Evaluation of Puffer Mating Disruption to Manage Codling Moth

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Project Summary

This project tested the efficacy of a money-saving mating disruption product to manage codling moth in apple orchards in Utah. The product is called Checkmate Puffer CM (Suterra Corp., Bend, OR), and it works by emitting a puff of codling moth pheromone (at 1 puffer/acre) into the orchard air every 15 minutes. The air becomes saturated with female pheromone, preventing males from finding females for mating, and hence, reducing injury to the fruit.

All of the proposed objectives of this two-year project were completed without any problems or delays:

1. *Demonstrate a cost-effective, labor saving, efficient method of delivering pheromone in a mating disruption program.*
    a. We established two demonstration orchards and presented results.
2. *Determine if puffer technology works in commercial orchards in Utah.*
    a. We found that puffer technology works best on large orchards (35+ acres) with low codling moth population.

The primary insect pest for commercial growers of apple and pear trees in Utah is codling moth. The adult lays eggs on the fruit, and the larvae bore into the flesh. Without any control, orchards in Utah can have 70% - 90% damage to fruit. Many specialty crop orchards that have 10 or more acres in Utah use a technology called mating disruption as an effective, low-chemical use tool to manage this pest. The most widely used method of mating disruption is to hand-apply small dispensers to trees, at a rate of 200-400 per acre. Each dispenser emits a small amount of pheromone that mimics the female codling moth, preventing males from mating with females.

Hanging dispensers by hand is a labor-intensive process, averaging about $50/acre. During an era of reduced labor availability, increased costs, and relatively lower returns, Utah operations are looking for new options to save on labor and other costs. The application rate of the puffer is one per acre, with a labor cost of about $10/acre. For a 40-acre orchard, material costs of the two options are the same, but the orchard using Puffers will spend $1,600 less.

Puffer technology is used successfully in specialty orchards in California, Oregon, and Washington, and by a few in Idaho. From this project, we learned that in Utah, Puffers do last throughout the entire growing season, and they are most effective on orchards 35 or more acres in size where the codling moth population is low.

Project Approach

Objective 1: Demonstrate a cost-effective, labor saving, efficient method of delivering pheromone in a mating disruption program.

The project applicants (Murray, Alston) received permission from two fruit operations in which to conduct this demonstration and study. Larger-sized orchards were selected based on the manufacturer's recommendation. The first site, located in Payson, was a 35-acre apple orchard, and the second site, located in West Mountain, was a 40-acre apple orchard. For each site where Puffers were used, we also included a nearby 10-acre apple orchard using the hand-applied mating disruption dispensers for comparison.

The Checkmate Puffer CM units were donated by Suterra, the manufacturer. We deployed the puffers before bloom, on April 15, 2011 and again on April 9, 2012, throughout the two orchard blocks at a rate of one per acre, based on an aerial map provided by Suterra. Using factors such as wind direction and prior insect trapping records, puffers were strategically placed high in the tree or on posts to minimize codling moth fruit injury. The Puffer product is comprised of a cabinet that encloses a puffer aerosol can. For this project, the cabinet was programmed to release pheromone sprays at 15-minute intervals, starting at 6 pm and stopping at 6 am. The hand-applied dispensers were hung by the operation at the same time as the puffers.

To introduce the puffer technology to specialty crop growers, Murray and Alston demonstrated how Puffers work and how they are installed to commercial growers in Utah County at a tree fruit field day in 2011 and 2012 at one of the Puffer test orchards. Murray also discussed the use of Puffers at the Utah Horticultural Association Annual Convention in winter 2012. At all events, we noted the financial advantage of using Puffers where codling moth populations are low.

Objective 2. Determine if puffer technology works in commercial orchards in Utah.

In each treatment block, we hung insect traps to help determine effectiveness of the Puffer mating disruption. (The more moths the traps catch, the lower the effectiveness of the mating disruption.) We hung 20 traps in each Puffer block and 6 traps in each hand-applied block, using a pheromone lure designed for use in mating disruption orchards (CM-DA Combo (Trécé)). We also hung 20 additional traps in each Puffer block using lures designed for non-mating disruption orchards. Any moths caught in these types of traps could mean a failure of the Puffers (no moths were caught in these traps in either orchard in both years).

