State of IPM in Vermont Apple Orchards
VT Senate Committee on Agriculture

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THE UNIVERSITY OF VERMONT
PLANT AND SOIL SCIENCE

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Vermont Apples: 2nd Largest Specialty Crop

Apples are grown on 1700 acres in VT

- $18.5 M direct farmgate sales 2017.
- Est. $30 M total revenue with value-added
  - ~60 orchards active with VTFGA
- Orchards located in every county but Essex

Year	bearing acres	yield/ acre (bu)	total production (bu)	utilized production	utilized price/ bu	value of utilized production $1,000	% util
2009	2800	340	952	881	9.94	8760	92.5%
2010	2800	298	833	786	12.99	10210	94.4%
2011	2800	286	798	631	12.75	8044	79.1%
2012	2800	217	607	571	18.21	10405	94.1%
2013	1600	507	810	738	18.93	13970	91.1%
2014	1700	412	700	671	17.09	11470	95.9%
2015	1700	507	862	855	18.14	15517	99.2%
2016	1700	376	640	636	28.77	18293	99.4%
2017	1700	350	595	593	31.16	18477	99.7%

Source: NASS New England Fruit and Vegetable Report
USDA Agriculture Census

UVM Fruit Program

COLLEGE OF AGRICULTURE AND LIFE SCIENCES
UNIVERSITY OF VERMONT

UVM Apple and Grape Program: What we do

- Grower outreach (Extension)
- Research
  - Cultivar and germplasm evaluation
  - Orchard management systems
  - Organic apple and grape production
  - Cider apple research
- Public service
- Teaching

Grower Outreach

- Primary technical support provider for apple & grape producers in VT
- Distribution list of ~400 recipients
- 50+ electronic alerts during the growing season
- Site visits
- Convener: VT Tree Fruit Growers, VT Grape & Wine Council annual meetings
- Regional collaborator: annual joint meetings & presentations in New England & New York

Key concepts in Integrated Pest Management

- Understand life cycles and how they are applied in the orchard
- Reduce inoculum
- Reduce susceptibility
- Treat pests when they are most vulnerable

NEWA

18 stations in Vermont
- Six airports
- Twelve on-farm stations

Nationwide (East)
- 25 states
- Over 500 stations
- New coordinator at Cornell

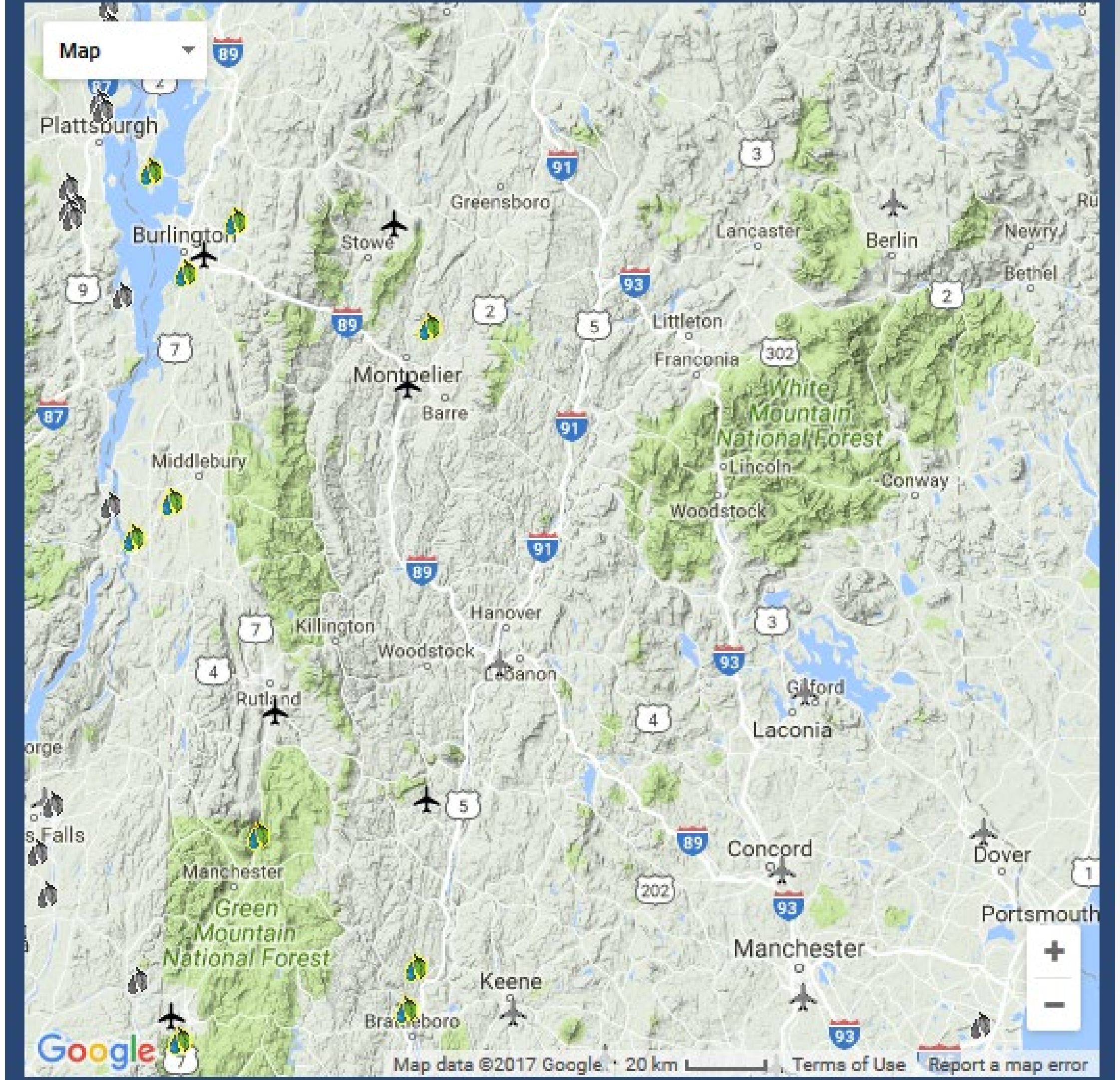
newa.cornell.edu

Weather Stations in Vermont

Weather Stations
Bennington (airport)
Bennington (SVO)
Burlington
Cornwall
Dummerston
East Dorset
East Montpelier
Essex
Montpelier
Morrisville
Putney
Rutland
Shoreham
South Burlington
South Hero
Springfield

16 records found.

