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Improved monitoring and management of apple maggot fly using multi-cultivar grafted trees and a novel attract-and-kill IPM strategy

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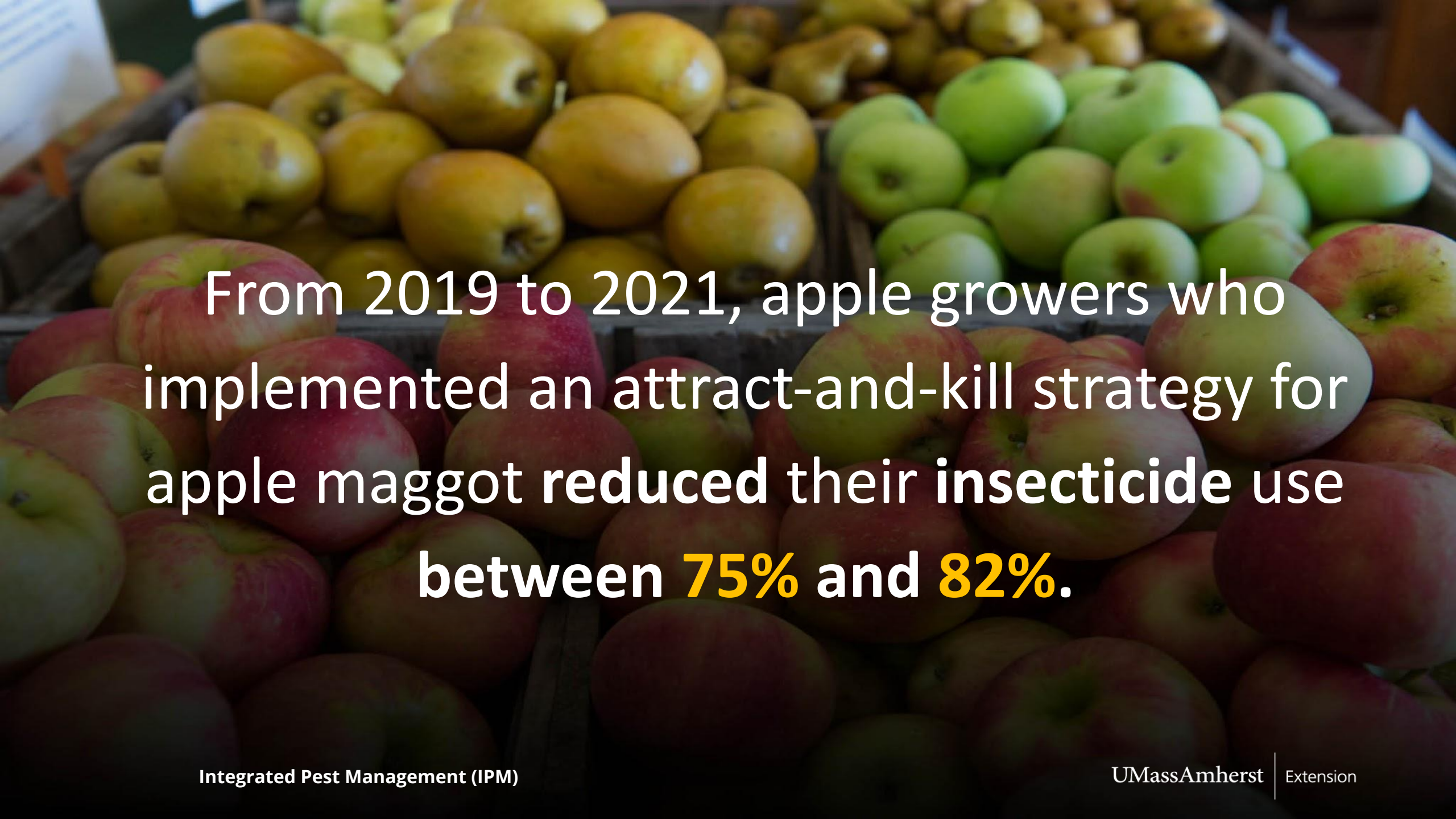
From 2019 to 2021, apple growers who implemented an attract-and-kill strategy for apple maggot **reduced** their **insecticide** use **between 75% and 82%.**

Pest monitoring is the cornerstone of IPM

Effective commercial lures are available for some pests

Pest	Attractant	Uses	Level of adoption
Plum curculio	Benzaldehyde + grandisoic acid	Monitoring (trap tree)	None
		Control (attract-and-kill)	None
Apple maggot fly	5-component blend	Monitoring	Low
		Control (attract-and-kill)	None
European apple sawfly	None	-----	-----
Tarnished plant bug	None	-----	-----

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Long-term project: Idea developed in 2018 WITH growers

Developing a permanent, low-cost, trap cropping system for multiple apple pests via *multi-cultivar grafting*

Research done in collaboration with Jeremy Delisle and Heather Bryant (UNH Extension)

