Title: Thrips prevalence and management in southeastern blackberries

Progress Report

SRSFC Project # 2008-11

Research Project

Dr. Hannah Burrack
Assistant Professor and Extension Specialist
Department of Entomology
North Carolina State University
1130 Grinnells Laboratory
Campus Box 7626
Raleigh, NC 27606
Hannah_burrack@ncsu.edu

Dr. Gina Fernandez
Associate Professor and Small Fruit Specialist
Department of Horticultural Science
North Carolina State University
170 Kilgore Hall
Campus Box 7609
Raleigh, NC 27695
Gina_Fernandez@ncsu.edu

Objectives:

1. Identify thrips species feeding on blackberries in North Carolina.
2. Determine the seasonal abundance of thrips on blackberries.
3. To correlate thrips incidence and densities to fruit yield and disease occurrence.
4. To test available insecticides agents for thrips management.

Justification

Thrips (spp. unknown) are common pests on brambles in the southeast, but very little is known about their biology and management on blackberries. So little is known that, prior to the initiation of this project, it was unclear which thrips species are present on and economically damaging to blackberries. However, growers have indicated that thrips are their number one insect pest (G. Fernandez pers. comm.) The two most likely thrips to be found on blackberries are in the genus *Frankliniella*, the flower thrips, *F. tritici,* and the western flower thrips, *F. occidentalis*. These thrips may be found individually on blackberries, in combination, or with additional thrips species. The goals of the proposed project are to determine which thrips species are present on blackberries in the southeast; track the seasonal abundance of these species; to correlate these population fluctuations with reductions in yield, fruit damage, and possible disease incidence; and to test available control methods, both chemical and biological.

Blackberry acreage is rapidly expanding throughout the southeast, in particular in western North Carolina and South Carolina. Significant plantings are also present in Georgia and Arkansas. Thrips occur in all these locations and are of concern to growers elsewhere in the United States, including Oregon and California. The utility of the results generated by this project, therefore, are certainly regional and potentially national.

Western flower thrips species are known virus vectors. This species is a key vector of Tomato Spotted Wilt Virus in vegetable and tobacco systems and is capable of vectoring Impatiens Necrotic Spot Virus (INSV), which has been detected in southeastern blackberries. The impact of thrips vectored viruses in blackberries is unknown. Limited chemical control options are available for thrips on brambles, particularly during the bloom period when thrips are most prevalent. The overlap between bloom and harvest in brambles also limits which insecticides which can be used, and our assays include organic and reduced risk materials with short preharvest intervals.

This report summarizes the findings of the first of a multi-year project. In the first year, we have compared which thrips monitoring methods, identified thrips species present in flowers and on foliage, and begun to understand the relationship between thrips density and plant damage.

Methodologies

Objective 1: Thrips diversity

A subsample of 30 thrips per trap or plant sample were (when available) collected from monitoring traps (*Objective 2*) and treatment trials (*Objective 4*), slide mounted, and identified to species. This allowed for both determination of species composition and tracking of these species throughout to season to determine their relative abundances over time.

Objective 2: Thrips abundance and seasonal biology

Five thrips monitoring locations were established; one in eastern NC (Lenior County), and 4 in western NC. Sites 1, 2, 3, and 4 (western NC) were maintained by industry cooperators, while the eastern NC site was maintained by the Burrack Laboratory. This report focuses on data from Sites 1, 2, 3, and 4, in North Carolina's main blackberry production area. At each location, 5 trap types were compared: AM (yellow sticky traps), blue sticky cards, and 3 different colored PVC traps, yellow, blue, and dark blue (Figure 1). PVC traps were coated with stable fly paper. Yellow traps are attractive to a broad range of insects, while blue traps are more attractive to western flower thrips. Two colors of blue were used because commercial western flower thrips traps vary in hue. Traps were changed weekly, and bud, blossom, or fruit samples (depending upon the season) were collected from the bush adjacent to the traps to relate trap captures to insect presence on plant reproductive tissue. These samples were stored in 70% EtOH.