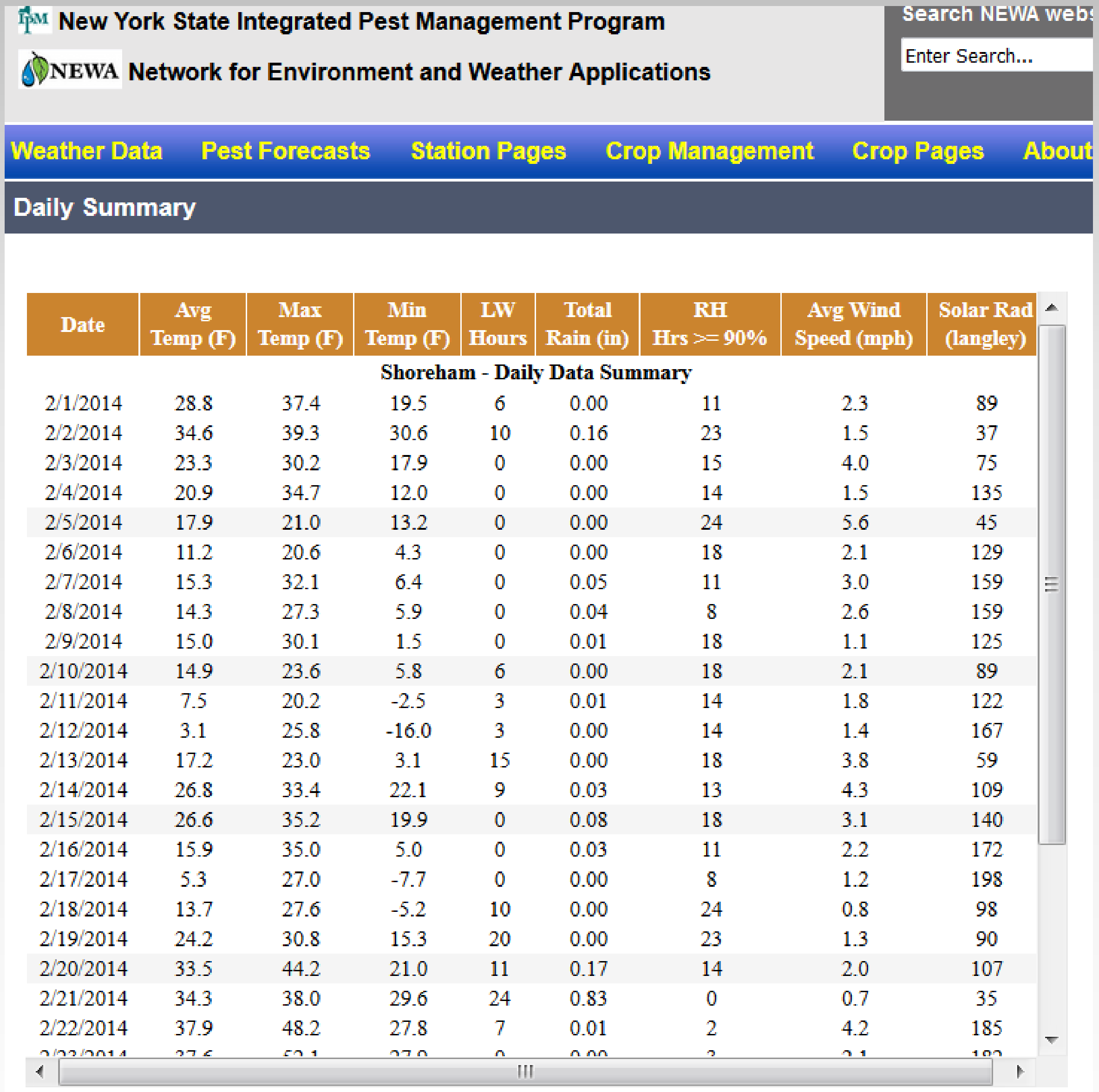
Click on a map marker to go to the weather station's home page.



NEWA: Apple Models

- Three disease models
  - Apple scab, fire blight, sbfs
- Six insect models
  - Codling moth, plum curculio, obliquebanded leafroller, Oriental fruit moth, apple maggot, San Jose scale
- Multiple horticultural models
  - Carbohydrate thinning, evapotranspiration, irrigation, frost risk, degree days
- Archived weather data

- Caveat: NEWA is a tool, not a silver bullet. It needs to be used as part of a comprehensive IPM program!!


New York State Integrated Pest Management Program
NEWA Network for Environment and Weather Applications
Search NEWA webs
Enter Search...
Weather Data | Pest Forecasts | Station Pages | Crop Management | Crop Pages | About

Daily Summary

Date	Avg Temp (F)	Max Temp (F)	Min Temp (F)	LW Hours	Total Rain (in)	RH Hrs >= 90%	Avg Wind Speed (mph)	Solar Rad (langley)
Shoreham - Daily Data Summary								
2/1/2014	28.8	37.4	19.5	6	0.00	11	2.3	89
2/2/2014	34.6	39.3	30.6	10	0.16	23	1.5	37
2/3/2014	23.3	30.2	17.9	0	0.00	15	4.0	75
2/4/2014	20.9	34.7	12.0	0	0.00	14	1.5	135
2/5/2014	17.9	21.0	13.2	0	0.00	24	5.6	45
2/6/2014	11.2	20.6	4.3	0	0.00	18	2.1	129
2/7/2014	15.3	32.1	6.4	0	0.05	11	3.0	159
2/8/2014	14.3	27.3	5.9	0	0.04	8	2.6	159
2/9/2014	15.0	30.1	1.5	0	0.01	18	1.1	125
2/10/2014	14.9	23.6	5.8	6	0.00	18	2.1	89
2/11/2014	7.5	20.2	-2.5	3	0.01	14	1.8	122
2/12/2014	3.1	25.8	-16.0	3	0.00	14	1.4	167
2/13/2014	17.2	23.0	3.1	15	0.00	18	3.8	59
2/14/2014	26.8	33.4	22.1	9	0.03	13	4.3	109
2/15/2014	26.6	35.2	19.9	0	0.08	18	3.1	140
2/16/2014	15.9	35.0	5.0	0	0.03	11	2.2	172
2/17/2014	5.3	27.0	-7.7	0	0.00	8	1.2	198
2/18/2014	13.7	27.6	-5.2	10	0.00	24	0.8	98
2/19/2014	24.2	30.8	15.3	20	0.00	23	1.3	90
2/20/2014	33.5	44.2	21.0	11	0.17	14	2.0	107
2/21/2014	34.3	38.0	29.6	24	0.83	0	0.7	35
2/22/2014	37.9	48.2	27.8	7	0.01	2	4.2	185

VT Orchard Scouting Program

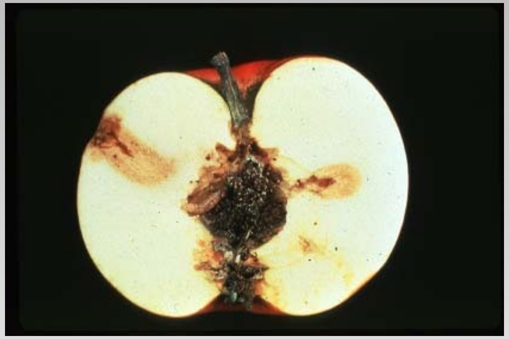
VT Apple IPM 101: Tarnished plant bug traps