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Early-season pests

Plum curculio

Tarnished plant bug

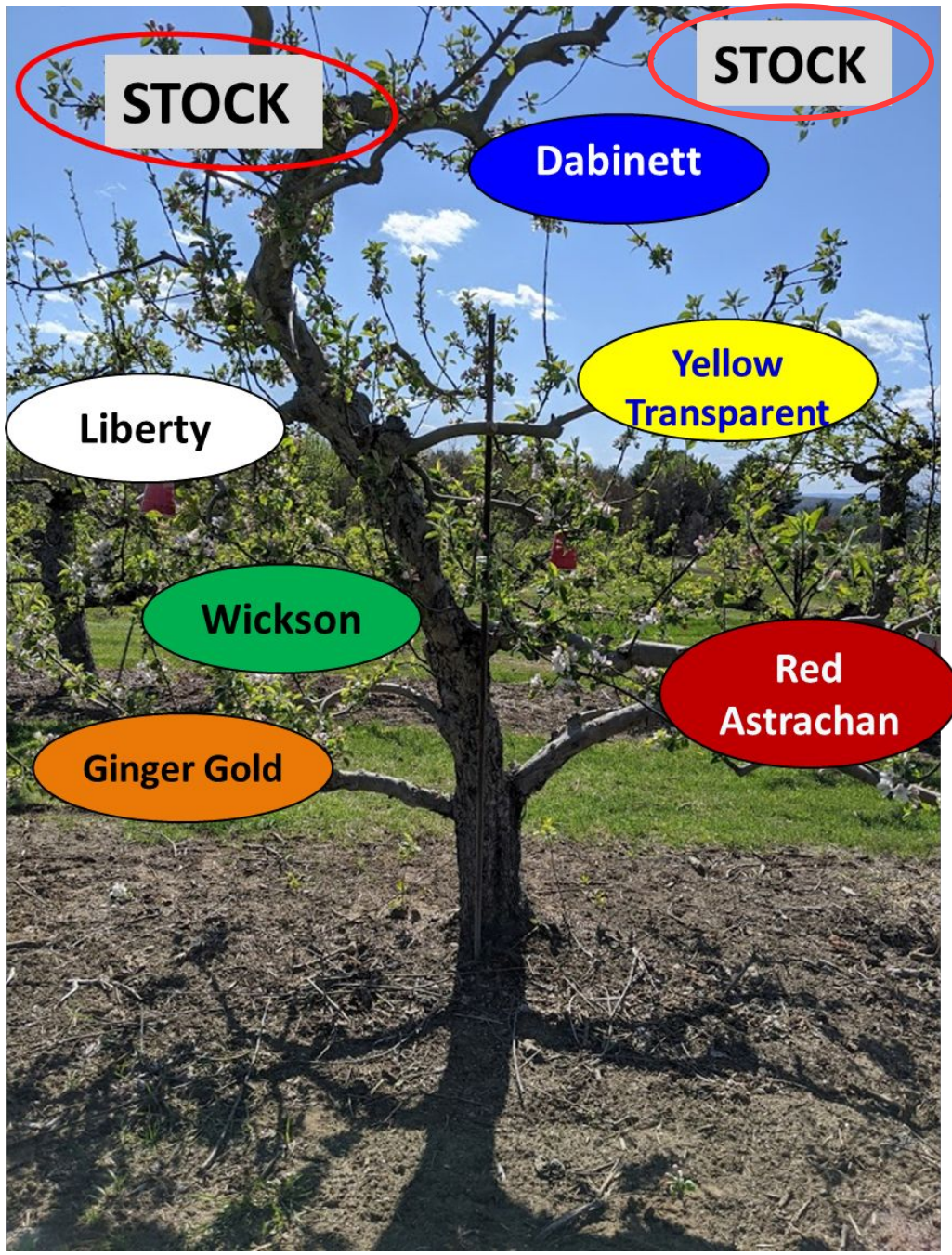
European apple sawfly

Summer

Apple maggot fly

- Each trap tree is grafted with **6 cultivars that are very attractive to plum curculio (PC) and apple maggot fly (AMF)**.
- **Research focuses on PC and AMF** and includes European apple sawfly, Tarnished plant bug, and other pests.
- The concept is simple, affordable, and grower-friendly.

Is it effective?



21 experimental blocks in MA, NH, and ME

State	Orchard name	Area (in acres) with grafted trees	No. grafted trees	Year grafting done
NH	1. Poverty Lane Orchards	8.8	32	2018
MA	2. UMass CSO – X-block	0.5	4	2018
MA	3. UMass CSO – Empire block	0.2	4	2018
MA	4. UMass CSO – Rock Mountain	1.7	6	2019
MA	5. Clarkdale	2.1	6	2018
MA	6. Nicewicz farm	1.1	4	2018
ME	7. Ricker Hill orchards – block 1	?	?	2018
ME	8. Ricker Hill orchards – block 2	?	?	2019
NH	9. Apple Hill farm	4.8	7	2019
MA	10. Sholan Orchards	7.3	11	2019
MA	11. Tougas farms	0.6	4	2019
MA	12. Ragged Hill Orchard	0.3	3	2019
MA	13. Red Apple Farm	2.9	6	2019
MA	14. UMass campus (Ag. Learning Center)	0.2	3	2019

2020: No grafting.