All traps were checked every week by Murray and a hired student, and the lures were changed as suggested by the manufacturer. When checking the traps, the moths were removed and stored in alcohol, and the student assistant later determined the gender of the moths using a microscope. For both seasons, we measured codling moth damage to the crop in each test orchard at the end of codling moth generations one and two (typically early July and mid-August, respectively). Approximately 1,000 apple fruits were visually inspected in each orchard treatment for larval

entries. Fruit with suspect larval entries were cut open to verify the cause. The percentage of fruit with larval entries (new or old) was then determined as an average of both generations.

Average weekly trap catch results for 2011 and 2012 are shown in Tables 1 and 2 below. In the Payson orchard, where the codling moth population was low, the trap catches in the Puffer block were no different from the trap catches in the hand-applied mating disruption block. Figure 1 shows a graph of the weekly trap catch in the Payson orchard. The West Mountain orchard was a site with a high population of codling moth, and there were more moths caught in the traps in the Puffer block than in the hand-applied block. In that orchard, neither the Puffers nor the hand-applied mating disruption was effective, and farm, even though it received supplemental insecticides for codling moth, had unacceptable injury for both treatments.

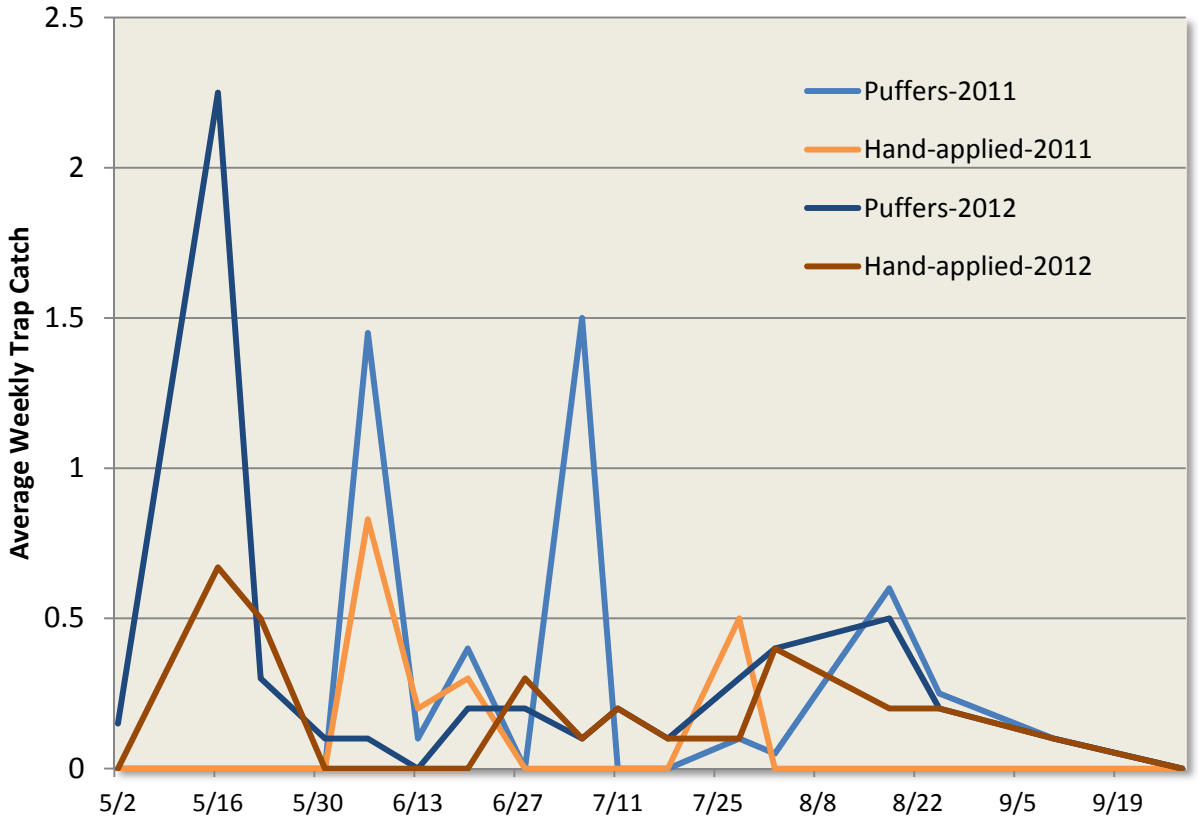
Table 1. Average weekly codling moth counts for all traps in the puffer block and hand-applied comparison block at the Payson and West Mountain orchards in 2011.