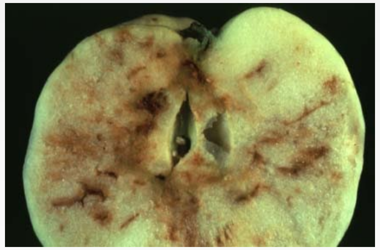
UVM Fruit Program
465 subscribers
Analytics
Edit video
1

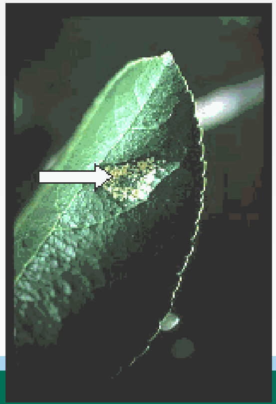
Primary Diseases of Apples in the Northeast

- Apple Scab
- Cedar Apple Rust
- Powdery Mildew
- Black/Bitter/White Rots
- Sooty Blotch / Fly Speck
- Brooks spot

Key Arthropod Pests of Apple



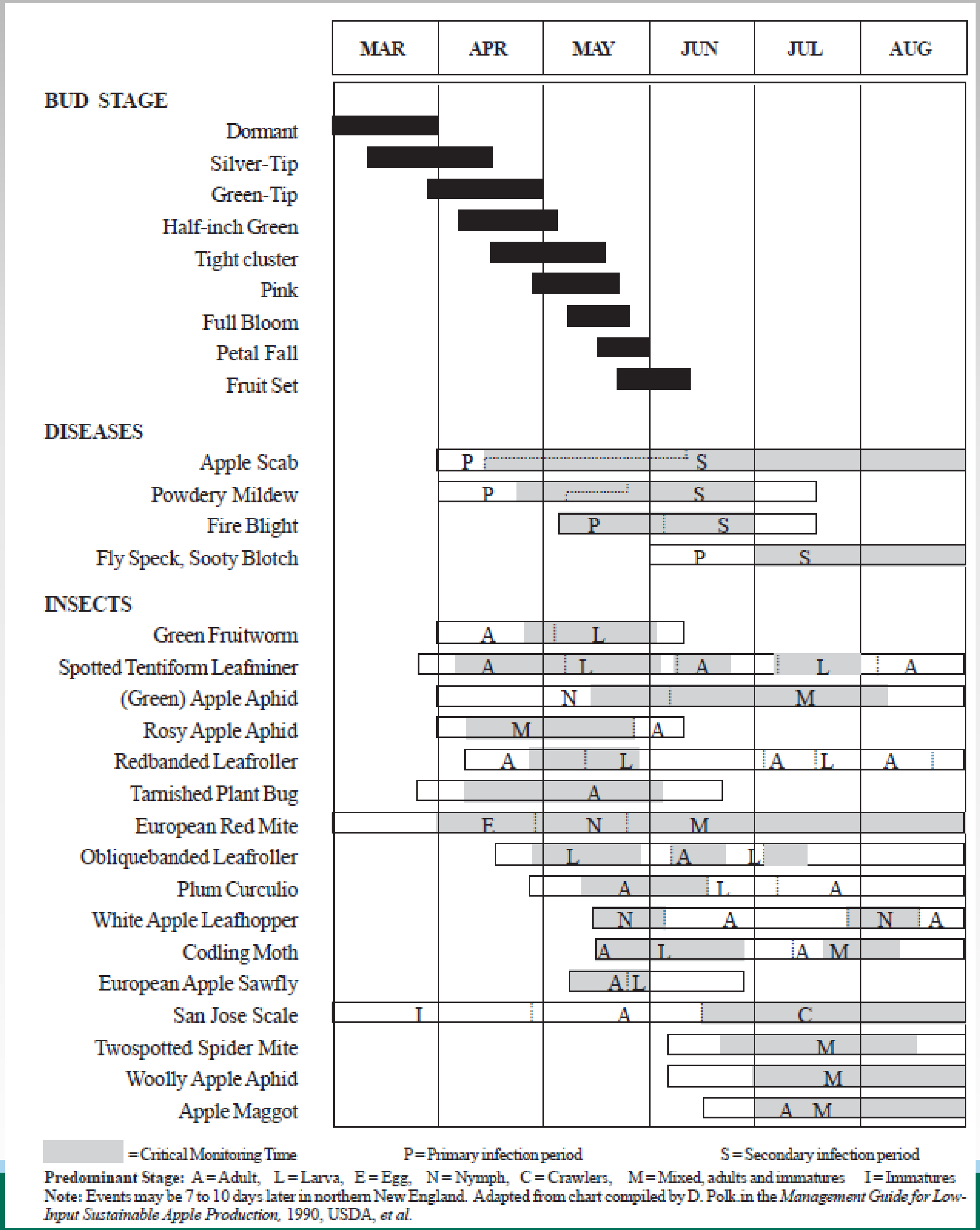




- Tarnished Plant Bug (TPB)
- Leafminers (LM)
- European Apple Sawfly (EAS)
- European Red Mite (ERM)
- Plum Curculio (PC)
- Codling Moth (CM)
- Leafhoppers (LH)
- Green Apple Aphid (GAA/SA)
- Apple Maggot Fly (AMF)

Apple pest management 'calendar'

https://netreefruit.org/sites/netreefruit.org/files/pdf-doc-ppt/pest_activity_times.pdf



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EXTENSION

Apple insecticide efficacy

2023 update

APPLE – PETAL FALL

S= Suppression only

HIGH AND **MODERATE** EFFECTIVENESS

	a.i.	IRAC	TPB	EAS	PC	CM	OFM	OBLR	RBLR	SJS	Rosy apple aphid	STLM
Actara 25WDG	Thiamethoxam	4A		H*	H					M	H	H
Admire PRO 4.6SC	Imidacloprid	4A									H	H
Altacor 35WDG	Chlorantraniliprole	28		H		H	H	H	H			M
Assail 30SG	Acetamiprid	4A		M		H	H			M	H	H
Avaunt eVo	Indoxacarb	22	M	M	H	M	M					M
Belt 4SC	Flubendiamide	28				H	H	H	H			H
Beleaf 50 SG	Flonicamid	29	H			M				M	H	M
Danitol 2.4 EC	Fenpropathrin	3				H						
Delegate 25WG	Spinetoram	7				H	H	H	H			H
Dipel DF **(OMRI)**	B.t.	11A				M	M	H	H			
Entrust SC **(OMRI)**	Spinosad	5				M	M	H	H			H
Exirel	Cyantraniprole	28				H	H	H	H		H	M
Intrepid 2F *(IGR)*	Methoxyfenozide	18				M	M	H	H			
Imidan 70W	Phosmet	1B		H	H	H	H					M
Movento 240SC	Spirotetramat	23								H	M	
Rimon 0.83 EC	Novaluron (IGR)	15				H	H	H				M
Senstar	Pyriproxyfen+ Spirotretamat	23+7C				S				H	H	S
Transform WG	Sulfoxaflor	4C	?							S		
Voliam Flexi WDG	Thiamethoxam + chlorantraniliprole	28 + 4A			H	H	H	H	H		H	H
Verdepryn 100SL	Cyclaniliprole	28		?	H	H	H	?	?			?