2021: One more block grafted (MA)

2022: 5 more blocks (NH and ME)

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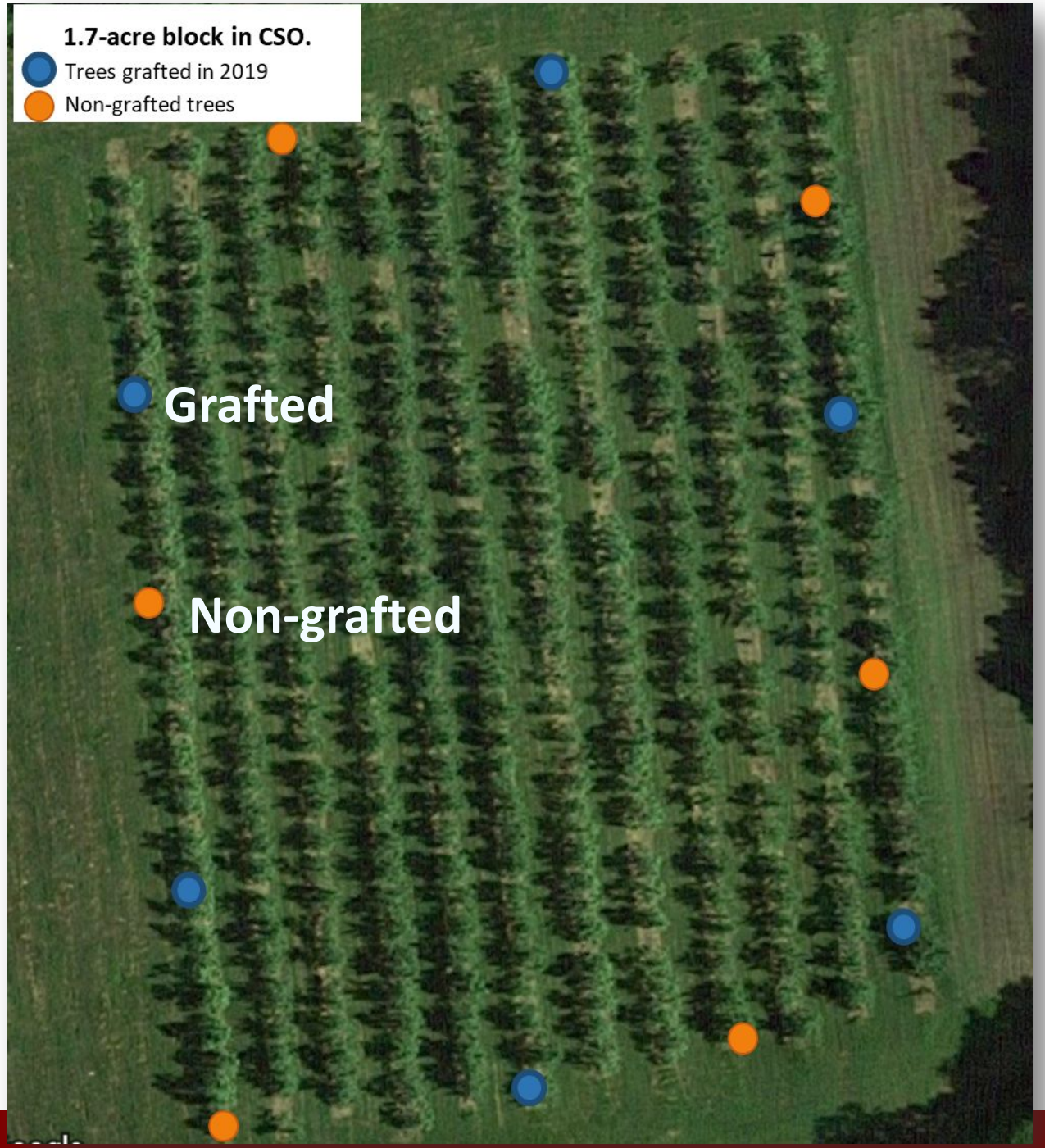
Comparing AMF captures in red unbaited sticky spheres in GRAFTED vs. NON-GRAFTED TREES

