Earwig Management in Peach Orchards – 2011

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The European earwig is an economically damaging pest of stone fruits, especially peach, nectarine, and apricot. Earwigs chew holes into the ripening fruits and reduce fruit quality, harvestable yield, and economic value. In a pre-project survey of Utah peach growers conducted at the Utah State Horticultural Association Convention in January 2010, 68% responded that their peach crop is damaged by earwigs. Insecticides were the most common method for earwig management (used by 61% of peach growers who reported earwig damage in their orchards).

Objectives

1) To evaluate attractiveness of corrugated cardboard traps placed on tree trunks and scaffold limbs for monitoring adult and nymphal life stages of the European earwig in peach orchards.
2) To evaluate efficacy of conventional and reduced-risk insecticides for suppressing European earwig populations in peach orchards.
3) To evaluate season-long feeding injury of European earwig on peach tree leaves and fruits.

Methods

1) Earwig trapping and phenology

Small rolls of corrugated cardboard (open face turned inward; flute size A; 9-10 in long 4-in wide strips; Wagner Packaging, Inc., Salt Lake City, UT) were held closed with small rubber bands and tied to the trunk or a main scaffolding limb of peach trees in one research orchard (Kaysville, Davis County) and three commercial orchards (Payson, Santaquin, and Genola, Utah County). Traps were initially placed in mid May, collected and replaced approx. weekly, and removed in mid September. The experimental design was 12 replicates in each of the three commercial orchards and 6 replicates (two replicates in each of three blocks) in each of the insecticide treatments (see "Insecticide efficacy" methods below) in the research orchard. The number of each earwig life stage (adult male and female, and nymphal instars 1-4) per trap was counted.

2) Insecticide efficacy

Six insecticide treatments were assigned in a randomized complete block design (3 replicate blocks) to a 1-acre peach orchard at the Kaysville research farm: 1) untreated control, 2) Sevin XLR at 3 qt/acre, 3) Success at 6 oz/acre, 4) Entrust at 2 oz/acre, 5) Intrepid 2F at 12 oz/acre, and 6) Warrior at 3.5 oz/acre. The insecticide treatments were applied once on August 10 with an orchard airblast sprayer at a volume of 100 gpa. Earwig population densities in plots were monitored with cardboard traps as described above before and after insecticide applications. Fruit injury was

assessed by visually inspecting 10 fruit per plot (1,800 fruit on each sample date) weekly beginning pre-treatment and for 3 weeks post-treatment. Injury from earwigs, cat-facing insects, and split-pits was observed.

3) Seasonal peach injury

To assess earwig feeding injury in trees from mid May through mid September, four injury observation treatments were imposed by using sleeve cages made from no-see-um netting (Seattle Fabrics, Inc., Seattle, WA) placed on peach tree shoots: 1) cage with 2 adults (1 male and 1 female), 2) cage with 4 nymphs, 3) open shoot without a cage, and 4) earwigs removed from shoot and then caged to exclude earwigs. Cage treatments were replicated six times. Each caged or open shoot had an average of 28.9 leaves and 4.0 fruits. The number of leaves with earwig feeding injury (chewing along the edge or tip), the total number of leaves, the number of fruit with feeding injury (chewed holes), and the total number of fruit were determined approx. weekly.

The number of earwigs per trap and proportion of leaves and fruit injured were compared among insecticide and cage treatments, and over time with repeated measures analysis of variance (Proc Mixed, SAS version 9.2; SAS Institute Inc., Cary, NC). Count data were square root transformed and proportion data were arcsine-square root transformed prior to analysis to meet normality assumptions. When significant, means were separated with Tukey's test (α=0.1).

Clockwise from upper left: cardboard roll trap tied to tree trunk, sleeve cage on peach shoot, earwig leaf-chewing injury, and fruit with earwig injury and adult male.

