N O T E

Influence of Trap Crops on Tomato and Squash Insect Pests[1]

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Demand for alternative pest management strategies for key pests of vegetables continues to increase in the United States. In 2015, farmers produced and sold $8.7 billion of edible food commodities directly to consumers, retailers, institutions, and a variety of local food intermediaries (USDA, NASS Dec. 2016, ACH 12-35, https://www.nass.usda.gov/Publications/Highlights/2016/LocalFoodsMarketingPractices_Highlights.pdf, accessed 20 March 2020). The squash bug, *Anasa tristis* (DeGeer), feeds on the leaves, stems, and vines of the squash (*Cucurbita* L.) plant consuming nutrients and reducing photosynthetic capacity due to leaf chlorosis and necrosis (Beard 1935, Connecticut Agric. Exp. Stn. Bull. 383: 333–339) and transmitting cucurbit yellow vine disease caused by the bacterium *Serratia marcescens* Bizio (Bruton et al. 2003, Plant Dis. 87: 937–944; Pair et al. 2004, J. Econ. Entomol. 97: 74–78). Other key pests of squash include the squash vine borer, *Melittia cucurbitae* (Harris) (Jackson et al. 2005, J. Agric. Urban Entomol. 22: 27–39), and the spotted cucumber beetle, *Diabrotica undecimpunctata howardi* Barber, which damages cucurbits by feeding and by vectoring a bacterial wilt disease (Bessin 2004, ENTFACT -311, Univ. Kentucky Cooperative Extension Serv., http://entomology.ca.uky.edu/ef311, accessed 20 March 2020). Leaf-footed bugs, *Leptoglossus phyllopus* (L.), are widely distributed and cause economic damage to more than 30 crops, including squash and tomatoes (Mitchell 2000, Chapter 11 *in* Schaefer & Panizzi [eds.], Heteroptera of Economic Importance, CRC Press, New York). Potato aphid, *Macrosiphum euphorbiae* (Thomas), is a common pest of tomato in summer months stunting plant growth, causing blossom drop and fruit deformities, and potentially vectoring viruses.

While chemical control is an option, especially for conventional farmers, small-scale growers and organic farmers may opt for other means to suppress pests.

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Resistant cultivars, row covers, mulch, trap crops, and biological control have been assessed (Cartwright et al. 1990, J. Econ. Entomol. 83:1988–1993; Chalfant et al. 1977, J. Am. Soc. Hort. Sci. 102:11–15; Kring 1964, Front. Plant Sc. 17:6–7; Margolies et al. 1998, Entomol. Exp. Appl. 89: 65–70; Natwick and Durazo 1985, California Agric. 39:21–22; Pair 1997, J. Econ. Entomol. 90:1307–1314). Mizell et al. (2008, Proc. Florida State Hort. Soc. 121: 377–382) developed a trap cropping system using various grain crops to suppress stink bugs (Heteroptera: Pentatomidae) and leaf-footed bugs in the coastal plain of southern states. Furthermore, the incidence of viruses vectored by heteropteran insects has been reduced using crop borders (Difonzo et al. 1996, Ann. Appl. Biol. 129: 289–302). Based on these studies, our goal of the study reported herein was to assess if blue hubbard squash (*Cucurbita maxima* Duschene) and cherry tomatoes (*Solanum lycopersicum* var. *cerasiforme* [Dunal] D.M. Spooner, G.J. Anderson & R.K. Jansen) used as preferred plant borders alone could suppress insect pests commonly occurring on squash and tomatoes.