This list is not exhaustive for every active ingredient or labeled product. No endorsement of products mentioned is intended, nor is criticism implied of products not mentioned.

Apple insecticide efficacy

2023 update

APPLE – SUMMER

S= Suppression only

HIGH AND MODERATE EFFECTIVENESS

	a.i.	IRAC	Apple maggot	Stink bugs	CM	OFM	OBLR	SJS	Wooly apple aphid	Potato leafhopper
Actara 25WDG	Thiamethoxam	4A	H	M				M		H
Altacor 35WDG	Chlorantraniliprole	28			H	H	H			M
Assail 30SG	Acetamiprid	4A	H	M	H	H		M	M	H
Avaunt eVo	Indoxacarb	22	M		M	M				M
Belt 4SC	Flubendiamide	28			H	H	H			H
Beleaf 50 SG	Flonicamid	29			M			M	H	M
Danitol 2.4 EC	Fenpropathrin	3		M	H					
Delegate 25WG	Spinetoram	7	M		H	H	H			H
Dipel DF **(OMRI)**	B.t.	11A			M	M	H			
Entrust SC **(OMRI)**	Spinosad	5			M	M	H			H
Exirel	Cyantraniprole	28	M		H	H	H			M
Intrepid 2F *(IGR)*	Methoxyfenozide	18			M	M	H			
Imidan 70W	Phosmet	1B	H		H	H				
Movento 240SC	Spirotetramat	23						H	H	
Rimon 0.83 EC	Novaluron (IGR)	15			H	H	H			
Senstar	Pyriproxyfen+ Spirotretamat	23+7C			S			S	H	
Transform WG	Sulfoxaflor	4C						S		
Voliam Flexi WDG	Thiamethoxam + chlorantraniliprole	28 + 4A			H	H	H		H	H
Verdepryn 100SL	Cyclaniliprole	28			H	H	?			?
Brigade/Warrior II/Brigade (RUP)	Pyrethroids	3A	M	H	M	M	M	M		M

This list is not exhaustive for every active ingredient or labeled product. No endorsement of products mentioned is intended, nor is criticism implied of products not mentioned.

'Conventional' Apple Production in Vermont

- Production concentrated in Champlain & Connecticut River Valleys
- 500-1000 bushels/acre
- Main cultivars:
  - McIntosh, Cortland, Empire, Macoun, Honeycrisp
- >60% orchards in business before 1980
- 8-12 fungicide sprays/year
- 3-6 insecticide sprays/year

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- Production concentrated in Champlain & Connecticut River Valleys
- 500-1000 bushels/acre
- Main cultivars:
  - McIntosh, Cortland, Empire, Macoun, Honeycrisp
- >60% orchards in business before 1980
- **4-8 fungicide sprays/year**
- **2-4 insecticide sprays/year**
- **(1/3-1/2 reduction in past 10-15 years)**

Apple IPM in Vermont: Where are we? (2017)

- 100% of respondents report practicing IPM
- 100% report UVM Apple Program as:
  - "Useful", "Somewhat useful", or "Highly useful"
- 92% use UVM Apple Program information in decision making
- 92% report and economic impact from using IPM information
  - 100% of those report the impact as positive

Has the information obtained through the UVM Apple IPM Program allowed you to:	Yes	No
Increase your knowledge or understanding of Apple IPM	**84.62%** 11	**15.38%** 2
Increase your knowledge on how to prevent pest management problems	**84.62%** 11	**15.38%** 2
Adopt at least one new IPM practice	**50.00%** 6	**25.00%** 3
Reduce or minimize pesticide use	**69.23%** 9	**23.08%** 3
Determine if pesticides are needed in your orchard	**76.92%** 10	**15.38%** 2
Effectively time pesticides if they were needed	**76.92%** 10	**15.38%** 2
Adopt a reduced-risk alternative to manage a pest (e.g., insect, disease, weed, vole, deer, etc.)	**61.54%** 8	**23.08%** 3

http://www.uvm.edu/%7Efruit/pubs/2017AppleIPMstatus.pdf

Bradshaw, T., & Hazelrigg, A. (2018). Status of IPM practice adoption in Vermont apple orchards in 2017.

Which of the following practices do you employ to reduce impacts on pollinators in your orchard? (2017)

Mowing to reduce flowering weeds prior to spraying	**72.73%** 8	**27.27%** 3	**0.00%** 0	11	0.73
Herbicides to reduce flowering weeds prior to spraying	**9.09%** 1	**72.73%** 8	**18.18%** 2	11	0.09
Maintaining flowering habitat within the orchard to encourage pollinators	**27.27%** 3	**63.64%** 7	**9.09%** 1	11	0.27
Maintaining flowering habitat outside but near the orchard to encourage pollinators	**81.82%** 9	**9.09%** 1	**9.09%** 1	11	0.82
Avoiding use of neonicotinoid insecticides	**63.64%** 7	**36.36%** 4	**0.00%** 0	11	0.64
Avoiding use of neonicotinoid insecticides before bloom	**100.00%** 11	**0.00%** 0	**0.00%** 0	11	1.00
Avoiding use of pesticides rated highly toxic to bees	**81.82%** 9	**18.18%** 2	**0.00%** 0	11	0.82
Avoiding use of demethylase/sterol inhibitor fungicides (e.g. Inspire, Rally, Procure, etc.) during bloom	**90.91%** 10	**9.09%** 1	**0.00%** 0	11	0.91

Which of the following practices do you employ to reduce impacts on pollinators in your orchard? (2017)

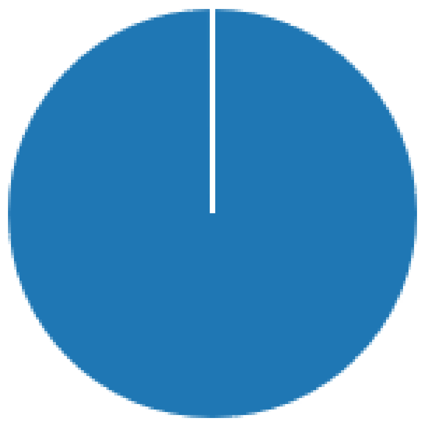
	Yes	No	Unsure	Total	Weighted Average
Use of migratory honey bees during bloom	**54.55%** 6	**36.36%** 4	**9.09%** 1	11	0.55
Keeping honey bees on the orchard property year-round	**9.09%** 1	**90.91%** 10	**0.00%** 0	11	0.09
Use of purchased bumble bees in the orchard	**20.00%** 2	**80.00%** 8	**0.00%** 0	10	0.20
Reliance on wild bees for pollination	**54.55%** 6	**45.45%** 5	**0.00%** 0	11	0.55
Use of nest boxes to encourage wild bee populations	**9.09%** 1	**81.82%** 9	**9.09%** 1	11	0.09
Minimum tillage to improve ground bee habitat	**72.73%** 8	**18.18%** 2	**9.09%** 1	11	0.73
Not spraying insecticides during apple bloom	**100.00%** 11	**0.00%** 0	**0.00%** 0	11	1.00

