MINNESOTA APPLE SURVEY 2023: RESULTS SUMMARY

Publication Date
June 2023

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Funding
The survey and this report were supported with funding from the Minnesota Department of Agriculture for a project, Expanding the Use of Hail Netting for Non-Chemical Insect Pest Management in Apple (grant #3005-11506UMSPR-00090681-1).

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Acknowledgements
We wish to thank Annie Klodd for her assistance with survey design and testing as well as Suzanne Wold-Burkness for her help compiling survey contacts and administering the direct mail surveys. We also sincerely thank the Minnesota apple growers who took the time to complete and return the survey.

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Survey Profile

Title

University of Minnesota Apple Survey, 2023

Objectives

A research team at the University of Minnesota-Twin Cities launched a state-wide survey to: (1) quantify the value of apple (*Malus domestica*) production and agritourism on apple orchards in the state; (2) identify common marketing strategies; and (3) ascertain pest control needs. Results from the survey can be used to inform on farm production decisions, research efforts and policy recommendations.

Target Population

The target survey population included owners/operators of apple (*Malus domestica*) orchards in Minnesota. Business ownership characteristics including size, scale, and experience was expected to vary among the survey respondents.

Timeframe

January 2, 2023 - April 30, 2023

Survey Design and Methods

The survey questionnaire was developed using the Tailored Design Method by the project PIs - including two Extension educators as well as faculty and research staff from the Department of Entomology and the Department of Applied Economics at the University of Minnesota. Researchers met once to discuss survey design and reviewed subsequent questionnaire drafts by email. The survey questionnaire was field tested by several Minnesota apple orchard owners who each were offered a $25 VISA gift card to compensate for their time. Growers were asked to provide feedback about: 1) survey flow; 2) technical content of survey questions; 3) time required to complete the survey; and 4) additional information needed. Based on feedback obtained during the testing phase, adjustments were made and the survey questionnaire was completed in January 2023.

The final electronic questionnaire, consisting of 20 unique questions, was formatted in Qualtrics. Survey questions addressed: (1) baseline and demographic information; (2) production; (3) marketing and sales; (4) yield loss due to insects, disease and weather; (5) pest management strategies; (6)) attitudes towards insecticide alternatives; and (7) information needs. The survey instrument was designed to allow respondents to exit the survey and return to complete it any time prior to survey closure on April 1, 2023. The survey cover page informed recipients of the study protocol and a University of Minnesota contact was provided to address questions and/or concerns.

Valid surveys were distributed electronically to 247 individuals directly via email and indirectly using an anonymous link to listservs of collaborating industry organizations and Facebook membership pages. Individual email contacts were compiled with the help of membership organizations (Minnesota Apple Growers Association, Minnesota Fruit and Vegetable Growers Association, Minnesota Grown). Social media sites (Facebook) were also explored to identify contacts. Additionally, printed copies of the survey were mailed to 131 recipients and included self-addressed stamped envelopes to encourage a strong response. The survey was launched on January 11, 2023. Three follow-up reminder emails were sent to all non-respondents at approximately two-week intervals. As an incentive to improve overall response rates, all survey recipients were invited to opt into a randomized drawing for one of five $25 VISA gift cards. The gift card drawing took place on April 28, 2023 and gift cards were mailed on May 1, 2023.

Contact Sequence

Introductory email sent to industry organizations	Dec.13, 2022 - Jan.4, 2023
First questionnaire email	January 11, 2023
First email reminder	January 25, 2023
Second email reminder	February 8, 2023
Mailing	February 28, 2023
Final email reminder to all recipients	March 16, 2023

Data storage and security

Survey responses were aggregated and cleaned of disclosive information to protect participants' privacy and confidentiality. Quantitative data generated using Qualtrics is stored on the Qualtrics server at University of Minnesota. Qualtrics offers Transport Layer Security encryption (HTTPS) and survey security options like password protection and HTTP referer checking. Their servers are stored in a tier one data storage facility that includes security measures such as biometric entry and double card swipe.

A long-term data sharing and preservation plan will be used to store and make publicly accessible the survey instrument and data beyond the life of the project. The survey instrument and deidentified survey data will be deposited into the Data Repository for the University of Minnesota (DRUM), http://hdl.handle.net/11299/166578. This University of Minnesota Libraries' hosted institutional data repository is an open access platform for dissemination and archiving of university research data. DRUM curators review all incoming submissions and work with data authors to comply with data sharing requirements in ways that make data FAIR (Finable, accessible, interoperable, reusable).