Distance between grafted trees:
30 meters



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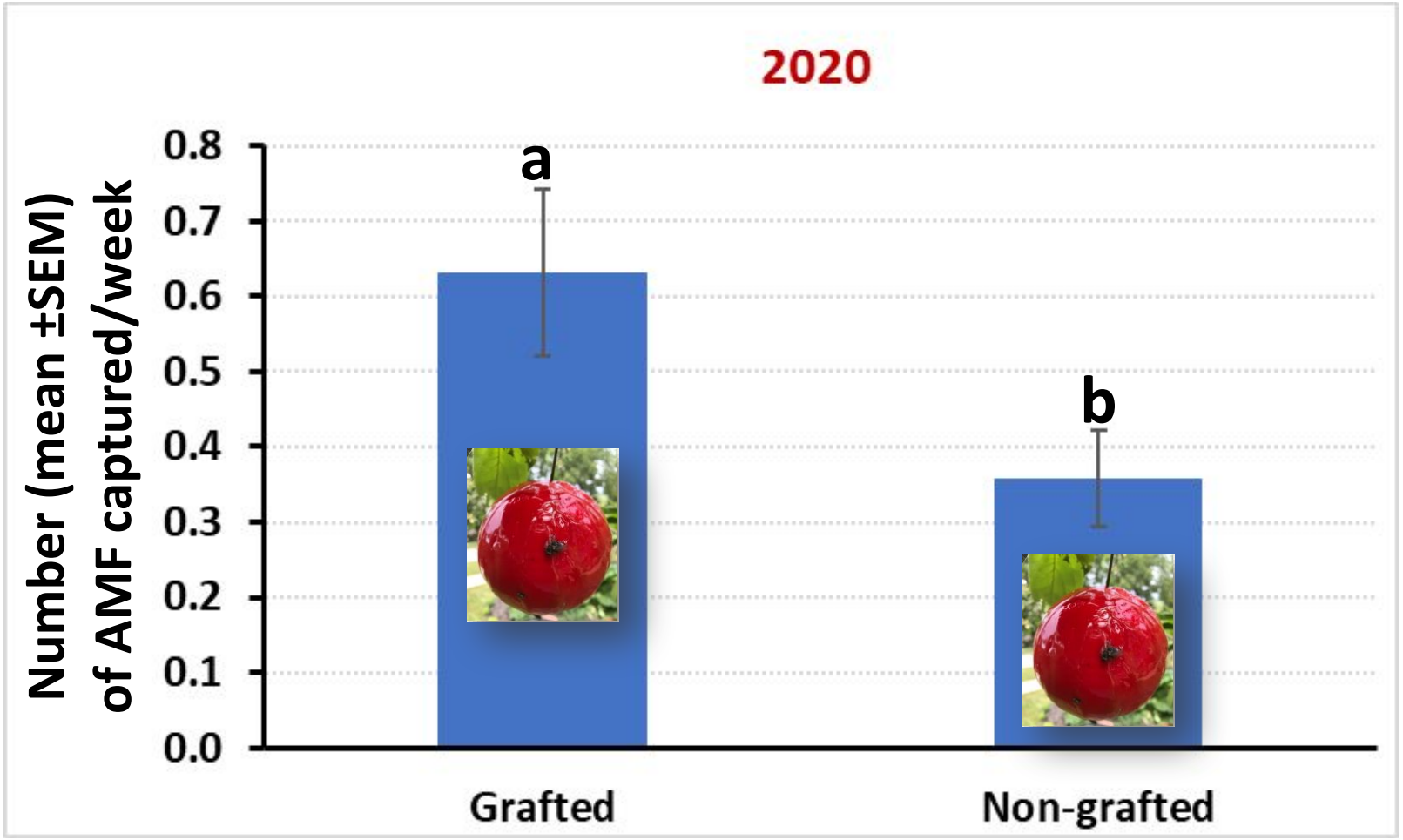
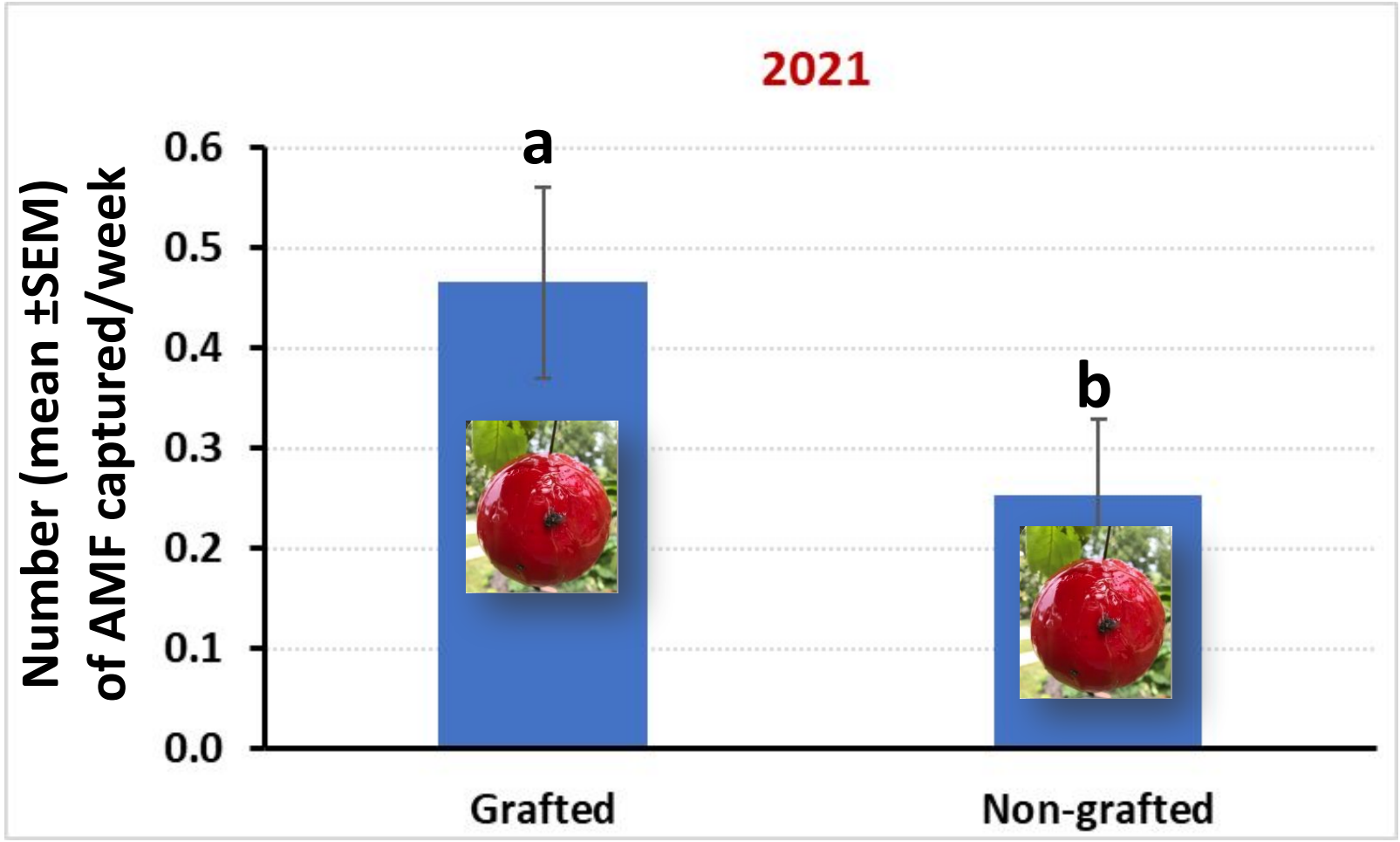
2020 results