Objective 3: Relating thrips abundance to fruit injury

Harvest samples were collected for the 2 treatment trials conducted (*Objective 4*): registered materials at trapping Site 1 in Cleveland County, NC and unregistered materials at the Cunningham Research Station, Kinston, NC. Forty fruit samples were collected from each plot at Kinston, and 60 fruit samples were collected at Site 1. These samples were weighed, rated as percent marketable, and subsamples of 20 fruit from each plot were measured (length, width, and height) and number of druplets per fruit. Size measurements and druplet counts were collected to determine if thrips feeding on developing fruit had any impact on resulting size and shape.

Objective 4: Testing available materials for thrips management

Two treatment trials were established in 2008, the first designed to gather efficacy data on unregistered materials on thrips in southeastern blackberries. This trial was supported by the Southern Region IR Program, and a separate report submitted to them details the results to date. A second trial comparing currently registered materials with potential activity against thrips was established with a grower cooperator in Cleveland County, NC. This site was also used for trap comparisons as Site 1 (*Objective 2*). The following treatments were compared in a RCB design, replicated 4 times:

1. Untreated Control
2. Pyganic EC 1.4 E (pyrethrins), 32 fl oz/A, Organically acceptable
3. Delegate WG (spinetoram), 4 oz/A
4. Delegate WG (spinetoram), 6 oz/A
5. Ecotec (horticultural oils), 2 qt/A, Organically acceptable
6. Assail 30 SG (acetamiprid), 4.5 oz/A
7. Assail 30 SG (acetamiprid), 5.3 oz/A
8. Aza-Direct (azadirectin), 32 fl oz/A, Organically acceptable

All treatments were applied with a Solo Mistblower at 200 gpa to simulate grower standard airblast application. Treatments were applied on 19 May 2008 (prebloom), 26 May 2008, and 2 June 2008. Plots consisted of 5 plants, and samples were collected from the center 3 plants in each plot.

One yellow and 1 blue PVC trap was placed in each plot to determine if trap captures were reduced by treatments. Blossom and foliage samples were also collected from plots as follows: 10 blossom clusters (4 to 5 flowers) and 10 trifoliate leaves (from a fruiting cane) were collected and washed in 70% EtOH to remove thrips. Thrips were then counted and a subsample indentified to species (*Objective 1*). Traps were changed and samples collected 3 and 7 days post treatment.

Data for all objectives were analyzed in SAS v.9.1 via Proc Mixed as repeated measures.

Results

Objective 1: Thrips diversity

Thrips collected from blackberry blossoms and indentified to species to date are almost exclusively *Frankliniella tritici* (eastern flower thrips), but only 2 early season dates (5/26/2008 and 5/29/2008, from Site 1) have been completely identified thus far. High trap captures in blue sticky traps from later in the season indicate that a flight of western flower thrips (*Frankliniella occidentalis*) may occur as well. Thrips were also found on blackberry foliage, but at roughly 1/10 the density as in blossoms. Foliage samples were more diverse, however, and included tobacco thrips (*F. fusca*), onion thrips (*Thrips tabaci*), cereal thrips (*Limothrips cerealium*), tomato thrips (*F. schultzei*), soybean thrips (*Seicothrips variabilis*), and *F. tenuicornis*. Many of these species are likely nonresident visitors to blackberries and are not of economic concern. Tobacco thrips, onion thrips, tomato thrips, and *F. tenuicornis* are potential vectors of INSV, so their presence, although transient, may have implications for disease movement.

Objective 2: Thrips abundance and seasonal biology

Thrips populations can reach very high numbers in blackberry blossoms (Figure 2), and mirrors blackberry phenology. Thrips can be present on plants from before bloom through harvest. Low numbers of thrips were washed from harvest fruit samples in 2008. Traps do a good job of mirroring thrips fluctuations in blossoms during bloom, but as fruit develop and fewer thrips are present in plant reproductive tissue, trap captures still increase. This is likely due to a post bloom population of western flower thrips, as evidenced by the increase of trap capture in blue traps and decreased capture in yellow traps (Figure 3).