2023 Survey

1. Do you use IPM in your orchard?

More Details

Yes	16
No	0

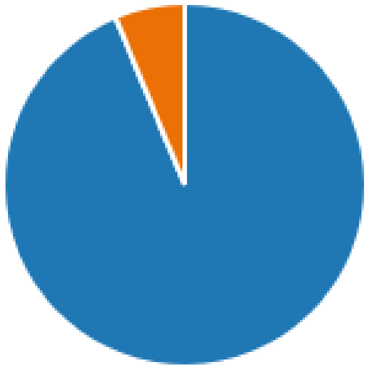


2023 Survey

6. Do you maintain diverse habitat including flowering plants near your orchard edge to promote beneficial insects?

More Details   Insights

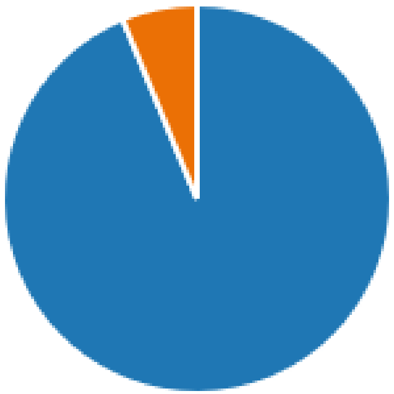
Yes	15
No	1



7. Do you maintain wild pollinator habitat spaces on your farm?

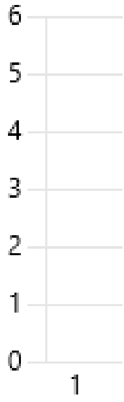
More Details   Insights

Yes	15
No	1



2. On a scale of 1-10 where 1= none and 10= excellent, how would you rate the general pollir
in the past five years?

More Details | Insights

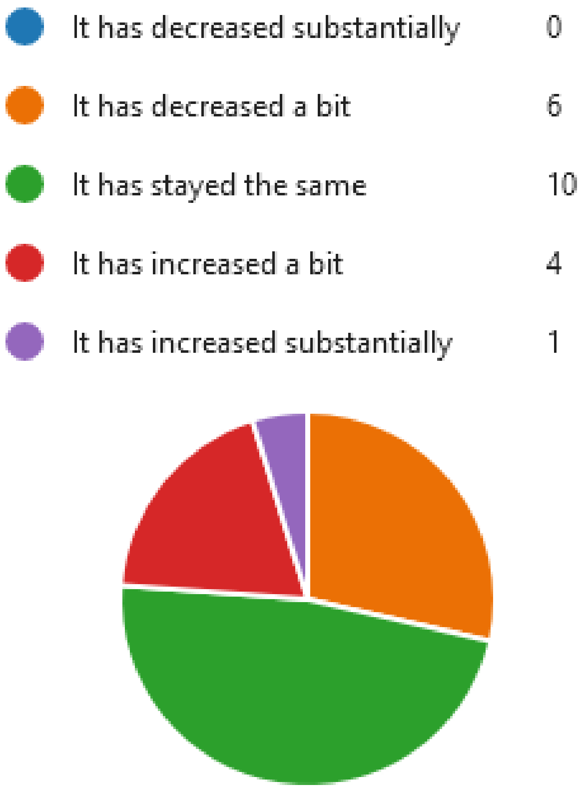


4. On a scale of 1-10 where 1= none and 10= excellent, how would you rate the diversity and abundance of wild bees on your farm at bloom time?

More Details | Insights

5. What is your perception of pollinator health or availability over the past five years?

More Details

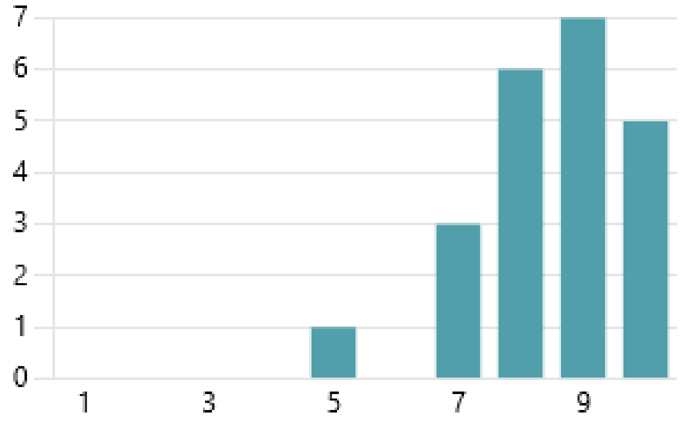


6. On a scale of 1-10 where 1= no effort and 10= extreme effort, how would you rate yourself on your effort to protect bees and other pollinators on your farm?

More Details Insights

8.50

Average Rating

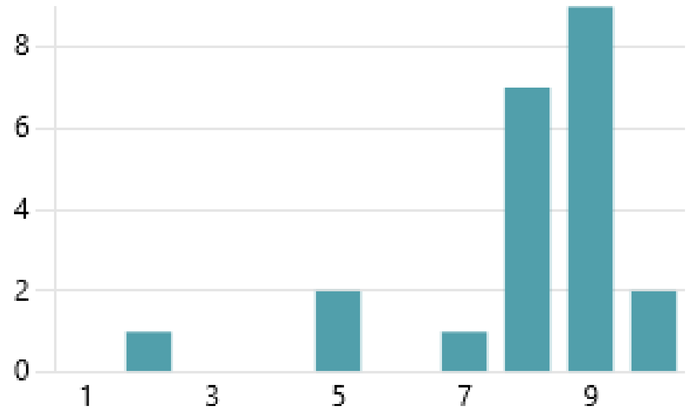


7. On a scale of 1-10 where 1= no knowledgeable and 10= extremely knowledgeable, how would you rate your knowledge of best practices to to protect bees and other pollinators on your farm?

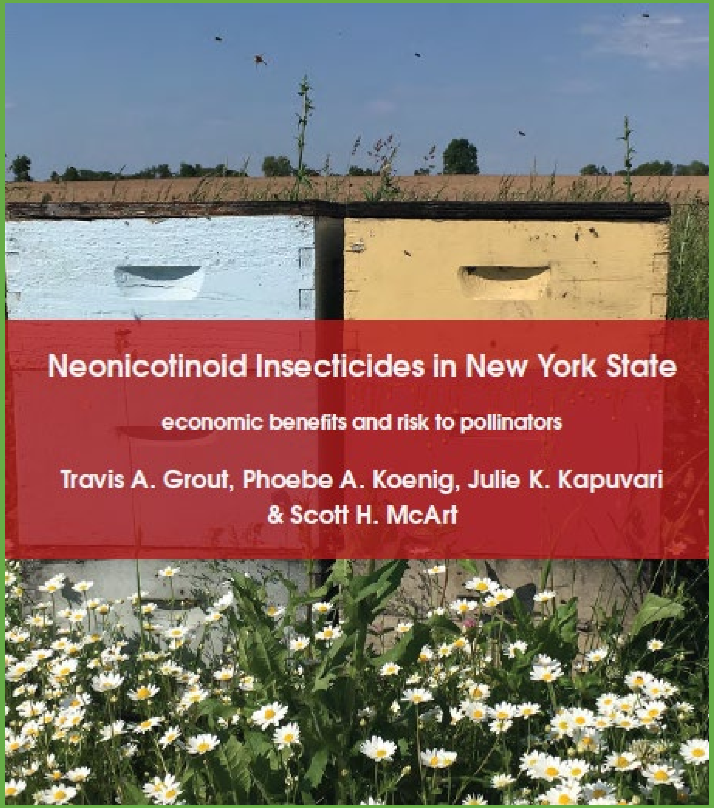
More Details Insights

8.00

Average Rating



College of Agriculture and Life Sciences
University of Vermont



Grout, T. A., Koenig, P. A., Kapuvari, J. K., & McArt, S. H. (2020). *Neonicotinoid Insecticides in New York State*. Retrieved from Ithaca, NY: https://cals.cornell.edu/pollinator-network/pollinator-research

