

Mating Disruption/SIR

Are Puffers as Good as Hand-Applied Dispensers for Mating Disruption of Codling Moth and Obliquebanded Leafroller?

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*Keywords:* puffer technology, codling moth, *Cydia pomonella*, obliquebanded leafroller, *Choristoneura rosaceana*, Isomate, apple

Apple pest management in the United States is in a process of redefining itself. The tools used to control codling moth, *Cydia pomonella* (L.), are changing and the future availability of broad spectrum neuroactive insecticides is in question. New selective materials that will partially offset this loss may soon be registered. Meanwhile, adoption of mating disruption (MD) of codling moth has increased steadily since its registration in 1991, and currently, 25% of the apple acreage in Washington is treated with sex pheromones. Yet, MD is not a silver bullet and remains a limited technology, due to problems in distributing the pheromone throughout the orchard (problem spots are: edges, slopes, windy areas, uneven canopies, etc.), in effectively controlling moderate to high moth population densities, and due to its higher cost than traditional tools. Grower surveys have shown that on most acreage treated with MD supplemental broad spectrum insecticides are applied which likely reduces the potential benefits from biological control. Further improvements in the efficacy of MD for codling moth are needed, while further reducing its cost.

New technology is needed to reduce the cost of mating disruption, increase grower's flexibility in integrating this approach with other tactics, and improving its effectiveness. Various studies are in progress to develop the use of paraffinic emulsions, sprayable formulations, 'attract and kill' formulations, and aerosol puffers. These products will allow growers to better manage their use of pheromones both spatially and temporally. The puffer technology appears particularly attractive due to its ease of application and high level of flexibility. Puffers can be programmed to release pheromone at preselected rates, frequency, and time periods. The initial development of this technology used 1-2 puffers per acre arranged around the perimeter of the treated orchard. However, results in various walnut, apple, and pear orchards were mixed. My studies beginning in 1998 have used a different approach that is much more cost effective and may avoid the difficulty of distributing pheromone around the orchard's perimeter. In 1998 a 50 acre apple orchard in Malott was treated with a 10 m band of Isomate-C+ dispensers at the full rate around its perimeter and then one puffer per hectare (2.5 acres) was deployed internally. Codling moth pressure surrounding the Malott orchard was high to moderate (32 moths were caught in an adjoining, upwind orchard treated with Isomate-C+). Within the puffer-treated orchard a low level of injury (0.1-0.2%) occurred only on the upwind edge. This edge (6 rows) was sprayed with two organophosphate applications and the remainder of the orchard was free of injury and was left unsprayed.

In 1999 a study was conducted using replicated 40 acre orchards that compared this puffer arrangement against Isomate dispensers at either 400 or 200 dispensers per acre. No difference was found among these three treatments. Three puffer deployments were evaluated that involve different daily cycles of operation (12 or 24 h) and the frequency of puffing (every 15 or 30 min). All of the puffer settings for codling moth were similar to the two Isomate dispenser densities tested (Table 1). However, the 12 h cycle of operation (3 PM to 3AM) every 15 min appeared to be more effective for the obliquebanded leafroller (Table 2). This is also the current use of puffers in California for codling moth. The cost of this puffer program is expected to be similar to the cost of using a half rate of Isomate-C+ (200 dispensers per acre) and has a

much lower application cost. Additional studies are needed to assess the effectiveness of this puffer use strategy and to evaluate its use in combination with sprayable pheromone and 'attract and kill' formulations. Recent studies by Steve Welter suggest that an optimal puffer deployment may not be a grid but should consider the primary wind direction in the orchard.

In the second study, three growers' orchards were managed with the use of puffers and border application of hand-applied dispensers. Orchards were monitored by a private consultant with lure-baited traps and levels of fruit injury were assessed at harvest. Fruit from codling moth and obliquebanded leafroller averaged 0.24 and 0.12%, respectively (Table 3). These levels of fruit injury were acceptable based on the high pest pressure in these orchards.

**Table 1.** Average moth catches per trap from replicated 40 acre orchards treated with either puffers with a border of Isomate-Special or 200 or 400 Isomate Special per acre.

Treatment	Time period/puffer setting	Moths per trap per day 1 mg lure	Moths per trap per day 10 mg lure
Isomate 200	<b>17 May to 1 July</b>	-	0.75
Isomate 400	7.5 mg puff, 24 h per day	-	0.63
Puffers	every 30 min	-	0.72
Isomate 200	<b>7 July to 27 July</b>	-	1.45
Isomate 400	7.5 mg puff, 24 h per day	-	1.60
Puffers	every 15 min	-	1.67
Isomate 200	<b>3 August to 25 August</b>	0.30	1.44
Isomate 400	7.5 mg puff, 12 h per day	0.31	1.20
Puffers	every 15 min	0.30	1.22
Isomate 200	<b>1 Sept to 22 Sept</b>	0.26	0.79
Isomate 400	7.5 mg puff, 24 h per day	0.23	0.74
Puffers	every 30 min	0.24	0.73
<b>TOTALS for SEASON</b>	<b>Isomate 200</b>	<b>0.28</b>	<b>1.11</b>
	<b>Isomate 400</b>	<b>0.27</b>	<b>1.04</b>
	<b>Puffers</b>	<b>0.27</b>	<b>1.09</b>

**Table 2.** Comparison of obliquebanded moth capture in pheromone baited traps in replicated 40 acre orchards treated either with puffers or 200 or 400 Isomate-Special dispensers. Puffer settings were 7.5 mg puffs for 12 or 24 h per day and every 15 or 30 min.

Treatment	Mean moth capture per trap per day			
	6/8 - 7/1 24 h-30 min	7/7 - 7/27 24 h-15 min	8/3-8/25 12 h-15 min	9/01 - 9/22 24 h -30 min
Isomate CM/LR 200 per acre	0.15	0.26	0.16	0.36
Isomate CM/LR 400 per acre	0.10	0.28	0.12	0.28
Puffers	0.32	0.24	0.09	0.20

**Table 3.** Comparison of moth catch and fruit injury of codling moth and obliquebanded leafroller in three replicated 40 acre orchards treated with puffers plus a border treatment of Isomate CM/LR, Isomate C+ for codling moth only, or Isomate CM/LR for both leafrollers and codling moth.

CM Dispenser	OBLR Dispenser	Season-long CM catch per trap	Season-long OBLR catch per trap	% CM fruit injury	% OBLR fruit injury
CM/LR	CM/LR	1.8	2.5	0.01	0.10
C+	none	2.3	32.2	0.08	1.37
Puffers	Puffers	-	-	0.24	0.12