Grafted trees are at least twice as likely than non-grafted trees to detect AMF



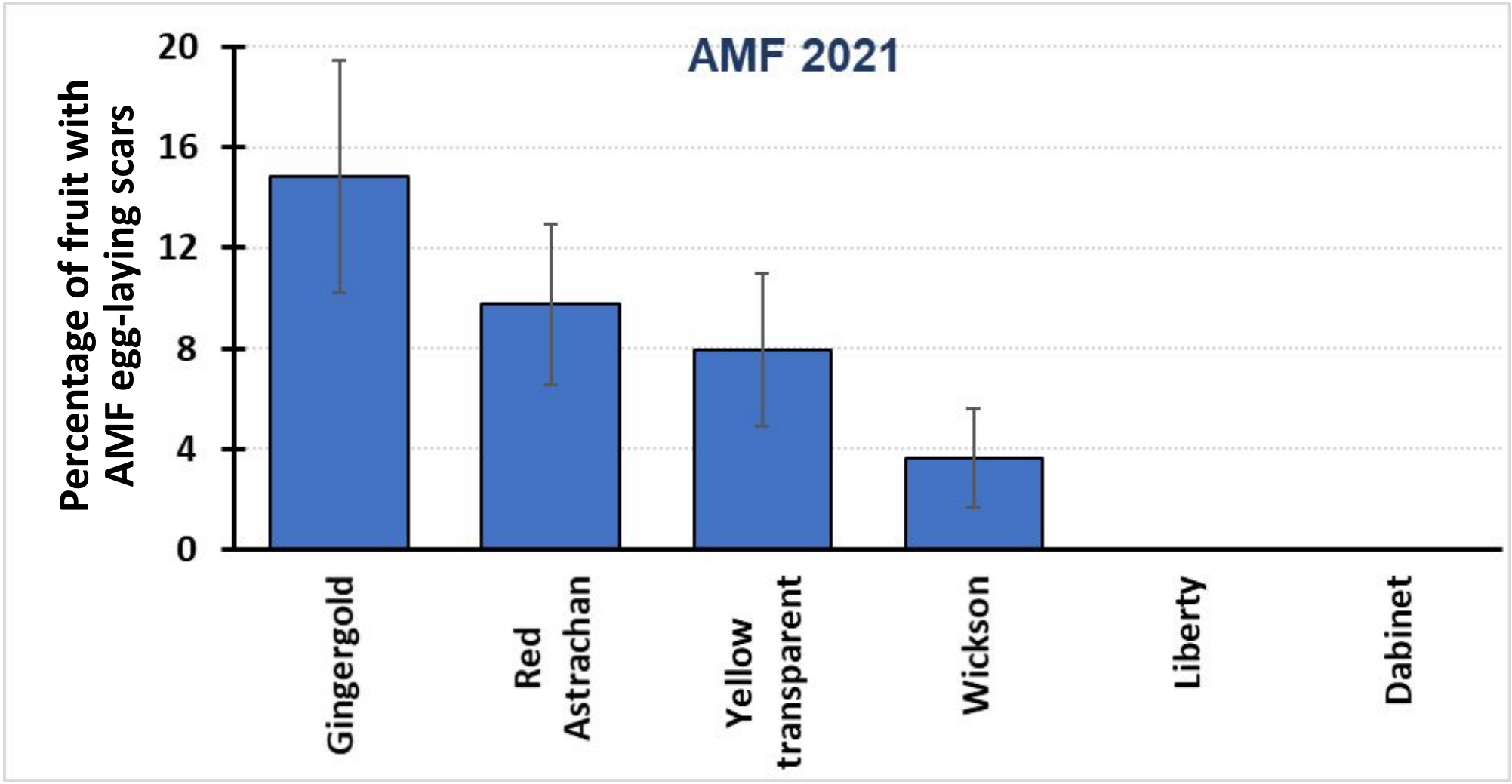
2021 results

Grafted trees are at least twice as likely than non-grafted trees to detect AMF



2021 Levels of fruit injury according to cultivar

Across 3 years: Most attractive cultivars: Red Astrachan and Ginger gold



Conclusion

Grafted trees seem to be effective at attracting AMF relative to non-grafted trees

Grower-friendly attract-and-kill approach for AMF management

Research done in collaboration with Jeremy Delisle and Heather Bryant (UNH Extension), and Glen Koehler (UME Extension)

The apple maggot fly (AMF)

- Most AMF:
  - Penetrate orchards from forested areas
  - Sexually mature = females are ready to lay eggs
- Males and females respond strongly to synthetic apple odor (5-component lures are available)

Attract-and-kill strategies that intercept immigrating AMF before they have the opportunity to penetrate into apple blocks could prove effective at managing AMF.

Evaluation of a Grower-friendly Attract-and-kill Strategy for Apple Maggot Control in New England Apple Orchards

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Evaluation of a Grower-friendly Attract-and-kill Strategy for Apple Maggot Control in New England Apple Orchards: Research Results for Year Two

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Stockbridge School of Agriculture, University of Massachusetts

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Objective

To quantify the level of AMF control achieved in commercial orchards using an attract-and-kill strategy involving use of **synthetic lures** deployed in **perimeter-row** trees in combination with **insecticide sprays with 3% sugar**

Approach

- **Commercial orchards (MA,NH, ME)**: **6** (2019), **11** (2020), and **10** (2021).
- **2 treatments per block**: 'Attract-and-Kill' (AK) vs. grower standard (GS).

  'Attract': 5-component lures deployed every ~30 meters along entire perimeter.

  'Kill': Insecticide sprays with **sugar added** (to induce feeding)

Orchard (2019)	Area (AK / GS)	No. AMF lures (AK block)
Clarkdale (MA)	1.7 ac / 1.7 ac	11 lures (6.4/ac)
Red Apple (MA)	3.0 / 2.8 ac	13 lures (4.3/ac)
UMass Cold Spring Orchard	1.8 ac / 2 ac	10 lures (5.5/ac)
Poverty Lane (NH)	3.5 ac / 2.7 ac	13 lures (3.7/ac)
Apple Hill (NH)	4 ac / 3.8 ac	17 lures (4.3/ac)
Ricker Hill (ME)	5 ac / 5 ac	25 lures (5.0/ac)