Table 5.23: **Number of tree fruit field trials reporting significantly positive (green), negative (red), or no difference in yield, crop damage, or pest populations in tree fruit plots treated with foliar acetamiprid or nitroguanidine neonicotinoid products, compared to untreated controls of plots treated with only non-neonicotinoid foliar insecticides**

	New York State			NYS & region[1]			North America		
Comparison	Y+	Y-	NS	Y+	Y-	NS	Y+	Y-	NS
Acetamiprid foliar sprays and alternatives									
Foliar acetamiprid vs. untreated controls	1	0	0	20	0	7	22	0	7
Foliar acetamiprid vs. other foliar insecticides	0	2	1	8	2	37	9	2	41
Nitroguanidine neonicotinoid foliar sprays and alternatives									
Foliar nitroguanidines vs. untreated controls	12	0	0	30	0	13	33	0	15
Foliar nitroguanidines vs. other foliar insecticides	0	4	53	15	6	71	15	10	80

Notes: (1) Regional results used data from field trials in New York and Ontario. This analysis compares reported significance of differences in yield, crop damage, or pest populations following treatment using (a) a foliar neonicotinoid (acetamiprid and/or nitroguanidine neonicotinoid(s)) product or (b) a non-neonicotinoid foliar insecticide or no insecticide treatment (untreated control).

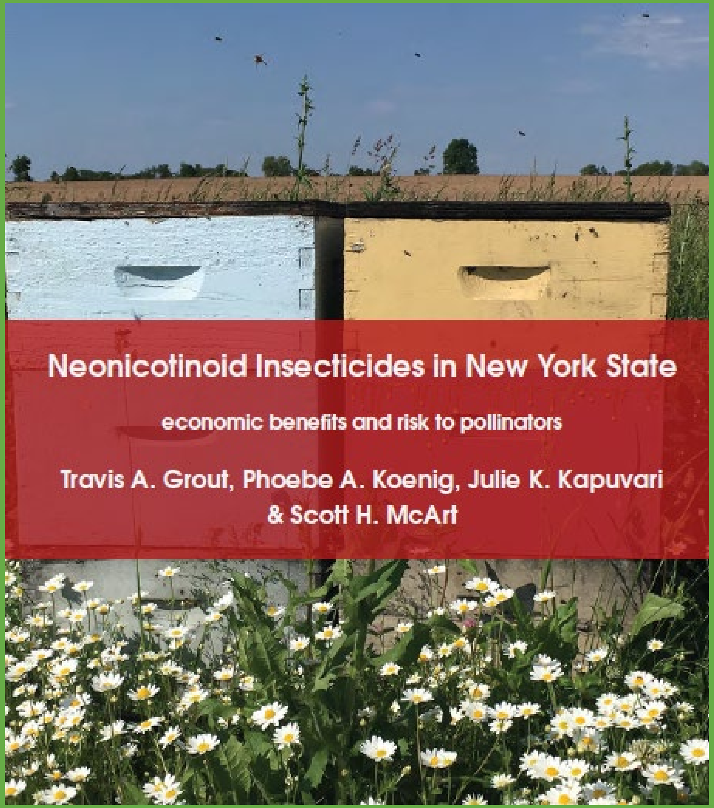


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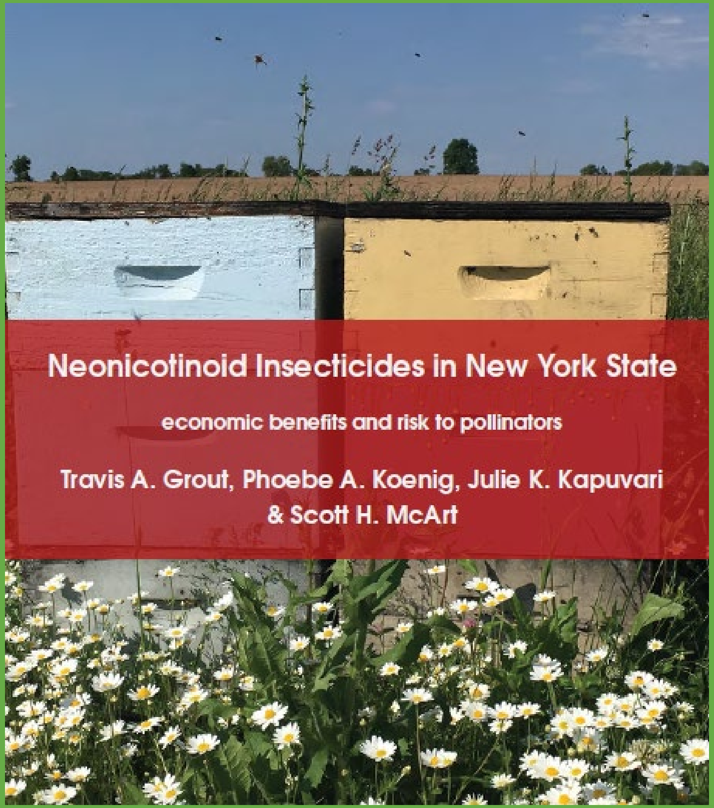
Table 5.24: **Performance of tree fruit foliar treatment plans including neonicotinoid-based products, relative to non-neonicotinoid foliar treatment plans: sign test of paired North American trials**

			Significantly more successes with:	
Comparison	Paired obs.	**Percent Positive**	H_{a1}: **neonic.** P-value	H_{a2}: **alternative** P-value
Foliar treatment plans with **acetamiprid** vs. non-neonicotinoid foliar treatment	70	57%	0.071	0.957
Foliar treatment plans with **imidacloprid** vs. non-neonicotinoid foliar treatment	40	41%	0.895	0.174
Foliar treatment plans with **thiamethoxam** vs. non-neonicotinoid foliar treatment	38	34%	0.983	0.037

Notes: The outcomes of interest in these trials were damage by insect pests to trees, leaves, or fruit. Results highlighted in red suggest that the neonicotinoid-treated plot performed worse than its paired alternative in a significantly higher proportion of field trials than vice-versa. Results in grey are not statistically significant. (1) The right two columns reflect significance of the null hypothesis that the true proportion of positive to negative mean differences is 1:1 ($H_0 : Prob[D > 0] = \frac{1}{2}$) against two alternative hypotheses: that the neonicotinoid-treated group performs better than the alternative-treated group in a majority of field trials ($H_{a1} : Prob[D > 0] > \frac{1}{2}$) and that the alternative-treated group performed better in a majority of crop damage trials ($H_{a2} : Prob[D < 0] > \frac{1}{2}$). This test makes no assumptions about the distribution of data.



