 0.01$) more effective in detecting *F. bispinosa* than the other techniques (dipping flower clusters into alcohol, tapping floral clusters over white cardboard, or dissecting flower clusters) (Table 3). Although there were significant ($F = 52.9$; df = 12, 36; $P < 0.01$) interaction effects between treatment and time, white boards were always the most effective technique for sampling thrips in our rabbiteye planting, regardless of sampling date (Table 3). Similar results were recorded in our southern highbush planting, where white boards were significantly ($F = 21.6$; df = 3, 9; $P < 0.01$) more effective in detecting thrips than the other techniques evaluated. Overall, our alcohol dip and floral dissection techniques were equivalent in their ability to detect thrips in both of the plantings. Tapping floral clusters over a flat white surface was the least effective technique for rabbiteye. However, this technique performed as well as alcohol dip and dissection techniques in the southern Highbush planting (Table 3).

While dissecting the floral organs, we noted that nymphs and adults were present on the ovary, style, filaments, and anthers. We also noted the presence of feeding scars on the tissues of the ovary that develop into the calyx cup. In general, feeding scars were brown and contrasted the green color of the developing fruit.

DISCUSSION

Overall, our results indicated that blue and white sticky boards were the most consistent colors that captured high numbers of thrips, specifically *F. bispinosa*, in Florida blueberry plantings. These results parallel work by Childers and Brecht (1996) who found that blue and white were effective colors for monitoring *F. bispinosa* using sticky boards during the flowering cycles of citrus in Florida. In our studies, yellow sticky boards were found to be effective for monitoring thrips early in the flowering season when populations were low. The reason why there is a shift in trap captures from yellow early in the season to white or blue later in the flowering period is unknown. One hypothesis is that males and females of *F. bispinosa* are attracted to different ranges of the visual spectrum. While we did not systematically quantify specimens based on sex throughout our studies, it appeared that the ratio of females to males was low early in our sampling period when yellow traps captured the most thrips (E. Sarzynski, pers. observation). This pattern appeared to reverse later in the flowering period when the ratio of females to males increased. In greenhouse studies with *F. occidentalis*, Vernon and Gillespie (1990) found that the ratio of females to males was consistently higher on blue traps than on yellow or white traps. Future studies with *F. bispinosa* may address this hypothesis.

The presence and abundance of thrips in blueberry plantings appears to be heavily influenced by climatic conditions. In 2002, thrips populations were much higher than in 2003. The variation in population density from 2002 to 2003 is probably the result of a

milder winter in 2002. Temperatures in north-central Florida exceeded 27°C in mid-February, which may have allowed thrips populations to build up earlier in our southern highbush planting. However, there was a late freeze in early March 2002 that delayed the build-up of thrips in rabbiteye plantings later in the season. Consequently, in 2002 we observed a long period between peak thrips densities in our southern highbush and rabbiteye plantings. A cold winter in 2003 allowed for a short flowering period in rabbiteye and southern highbush blueberries, which may partially explain the reduced duration and abundance of thrips in our plantings.

The development of a sub-sampling protocol for sticky boards has facilitated the speed and accuracy for which we can count flower thrips in blueberry plantings. We determined that there is no increase in precision on counting more than 15 quadrats on a sticky trap with a 63-quadrat internal grid system. In our studies, thrips were distributed randomly on our traps, and therefore we were able to adopt an accurate systematic approach for counting flower thrips within quadrats. The major advantage with this system is that it allows for more accurate estimates of thrips densities during peak flight.

In our sampling techniques study, we found that sticky boards were the most effective technique for monitoring flower thrips in blueberry plantings. Overall, this technique is less labor intensive and more cost effective than other monitoring techniques we evaluated. The standard technique of tapping flower clusters was also cost effective and simple, but it was less reliable for detecting flower thrips than sticky boards, particularly early in the season when populations were low. The dipping of infested flower clusters into alcohol was largely impractical, since the structure of blueberry flowers, specifically the shape and length of the corolla, often prevented easy separation of plant and insect material. Our final technique, flower dissection, was the most labor-intensive strategy for monitoring thrips in our plantings and is not recommended for practical purposes.

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Literature Cited

Arévalo, H.A. and Liburd, O.E. 2007. Horizontal and vertical distribution of flower thrips in southern highbush and rabbiteye blueberry fields, with notes on a new sampling method for thrips inside the flowers. J. Econ. Entomol. 100:1622–1632.

Childers, C.C. and Brecht, J.K. 1996. Colored sticky traps for monitoring *Frankliniella bispinosa* (Morgan) (Thysanoptera: Thripidae) during flowering cycles in citrus. J. Econ. Entomol. 89:1240–1249.

Kirk, W.D.J. 1995. Feeding behavior and nutritional requirements. In: B.L. Parker, M. Skinner and T. Lewis (eds.), *Thrips Biology and Management*. Plenum Press, New York, NY, pp. 21-29.

Lewis, T. (ed.) 1997. Thrips as crop pests. CAB International, New York, NY, p.740.