Experiments to test the effectiveness of trap crop plants in reducing squash and tomato pests were conducted in 2017 and 2018 at the University of Georgia Research and Education Garden (Griffin Campus, Spalding Co.) and three cooperating farms located in Spalding, Fayette, Pike, and Lamar counties, GA. Global positioning system coordinates of each of the test sites were 33°23′04.0″N 84°24′10.8″W (Fayette Co.), 33°03′36.0″N 84°12′16.8″W (Pike Co.), 33°03′36.0″N 84°30′25.1″W (Lamar Co.), and 33°15′47.5″N 84°17′34.5″W (Spalding Co.). Testing was conducted at four sites during 2017 and two sites (Spalding Co. and Pike Co.) in 2018. During both years the cash crops were ‘Big Beef’ tomatoes, ‘Raven‘ zucchini, and ‘Delta’ hybrid squash. Trap crop plants were ‘Juliet’ cherry tomatoes and ‘Blue Hubbard’ squash. Squash were planted as seed while tomatoes were planted as transplants. All sites were irrigated as needed with drip irrigation. Plots were fertilized at planting and 1 mo later at 13.6 kg of premium 16–4–8 fertilizer plus micronutrients per 93 m^2. Planting dates were 2.5 to 3 weeks after planting the trap crop in mid-April each year. The treatments, e.g., two types of trap crop borders, were arranged in a completely randomized design with three replicates at each of the sites. Treatment plots were planted in an area of approximately 0.1 ha at each site with individual plots measuring 15 × 61 m. Treatments of cash crops grown with trap crops were separated by approximately 91 m from cash crops grown alone. Visual insect counts were taken weekly from three randomly selected plants per plant type. In 2017, plants were sampled on 10 dates from 24 April to 26 June. In 2018, plants were sampled on nine dates from 4 May through 9 July. A generalized linear mixed (GLM) model was applied to determine the influence of trap crops, site, and date on occurrence and abundance of *A. tristis, Melittia cucurbitae, L. phyllopus*, and *Macrosiphum euphorbiae* (PROC GLM, SAS Institute Inc., Cary, NC).

Mean squash bug abundance ranged from 0 to 270 per plant during 2017 and 0 to 60 per plant in 2018. Squash bug abundance varied by treatment for year, site, and date (Fig. 1, 2017, $F = 8.96$, df = 15, $P < 0.0001$; Fig. 2, 2018, $F = 4.57$, df = 12, $P < 0.0001$). Numbers of squash bugs on plants with no trap crop were numerically higher on most dates and significantly higher during 2017 at Site A on Sample Date 10 ($F = 6.0$, df = 1,2, $P = 0.04$), Site B on Sample Date 7 ($F = 5.4$, df = 1,2, $P = 0.05$), Site C on Sample Date 7 ($F = 8.4$, df = 1,2, $P = 0.02$), and Site D on Sample Date 9