At Site 1, blue traps consistently caught more thrips than yellow PVC traps (Figure 3), but this trend did not hold across all 4 western sites. While blue traps generally caught more thrips (Figure 4), these differences were not significant on most dates. Monitoring at Sites 2, 3, and 4 terminated before the largest number of thrips were captured at Site 1, so these differences may have appeared if trapping continued. Western flower thrips populations are also not uniform across North Carolina, so it is possible that Site 1 has a great proportion of western flower thrips than the other locations. Ongoing thrips identification of samples from these traps will address these questions.

Objective 3: Relating thrips abundance to fruit injury

There were no significant effects of treatment on percent marketable fruit, fruit size, shape, or druplet number. Our treatments, however, were not generally successful at reducing thrips populations, so we cannot necessarily conclude that thrips feeding did not damage fruit. In 2009, we will cage developing fruit to exclude thrips and introduce laboratory reared thrips on separately caged fruit in different densities to determine if thrips feeding injures fruit under these conditions.

Objective 4: Testing available materials for thrips management

Larval numbers were lower in blossom samples, but are more interesting than adult numbers, as adults rapidly re colonize blossoms following treatments. Larval populations indicate that adults were resident in blooms long enough to lay eggs and were not just feeding and departing. Treatment trial results were inconsistent (Tables 1 and 2), likely due to in migration of adult thrips between treatments. Larval thrips data were more consistent, with the 2 Delegate treatments resulting in fewer larvae. Assail treatments seems to flair thrips populations toward the end of the trial, possibly due to non target impacts on beneficial predators. Minute pirate bugs (*Orius* spp.) and big eyed bugs (*Geocoris* spp.) were observed in plots, although counts were collected of these insects. Both predators can feed on thrips eggs and larvae. The minimal treatment effects observed were present for less than a week following treatments, and then thrips movement into plots overwhelmed the treatments. Treatment trial methods will be refined in 2008 and will employ an air blast sprayer rather than backpack application.

Conclusions

We have determined that thrips are present, often in very high numbers, and reproduce in southeastern blackberry blossoms. We identified some of the key thrips species present and will categorize species composition through time. We have begun initial tests of chemical efficacy for managing thrips in blackberries, but these highly variable results will need to be replicated and assay methods refined. A link between thrips presence and yield loss through fruit malformation has yet to be established. Through direct manipulation of thrips on blooms through fruit maturation, we will further address this question to determine at what density thrips are damaging to blackberries.

Impact Statement

This project has developed monitoring tools to track thrips populations in southeastern blackberries, identified key thrips species present, and begun work to identify damage thresholds and management tools for thrips in this crop.

Citations

No publications relating to this project were produced in 2008.

Table 1. Mean adult thrips (± SEM) per blossom sample, 2008 registered insecticide treatment trial. Means followed by the same letter are not significantly different (α = 0.05) via Fisher's Protected LSD. Note that mean separations were performed on adjusted means, but actual means are presented for comparison purposes.

