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SOUTHERN HIGHBUSH BLUEBERRIES ARE A NEW HOST FOR *SCIRTOTHRIPS CITRI* (THYSANOPTERA: THRIPIDAE) IN CALIFORNIA

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Citrus thrips, *Scirtothrips citri* (Moulton), is a major pest for citrus growers in California (Flint et al. 1991; Morse 1995). Citrus thrips feed on the rind at the stem end of young citrus fruit causing a characteristic ring scar (Morse 1995; Grafton-Cardwell et al. 1998, 2003). They also feed on the new flush of citrus, causing twisting and abnormal growth (Grafton-Cardwell et al. 1998). Heavy infestations of citrus thrips cause new flush to die and drop from the plant (Grafton-Cardwell et al. 1998). Even though citrus thrips was first described based on the damage it caused on California citrus (Horton 1918), it was obviously present prior to the introduction of citrus in the region, i.e., it is native to California and northwestern Mexico and has been observed on over 50 host plants in California, in particular in association with plants that produce an aromatic oil (Morse 1995).

Prior to 1992, highbush blueberries (*Vaccinium corymbosum* L.) were not grown commercially in California due to the warm climate (Jimenez et al. 2005; Strik & Yarborough 2005). However, several southern highbush blueberry varieties were developed by crossing northern highbush blueberries with several other *Vaccinium* species (Jimenez et al. 2005; Strik & Yarborough 2005). Southern highbush blueberries require lower chill hours for bud break and are well adapted to California's climate (Jimenez et al. 2005). As a consequence, California blueberry acreage dramatically increased after 1992 (Jimenez et al. 2005).

In 2005, several growers reported widespread damage to the young foliage of their blueberries that appeared to be associated with thrips. Most of the damage was curling and abnormal growth of the new leaves as well as scarring of new twigs.

