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Detection and Monitoring Trap for the Asian Citrus Psyllid, *Diaphorina citri* Kuwayama.

MAMOUDOU SÉTAMOU[1] and DAREK CZOKAJLO[2]

[1]Texas A&M University-Kingsville, Weslaco, TX, msetamou@ag.tamu.edu
[2]Alpha Scents, Inc., Bridgeport, NY 13030, darek@alphascents.com

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INTRODUCTION

The Asian citrus psyllid (ACP), *Diaphorina citri* Kuwayama, was first reported in Florida in 1998 and in Texas in 2001. Since then it has spread into many U.S. states including Alabama, Louisiana, Mississippi, Georgia, South Carolina, California, Puerto Rico, and Hawaii.

ACP vectors *Candidatus* Liberibacter asiaticus, the causative bacterial agent of citrus greening disease, Huanglongbing (HLB). Citrus trees infected by HLB produce small, misshapen fruit characterized by bitter tasting juice. Infected trees decline dramatically, drop much of their fruit load, and ultimately die. There is no known cure for the disease. Thus the only control method for the disease is removal of infected trees combined with pesticidal spray control program for the ACP.

HLB was first discovered in Florida in 2005 and is now present throughout the State. In 2008, HLB presence was confirmed in Louisiana, showing the potential of both the disease and its psyllid vector to rapidly spread throughout the U.S.

No ACP attractants are yet confirmed and only unbaited yellow sticky traps are currently used for monitoring ACP adult populations, which are marginally effective.
ACP is known to respond to different colors. Aubert and Hua (1990) recommended that brown-yellow or bright yellow traps should be used for ACP monitoring. Sétamou et al. 2008 and Hall et al. 2007 tested more trap colors and demonstrated that yellow and red sticky trap to be more attractive than green, blue and white traps. Moreover the attractiveness of the red and yellow traps to adult ACP depended on the crop (citrus species) in which they are deployed. For effective control programs of ACP, it is important that a reliable monitoring tool be developed. This monitoring tool should be sensitive enough to detect low populations of ACP that is essential for successful eradication programs in areas of new introductions.

The objective for this research project was to evaluate the effects of trap color on trapping efficiency of adult psyllid and determine the most effective color for monitoring and detecting psyllid populations.

MATERIALS AND METHODS

Eleven candidate colors of different shades of green yellow, magenta, red, and purple were selected and developed by Alpha Scents, Inc. The traps used hot melt, pressure sensitive adhesive to retain insects. All traps were 5.5” x 8” flat panels with adhesive applied on one side only. Traps were hung at 1.5 m-high inside tree canopy of a 4-year- old sweet orange (*Citrus* *sinensis* var 'Marrs') block. Trap deployment was done when psyllid populations were very low in the fields.

The traps were tested twice: first in late October/ November and then in December at the Texas A&M University-Kingsville Citrus Center orchards near Weslaco, TX. The first trial was performed between October 25 and November 25, 2008. Ten different colors: three shades of green, two shades of yellow, four shades of red, and one purple, were tested. Four traps of each color were deployed randomly in a large block of sweet orange. Traps were recovered after two weeks and the number of *D. citri* adults counted. Trap capture data were subjected to one-way ANOVA analyzed using SAS for windows (SAS Institute, 2001). Treatment means were separated by the REGWQ test. The second trial was performed between December 8 and 22, 2008. Eight different colors: three shades of green, four shades of yellow, and one purple were tested. One of the yellow traps was the Yellow Card available from Alpha Scents, Inc. (Bridgeport, NY). Because ACP exhibits strong directional distribution within citrus orchards with higher populations found along the perimeter (Sétamou, unpublished data), trap deployment was modified for this second experiment. One trap per color was randomly placed at the center and along each side (East, South, West, North, and center) of the orchard. Captured psyllids were counted 3 and 13 days after setting up traps. Trap capture data was first analyzed using two-way ANOVA to eliminate within orchard trap position effect. Trap capture within each location was then converted to capture proportions and analyzed using a log-likelihood ratio test (Zar, 1999).

