Progress Report on Goichman Family Endowment Research
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Title: Verification of mating pheromone for management of longhorn Prionus borers in NY apple trees

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Background

The Prionus borer is the grub or larval stage of a large longhorned beetle called the broadnecked root borer (Coleoptera: Cerambycidae, *Prionus laticollis*), which has become an increasing problem in certain apple growing regions of New York. The borer is among the largest of the North American beetles, and can reach 3.5 inches. During the past few years, these borers have been found infesting apple trees in both Long Island and the Hudson Valley, as well as in parts of Rhode Island and New Hampshire. Researchers in the western US identified the sex pheromone of a closely related species, *P. californicus*, as a first step in the possible development of non-insecticidal methods of monitoring and managing this important class of pests (Cervantes et al. 2006). They showed that female *P. californicus* produces a powerful sex pheromone (known as prionic acid [PA]) that specifically attracts males of this and related Prionus species, including broadnecked Prionus. In 2010, we set out field-trapping trials to assess the effectiveness of this pheromone in detecting the distribution and seasonal activity of this species in NY apple systems, which occurs generally from the middle of the month of June and into early August. The pheromone traps proved to be effective in attracting adult Prionus males from the general area in each of the locations surveyed. The synthetic pheromone used was a blend of several different isomers of PA, but further research has determined that the true pheromone produced by *P. californicus* consists of just one single isomer of the compound (3R,5S-dimethyldodecanoic acid). In 2011, to determine whether the broadnecked Prionus uses the same specific pheromone isomer as the western species, we set out field-trapping trials to assess the effectiveness of both the racemic pheromone mixture and also this specific isomer found in the general blend. We found that the single isomer-baited trap captured as many as 6 times the number of *Prionus laticollis* males as were taken in the trap baited with the general PA blend, indicating that this component can apparently increase the attractiveness to adults of the pheromone traps, and thereby provide more detailed information about this species' activity and distribution for management purposes.

Because the limited amount of single-isomer pheromone available in 2011 allowed only one non-replicated trial consisting of 2 traps, we were interested in repeating this trial in 2012 using two replicates in each of three different sites, one of which was directly adjacent to a commercial apple planting. In this way, we hoped to verify last year's preliminary results and also gain insight as to the occurrence of populations in proximity to (and possibly able to threaten) typical western NY orchards.

Methods

Three sites were chosen to conduct this experiment; two in Junius, Seneca Co., and one in Geneva, Ontario Co. Of the two Seneca Co. locations, one (Bayberry) was in a mixed hardwood

and coniferous forest and the other (Dunham) was approximately 1.4 km away at the edge of the same forest bordering an apple orchard. The Ontario Co. site (Beanfield), which was set up one week later, was at the edge of a soybean field bordering a mixed hardwood forest. Traps were constructed of plastic funnels attached to 2-qt plastic jars. The traps were buried in the ground deep enough for the mouth of the funnel to be level with the soil. At each site, two sentinel traps baited with a commercial PA lure (Contech Inc., Delta, BC, Canada) were set out approximately 10 days before the anticipated first occurrence, to establish the presence of sufficient Prionus numbers, and checked every 3–4 days until a sustained capture of beetles was obtained. Then, the test pheromone lures were constructed by inserting 100 µL of either 0.4 mg/mL of PA or 0.1 mg/mL of the "3R isomer" into a plastic bag. Control lures were made, containing 100 µL 70% ethanol. At each site, a total of five pitfall traps were placed, at a minimum of 25 m from each other: two traps baited with each lure formulation plus one control trap. The lures were suspended approximately 13 cm above the funnel openings, and were rotated on each trap check date, to eliminate any possible site effects. Lures were replaced weekly.

To obtain additional information about this species' occurrence and population persistence, pitfall traps baited with the commercial PA lure also were set out in two other locations where Prionus had been trapped for the previous two years, one a mixed hardwood and coniferous forest in Geneva (Huether, 2 traps), and the other an apple orchard located in Northport, Long Island (Amsler, 4 traps placed in various spots around the farm). All traps were checked every 2–3 days from late June through July. All *P. lacticollis* captured were collected and preserved.