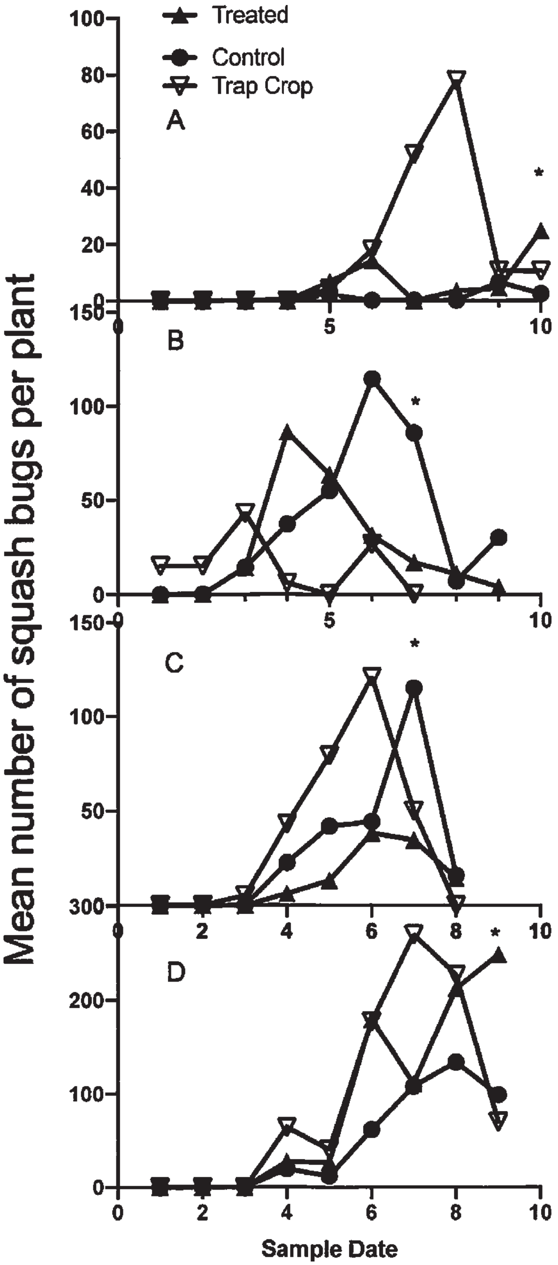

Fig. 1. **Mean number of *Anasa tristis* per plant during 2017 on trap crop, control (cash crop without trap crop), and treated (cash crop with trap crop) at Spalding (A), Pike (B), Fayette (C), and Lamar (D) county sites. Means with an asterisk (*) are significantly different ($P < 0.05$).**

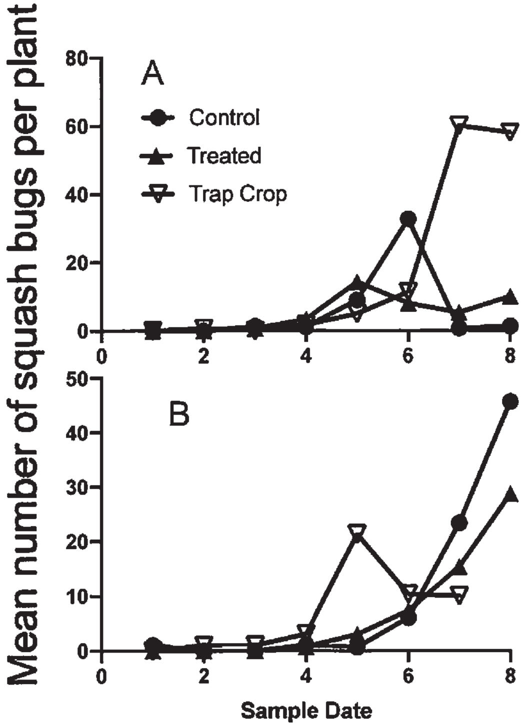

Fig. 2. Mean number of *Anasa tristis* per plant during 2018 on trap crop, control (cash crop without trap crop) and treated (cash crop with trap crop) at Spalding (A) and Pike (B) county sites. Means with an asterisk (*) are significantly different ($P < 0.05$).

($F = 8.1$, df = 1,2, $P = 0.04$). Numbers of squash bugs on other site and date combinations were statistically similar for cash crops grown with trap crops and cash crops without trap crops.

Cucumber beetles were present in low numbers during 2017, but not in 2018. Beetle abundance varied by site and date ($F = 9.6$, df = 15, $P = 0.0001$) ranging from 0 to 11 per plant. Treatment plants (with a trap crop) had significantly fewer beetles across all sites in 2017 ($F = 9.6$, df = 1,2, $P = 0.002$). Squash vine borers were present in low numbers, ranging from 0 to 4 per plant, during 2017 varying by site, date and treatment ($F = 4.9$, df = 15, $P = 0.0001$), with more borers per plant observed in plants with no trap crop plants at only one site on one sample date. They were not observed during 2018.

Potato aphids were abundant and varied by site, date and treatment during 2017 ($F = 2.6$, df = 15, $P = 0.001$) and 2018 ($F = 3.6$, df = 12, $P = 0.002$) (Figs. 3, 4). Aphids were significantly higher on tomatoes with no trap crop at Sites A ($F = 56.4$, df = 1,2, $P = 0.002$) and C ($F = 23.8$, df = 1,2, $P = 0.004$) during 2017 and Site A ($F = 22.5$, df = 1,2, $P = 0.004$) during 2018. Aphid numbers on the trap crop itself (not included in analysis but provided for reference) were often high compared to the

