COMPARISON OF ABSOLUTE ESTIMATES OF *THRIPS TABACI* (THYSANOPTERA: THRIPIDAE) WITH FIELD VISUAL COUNTING AND STICKY TRAPS IN ONION FIELD IN SOUTH TEXAS

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ABSTRACT

Absolute estimates of onion thrips, *Thrips tabaci* Lindeman, on onions were used to determine the reliability of field visual counting, and blue and white plastic cup traps and CC traps for monitoring thrips in onion fields. It took >140 min to sample one plant for the absolute estimates of thrips, which was ≈15-fold longer than needed to sample one plant by field visual counting, and 3.8- and 4.3-fold longer than processing a sample using a plastic cup trap or a CC trap sample, respectively. Results indicated that adult thrips comprised ≈16.4 and 15.8% of total thrips in the absolute estimates and field visual counting, respectively, and were well correlated with total thrips in each sampling method (r = 0.81 and 0.73, respectively). Total thrips and adults by field visual counting estimated ≈75% of total thrips and ≈78% of adults of the absolute estimates, and were highly correlated with the absolute estimates (r = 0.98 and 0.95, respectively). Blue plastic cup traps caught the most thrips (19-23 thrips/trap/day), followed by white plastic cup traps (10-12 thrips/trap/day), compared with <1 adult thrips/trap/day on CC traps. Adults caught on the sticky traps were not well correlated with numbers of thrips on onion plants in the field (r = 0.07-0.61). Field visual counting of either all thrips or only adults on onion plants was quick and provided >95% precision.

INTRODUCTION

Onion (*Allium cepa* L.) is a major vegetable crop in south Texas with >6,000 ha harvested with a value of >$80 million in 2001 and an economic impact of >$150 million (Anonymous 2001). Onion thrips, *Thrips tabaci* Lindeman, is one of the most important insect pests of onions in south Texas (Edelson et al. 1986, Royer et al. 1986, Sparks et al. 1998).

Shirck (1948) developed an absolute thrips sampling method that was later adopted by Edelson (1985). In brief, they collected the basal part (17.2 and 20 cm long) of onion plants into containers in the field and later placed them in funnel collection devices in ovens at 46°C to extract thrips from the onion plants into collecting vials. The limitations of this method were that small larvae and pupae might not be able to drop down into the collecting vials, and heated ovens are needed to extract the thrips.

Sticky traps of different colors, materials, and shapes have been used for sampling and monitoring, estimating populations, and controlling various species of thrips, including *T. tabaci, Thrips palmi* (Karny), and *Frankliniella occidentalis* (Pergande) under greenhouse and field conditions (Lu 1990, Cho et al. 1995, Tsuchiya et al. 1995, Vernon et al. 1995, Terry 1997, Roditakis et al. 2001, Szenasi et al. 2001). The CC trap was initially developed for monitoring the activity of silverleaf whitefly, *Bemisia argentifolii* Bellows & Perring, in cotton and other field crops (Chu and Henneberry 1998, Chu et al. 2000). Besides being used for trapping *B. argentifolii*, modified CC traps have been used for trapping various other insects, including leafhoppers, *Empoasca* spp., and *F. occidentalis* (Chu et al. 2000). These modifications for CC traps include changing colors of the trap base (yellow, rum, red, lime green, spring green, woodland green, true blue, white, and black).

The objectives of this study were to determine whether sticky traps can be used for monitoring thrips population dynamics with comparison with absolute estimate and field visual counting under field conditions in south Texas.

MATERIALS AND METHODS

The study was conducted at the Research Farm of the Texas A&M University Agricultural Research and Extension Center at Weslaco, Texas. Onions (var. '1015') were planted on 5 October 1999 on a 1-m wide bed and spaced at 25 cm. The plants were maintained under standard cultural practices for south Texas. There were four plots (replicates); each plot had 10 rows, and each row was 30-m long. Herbicides (bensulide [Prefar 4E], Gowan, Yuma, AZ; 1,112 g AI/ha) and fungicide (chlorothalonil [Equu 720], Griffin, Valdosta, GA; 1,260 g AI/ha) were applied as needed.

