**Graduate Student CERES Grant Final Report**

**1. Project Title**: Potential of organic hogs as a tool for post-harvest orchard floor sanitation and pest management (2nd year of funding)

**2. Project Leader**: Krista Buehrer, Graduate Student, Michigan State University, Dept of Entomology

**3. Major Professor**: Dr. Matthew Grieshop, Assistant Professor, Michigan State University, Dept of Entomology

**4. Accomplishments:**

The study was conducted in organic apple and cherry orchards in Leelanau County, Northport, MI. The orchards were comprised of mature trees. The tart cherry tree orchards had 6 m (20 ft) wide drive rows and the trees were 4.5 m (15 ft) apart. The apple orchard also had 6 m (20 ft) wide drive rows and the trees were 4.5 m (15 ft) apart. Both the apple and cherry orchards were maintained and harvested. We established three experimental units in the cherry orchards. Only one experimental unit could be established in the apple orchard. An experimental unit consisted of a control plot without hogs and an experimental plot with hogs. Each plot in the cherries was 76.8 m by 106.7 m (252 ft by 350 ft), or 0.82 hectares (2.02 acres). Each plot in the apples was 192 m by 64 m (630 ft by 210 ft), or 1.23 hectares (3.04 acres). The hog plots were fenced using electric rope, step-in poly fence posts, and a solar controller. The grower purchased 18 Duroc-Yorkshire mixed piglets in early May of 2011. The piglets were trained to electric fencing and raised on pasture until transferred to the apple orchard. Once finished in the apples, the hogs were next transferred to a pasture planted with field peas until post-harvest in the cherry orchards. After grazing in the cherry orchards, the hogs were allowed to graze in pear orchards until time of slaughter. The 18 hogs were kept as a single group and rotated through the experimental plots. The hogs were in the apple orchard form June 30, 2011 through July 11, 2011. Hogs were rotated through the cherry plots post-harvest beginning on August 18, 2011. They spent one week in each grazed plot.

***Objective 1:*** *Determine level of orchard floor and insect pest management services provided by hogs grazing and rooting within cherry orchards on a large scale post-harvest.*

Objective one was addressed through measurements and observations made in the cherry orchards. We established four 30 m transects along tree rows under the canopy in each plot. We evaluated ground cover and the amount of fruit along transects before and after grazing. We collected fruit and took it back to the lab to determine biomass and allow any pest insect larvae to emerge. Insects were counted and identified to family level for non-pests and species level for pests.

The hogs significantly decreased grass, and significantly increased bare ground in the cherry orchards (Fig. 1). Cherries did not contain any pest insect species, but did contain detritivore beetles (Fig. 3). The hogs consumed all fruit on the ground in the cherry orchards (Fig. 2). The hogs cleaned the orchard very well, and can be used for orchard sanitation post-harvest while also providing weed suppression. Since no fruit was found in treatment plots after hogs had grazed, no insects were found either post-grazing (Fig. 3).

The hogs provided a valuable service by removing fruit and weeds from the orchard floor post-harvest in the cherry orchards. The growers had no problem finding buyers for the pork before the hogs were harvested. The sale of the meat helped to make the hog-orchard integrated system economically sustainable.

The spring following grazing, we monitored the population of the first generation of Plum Curculio with stand alone pyramid traps and mesh funnel traps wrapped around the trunks of trees. We found no significant difference between ungrazed and grazed plots (Fig. 4). Over the course of the first generation, we caught an average of 4.5 adults per trap in ungrazed plots and an average of 3.8 adults per trap in grazed plots (Fig. 4). Trap catches were very low in general. It is not uncommon to catch upwards of 50 weevils in a trap per week in an area where there is an established population, but our highest trap catch at any point was 26. The low occurrence of Plum Curculio in the cherry orchards was most likely due to the fact there was no cherry crop in 2012 due to multiple early freezes. Plum Curculio adults likely moved out of the cherry orchards to find food and reproductive sites. Any difference that may have existed between plots may not have been detected due to these circumstances.

We also monitored Cherry Fruit Fly populations in the cherry orchards the following year for two months with baited yellow sticky cards. Again, we found no significant difference between ungrazed and grazed plots. Trap catches for this pest species were also very low. We caught a total of 13 cherry fruit flies. The average number of cherry fruit flies caught in ungrazed plots was 2.7 and the average caught in grazed plots was 1.7. The low occurrence of Cherry Fruit Fly may have also been due to the lack of a cherry crop, and any emerging flies likely left the cherry orchards in search of food and viable reproductive sites. Any difference that may have existed between plots may not have been detected due to these circumstances.

***Objective 2:*** *Determine how many hogs per acre and number of days needed to achieve desired level of fruit removal in apple orchards during “June drop” period.*

Objective two was addressed through measurements and observations made in the apple orchard. We randomly selected a tree on the north side and a tree on the south side of each of the 11 rows in the grazed and ungrazed plots. We then evaluated the amount of dropped fruit present beneath each selected tree. Any dropped fruit found was collected and taken back to the lab to allow any pest insect larvae to emerge. Insects were counted and identified to family level for non-pests and species level for pests.

