

# A Sustainable, Non-Chemical Thinning Method for US Midwestern Apple Producers: Novel Use of Anti-Hail, Insect-Exclusion Netting

Mokhles Elsysy, Richard Aspinall and Todd Einhorn



FRUIT, VEGETABLE & FARM MARKET

# **Background:**

Over-the-row, anti-hail, insect exclusion nets provide an environmentally clean method to adjust fruit set and yield in addition to managing key insect pests of apple (codling moth, plum curculio, and brown marmorated stink bug). The potential for fewer insecticidal applications reduces environmental risks associated with drift and/or surface runoff and surface water contamination. Reduced risk of chemical toxicity to humans, fish, birds, and non-targeted plants enhances biodiversity and improves the quality of life of farmers and society, as a whole.

**Background and Goals** 

Enhancing crop productivity, yield security, fruit quality and uniformity.



# **Experimental Procedure:**

Three high-value apple cultivars with different bearing tendencies netted in three disparate production regions of Michigan; two commercial orchards ('Liberty' at Almar Orchards Organic, Flushing, MI & 'Honeycrisp' at Schwallier's Country Basket, Sparta, MI) and 'Gala' at MSU Clarksville Research Center (CRC).
Nets for a specific treatment are covered when target bloom percentage is achieved, 30% and 60% King Bloom.

Procedure

### Measurements:

Fruit set, yield and fruit number, vegetative growth, fruit quality attributes; individual fruit weight, shape, surface color, fruit firmness, starch, total soluble solids, titratable acidity, and seed content.

- Improving crop retention.
- Reducing stress and costs associated with thinning and insect pressure.

## **Objectives:**

- Investigate economic and environmental impacts of netting on apple production in the Midwest.
- Provide stakeholders with recommendations from commercial-scale trials.
- Better understand pollination processes and fruit set biology under controlled environment systems.
- Form a methodology for use of netting systems to manage pests, hail, and crop load for both growers and producers.



### Pest Monitoring

Traps: Traps implemented with species-specific lures along wooded edges of orchard blocks to assess farm level pest populations. Passive trapping (sticky traps without lures) also used to assess relative abundance/activity.
Monitoring/inspecting traps performed at bi-weekly intervals to identify species.
Baited traps were used to monitor codling moth (CM), apple maggot (AM), and San Jose scale (SJS); *Encarsia perniciosi* abundance was also recorded on SJS traps. Passive traps were used to monitor flower thrips populations. Traps were hung on trees inside (net) and outside (open) nets, with 5 reps each, collected bi-weekly.

Season-long woolly apple aphid (WAA) aerial colony incidence was recorded in biweekly visual inspections of 5 trees per rep.

Near harvest and before net removal, we examined 200 fruit from each plot in open vs. netted treatments at each site. Fruit were inspected for plum curculio stings, SJS scales, and internal feeding by lepidopteran pests.



Treatment	Firmness	Fruit wt	SSC	Starch index	BitterPit	Hail (%)	Leaf No.	Shoot Length	Leaf Area	Red	Yellow	Green	Pink
	(lb)	g	%	0-10				cm	cm <sup>2</sup>				
							Gala'						
Non-netted	$14.3 \pm 0.6$	$179.4 \pm 3.1$	$12.7 \pm 0.5$	7.1 ± 0.1	NA	$11 \pm 0.05$	$9.9 \pm 0.4$	$20.7 \pm 0.6$	$279.6 \pm 7.07$	44.1 ± 4.5	$11.6 \pm 1.7$	$1.1 \pm 0.5$	$32.5 \pm 2.4$
30% Bloom	$13.7 \pm 0.3$	$170.2 \pm 3.8$	$11.9 \pm 0.3$	$7 \pm 0.3$	NA	2 ± 0	$9.4 \pm 0.3$	20.4 ± 1.1	257.7 ± 9.5	49.8 ± 3.3	9.6 ± 1.3	$1.2 \pm 0.4$	$31.1 \pm 1.6$
60% Bloom	$14.1 \pm 0.3$	$169.9 \pm 2.9$	$12.1 \pm 0.3$	$6.9 \pm 0.3$	NA	2 ± 0.01	$9.8 \pm 0.2$	$21.26 \pm 0.95$	275.1 ±13.9	42.92.8	$13.2 \pm 1.4$	0.7±0.2	36.2 ± 1.25
							Honeycrisp						
Non-netted	$14.6 \pm 0.16$	$241.8 \pm 4.6$	$12.1 \pm 0.17$	8 ± 0	$0.28 \pm 0.05$	NA	$13.5 \pm 0.9$	$16.6 \pm 0.6$	$337.5 \pm 0.9$	$10.1 \pm 0.87$	$38.4 \pm 1.7$	$1.4 \pm 0.1$	$31.4 \pm 0.9$
30% Bloom	$14.7 \pm 0.3$	$246.5 \pm 1.2$	$12.3 \pm 0.1$	8 ± 0	$0.7 \pm 0.09$	NA	13.2 0.24	17.7 0.7	$394.6 \pm 7.1$	$5.9 \pm 0.45$	$39.1 \pm 1.1$	$0.9 \pm 0.1$	31.5 ± 1
60% Bloom	14.8 0.2	$247.7 \pm 0.2$	$12.3 \pm 0.2$	8 ± 0	$0.6 \pm 0.16$	NA	$13.4 \pm 0.3$	20.2 2	403.3 ± 13.9	$6.7 \pm 0.46$	$38.4 \pm 2.2$	$0.84 \pm 0.12$	31.8 ± 1.4
							Liberty'						
Non-netted	$16.2 \pm 0.2$	$148.8 \pm 1.9$	$13.7 \pm 0.18$	$6.8 \pm 0.16$	NA	11 ±	$7.5 \pm 0.05$	$14.14 \pm 0.4$	$123.4 \pm 3.0$	57.8 ± 2.25	$10.3 \pm 0.9$	$2.4 \pm 0.3$	$24.8 \pm 0.9$
30% Bloom	$16.3 \pm 0.3$	$154.6 \pm 1.6$	$13.8 \pm 0.1$	$6.7 \pm 0.1$	NA	4 ±	$8.4 \pm 0.3$	$16.4 \pm 1.4$	$185.4 \pm 8$	52.8 ± 1.9	$12.7 \pm 1.1$	$2.6 \pm 0.5$	26.9 ± 1.1
60% Bloom	$16.1 \pm 0.25$	$156.8 \pm 2.7$	$13.8 \pm 0.12$	$6.8 \pm 0.18$	NA	4 ±	$8.2 \pm 0.27$	$15.14 \pm 0.6$	$167.3 \pm 5.4$	48.9 ± 2.2	12.9 1.1	$2.8 \pm 0.3$	27.8 ± 0.9









# Fruit quality attributes were similar between netted and nonnetted (thinned) trees. Vegetative growth was similar in netted and non-netted (thinned) trees. Drape netting excluded codling moth males. Fewer San Jose scale males were captured under nets, but no scales were found on any fruit. Woolly apple aphids and flower thrips were more abundant under netting. Very low pest pressure for both

plum curculio and apple maggot

(data not shown).