	Payson Orchard		West Mountain Orchard	
Date	**Puffers**	**Hand-applied**	**Puffers**	**Hand-applied**
05/16/11	0.0	0.0	0.3	0.1
05/23/11	0.0	0.0	0.4	0.2
05/31/11	0.0	0.0	0.3	0.1
06/06/11	1.4	0.8	6.9	6.3
06/13/11	0.1	0.2	7.3	2.5
06/20/11	0.4	0.3	9.5	2.6
06/28/11	0.0	0.0	13.2	2.3
07/06/11	1.5	0.0	11.9	2.9
07/11/11	0.0	0.0	7.2	0.8
07/18/11	0.0	0.0	10.2	4.5
07/28/11	0.1	0.5	0.9	0.2
08/02/11	0.1	0.0	0.3	0.2
08/18/11	0.6	0.0	7.4	3.6
08/25/11	0.2	0.0	5.8	5.7
09/10/11	0.1	0.0	4.4	2.8
10/22/11	0.0	0.0	0.2	0.2
TOTAL	4.5	1.8	86.4	108.9

Table 2. Mean codling moth trap catch per week for all traps in the puffer block and hand-applied comparison block at the Payson and West Mountain orchards in 2012.

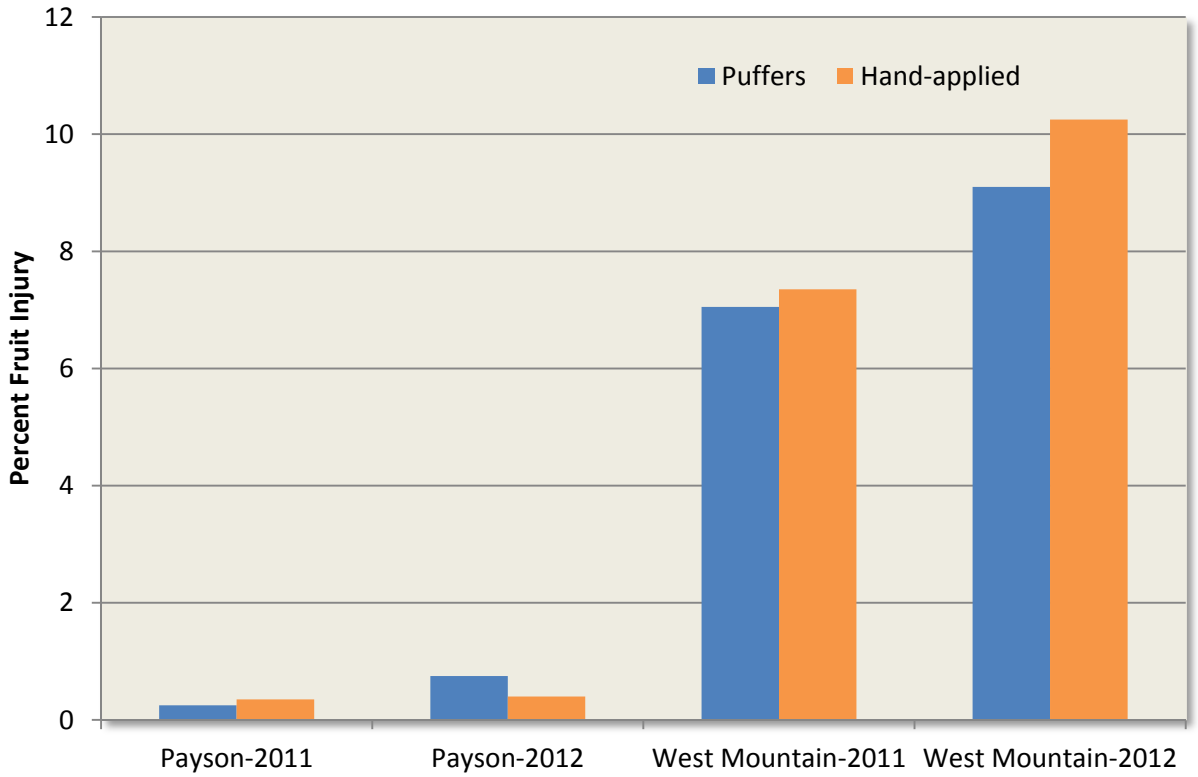
	Payson Orchard		West Mountain Orchard	
Date	**Puffers**	**Hand-applied**	**Puffers**	**Hand-applied**
5/02/12	0.2	0.0	0.4	2.0
5/16/12	2.2	0.7	13.8	17.5
5/22/12	0.3	0.5	12.2	29.3
6/06/12	0.2	0.0	31.4	42.5
6/20/12	0.1	0.0	15.1	27.0
6/27/12	0.2	0.3	6.0	23.0
7/11/12	0.2	0.3	3.0	8.8
8/02/12	0.8	0.5	5.9	8.0
8/22/12	0.6	0.3	4.0	18.8
9/11/12	0.1	0.2	1.6	4.0
9/28/12	0.0	0.0	0.1	0.67
TOTAL	4.75	2.83	93.2	181.6