Thrips sampling began on 7 February 2000 and was carried out weekly until harvest. Two methods were used for estimating thrips densities on onion plants, absolute estimates and field visual counting. For the absolute estimates, 10 onion plants, randomly selected from each plot, were carefully cut at ground level before the bulb was formed or were cut from the neck or the upper part of the bulb after the bulb was formed. The plants were carefully handled to avoid disturbing the thrips on the plants. The plants were individually placed in 3.7-l zip-lock plastic bags (S. C. Johnson & Son, Inc., Racine, WI). In the laboratory, each bag was filled with 500 ml water, and all leaves of the plant were separated so that all thrips and other insects were washed off. To ensure all arthropods were washed off, the leaves were washed with water a second time using a bottle sprayer (Plant & Garden Sprayer, Sprayco, Detroit, MI). All arthropods washed off each plant were filtered in a funnel, and transferred to a clear plastic Petri dish (9-cm diameter × 1.5-cm deep). Thrips adults, larvae, pupae, and other arthropods were identified and counted. All voucher specimens were deposited in the Insect Collection of the Texas A&M University Agricultural Research and Extension Center at Weslaco, Texas. For field visual counting, 10 onion plants adjacent to the ones collected for absolute estimates from the same plots were selected on the same date. All leaves were gently inspected for thrips and other arthropods.

Time needed to perform a sample, including counting thrips and other arthropods in the field, labeling bags, collecting plants, washing off and filtering arthropods, and counting thrips was recorded. The times used for sampling thrips from onion plants for both the absolute estimates and the field visual counting were determined twice, on 14 February, when thrips populations were low, and on 29 March, when thrips populations were high.

Blue and white disposable plastic cups (255 ml SOLO Party Cups, SOLO Cup Co., Urbana, IL) and CC traps were used to monitor thrips in the onion field. The CC trap consists of three parts: a top clear plastic cup (Comet T12, Tumbler 255 ml, Comet Products Inc., Chelmsford, MA) that admits light for adult orientation to the trap, a deflector plate that prevents insects from escaping from the trap, and a blue or white cylinder base with an open-ended container attenuated cone that allows adult entrance (Chu et al. 1998, 2000). The CC trap used in this study was modified by removing the deflector plate and coating the inner surface of the clear cup with sticky Tanglefoot glue (Tangle-Trap Insect Trap Coating, Aerosol formula, The Tanglefoot Company, Grand Rapids, MI). The plastic cup traps were coated with Tanglefoot glue on the outside surface only. Both the plastic cup traps and CC traps were individually hung on a wooden stake with an iron wire hook 2-3 cm above the plant canopy. The height of the traps was adjusted with growth of the plants. In each plot, 20 plastic cup traps (10 of each color) and 20 CC traps (10 of each color) were randomly placed in the field at a distance of ≈3-5 m from the nearest trap. The traps were placed in the field in the early morning. After remaining in the field for 24 h, they were brought to the laboratory, and all thrips on the traps were identified and counted. Traps were placed in the field weekly on the same day as the whole onion plants were sampled. The time used to sample thrips on sticky traps, including labeling, assembling, painting with Tanglefoot glue, installing traps in the field, collecting and returning traps back to the laboratory, and counting thrips was recorded on 14 February.

Numbers of thrips collected from onion plants and sticky traps, and the time used for sampling thrips on onion plants or traps were analyzed using analysis of variance (SAS Institute 2002). Numbers of adult thrips on CC traps were pooled for data analysis because no significant differences were found between trap colors. Means were separated using the honesty significant difference test or Tukey test after a significant F-test at P = 0.05 (Zar 1999). Because only a few pupae (<1% of total thrips) were collected from onion plants, they were combined with larvae in the analysis. Correlations of the numbers of thrips from plant examinations (adults, larvae, and all thrips) with the numbers of adult thrips caught on sticky traps were analyzed using PROC CORR (SAS Institute 2002).

RESULTS AND DISCUSSION

Only *T. tabaci* was found in the experimental field in 2000. Thrips were present on onion plants from early February until harvest with peaks in early March and early April (Fig. 1). Thrips densities were high throughout the season relative to those in previous years (Sparks et al. 1998, Liu, unpublished data). An average of 221.6 ± 11.1 thrips were found on each onion plant in the absolute estimates, of which 34.8 ± 3.7 were adults or 15.7% of total thrips. An average of 166.8 ± 21.8 thrips was counted by field visual counting, of which 26.4 ± 3.1 were adult thrips or 15.8%. Field visual countings of both total thrips and adults thrips were significantly less than the absolute estimates (F = 13.91; df =1, 9; P = 0.0057 for all thrips; and F = 10.74; df = 1, 9; P = 0.0096 for adult thrips) (Figs. 1, 3). Field visual counting accounted for 75.1 and 78.0% of total thrips and adult thrips of the absolute estimates, respectively. Of the total thrips from onion plants, 84.3 and 84.1% were larvae (including pupae), and 15.7 and 15.9% were adults from the absolute estimates and field visual counting, respectively.