Results

In the lure comparison study, all the pheromone traps once again proved very effective in attracting adult Prionus males from the general area at each of the locations surveyed, although the 3R,5S single-isomer did not appear to be more attractive than the commercial racemic blend. The 2012 season was warmer than usual, so the first captures occurred much earlier than in past years: Junius (both sites), 19 June (934 DD_{50}); Geneva (Contech lures), 26 June (1080 DD_{50}); Geneva (Beanfield), 29 June (1151 DD_{50}). In the Northport site, traps were not placed until after the first emergence, so the first trap capture date was 5 July (1444 DD_{50}). Population levels varied among the sites, with Bayberry recording the highest numbers, followed by Dunham, and the Beanfield site, which had the lowest population. Peak capture at the Bayberry site was recorded on 13 July. Only a single Prionus beetle was captured in any of the control traps – at Bayberry on 25 June.

Despite some individual dates with large differences between numbers of adults trapped using one vs. the other lure formulation, there was no overall trend of one lure being significantly more attractive than the other (Fig. 1). When adults captured are viewed on the basis of weekly totals (corresponding to individual lure-change periods), there were more instances of the 3R lure seeming to catch more than the PA formulation in the two sites having lower populations (Dunham and Beanfield), with the trend reversed at the high-population Bayberry site (Fig. 2), but the respective trap totals are not significantly different (Student's t-test, $P = 0.05$).

In the Amsler Contech lure-baited site, captures were comparable to those seen the previous two years (Fig. 3), but at the Huether Contech site, only 8 total beetles were trapped (compared with 54 taken per 2 traps in 2010, and 44 in 2011), indicating that there may be some local

depletion of the Huether population that is being caused by the successive years' trapping. Two related species, *P. imbricornis* and *P. pocularis*, have also been reported taken in traps baited with this pheromone, but these appear not to occur in our region.

Projected Impacts:

We anticipate that this pheromone could find useful application in monitoring the distribution and abundance of broadnecked Prionus, improving the efficiency of preventive insecticide treatments, and it ultimately might also be exploited for control of the insect via pheromone-based mating disruption, mass trapping, or attract-and-kill strategies. Researchers in the western states have already made progress in assessing the racemic blend of this pheromone for use against *P. californicus* as a mass-trapping or mating disruption tactic in hops (Maki et al. 2011) and sweet cherries (Alston 2011). We hope to parallel their efforts against *P. laticollis* in NY settings, to eliminate the threat they may pose to established apple plantings.

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Pheromone suppliers: Jim Barbour, Univ of Idaho; Jocelyn Millar, UC-Riverside; Contech Enterprises, Delta, BC, Canada

Technical Assistance: Cortni McGregor, Kristin McGregor

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Maki, E. C., J. G. Millar, J. Rodstein, L. M. Hanks, and J. D. Barbour. 2011. Evaluation of mass trapping and mating disruption for managing Prionus californicus (Coleoptera: Cerambycidae) in hop production yards. J. Econ. Entomol. 104: 933–938.

Fig. 1. Numbers of Prionus adult males captured on each trap check date using either racemic Prionic Acid or the 3R,5S-isomer, NY. 2012.