Figure 1. Average weekly codling moth trap catch for all traps in the puffer block and hand-applied comparison block at the Payson orchard in 2011 and 2012.



The chart below shows the differences in fruit injury between the two treatment types for each orchard in each year. In general, injury in both the Payson orchard (where codling moth populations were low) and the West Mountain orchard (where populations were higher) was similar between the Puffer and hand-applied mating disruption treatments. In the West Mountain orchard, however, the amount of injury that occurred under both treatments showed that mating disruption in general does not work under very high populations.

Figure 1. Percent injury (out of 1,000 fruits assessed) caused by codling moth on apples in each orchard and each treatment type in 2011 and 2012.



To ensure the operation of the puffer units, Murray tested 20% of the units twice during each growing season. Murray checked the Puffer batteries and weighed the aerosol canisters to determine if their contents were dropping evenly among the Puffers. No defects or anomalies were found.

To provide a visual map of the puffer locations and overall trap catches, we recorded each puffer and trap location using a Trimble GPS. The student assistant then used ArcMap to produce the maps shown under "Additional Information." The maps show the concentration of the codling moth populations on each farm in relation to the puffer units.

Goals and Outcomes Achieved

Because the research was just completed in fall 2012, we expect that changes in grower behavior in codling moth pest management will change in subsequent years. The results of this study will be presented to the 2013 Utah State Horticulture Association meeting, held in Provo, UT. Attendance ranges from 65-85 growers. We will survey the audience at that time to determine which growers may be considering using Puffers for the 2013 season. The following outcomes (# 1 and 2) are expected to occur on farms that adopt the use of Puffers, now that they have been shown to work on blocks 35 acres in size or more with a low codling moth population.

1. **Increased cost savings for apple and pear growers using Puffers.** The use of Puffers for codling moth control on farms over 35 acres in size that are already using hand-applied mating disruption will result in a savings of at least $40/acre each year. For a 400-acre operation, savings could potentially be $12,000 - $16,000 per year. In addition, it will free up labor for other important activities. Mating disruption supplies need to be hung in the orchard by bloom, at a time when many activities are happening and workers are busy with other orchard projects. A crew of two would take a full day to hang hand-applied dispensers on 35 acres, whereas those same two would take just 1-2 hours to hang Puffers.

2. **Increased adoption of mating disruption for codling moth, thus reducing pesticide inputs.** In Utah, codling moth control requires the greatest amount of pesticide inputs on apples and pears, costing growers thousands of dollars yearly, and contributing to pesticide exposure of farmworkers and natural resources. These specialty crop growers appreciate having options for pest management, and seeing one that works in certain settings (larger farms with already reduced pest populations), where labor requirements and costs are minimal, may help to increase the use of this control technology for codling moth.

   We will continue to measure codling moth damage, total trap catches, and the number of pesticide sprays in subsequent years to demonstrate reduction of total insecticide use and the shift to mating disruption in Utah.

3. **Training opportunity for student employee.** One USU undergraduate student was hired from the biology department to help with this project over the 2-year period. He received training in insect identification, monitoring and trapping techniques, and a control strategy (mating disruption) that is an emerging option for larger organic and conventional growers. He also learned valuable computer skills including ArcGIS. The student will graduate in 2013.