		Prebloom Treatment		**Bloom Treatment**		**Bloom Treatment**		
Treatment	**Rate per acre**	**5/19/2008**	**5/22/2008**	**5/26/2008**	**5/29/2008**	**6/2/2008**	**6/7/2008**	**6/14/2008**
Untreated Control	NA	23.00 ± 7.01 **a**	148.50 ± 31.52 **a**	228.00 ± 66.64 **ab**	128.75 ± 19.60 **ab**	95.00 ± 16.77 **a**	36.50 ± 6.25 **a**	13.75 ± 3.57 **a**
Pyganic EC 1.4 E	32 fl oz	21.50 ± 7.93 **a**	124.00 ± 20.85 **ab**	231.50 ± 51.00 **ab**	163.50 ± 34.41 **a**	113.75 ± 24.55 **a**	39.00 ± 4.69 **a**	14.25 ± 1.55 **a**
Delegate WG	4 oz	10.00 ± 3.00 **a**	46.25 ± 15.40 **bc**	66.50 ± 20.87 **b**	90.25 ± 25.96 **ab**	96.50 ± 23.57 **a**	61.75 ± 9.87 **a**	25.75 ± 4.89 **a**
Delegate WG	6 oz	19.5 ± 7.27 **a**	30.00 ± 4.85 **c**	183.00 ± 53.76 **b**	75.75 ± 19.02 **b**	145.25 ± 44.32 **a**	51.25 ± 16.51 **a**	23.50 ± 8.03 **a**
Ecotec	2 qt	24.25 ± 10.73 **a**	118.75 ± 13.76 **abc**	210.50 ± 34.34 **ab**	123.00 ± 44.22 **ab**	85.50 ± 16.43 **a**	56.75 ± 14.90 **a**	18.25 ± 4.66 **a**
Assail 30 SG	4.5 oz	13.25 ± 3.09 **a**	67.00 ± 24.25 **bc**	283.50 ± 81.17 **a**	96.25 ± 12.24 **ab**	135.75 ± 39.22 **a**	106.00 ± 24.02 **a**	60.75 ± 17.60 **a**
Assail 30 SG	5.3 oz	13.25 ± 4.00 **a**	58.00 ± 7.82 **bc**	172.00 ± 55.15 **b**	81.75 ± 14.23 **ab**	164.25 ± 35.23 **a**	123.00 ± 15.66 **a**	69.75 ± 18.71 **a**
Aza-Direct	32 fl oz	11.75 ± 1.93 **a**	110.00 ± 31.90 **abc**	152.75 ± 53.47 **b**	160.00 ± 32.18 **a**	114.5 ± 14.24 **a**	47.50 ± 3.48 **a**	18.25 ± 4.84 **a**

Table 2. Mean larval thrips per blossom sample, 2008 registered insecticide treatment trial. Means followed by the same letter are not significantly different (α = 0.05) via Fisher's Protected LSD. Note that mean separations were performed on adjusted means to control for occasional missing data points, but actual means are presented for comparison purposes.

		Prebloom Treatment		**Bloom Treatment**		**Bloom Treatment**		
Treatment	**Rate per acre**	**5/19/2008**	**5/22/2008**	**5/26/2008**	**5/29/2008**	**6/2/2008**	**6/7/2008**	**6/14/2008**
Untreated Control	NA	1.00 ± 0.58 **a**	9.25 ± 2.66 **a**	14.75 ± 3.71 **a**	72.50 ± 22.86 **bc**	28.75 ± 7.20 **bc**	4.25 ± 1.65 **a**	0.50 ± 0.29 **a**
Pyganic EC 1.4 E	32 fl oz	0.25 ± 0.25 **a**	3.5 ± 2.22 **a**	20.25 ± 4.71 **a**	136.00 ± 50.00 **a**	49.50 ± 7.51 **bc**	8.00 ± 1.47 **a**	0.00 ± 0.00 **a**
Delegate WG	4 oz	0.33 ± 0.33 **a**	0.75 ± 0.48 **a**	48.50 ± 26.14 **a**	38.75 ± 14.18 **d**	21.75 ± 5.04 **bc**	4.00 ± 1.87 **a**	0.75 ± 0.75 **a**
Delegate WG	6 oz	0.75 ± 0.48 **a**	0.50 ± 0.29 **a**	4.75 ± 2.50 **a**	29.75 ± 11.34 **d**	16.75 ± 2.17 **c**	1.50 ± 1.19 **a**	0.50 ± 0.50 **a**
Ecotec	2 qt	0.00 ± 0.00 **a**	5.75 ± 3.07 **a**	25.25 ± 12.21 **a**	88.00 ± 12.92 **ab**	32.25 ± 12.96 **bc**	9.00 ± 4.08 **a**	0.25 ± 0.25 **a**
Assail 30 SG	4.5 oz	0.25 ± 0.25 **a**	6.00 ± 5.67 **a**	13.00 ± 6.40 **a**	47.25 ± 10.71 **cd**	38.00 ± 25.33 **ab**	18.25 ± 4.48 **a**	1.25 ± 1.25 **a**
Assail 30 SG	5.3 oz	0.75 ± 0.48 **a**	0.75 ± 0.75 **a**	6.75 ± 3.71 **a**	36.25 ± 10.76 **d**	88.75 ± 9.10 **a**	14.75 ± 4.44 **a**	4.25 ± 1.70 **a**
Aza-Direct	32 fl oz	0.50 ± 0.28 **a**	3.25 ± 1.97 **a**	17.75 ± 9.20 **a**	62.50 ± 19.58 **cd**	47.00 ± 21.98 **bc**	7.00 ± 2.35 **a**	0.50 ± 0.50 **a**