Liburd, O.E. and Arèvalo, H.A. 2005. Integrated strategies for controlling flower thrips in southern Highbush blueberries. EDIS. UF/IFAS IPM-140/IN637 University of Florida, Gainesville, FL. http://edis.ifas.ufl.edu/IN637.

SAS Institute Inc. 2001. SAS System for Windows Rel. 8.2. SAS Institute, Inc. Cary, North Carolina, USA.

Vernon, R.S. and Gillespie, D.R. 1990. Spectral responsiveness of *Frankliniella occidentalis* (Thysanoptera: Thripidae) determined by trap catches in greenhouses. Environ. Entomol. 19:1229–1241.

Wood, G.W. 1956. Note on injury to blueberry sprouts by the blueberry thrips, *Frankliniella vaccinii* Morgan (ThysanopteraL Thripidae). Can. J. Agric. Sci. 36:510.

Tables

Table 1. Comparison of various colors of sticky board traps for monitoring *F. bispinosa* in rabbiteye and southern highbush blueberries in north-central Florida (2002).

Color	Mean ± SEM* *F. bispinosa*	
	Rabbiteye	Southern highbush
Standard pantone yellow	1106.0±342.0b	167.8±21.2b
Safety white	3285.0±931.7a	277.8±28.0a
Walnut husk green	465.3±192.4b	53.8±5.9c
Thrips blue	4061.5±2131.6a	281.5±24.4a

*Means within columns followed by the same letter are not significantly different, $P = 0.05$, LSD Test. Analysis was performed on square-root transformed data, but means shown reflect untransformed data. Sampling was conducted on 3/5, 3/13, 3/22, 3/28, and 4/5 in the rabbiteye planting, and 1/31, 2/6, 2/13, 2/21, 2/27, and 3/6 in the southern highbush planting. Means given are the total number of *F. bispinosa* over all sampling dates as determined by my subsampling protocol.

Table 2. Comparison of various colors of colored sticky board traps for monitoring flower thrips in rabbiteye and southern highbush blueberries in north-central Florida (2003).

Color	Mean ± SEM* *F. bispinosa*	
	Rabbiteye	Southern highbush
Standard pantone yellow	229.8±20.5a	83.3±26.2a
Safety white	193.0±35.2a	56.0±9.7a
Walnut husk green	76.8±11.8b	14.0±1.9b
Thrips blue	211.8±38.0a	65.8±11.1a

*Means within columns followed by the same letter are not significantly different, $P = 0.05$, LSD test.

Table 3. Comparison of sampling techniques for monitoring flower thrips in rabbiteye and southern highbush blueberries in north-central Florida (2003).

Sampling technique	Mean ± SEM* *F. bispinosa*	
	Rabbiteye	Southern highbush
White sticky boards	168.8±9.3a	271.5±72.8a
Alcohol dip	101.0±9.8b	50.0±9.6b
Floral tap	57.5±10.2c	30.0±4.9b
Floral dissection	100.0±13.5b	11.8±2.1b

*Means within columns followed by the same letter are not significantly different, $P = 0.05$, LSD test.

Figures

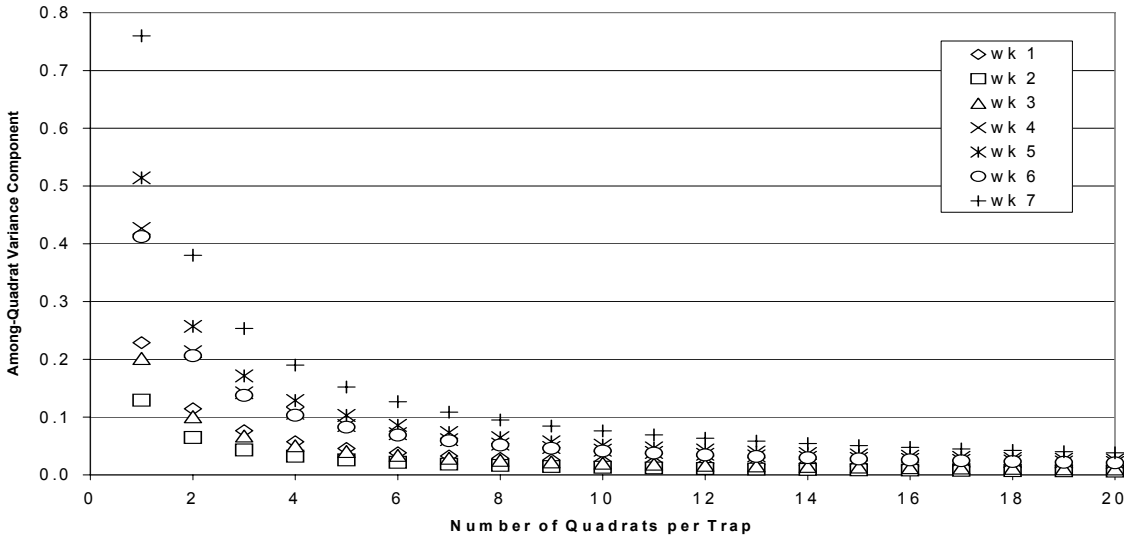

Fig. 1. Results of a pilot study to determine how many quadrats on an individual sticky board trap had to be counted to reasonably estimate true counts of flower thrips. The variance components on the y-axis were calculated by dividing the between-quadrat variance component by the total number of quadrats to be sampled. Overall, the variance among quadrats was not greatly reduced upon sampling more than 15 of the 63 quadrats per trap.