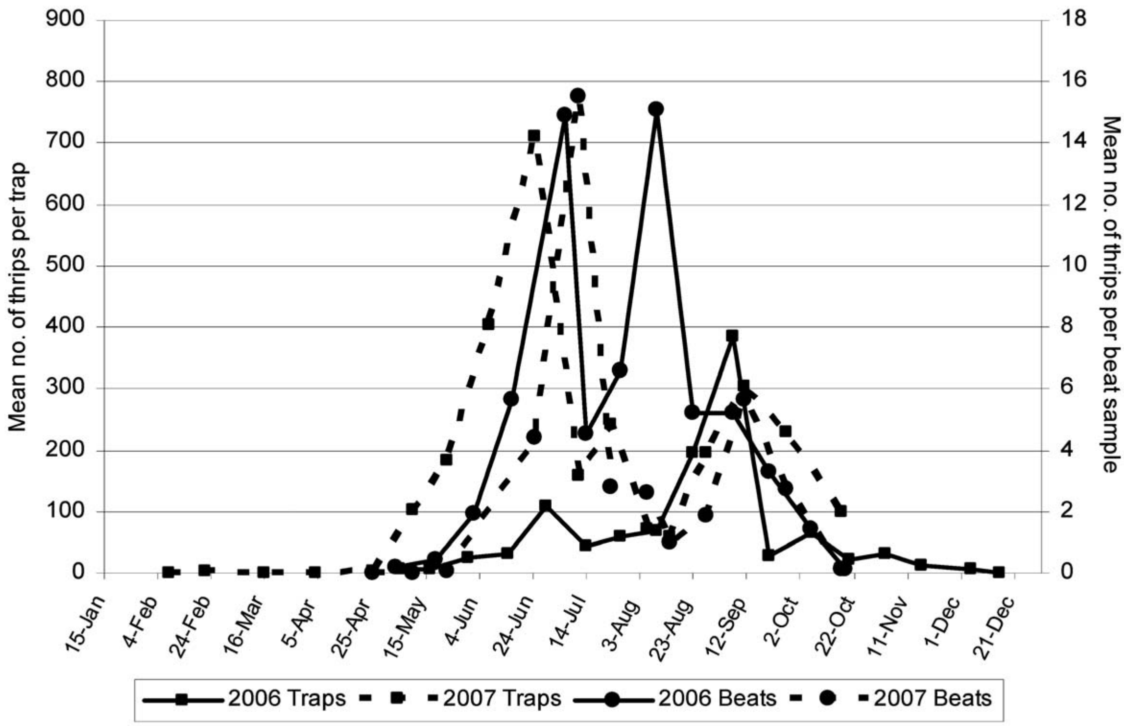

Fig. 1. Mean number of citrus thrips per yellow sticky card and beat sample in 2006 and 2007.

Growers were concerned that the damage would lead to lower fruit set the following year. On 20 Jun, thrips were collected in a commercial blueberry field near Richgrove, CA, and identified as citrus thrips by Steve Nakahara (USDA-ARS, Beltsville, MD) based on Palmer's key to adult thrips of the Terebrantia suborder (Palmer et al. 1992). Blueberries had not previously been documented as a host plant of citrus thrips and the seasonal biology and varietal differences in susceptibility to thrips damage required evaluation.

To determine the time of year thrips populations were observed within the canopy of blueberries, sticky traps and beat samples were used to determine thrips abundance in 2006 and 2007. Eight yellow sticky traps (Seabright Laboratories, Emeryville, CA) that were 15.2 cm × 10.2 cm were placed in the 4 corners of two 6-ha fields near Richgrove and the number of citrus thrips were counted every 2 weeks from May 2006 to Oct 2007. Ten beat samples in the area of each sticky trap also were collected. The beat samples consisted of 1 beat of the terminal 15 cm of new growth from an unbranched shoot tip onto a 30.5-cm square piece of black acrylic and the number of citrus thrips was recorded after each beat.

In 2006, varietal preference of citus thrips was evaluated in a commercial blueberry field containing 4 different southern highbush varieties: Jubilee, Misty, O'Neal, and Star. Plot size was 2 rows by a minimum of 45.7 m organized into a RCBD with 2 replicates of each variety. Sixteen beat samples per plot were taken on 19 Jul and 25 Aug and data were analyzed by ANOVA with LSD mean separation ($P = 0.05$).

The final part of the study determined if hoop-houses, which are used to promote early budding and harvest, affected the densities of citrus thrips. This study was conducted during spring 2006 with a RCBD with 5 replicates and 2 treatments consisting of blueberries under an enclosed environment (hoop-house) and open environment (no hoop-house). Each hoop-house was approximately 207 m long × 7 m wide × 4 m high that consisted of a half circle metal frame with 0.15 mm thick polythene cover. Plot size was a minimum of 3 ha. Four replicates of plots contained the varieties 'Misty' and 'O'Neal' and 1 replicate contained 'O'Neal' and 'Wonderful'. Ten beat samples per variety were taken in each plot as described above on 5 dates from May to early Jul and data were analyzed by ANOVA with LSD mean separation ($P = 0.05$).

Sticky cards and beat samples showed citrus thrips first appeared in the blueberry canopy in late Apr to early May (Fig. 1). Beat samples produced many small first instar citrus thrips as well as second instars and adults, making it clear that blueberry should be added to the list of reproductive hosts for citrus thrips. Citrus thrips densities remained high throughout the summer with sticky card counts peaking at 383 and 709 adult