Results

1) Earwig trapping and phenology

At the Kaysville site, significantly more ($p \leq 0.05$) earwigs were caught in cardboard roll traps placed on tree trunks than on scaffold limbs (Fig. 1). Differences were greatest from mid June to early August when trap capture was highest during the season. When trap capture was sorted by earwig life stage (overwintered adults, nymphs, and summer adults), trunk traps caught significantly more overwintered adults and nymphs than scaffold traps, but traps in both locations caught similar numbers of summer adults (Fig. 2). These same trends in trap capture were observed in the three commercial peach orchards (data not shown). Earwig phenology during the season based on capture in trunk traps showed only a small peak of overwintered adults in May, few early instars (1 and 2) attracted to the traps throughout the season, a large peak of first generation late instars in late June to early July, a peak of first generation summer adults in late July to early August, and a peak of second generation late instars and adults in early and late August, respectively (Fig. 3). Earwig phenology in the three commercial orchards was similar with dampened peaks in one of the orchards most likely due to early summer insecticide applications (data not shown). These results suggest that overwintered adults and nymphs spend more time on the ground and trunk while summer adults spend similar amounts of time on the ground and in the tree canopy. These results also confirm that the European earwig is bivoltine (2 generations per year) in northern Utah.

Fig. 1. Comparison of cardboard trap location in peach trees, Kaysville, 2011

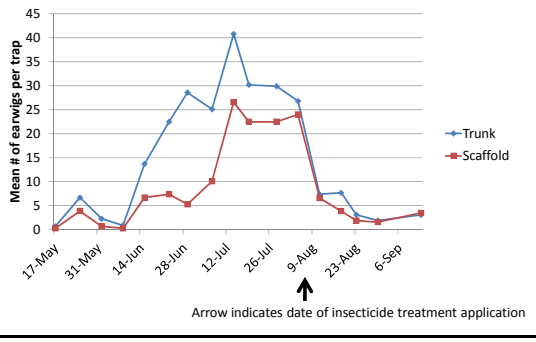


Fig. 2. Earwig life stage capture by trap location, Kaysville, 2011

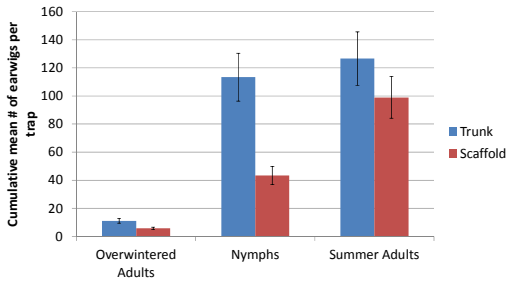
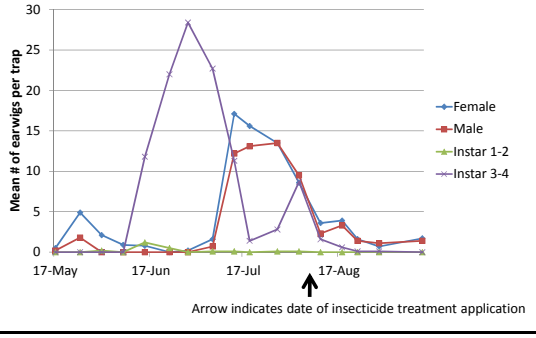


Fig. 3. Earwig life stage phenology, Kaysville, 2011 (trunk traps only)



2) Insecticide efficacy

The insecticides Success and Entrust which both contain the active ingredient spinosad, significantly reduced earwig capture in trunk traps for more than two weeks after application (Fig 4). Sevin and Warrior reduced earwig counts one week after application, but then numbers were similar to the untreated plots by two and three weeks after application. Earwig counts in the Intrepid plots were never different from the untreated plots. All insecticides except Intrepid reduced fruit injury from earwig feeding as compared to the untreated (Tables 1 and 2). There were no effects on cat-facing injury or split-pits which were relatively low (Table 2). Sevin and Success provided the longest-lasting protection of fruit, up to three weeks after applications (Table 1).