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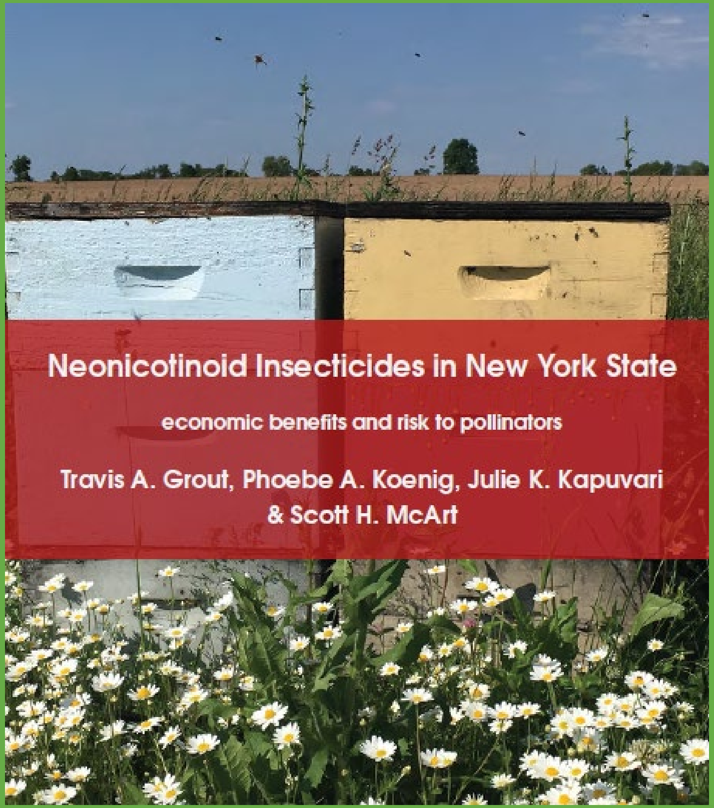
"In contrast to the inconsistent benefits observed in field crops, neonicotinoids provide much more consistent benefits in fruit crops: yield, crop damage, or pest control improved in 109 of 146 (75%) cases when neonicotinoid foliar sprays were compared to no-treatment controls "



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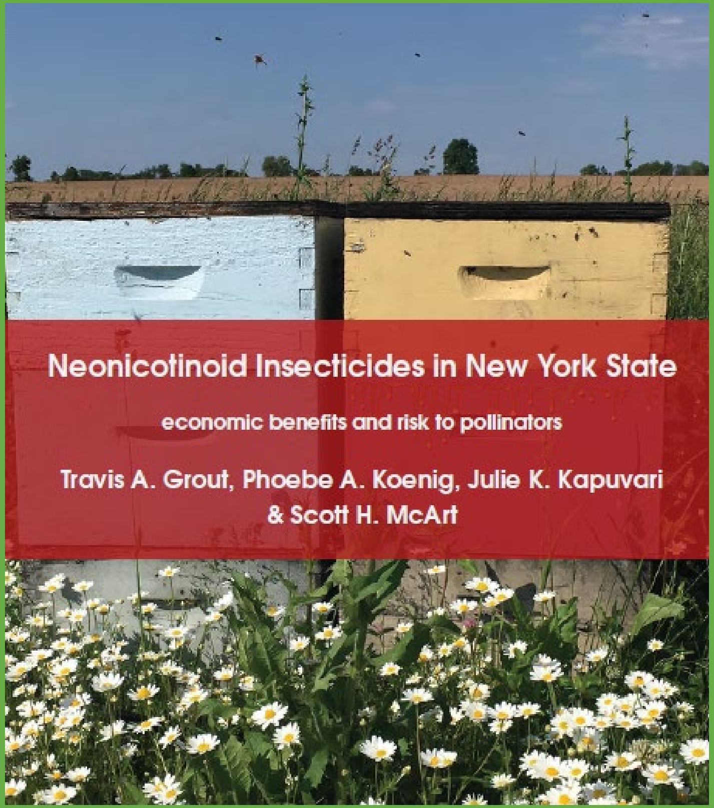
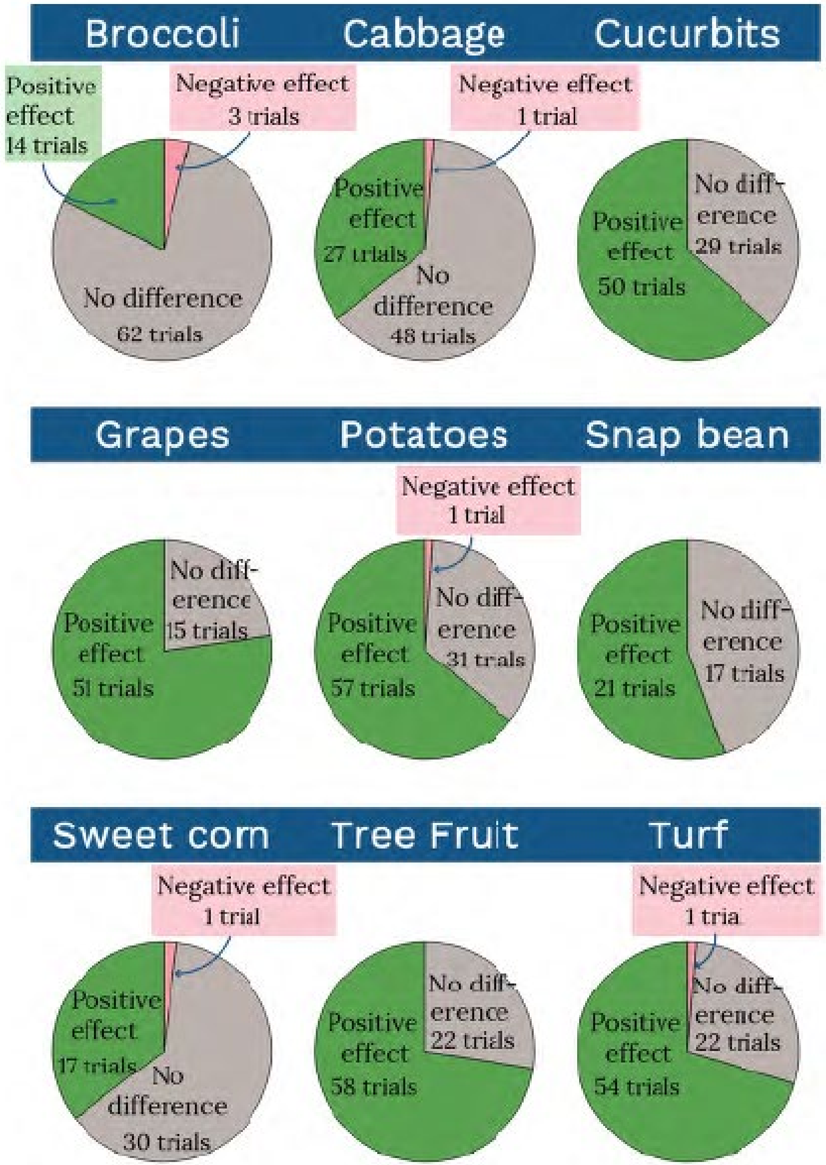
“Risk to bees from exposures associated with neonicotinoid usage in fruit crops does occur, but both the likelihood and magnitude of risk are lower than in other settings…