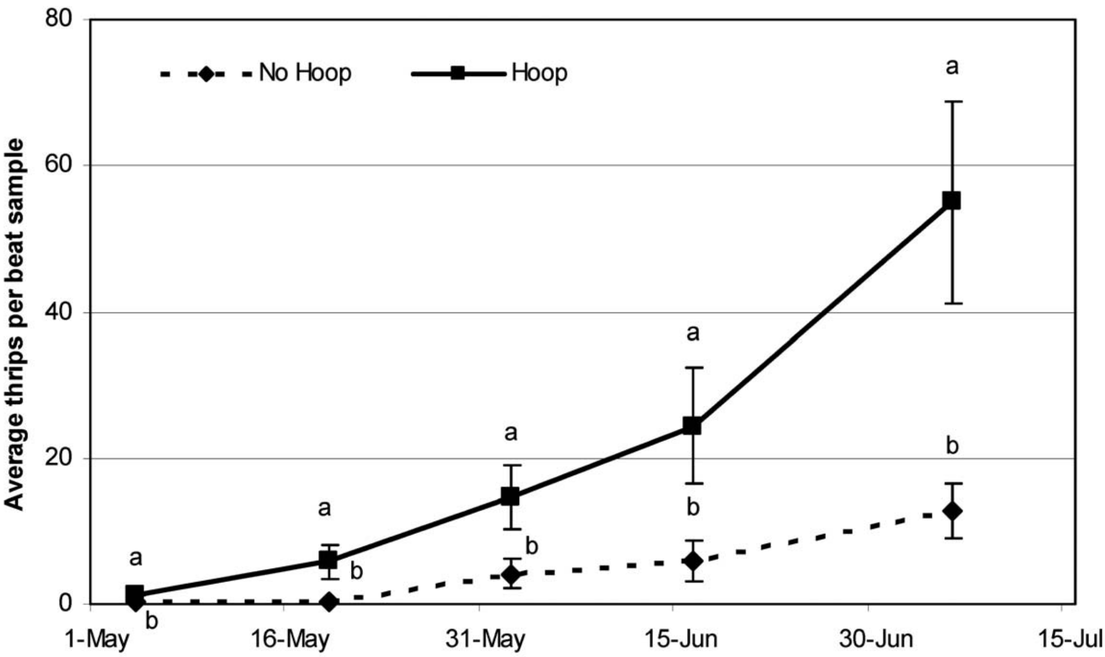

Fig. 2. The effects of open environment (no hoop-house) versus enclosed environment (hoop-house) on the density of citrus thrips during spring 2006.

thrips per trap for the 2-week periods ending 7 Sep 2006 and 25 Jun 2007, respectively. This high level of thrips was associated with damage to the blueberries that included curled leaves and reddened branches. Beat sample thrips densities corresponded with sticky traps (Fig. 1). After Jun, the fluctuations in thrips densities were due to insecticidal treatments used to lower populations of citrus thrips.

The 'Star' variety averaged 12.5 citrus thrips per beat sample, which was significantly higher than the 0.98, 1.5, and 2.1 thrips per beat sample observed with Jubilee, Misty, and O'Neal (F = 20.01, df = 3, P = 0.017). Therefore, it is recommended that growers avoid planting 'Star' in areas known to have moderate to high levels of citrus thrips. Additional research is needed to investigate the susceptibility of blueberry varieties to citrus thrips feeding and damage and the impact on blueberry yield.

Blueberries in hoop-houses had 2 to 3 times greater numbers of early-season citrus thrips compared with unenclosed blueberries (Fig. 2). On all 5 dates, citrus thrips densities were significantly higher within hoop-houses compared to levels in open blueberries (4 May: F = 43.27, df = 1, P = 0.003; 19 May: F = 19.55, df = 1, P = 0.01; 2 Jun: F = 12.78, df = 1, P = 0.023; 16 Jun: F = 14.28, df = 1, P = 0.020; 6 Jul: F = 15.26 df = 1, P = 0.018). In Jul, the mean number of thrips inside the hoop-houses was 60.6 ± 10.6 compared with 12.8 ± 3.8 in open blueberries. This is likely due in part to increased temperatures under the hoop-houses.

Summary

Southern highbush blueberry, *Vaccinium corymbosum,* is here reported as a new host association with citrus thrips, *Scirtothrips citri*. Citrus thrips were first observed on blueberries in late Apr to early May and declined by the end of Oct. During the summer when populations peaked, citrus thrips caused scarring and reddening on branches and curling and twisting of new foliage. The 'Star' variety had higher densities of citrus thrips than 3 other commercial varieties and blueberries enclosed in hoop-houses had higher levels than those grown in the open.

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