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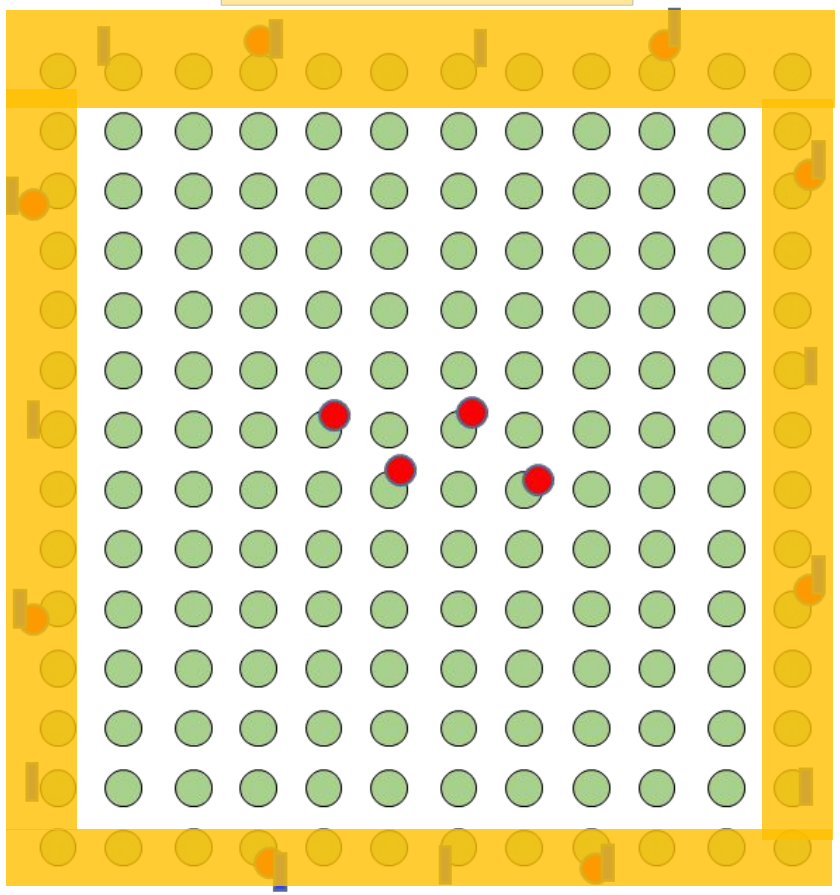
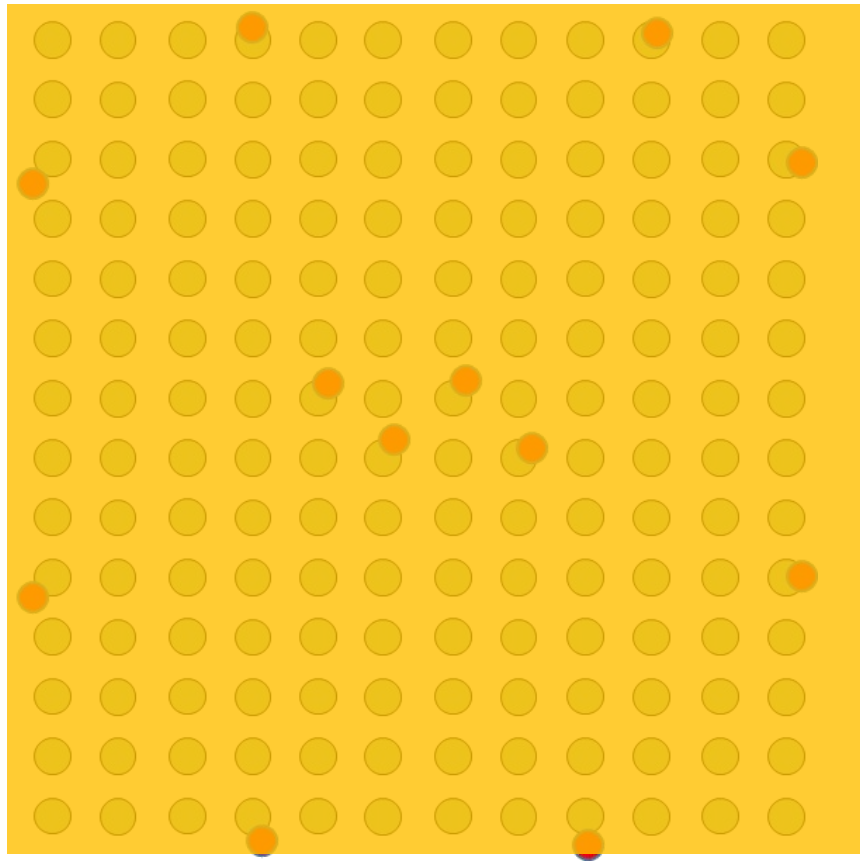
= AMF lures
= Monitoring sticky sphere

Attract-and-kill

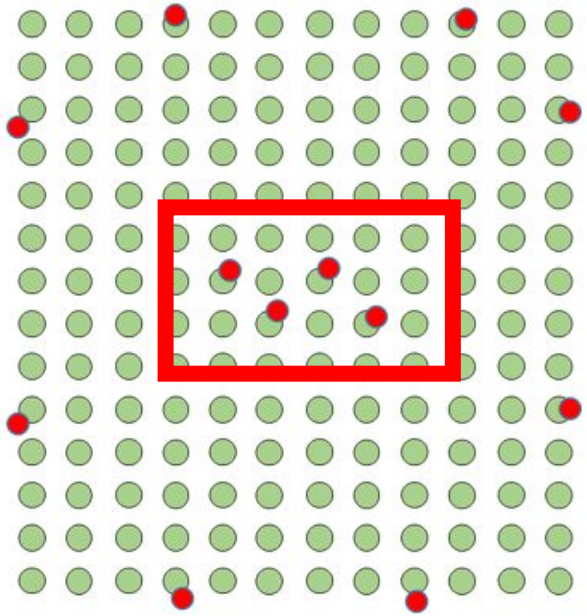


Grower standard



Two methods of assessing treatment performance

(1) Trap-capture data (interior spheres):
Indicator of relative numbers of AMF adults that had penetrated into the interiors of blocks.