Figure 1. Trap types compared in 2008. Clockwise from top, AM trap, blue sticky card (both from Great Lakes IPM, Vestaberg, MI), dark blue PVC, blue PVC, and yellow PVC. Note all PVC trap are the same size (approximately 3.5 inches long) but are shown different sizes for scale and detail.

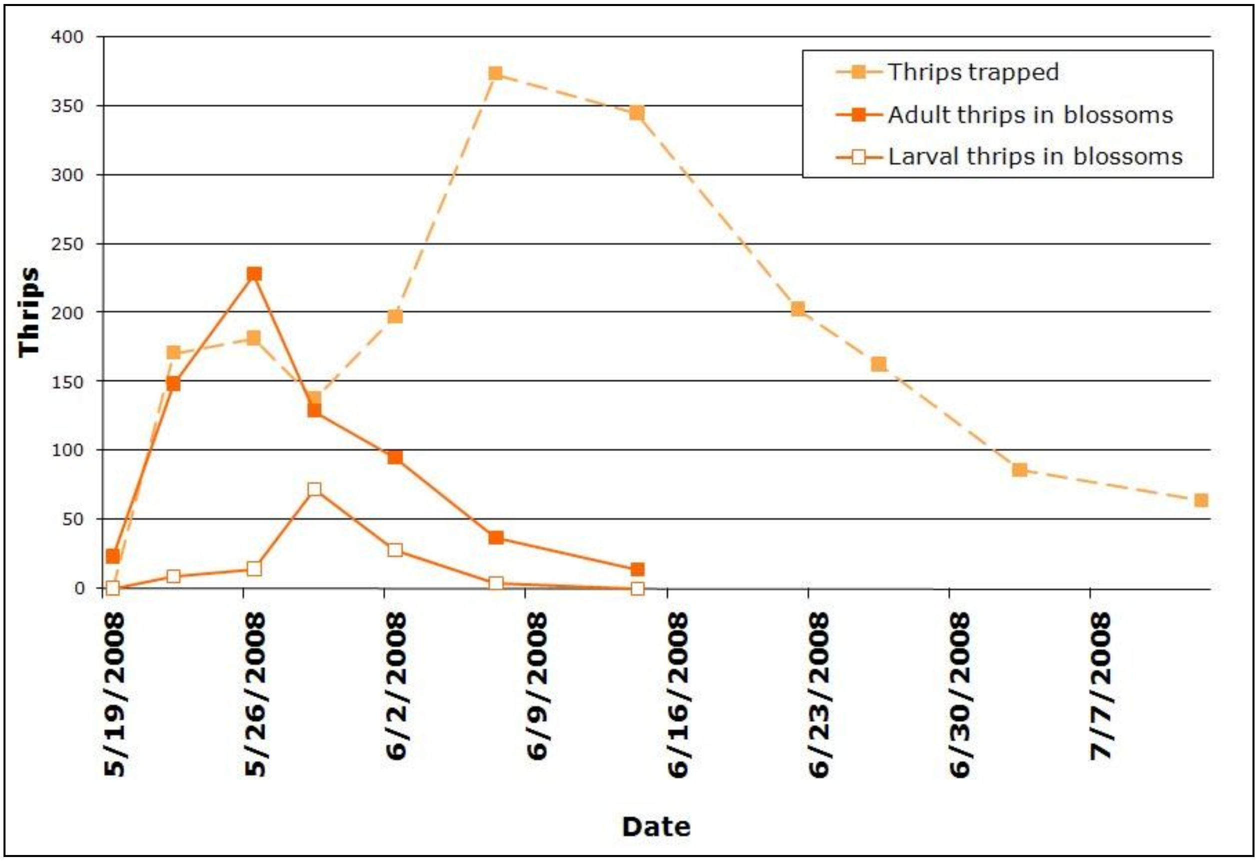

Figure 2. Thrips phenology, Site 1 (Cleveland County, NC). Blossom counts for adult and larval thrips are from untreated control plots from on farm insecticide trial, and