Data files in DRUM are written to an Isilon storage system with two copies, one local to each of the two geographically separated UMN Data Centers. DRUM provides long-term preservation of digital data files for at least 10 years using services such as migration (limited format types), secure backup, bit-level checksums, and maintains a persistent DOIs for data sets, facilitating data citations.

Response Rate

A total of 107 individuals opened the survey and, of those, 71 reported growing apples and were eligible to continue the survey. Twenty-eight percent of the respondents opted out of the survey after

completing the first question. Therefore, the final number of survey participants was 51 individuals (14% response rate).

Response Summary

Opened by email (direct link)	56
Opened by email (anonymous link)	25
Opened by social media (QR code)	2
Opened by mail (paper survey)	24
Opened (all methods)	107
Answered at least one survey question (all methods)	71
Completed more than one question (all methods)	51
Failed, duplicate or bounced	24
Total survey distribution (direct email and surface mail) *	378
Total eligible sample**	354
Cooperation rate (%)***	30
Response rate (%)****	14

* Surveys distributed by direct email and surface mail. Does not include email contacts by anonymous link.

** Total eligible sample = (total distributed by direct email and postcard) – (fails, duplicates, bounces)

*** Cooperation rate = (opened survey)/(total eligible sample)

**** Response rate = (completed more than one question)/(total eligible sample)

Survey Results

Survey results are presented below for: (1) baseline and demographic information; (2) production; (3) marketing and sales; (4) yield loss due to insects, disease and weather; (5) pest management strategies; (6) attitudes towards insecticide alternatives; and (7) information needs. The survey questionnaire can be found in the Appendix. All questions and responses refer to the 2022 apple production season.

1. Baseline and Demographic Information

Survey participants were asked to share the zip code in which their orchard was located (Q2). Fifty-one growers responded (*n = 51*). The zip codes correspond to 47 Minnesota cities and 27 counties. Orchards were well distributed throughout the central and southeastern areas of the state as shown in Figure 1 below.

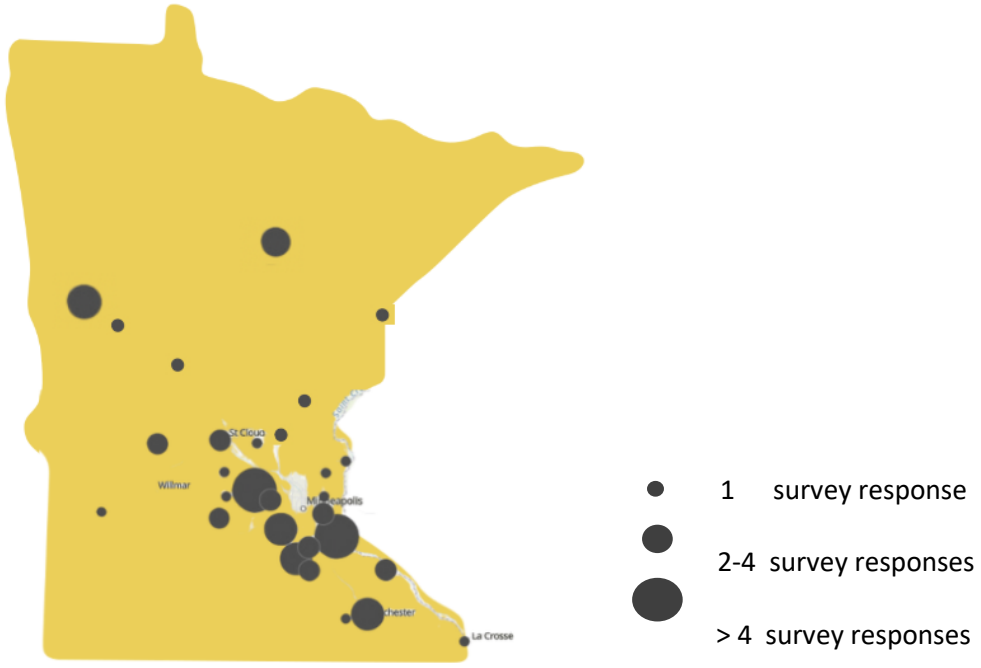

Figure 1. Survey responses by geographic location

Survey participants were asked "how many years" they'd been growing apples (Q3) (*n = 51*). The majority of growers (86%) reported having 11 or more years of experience with 55 percent averaging 21 or more years of experience. The survey captured few beginning grower responses, with only six percent reporting five or less years' experience growing apples.