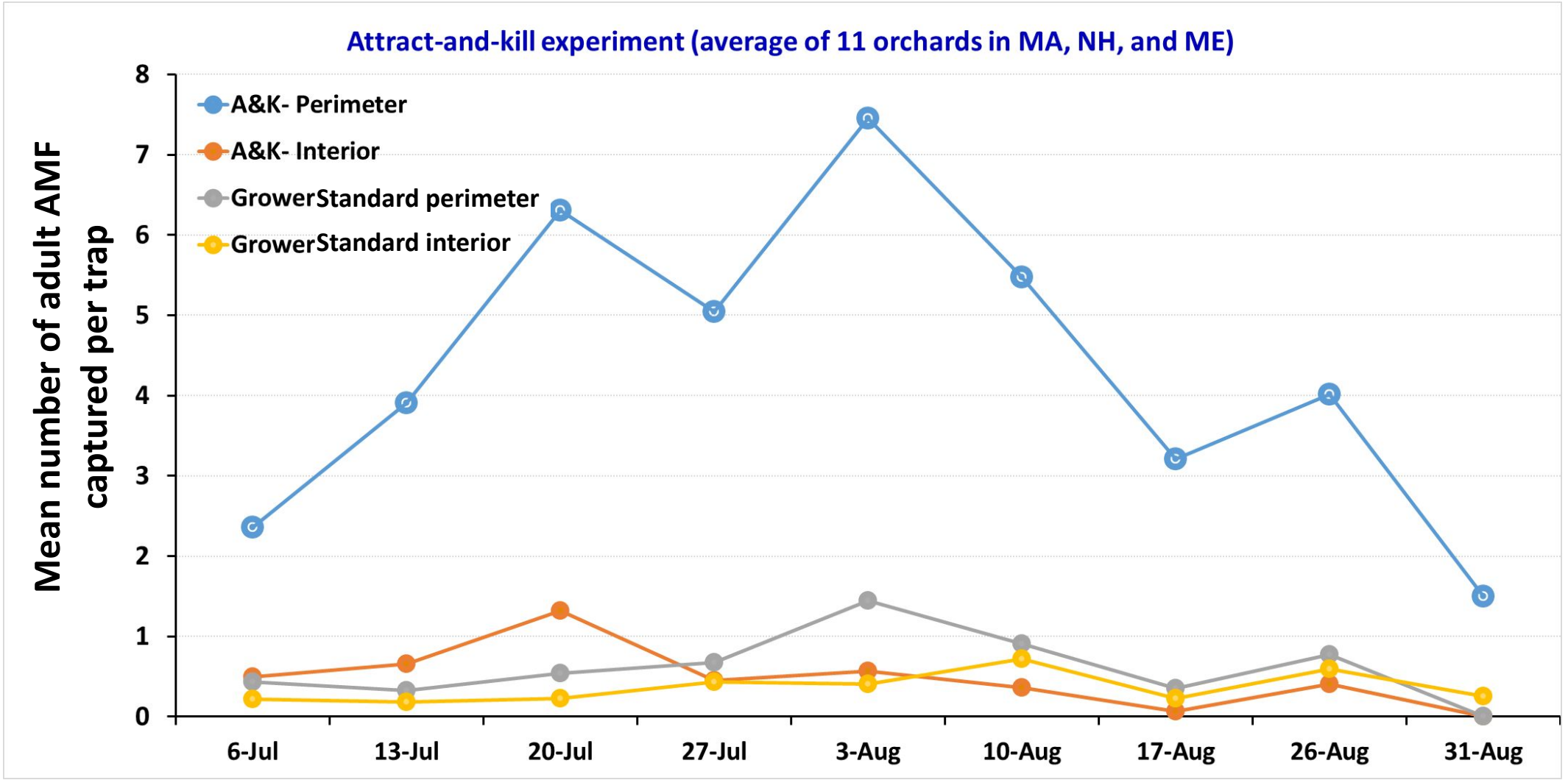
(2) Fruit infestation data: At harvest, we visually inspected:

- 20 apples on each of four trees on each of the four perimeter sides of each AK and each GS block.
- 20 apples on each of eight interior trees of each block.

- **2019:** 2,880
- **2020:** 5,280
- **2022:** 4,800

3 years: 12,960 fruits

2020 results: trap captures



Fruit infestation results (mean % infestation)

	Attract-and-Kill (AK)		Grower Standard (GS)		% reduction in insecticide use (AK relative to GS)
	Perimeter	Interior	Perimeter	Interior	
2019					75%
2020					65%
2021					82%

Conclusion

Over a 3-year period and across 27 orchard blocks, the new AK system controlled AMF to a level comparable to that provided by 2-3 full-block sprays

Further development of methods that promote **biodiversity** are expected to reduce chemical inputs (e. g., insecticides), thereby moving towards more sustainable crop production systems.

Acknowledgements

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USDA NIFA

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- New England Tree Fruit Growers Research Committee

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"We can't solve problems by using the same kind of thinking we used when we created them"

-Albert Einstein