RESULTS AND DISCUSSION

In this study the most effective traps in attracting ACP were traps named "Green 1". They consistently attracted and caught more psyllids than the other traps except for trap "Green 2" in the first trial. The red traps were the least attractive except for "Red 1" in the first trial, while trap catches of the two yellow were intermediate (Figure 1). The two "Green" traps "Green 1" and "Green 2" resemble the new flush shoots of citrus plants, and this could explain the higher attractiveness of those substrates.

In the second trial "Green 1" were still the most attractive but the trap capture were comparable to that of "Yellow 3", Yellow Card from Alpha Scents and "Green 2" (as in first trial) (Figure 2). Two-way ANOVA of numbers of adult psyllid caught in the second trial strongly suggested that trap catches significantly varied with trap location in the orchard (F = 14.46; df = 4, 26; $P < 0.0001$). Also, because strong east winds were recorded during the trapping period, very few adult psyllids were caught on that side of the orchard. Thus, data were analyzed per trap location. Since only one-trap was placed per side, a log-likelihood chi-squared was used to test the efficacy of each trap. The null hypothesis assumed that the proportion of trap catches per trapping location was the same for each trap color. Results of the analysis are presented in Table 1.

Overall, the proportions of adult psyllid caught after two weeks were strongly influenced by trap color with the exception of traps located at the center of the orchard (Table 1). Thus trap captures from center of the orchard were not included in further analysis. Along the perimeter of the orchard where most of the trap catches are generally made, adult psyllids exhibited strong preference for the newly developed colors "Green 1", "Yellow 3" and the Alpha Scents' Yellow Card. "Green 1" trap and Alpha Scents' Yellow Card had the highest trap catches on the east side of the orchard, while the traps "Green 1" and "Yellow 3" trapped significantly more adult psyllids than other traps at the south side of the orchard. However, the trap "Green 1" had consistently high trap catches on each side of the orchard. Based on this information, we can suggest the use of "Green 1" for Asian citrus psyllid detection and monitoring studies. These traps will be available from Alpha Scents under name "ACP-Trap".

REFERENCES

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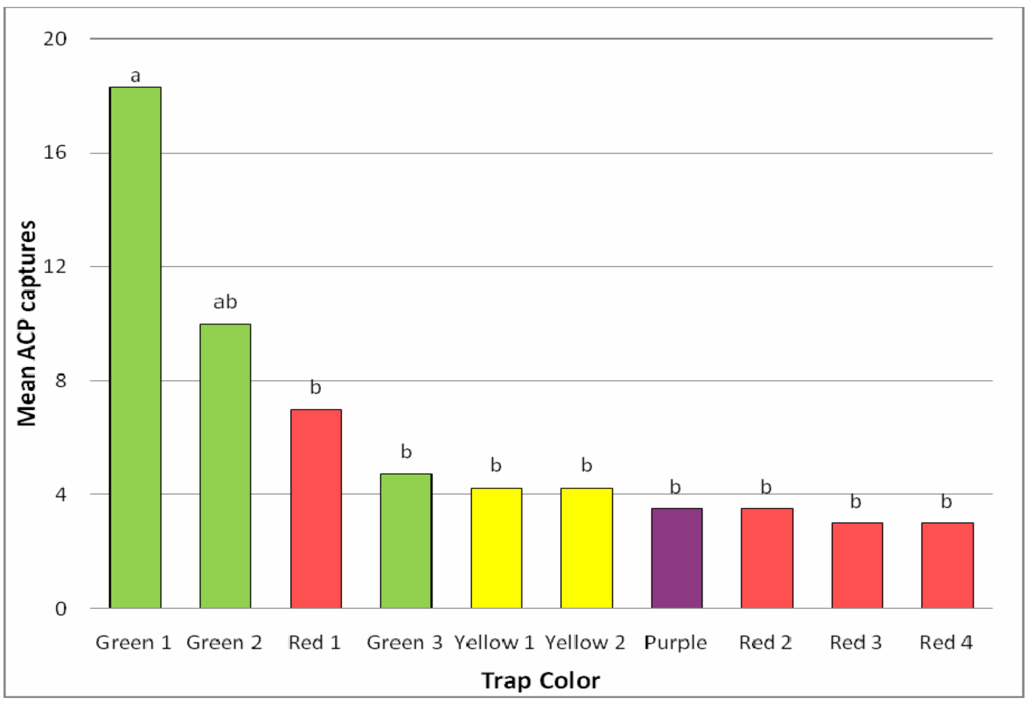