Growers were asked about the number of year-round and seasonal employees hired to work at their orchard in 2022 (Q4). On average growers employed one full-time and one part-time person year-round. Orchard owners also employed two full-time seasonal workers and 10 part-time seasonal workers annually on average (*n = 51*). The range for seasonal employment was 0 - 26 full-time employees and 0-50 part-time employees. Some growers also indicated that they relied regularly on volunteer labor during the production season.

Number of combined full-time and part-time workers employed annually on MN apple orchards year-round

Number of combined full-time and part-time workers employed seasonally on MN apple orchards each year

Survey respondents were asked to list the number of bearing and non-bearing apple acres that they managed in 2022 (Q6). Minnesota apple orchards averaged 26.67 acres with a standard deviation of 51.92 acres (bearing and non-bearing acreage) (*n = 51*), making them almost twice the average size of orchards throughout the United States (14.45 acres) (US Census of Agriculture, 2017).

Due to the large variation in orchard size, the median is a more appropriate measure of size. The median orchard size was 8.00 acres for survey participants. Farms with a large number of bearing acres skewed the median orchard size upward; Minnesota apple growers reported a median of 5.10 bearing acres and 0.20 non-bearing acres. The bearing acreage numbers reported in the survey are representative of the statewide averages compiled by the USDA for the 2017 Census of Agriculture (5.45 acres) and almost one-third the national average (16.98 acres). Total apple acreage, bearing and non-bearing, totaled 1,360 acres for survey participants (*n=51*) - accounting for 38% of all apple acreage in Minnesota (US Census of Agriculture, 2017).

2. Apple Production

Survey respondents were asked to identify varieties grown from a list of 15 apple varieties (Q7). On average, orchard managers reported growing more than six different varieties with a total yield of 2,514 bushels per farm (*n = 51*).

Of the 15 varieties included in the survey, the top three varieties grown were Honeycrisp (*Malus domestica 'Honeycrisp'*), SweeTango (*Malus domestica 'Minneiska'*) and Haralson (*Malus domestica 'Haralson'*). Together, these three apple varieties accounted for 70 percent of the total apple yield among survey participants (Figure 2). Total yield averaged 990 bushels per farm, 437 bushels per farm and 337 bushels per farm for Honeycrisp, SweeTango and Haralson varieties, respectively.

Survey respondents were also given the option to enter additional varieties grown. Among the "other" apple varieties identified were: Beacon; Hazen; Keepsake; La Cresent; Liberty; Lodi; McCoun; Northern Lights; Norwest Greenling; Oriole; Paula Red; Pazzaz; Kinder Crisp; Red Baron; Red Delicious; Red Duchess; Red Free; Smoothie; Sonya; State Fair; Sun Crisp; and Victory. Many of these varieties are grown for processing into pies and apple sauce (e.g., Liberty, Northern Lights) while others tend to be small and are typically produced for school lunches (e.g. Kinder Crisp).