Significantly more adult thrips were trapped on the plastic cup traps than on CC traps (F = 67.74-73.34; df = , 261; P<0.001) (Figs. 2, 3). Of the two colors of plastic cup traps, blue traps caught significantly more thrips than the white traps (F = 11.72; df = 1, 283; P<0.001). However, there were no significant differences in numbers of adult thrips caught on the two colors of the CC traps (F = 0.66; df = 1, 261; P = 0.4168) (Fig. 3).

Numbers of total thrips and adult thrips in the absolute estimates were well correlated with total thrips and adult thrips by field visual counting (r = 0.98 and 0.95, P < 0.0001, respectively) (Table 1). Meanwhile, numbers of adult thrips were relatively well correlated with total thrips in both the absolute estimates and field visual counting with r-values at 0.81 and 0.73, respectively. Furthermore, numbers of adults thrips in field visual counting were well correlated with that in the absolute estimates (r = 0.95; P < 0.0001).

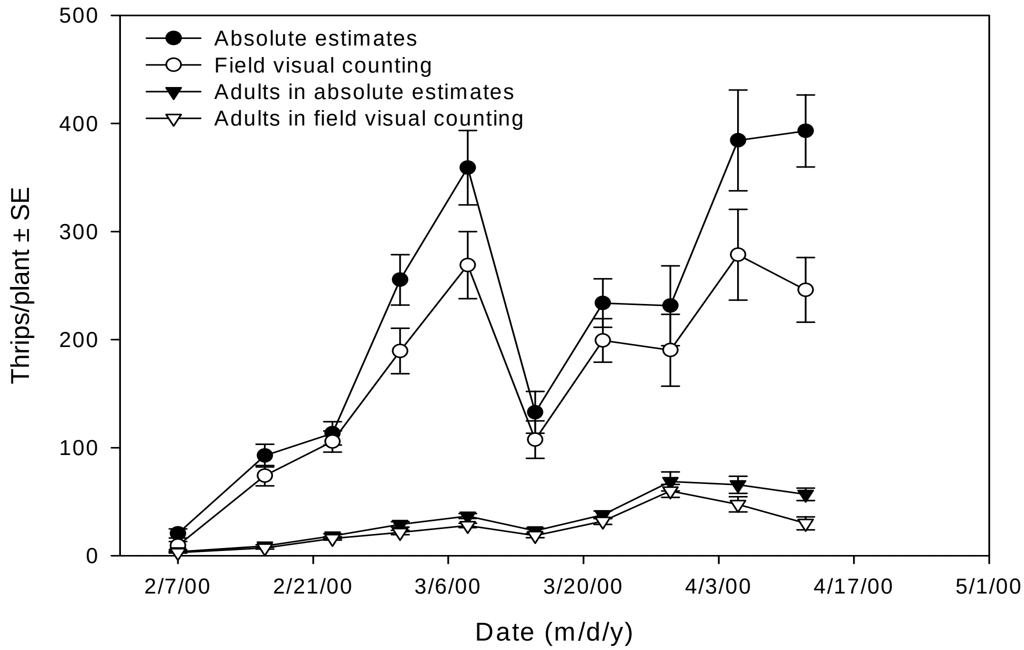

FIG. 1. Absolute estimates and field visual counting of *Thrips tabaci* on onion plants (Spring 2000, Weslaco, Texas).

TABLE 1. Correlations among the Mean Numbers of *T. tabaci* on Onion Plants and Mean Numbers of Adult Thrips on Traps (Spring 2000, Weslaco, TX)

	Correlation coefficients, r					
	Field visual counting: all thrips	Absolute estimates: adults	Field visual counting: adults	Blue cup trap	White cup trap	CC trap
Absolute estimates: all thrips	0.98[b]	0.81[b]	0.66[a]	0.20	0.17	0.58
Field visual counting: all thrips		0.83[b]	0.73[a]	0.23	0.18	0.61
Absolute estimates: adults			0.95 [b]	0.07	0.38	0.45
Field visual counting: adults				0.09	0.38	0.45
Blue cup trap					0.87 [b]	0.08
White cup trap						0.05

[a], [b] Significant at P = 0.05 and 0.01, respectively (PROC CORR, SAS Institute 2002).