Figure 1. Monitoring low populations of ACP with different color sticky traps, TAMU-K, Weslaco, TX, Oct 25-Nov 6, 2008. (n=4, REGWQ test for means separation, p<0.05)

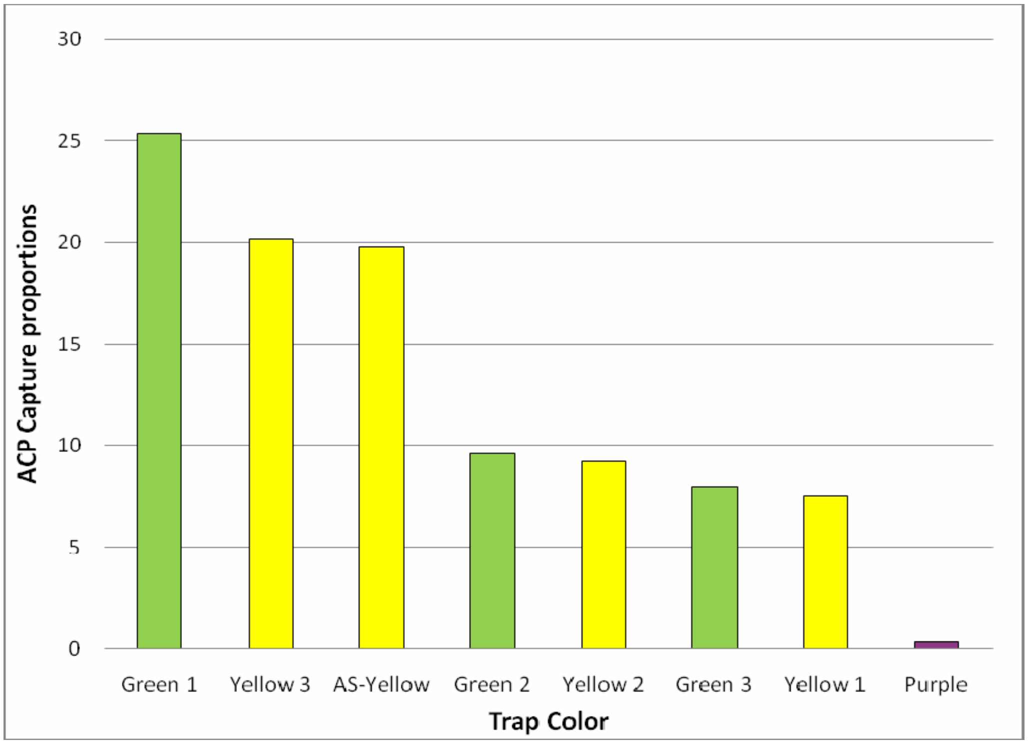

Figure 2. Monitoring low populations of ACP with different color sticky traps, TAMU-K, Weslaco, TX, Dec 8-22, 2008. (n=4, $\chi 2$ test for separation of trap capture proportions, p<0.02)

Table 1. Trap capture proportions of ACP with different color traps within each orchard location, TAMU-K, Weslaco, TX, Dec. 8-22, 2008.

Color\Location	East	West	South	North	Center
Purple	**0**			**1.4**	**12**
Green 2	**0**	**9.1**	**11.5**	**17.7**	
Yellow 3	**5**	**28.6**	**23**	**24.1**	**14.4**
Yellow 1	**15**	**3.9**	**3.5**	**7.8**	**16**
Yellow 2	**5**	**15.6**	**12.6**	**3.6**	**13.6**
Green 1	**30**	**16.9**	**29.9**	**24.8**	**10.4**
Green 3	**5**	**11.7**	**10.3**	**5**	**17.6**
AS Yellow Card	**40**	**14.3**	**9.2**	**15.6**	**16**
$\chi 2$	**13.6***	**19.1****	**29.7****	**68.3****	**3.3 ns**
P-value	**0.02**	**0.004**	**<0.0001**	**<0.0001**	**0.77**