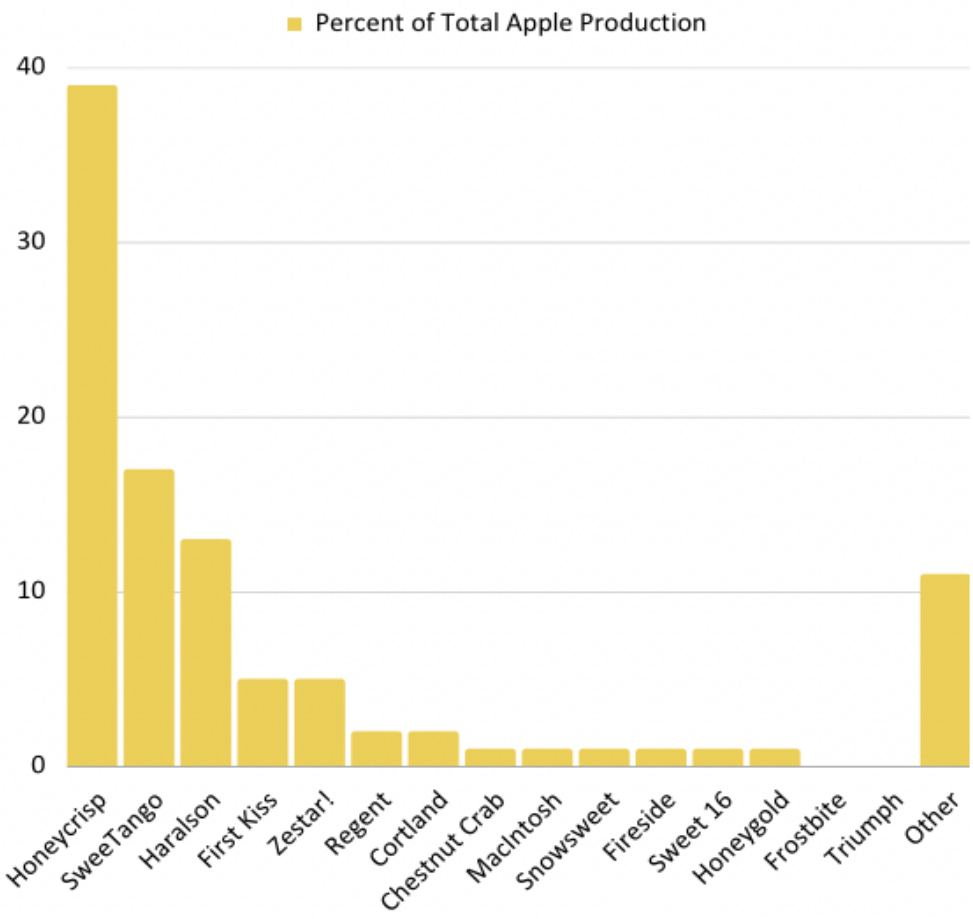

Figure 2. Percent of total apple production in Minnesota by variety

3. Sales and Marketing

Survey participants were asked about apple sales and the marketing channels used to sell apples in 2022 (Q8) (*n = 51*). Survey participants were asked to estimate gross sales from fresh apples, processed apples, agritourism and other products/services (Q5). Sales averaged $131,480 per apple orchard in 2022 across all product/service categories and marketing channels (*n = 51*).

The largest percent of sales (59%) came from the fresh apple category (Figure 3) where growers averaged $77,573 per farm. This is more than twice the average value of gross sales reported by all Minnesota apple growers, $35,306 per farm adjusted for inflation, in the 2017 Census of Agriculture (USDA Census of Agriculture, 2017). This suggests that the growers who responded to the survey are generating above average gross income compared to other apple producers in the state.

Gross sales reported for fresh apples varied significantly from orchard to orchard - with some growers having reported no fresh apple sales while others reported > $500,000 from this category. Due to the wide variability in fresh apple sales, the median was estimated at $20,000 per farm in 2022. Due to data privacy limitations, we were unable to calculate median sales from the 2017 Census for comparison.

The second most important sales category on Minnesota apple farms was agritourism which accounted for 18% of gross income or $23,666 on average per farm in 2022 (Figure 3). Agritourism sales on apple orchards typically include attractions and entertainment such as corn mazes, hay rides, petting zoos, corn pits, workshops and school tours.

Similar to fresh apples, there was a lot of variation in sales values within the agritourism category. Some growers reported no sales from agritourism while one grower reported grossing $400,000 in this category. Agritourism typically includes on-farm events, hay-rides, corn mazes and petting zoos, among other things.

Gross income from processed apples averaged $15,778 per farm in 2022 or 12 percent of total apple sales. The processed apple category includes juice, sauce, pies and other items that have been baked, chilled and frozen. The final sales category measured was "other" which averaged $14,463 per farm or 11% of overall orchard sales (Figure 3). Survey respondents were not asked to specify "other" sales.