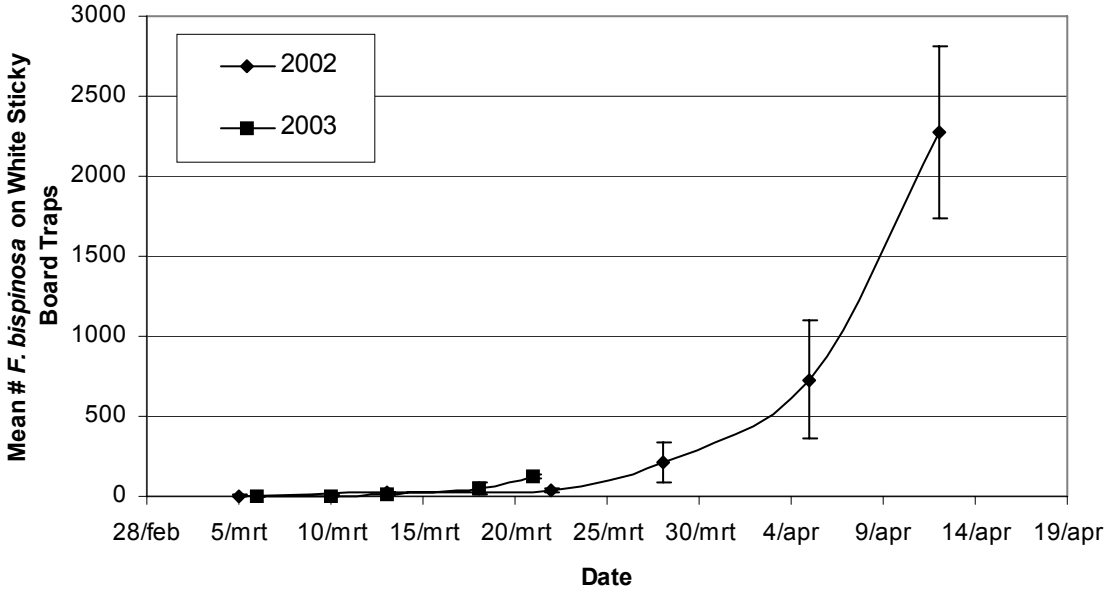

Fig. 2. Abundance of flower thrips throughout the flowering period of a rabbiteye blueberry planting in Windsor, FL (2002 and 2003).

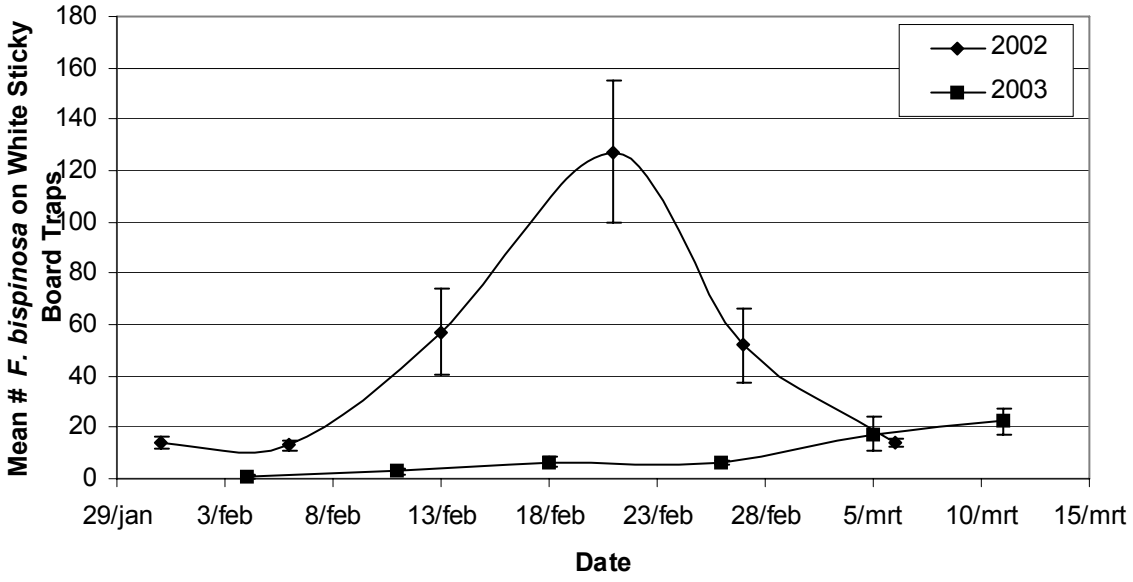

Fig. 3. Abundance of flower thrips throughout the flowering period of a southern highbush blueberry planting in Inverness, FL (2002 and 2003).