Fig. 4. Insecticide treatment effects on earwig densities, Kaysville, 2011 (trunk traps only)

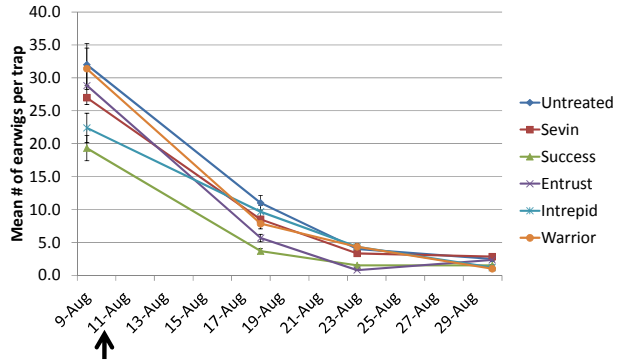


Table 1. Percentage of peach fruits with injury from earwigs, cat-facing, and split-pits following insecticide treatments applied on August 10, Kaysville, 2011.

Insecti-cide	Percentage of fruit with injury											
	Aug 9 (pre-trt)			Aug 16 (1 wk post-trt)			Aug 23 (2 wk post-trt)			Aug 30 (3 wk post-trt)		
	Ewg	Cat-f	Spl-pt	Ewg	Cat-f	Spl-pt	Ewg	Cat-f	Spl-pt	Ewg	Cat-f	Spl-pt
Untrt	16.7	0.0	6.7	30.0	3.3	16.7	46.7	3.3	6.7	33.3	6.7	13.3
Sevin	16.7	0.0	10.0	20.0	3.3	16.7	10.0	0.0	0.0	6.7	0.0	6.7
Success	16.7	0.0	30.0	13.3	0.0	16.7	6.7	0.0	0.0	0.0	0.0	3.3
Entrust	23.3	3.3	23.3	10.0	0.0	3.3	10.0	0.0	0.0	13.3	3.3	3.3
Intrepid	20.0	0.0	16.7	23.3	3.3	10.0	23.3	0.0	0.0	20.0	3.3	0.0
Warrior	16.7	0.0	6.7	13.3	3.3	16.7	23.3	0.0	0.0	10.0	0.0	0.0

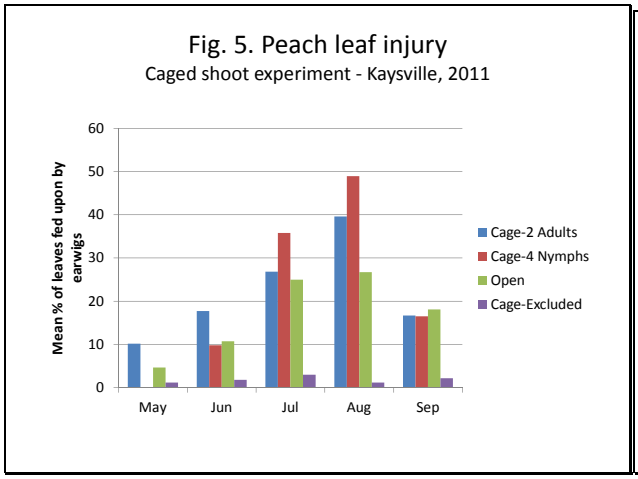
Ewg=earwig, Cat-f=cat-facing, and Spl-pt=split-pit.

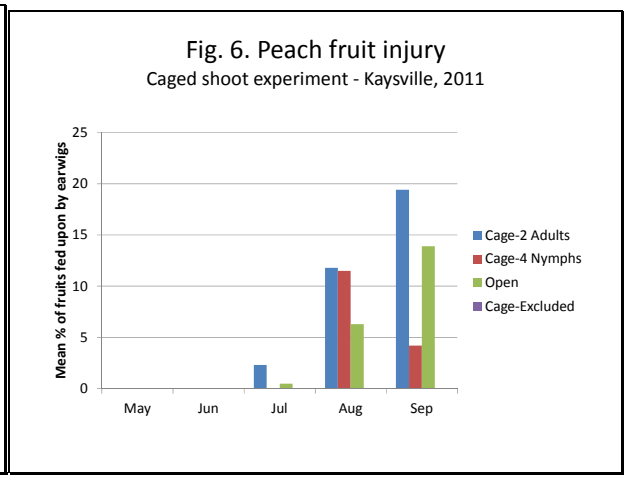
Table 2. Mean post-treatment fruit injury.