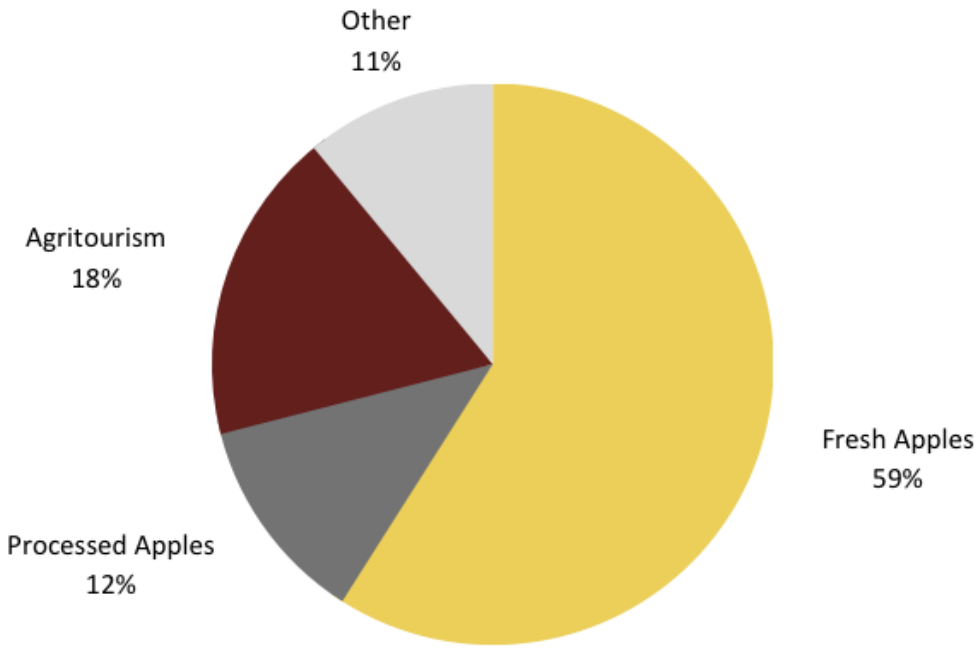

Figure 3. Sales at Minnesota apple orchards in 2022 by category

Most growers reported marketing fresh (69%) versus processed apples (31%) through a variety of sales channels. The majority of fresh apples were marketed on farm (70%) and at farmers markets (12%). The remainder of fresh apples were marketed wholesale (7%), direct-to-retail grocers (4%), direct to institutions such as schools (4%) and through community supported agriculture (CSA) shares (3%) (Figure 4).

Processed apples, were distributed via the same marketing channels with the bulk of processed apples being sold on farm (58%), wholesale (17%), direct-to-retail grocers (10%), farmers markets (9%) and

direct to institutions (6%). None of the survey participants reported marketing processed apples via CSA shares (Figure 4).