Numbers of adult thrips caught on the blue plastic cup traps were well correlated with those on the white plastic cup traps (r = 0.87; P = 0.0011), but there were no significant correlations between the plastic cup traps and the CC traps (r = 0.08-0.05; P > 0.05) (Table 1). There were also no significant correlations in numbers of thrips counted on onion plants and the adult thrips caught on both the plastic cup traps and the CC traps (r = 0.07- 0.61; P > 0.05).

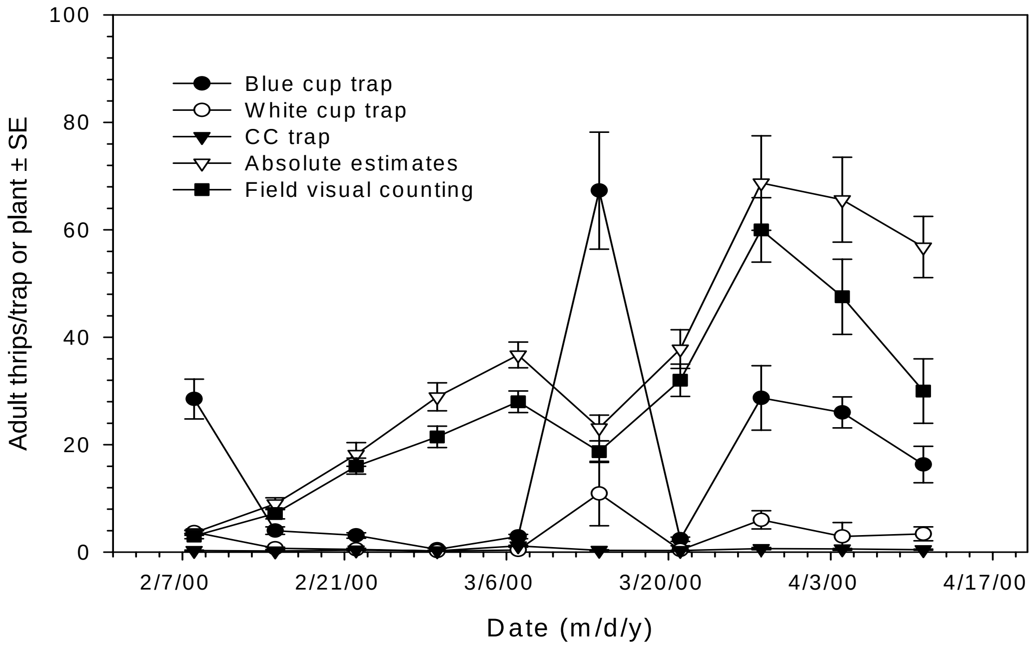

FIG. 2. *Thrips tabaci* adults counted on onion plants and caught on traps in the onion field (Spring 2000, Weslaco, Texas).

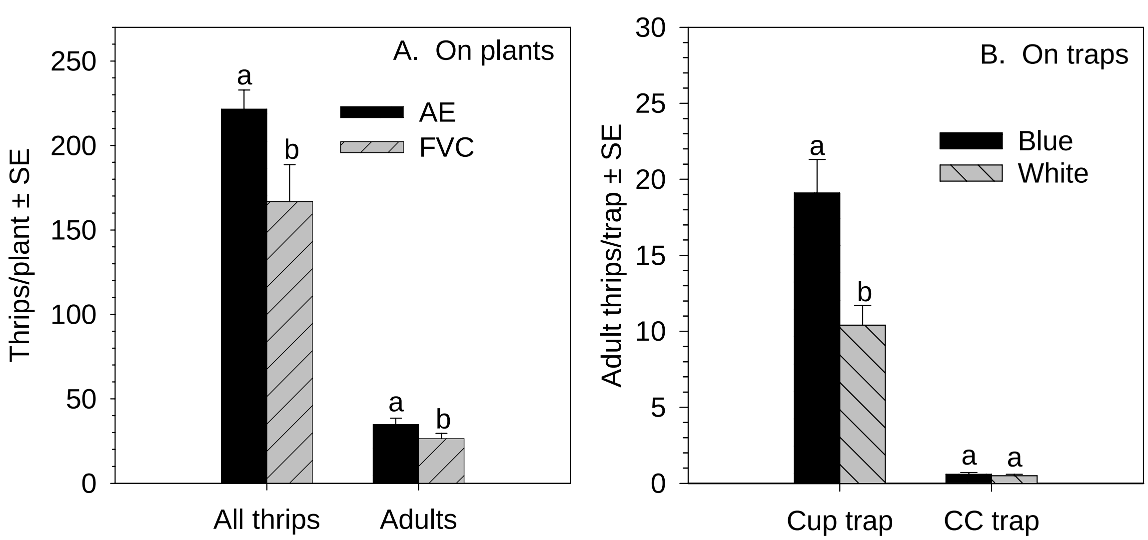

FIG. 3. Overall numbers of *T. tabaci* on onion plants and adults caught on sticky traps (Spring 2000, Weslaco, Texas). The same letters over the paired bars indicate that the

means are not significantly different at *P* = 0.05 (Tukey Test, SAS Institute 2002). AE – absolute estimates; FVC - field visual counting.