Beneficiaries

This project serves apple and pear growers in the state who have orchard blocks of 35 acres or more in size and low codling moth population. Currently, approximately 1,200 acres of apples are under mating disruption (using hand-applied dispensers). Of that, approximately 800 acres could potentially save costs by switching to puffers. At a time when farm labor is difficult to find, and in an economic downturn, this small amount could net huge savings for individual growers. Data from this study could apply to apple orchards in Colorado and Idaho that are similar in elevation and climate to Utah's. The results of this study will be presented to the 2013 Utah State Horticulture Association meeting.

Lessons Learned

1. We are fortunate that we could test this treatment option on actual grower farms. We worked closely with the farm operations throughout the process, by sending trapping and injury data throughout the season. The owner of the farm that had high levels of injury during the Puffer treatment project reported that the injury level was actually similar to what he has seen in past years. We consulted with him on any supplemental codling moth treatments and he was not dissatisfied with the results.

2. We learned from the field day activities that specialty crop growers appreciate seeing a demonstration of any new treatment option. There was much interest in the use of Puffers, but growers had never considered it an option for Utah farms because of the uncertainty of how they would work here.

Additional Information

Diagram of codling moth population density at the West Mountain farm in 2011 (left) and 2012 (right). The large black border is the puffer field, and the blue border is the hand-applied comparison field. The black squares represent the Puffer units.

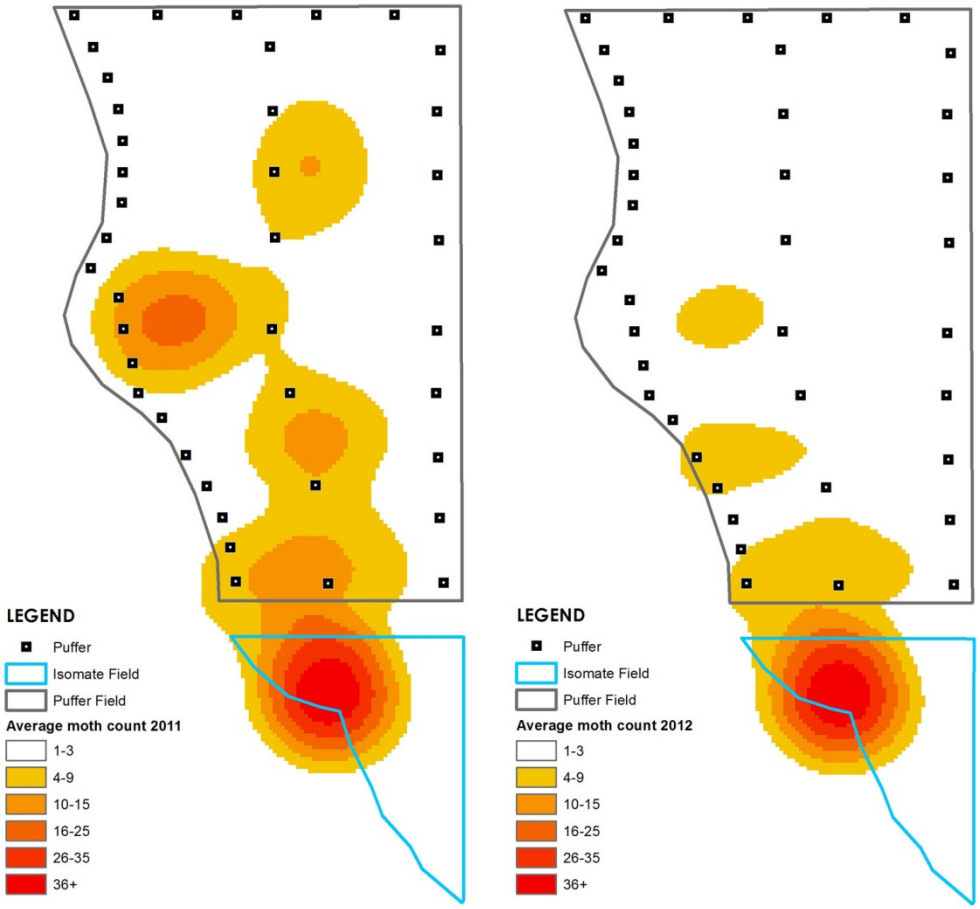


Diagram of codling moth population density at the Payson farm in 2011 (top) and 2012 (bottom). The large black border is the puffer field, and the blue border is the hand-applied comparison field. The black squares represent the Puffer units.