Insecticide treatment	% of fruit with injury post-trt		
	Earwig	Cat-facing	Split-pit
Untreated	36.7 a	4.4	12.2
Sevin	12.2 bc	1.1	7.8
Success	6.7 c	0.0	6.7
Entrust	11.1 bc	1.1	2.2
Intrepid	22.2 ab	2.2	10.0
Warrior	15.5 b	1.1	5.6
P>F	0.03	0.63	0.43

3) Seasonal peach injury

When caged in no-choice tests on peach shoots, adults and nymphs fed on both leaves and fruits (Fig. 5 and 6). The majority of leaf-feeding occurred in July and August, on both caged and open shoots (Fig. 5). Very little leaf-feeding and no fruit-feeding was observed on shoots from which earwigs had been excluded. A low level of leaf-feeding occurred in May before exclusion cages were applied and this injury carried through the trial. The first fruit injury by earwigs was observed in mid July, but levels were low (Fig. 6). The majority of fruit-feeding occurred in August and September when fruit softened as they neared maturity. Fruit ripened in early to mid September. Both adults and nymphs fed on fruits when caged on the shoots. Adult feeding was greatest in September, and few second-generation nymphs were active by this late in the season (Fig. 3).





Conclusions

Cardboard refuge traps placed on tree trunks were found to be an effective monitoring tool for earwigs. The traps provide a measure of relative density and life stage activity. Traps placed on trunks were more attractive than those placed on scaffold limbs, especially for overwintered adults and summer generation nymphs. The European earwig is bivoltine (two generations per year) in

northern Utah. It overwinters as an adult. The first generation of nymphs peaked in early July and adults in mid to late July. The second generation of nymphs peaked in late July to early August and adults in late August. Few early instar nymphs were caught in traps because they remain in ground nests which are cared-for by the female parent.

Of the insecticides evaluated, Success and Entrust reduced earwig densities more than the others, up to two weeks post-application. Both of these reduced-risk insecticides contain the active ingredient spinosad which is produced by fermentation of a bacterium. The conventional insecticides Sevin and Warrior reduced earwig densities one week post-application, but then densities were similar to the untreated plots by the following weeks. Intrepid, a growth regulator that mimics the molting hormone of lepidopterous insects (caterpillars) did not lower earwig densities. All insecticides, except Intrepid, reduced fruit injury from earwigs. Mean injury for the three week period following treatment was lowest in Success and next lowest in Entrust and Sevin plots.

Earwig adults and nymphs fed on peach leaves and fruits. Leaf-feeding occurred from May to September, but was greatest in July and August. The proportion of injured leaves declined in September. Because leaf injury carried forward to future shoot evaluations, these results suggest that little new leaf-feeding occurred in September when leaves are tougher and no longer actively growing. Second-generation adults caused the greatest injury to fruits in late August and September when fruits approach and reach maturation. Late-summer adults were also more active in tree canopies based on higher limb trap captures.

Future research will assess the role of European earwig in biological control of green peach aphid and a caterpillar pest, the codling moth. Earwigs were found to feed on green peach aphids during 2011 studies.

Publications

Alston, D. G., and A. Tebeau. 2011. European earwig, *Forficula auricularia*. Utah State University Extension and Utah Plant Pest Diagnostic Laboratory ENT-145-11 (3 pp.), Logan, UT. (http://extension.usu.edu/files/publications/factsheet/earwig-tf.pdf)

Alston, D. and A. Tebeau. 2011. European earwig functional roles in peach orchards. Utah Pests News Vol. 5: 6-7, Summer, Utah State University Extension and Utah Plant Pest Diagnostic Laboratory, Logan, UT. (http://utahpests.usu.edu/files/uploads/UtahPests-Newsletter-summer11.pdf)