trapping data are totals from one yellow and one blue sticky trap per plot. Adult and larval thrips samples are total for 10 cluster bud, blossom, or fruit samples (depending upon the season) per plot.

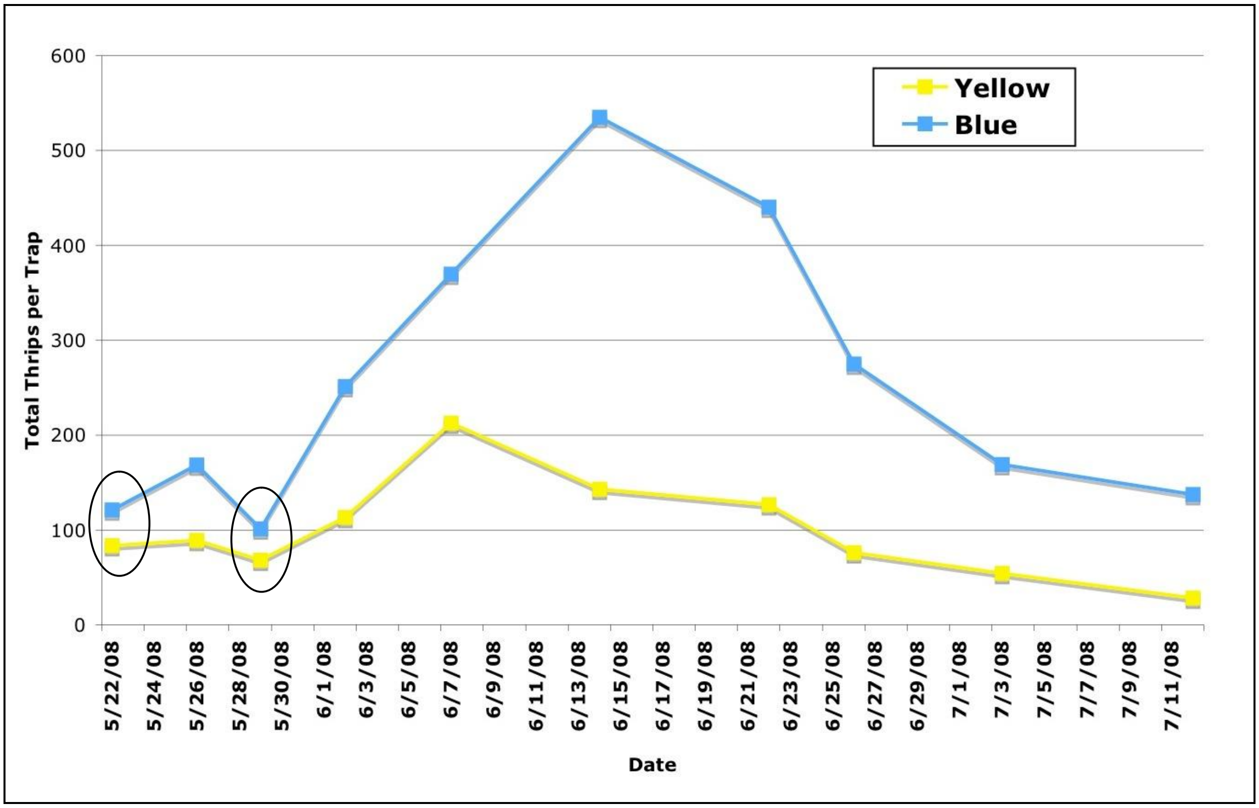

Figure 3. Thrips trap captures in insecticide treatment trial, Site 1 (Cleveland County, NC) in yellow and blue PVC cylinder traps. Values from a single date within the same circle are not significantly different ($\alpha = 0.05$) via Fisher's Protected LSD.