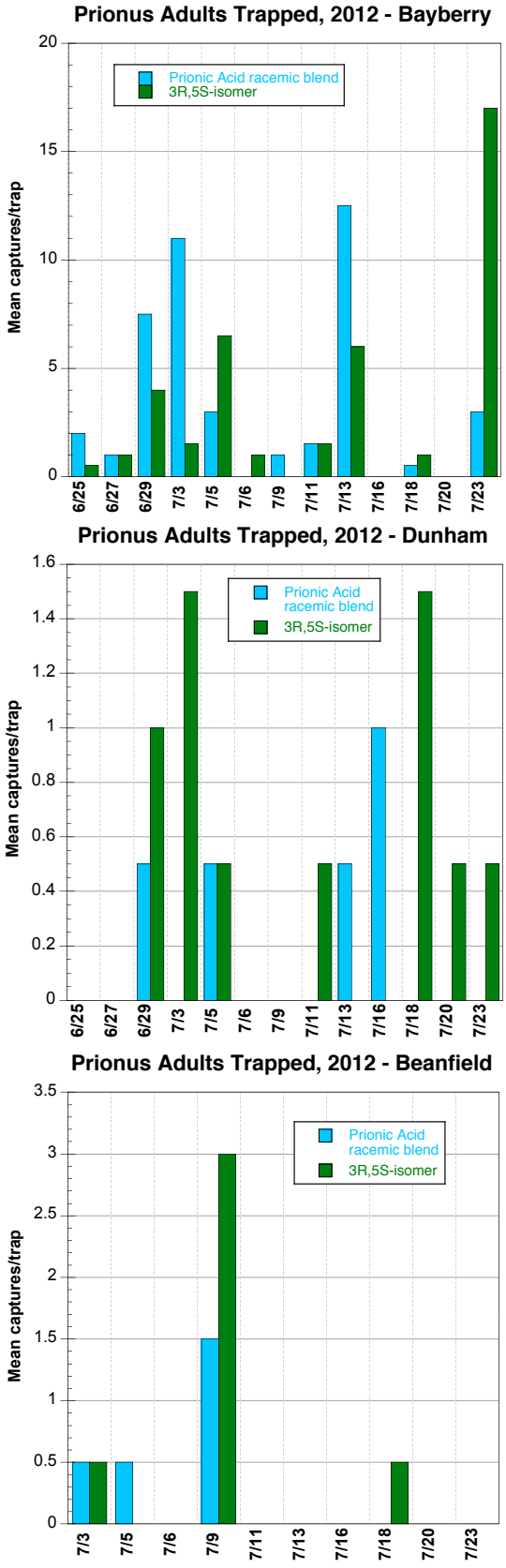
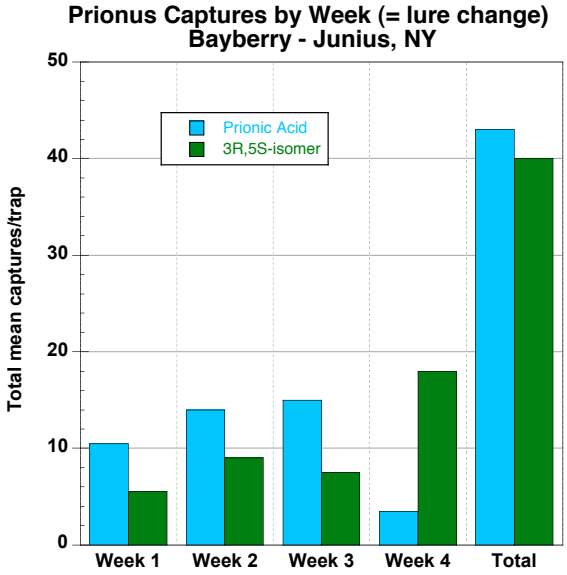
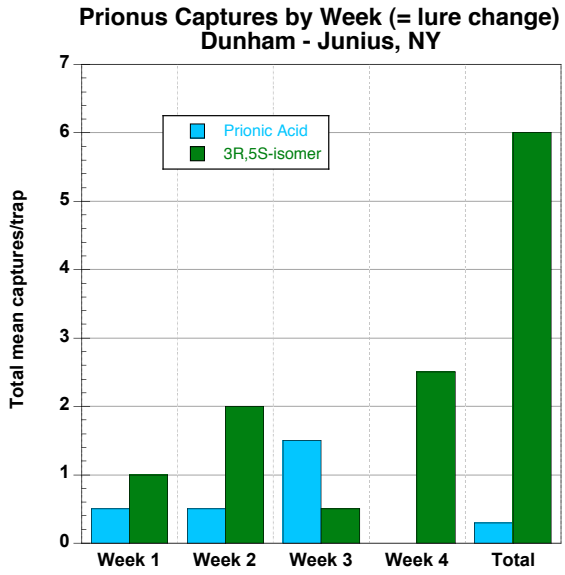


Fig. 2. Weekly totals of Prionus adult males captured using either racemic Prionic Acid or the 3R,5S-isomer, NY. 2012.





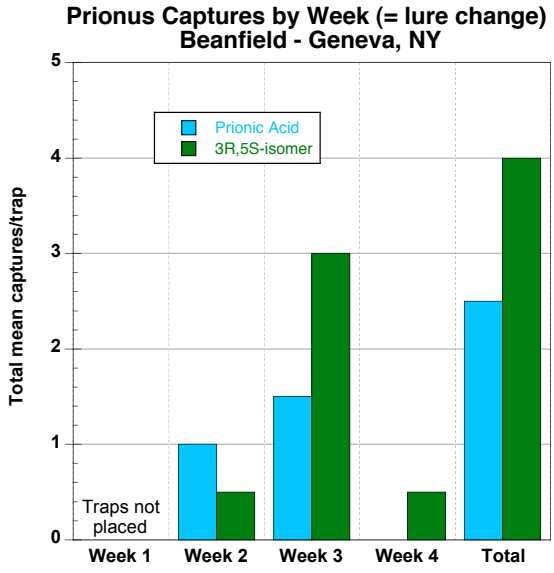


Fig. 3. Numbers of Prionus adult males captured using a commercial Prionic Acid lure. Northport, NY. 2012. (Trap locations: 1, west side of farm; 2, in Red Delicious planting; 3, south edge of farm; 4, north edge of farm)