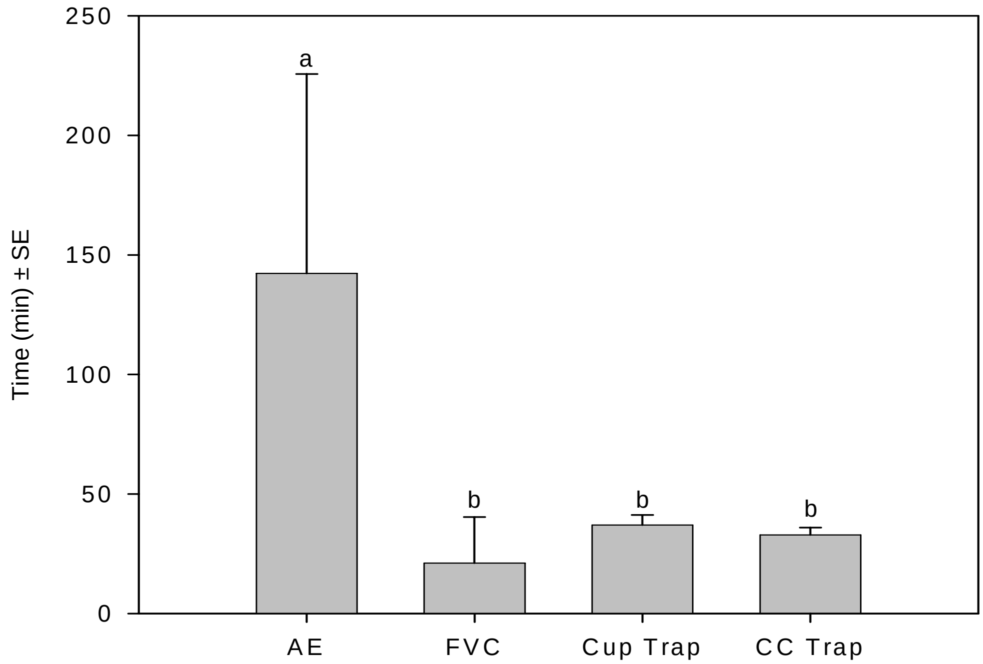

FIG. 4. Comparison of time (in minutes) used for sampling *T. tabaci* on onion plants and sticky traps from onion field (Spring 2000, Weslaco, Texas). The same letters over all bars indicate that the means are not significantly different at *P* = 0.05 (Tukey Test, SAS Institute 2002). AE – absolute estimates; FVC - field visual counting.

Time used for sampling thrips on onion plants and the sticky traps was remarkably different ($F = 45.27$; df = 3, 59; $P < 0.0001$) (Fig. 4). It took >140 minutes/person to process a single absolute sample (plant) from preparation to counting all thrips on each plant, which was almost a 15-fold increase in time compared to counting all thrips on a plant in the field, and a 3.8- and 4.3-fold increase of time for processing a plastic cup trap sample and a CC trap sample, respectively. The absolute estimates are the most time costly; however, the estimates are of utmost importance when the reliability of other relative estimate methods is evaluated. The field visual counting method, either counting all thrips or only adult thrips on onion plants, was the best, providing relatively reliable estimates of field thrips population with less time.

Trapping thrips with colored traps has been a general practice for monitoring and sampling thrips although the traps measured actively flying adults in the field while the whole-plant counts included all thrips on the onion plants (Lu 1990, Terry 1997). Generally, blue and white have been considered as the preferred or the most preferred colors for several species of thrips, including *T. tabaci*. Although the blue traps caught significantly more thrips than the white ones in this study, which was consistent with the previous findings (Lu 1990, Cho et al. 1995, Terry 1997, Chu et al. 2000), we found that both the plastic cup traps and the CC traps were not useful for monitoring and sampling thrips under field conditions in south Texas.

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