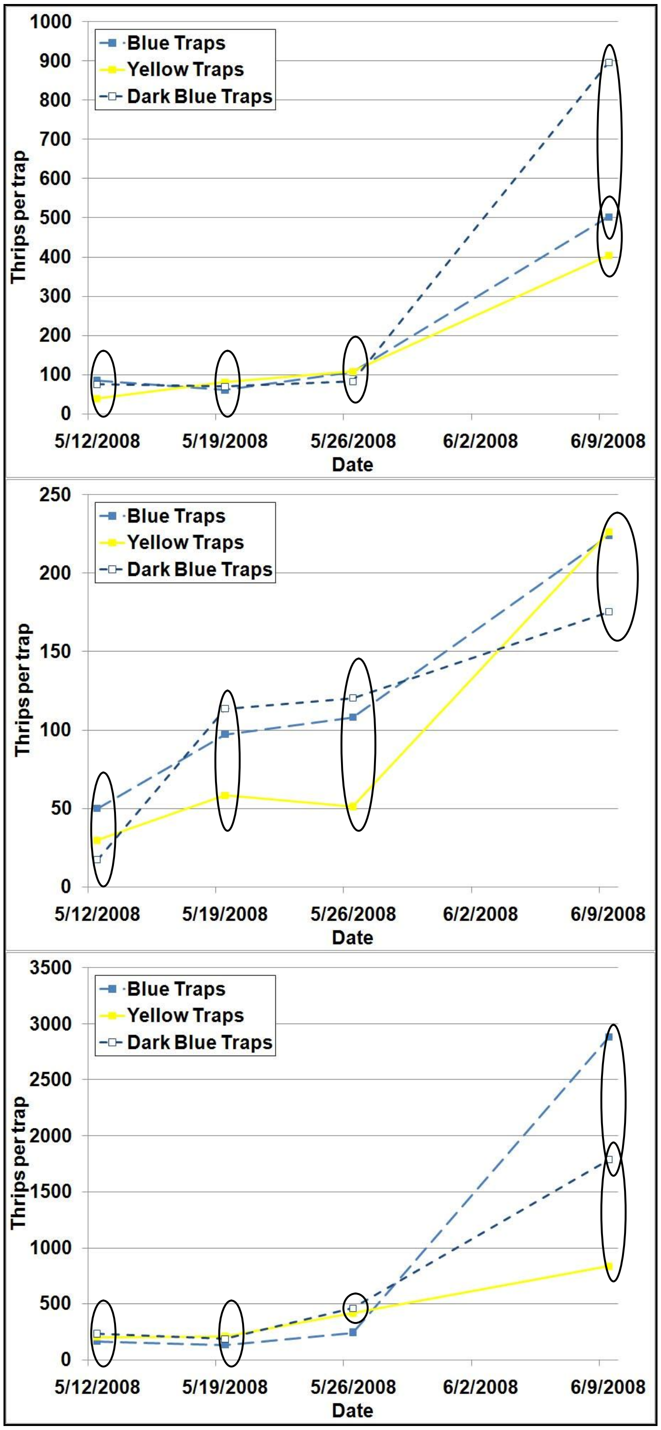

Figure 4. Trap color comparison. Yellow, blue, and dark blue PVC cylinder trap capture data from Sites 2, 3, and 4 (from top), all in southwestern NC. Data points for a date within the same circle are not significantly different ($\alpha = 0.05$) via Fisher's Protected LSD.