The hogs spent 11 days in the grazed apple plot. After the hogs, an average of 1 apple per tree was found in the grazed plot, whereas an average of 44 apples per tree was found in the ungrazed plot. The dropped apples collected from the grazed plot yielded only 1 Plum curculio larvae and 0 Oriental Fruit Moth larvae. The dropped apples from the ungrazed plot yielded 135 Plum curculio larvae and 4 Oriental Fruit Moth larvae.

The hogs did a thorough job at removing apples from orchard floor, along with a sizable number of Plum curculio larvae. The 18 hogs needed less than two weeks to remove nearly all dropped apples in a 3 acre area. Grazing the hogs in the apples pre-harvest provides another opportunity for managing insect pests found in dropped fruit. Rotating hogs through multiple pasture types throughout the season also contributes to reducing the amount of feed needed to maintain expected hog weight gain, as discussed below.

We also measured fruit damage from the first generation of Plum Curculio in the apple orchard in the spring of the following year. We sampled 100 apples in each of the 10 rows of the ungrazed and grazed plots. We found no significant difference between the number of apples with damage or the number of ovipositional stings per apple (Fig. 5). This finding could be due to the fact there was no cherry crop in adjacent orchards in 2012 due to early freezes, possibly leading Plum Curculio populations to move into the apple orchard in search of food and reproductive sites. Another possible explanation is subsequent generations of Plum Curculio after June 2011 may have rebounded from any impact the hogs had. Grazing hogs during the June-drop period as well as post-harvest may be more beneficial than grazing them only during the June-drop period, so they have a chance to impact multiple generations of Plum Curculio.

***Objective 3:*** *Determine the effect of utilizing hogs as a pest-management tool on hog weight gain.*

Hog health was monitored by Dr. Dale Rozeboom, an animal scientist at Michigan State University. All 18 hogs remained in good health during the course of this study. The hogs satisfactorily gained weight throughout the summer and fall, and reached the industry standard by the time of harvest in November. The hogs did not require more feed, as they had the previous year due to being free-range rather than being confined. Each hog required the industry standard of approximately 600 lb of feed in 2011, whereas each hog had required approximately 1000 lb of feed in 2010. The grower achieved this through rotationally grazing the hogs through different pasture and orchard types on the farm (Fig. 6). The pastures were planted with field pea and/or oats to provide supplementary nutrition. The dropped fruit in the different tree fruit orchards also provided supplementary nutrition. The six-week period where the hogs were rotationally grazed in the apple and cherry orchards for the study did not appear to negatively impact their weight gain.

***Objective 4:*** *Develop and deliver extension and educational materials for perennial fruit farmers considering using hogs for post harvest fruit management.*

Results have been presented in the form of oral presentations and posters at meetings and conferences. A general talk about the use of hogs in tree fruit orchards was given at an EPA farm tour in Northport, MI on July 20, 2011 and at an Organic Tree Fruit Grower Association Field Day in Flushing, MI on August 06, 2011. A poster titled “Post-harvest grazing of hogs in tree fruit orchards for orchard floor management” was presented at the Great Lakes Fruit, Vegetable and Farm Market Expo in Grand Rapids, MI on December 05-08, 2011. A poster titled “Hogs in the Orchards” was presented at the Midwest Organic and Sustainable Education Service Annual Organic Farming Conference in Lacrosse, WI from February 24 to 25, 2012. The poster was also presented at the Michigan Organic Conference in East Lansing, MI on March 02, 2012. The posters are available as PDFs on the Organic Pest Management Lab website ([www.opm.msu.edu](http://www.opm.msu.edu)).

**5. Impacts**

Our work contributes to the growing body of literature on livestock-crop reintegration. This project specifically provides a method of livestock-crop integration that avoids the problem of adhering to National Organic Policy (NOP) and Good Agricultural Practices (GAP) policies restricting the application of manure prior to harvest. This post-harvest method will allow many growers, who otherwise would not be interested —due to NOP and GAP policies— to reintegrate livestock into their farming operations. The reintegration of livestock into crops will provide growers with services such as weed reduction, orchard floor sanitation, and pest management. Our research will provide growers with desired information on how effective the method is and whether or not it is economically sustainable. The rotation of hogs through different pastures and orchards with supplemental nutrition sources resulted in a reduction of feed back down to industry standards. Being able to utilize hogs without incurring extra feed costs is vital to the economic sustainability of reintegration. This study demonstrates it is possible to keep feed costs at a reasonable level while allowing the hogs to provide pest management services in tree fruit systems. At the meetings the presentations were given, many growers expressed interest in the project. Providing growers with this information is important, and we will continue this research in order to expound upon what we have learned thus far.

**6. Figures**

Fig. 1

Fig. 2

Fig. 3

Fig. 4

Fig. 5



Fig. 6