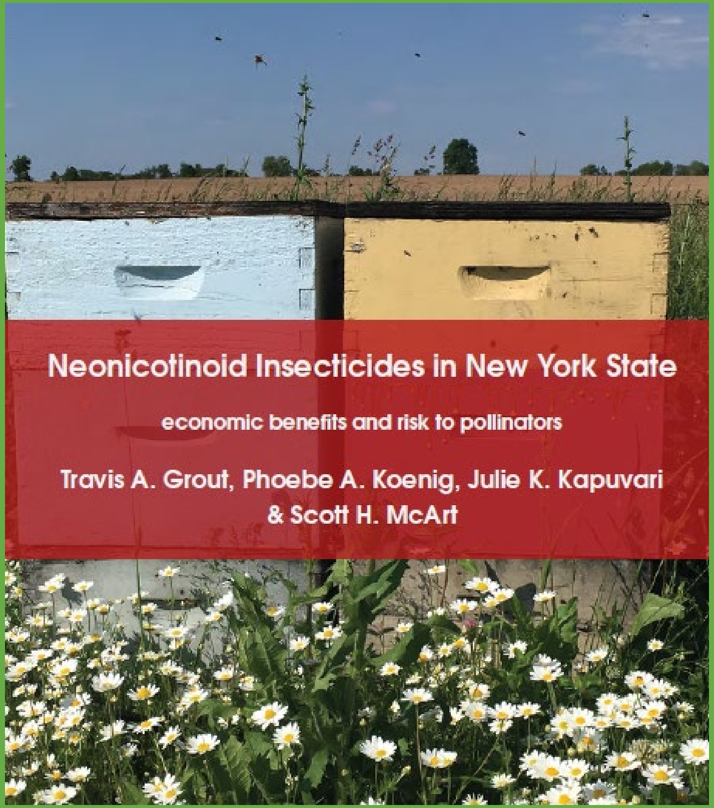
However, complementing this data set, our own data from New York apple and strawberry plantings show that risk from imidacloprid and thiamethoxam exposures can be high during the bloom period for these crops (Figures 6.4 & 6.5). In these studies, exposures to acetamiprid were typically far greater than exposures to imidacloprid and thiamethoxam, but because acetamiprid is much less toxic to bees, risk was always lower. “



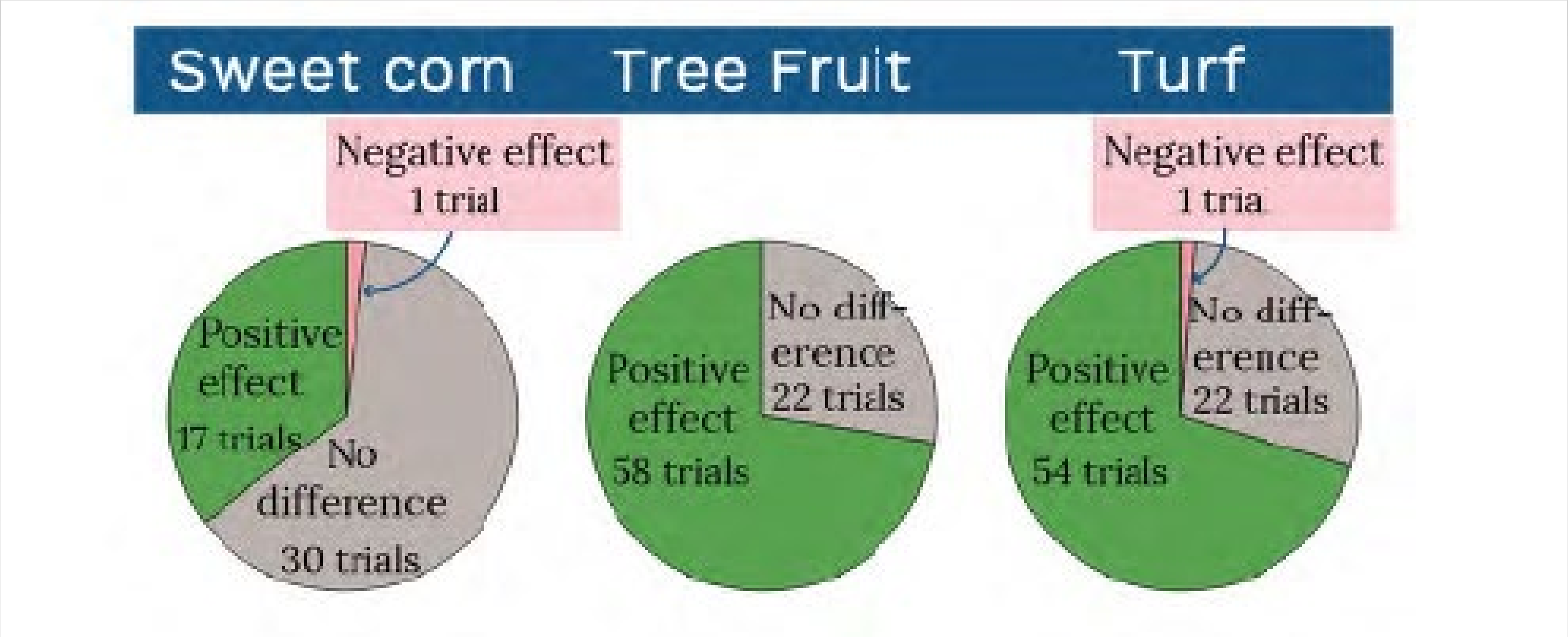
Grout, T. A., Koenig, P. A., Kapuvari, J. K., & McArt, S. H. (2020). *Neonicotinoid Insecticides in New York State*. Retrieved from Ithaca, NY: https://cals.cornell.edu/pollinator-network/pollinator-research

Figure 5.5: **Number of North American field trials reporting significantly better performance (green), significantly worse performance (red), or no significant difference (gray) in terms of yield, crop damage, or pest control for neonicotinoid-treated plots compared to no-insecticide controls**[1]





Grout, T. A., Koenig, P. A., Kapuvari, J. K., & McArt, S. H. (2020). *Neonicotinoid Insecticides in New York State*. Retrieved from Ithaca, NY: https://cals.cornell.edu/pollinator-network/pollinator-research



Questions?