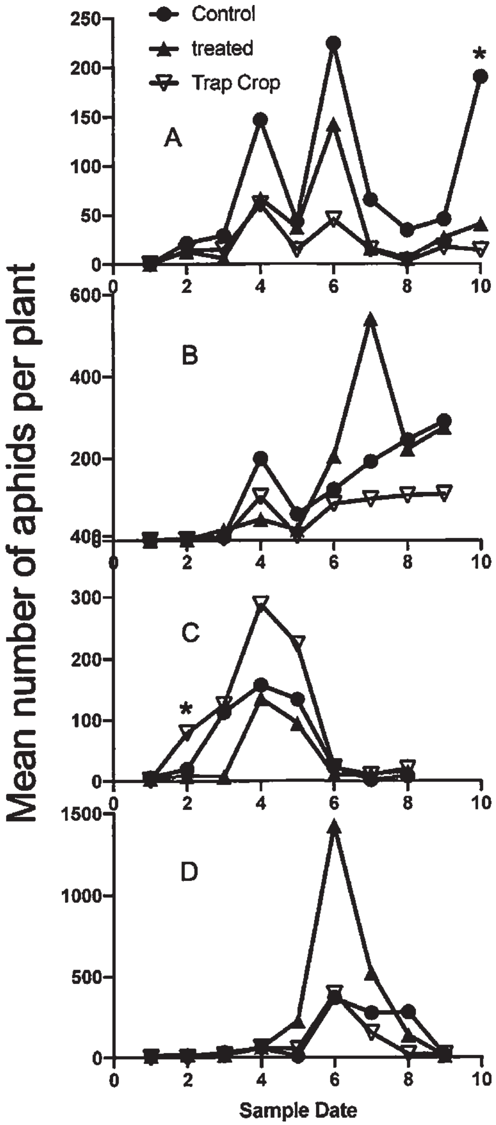

Fig. 3. Mean number of *Macrosiphum euphorbiae* per plant during 2017 on trap crop, control (cash crop without trap crop) and treated (cash crop with trap crop) at Spalding (A), Pike (B), Fayette (C), and Lamar (D) county sites. Means with an asterisk (*) are significantly different ($P <$ 0.05).

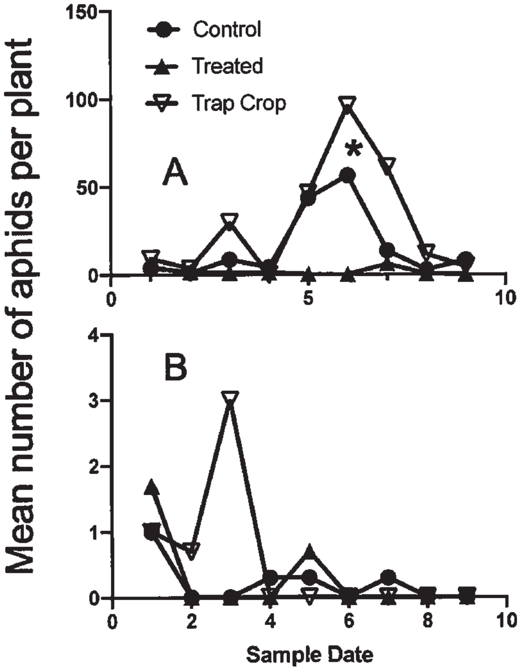

Fig. 4. Mean number of *Macrosiphum euphorbiae* per plant during 2018 on trap crop, control (cash crop without trap crop) and treated (cash crop with trap crop) at Spalding (A) and Pike (B) county sites. Means with an asterisk (*) are significantly different ($P < 0.05$).

cash crop grown with and without trap crops. Mean number of aphids per plant ranged from 0 to 1,423 during 2017 and 0 to 96 during 2018. Leaf-footed bugs were infrequently collected and significantly ($F = 38.4$, df = 1,2, $P = 0.025$) influenced by trap crop only at one site on one date with 27 bugs per plant on control (no trap crop) plants versus 0 on plants with the trap crop. While trap crops did not always reduce pest pressure and often depended on site, year, and date of observation, significant reductions were observed for multiple plant, pest, site, and date combinations. These data indicate the merit of future study to refine criteria for consistent pest suppression.

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