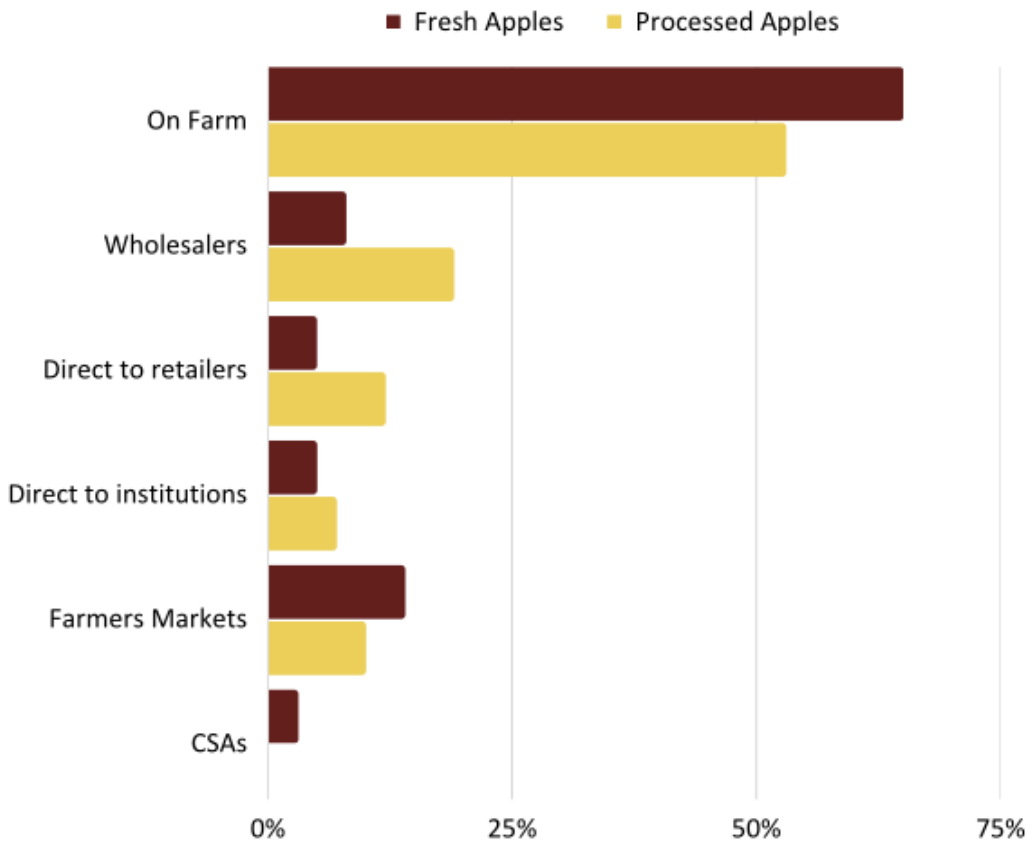

Figure 4. Marketing channels by Minnesota apple growers in 2022

4. Yield Loss

Survey participants were asked several questions about pests, disease, weather and subsequent yield loss (Q9 - Q12). Growers estimated apple yield loss due disease at 4%, insect pests at 6% and weather at 12% (*n = 51*). Next, respondents were asked to rank these production problems using a Likert scale from 0-4 where 0 represented "no" problem and 4 a "very big" problem (Q10). Grower results (*n = 48*) suggest that damaged fruit (77%), small fruit size (71%), low yields (69%) and damaged skin (65%) were the most significant production-related issues (Table 1).

Table 1. Degree of production problems encountered by Minnesota apple growers in 2022

Overall frequency (n = 48)	Frequency (%)
Pre-mature apple drop (n = 21|44%)	
No problem	27 (56)
Small problem	12 (25)
Moderate problem	8 (17)
Big problem	1 (2)
Very big problem	0 (0)
Damaged skin (n = 31|65%)	
No problem	17 (35)
Small problem	15 (31)
Moderate problem	14 (29)
Big problem	1 (2)
Very big problem	1 (2)
Damaged fruit (n = 37|77%)	
No problem	11 (23)
Small problem	15 (31)
Moderate problem	15 (31)
Big problem	4 (8)
Very big problem	3 (6)
Low yields (n = 33|69%)	
No problem	15 (31)
Small problem	14 (29)
Moderate problem	7 (15)
Big problem	5 (10)
Very big problem	7 (15)
Small fruit size (n = 34|71%)	
No problem	14 (29)
Small problem	13 (27)
Moderate problem	12 (25)
Big problem	6 (13)
Very big problem	3 (6)
Hail damage (n = 14|29%)	
No problem	34 (71)
Small problem	6 (13)
Moderate problem	3 (6)
Big problem	2 (4)
Very big problem	3 (6)

Next, we asked respondents to identify specific causes of yield loss and unmarketability such as insects (Table 2) and diseases (Table 3). The same Likert scale was used to rate each problem (Q11).

Table 2. Degree of insect or mite problems on Minnesota apple orchards in 2022

Overall frequency (n = 47)	Frequency (%)
Aphids (n = 7 | 15%)	
No problem	40 (85)
Small problem	6 (13)
Moderate problem	0 (0)
Big problem	1 (7)
Very big problem	0 (0)
Apple curculio (n = 15 |32%)	
No problem	32 (67)
Small problem	8 (17)
Moderate problem	5 (11)
Big problem	2 (4)
Very big problem	0 (0)
Apple maggot (n = 30 |64%)	
No problem	16 (34)
Small problem	17 (36)
Moderate problem	7 (15)
Big problem	4 (9)
Very big problem	2 (4)
Borers (n = 17 |36%)	
No problem	30 (64)
Small problem	11 (23)
Moderate problem	3 (6)
Big problem	2 (4)
Very big problem	1 (2)
Codling moth (n =27 |57%)	
No problem	20 (43)
Small problem	16 (34)
Moderate problem	6 (13)
Big problem	4 (9)
Very big problem	1 (2)
Green fruitworms (n = 14 |30%)	
No problem	33 (70)
Small problem	11 (23)
Moderate problem	2 (4)
Big problem	1 (2)
Very big problem	0 (0)
Japanese beetle (n = 24 |51%)	
No problem	23 (49)
Small problem	13 (28)
Moderate problem	6 (13)
Big problem	3 (6)
Very big problem	2 (4)

Table 2 Continued	Frequency (%)

Leafrollers (n = 25|53%)	
No problem	22 (47)
Small problem	15 (32)
Moderate problem	8 (17)
Big problem	2 (4)
Very big problem	0 (0)
Plum curculio (n = 26|55%)	
No problem	21 (45)
Small problem	18 (38)
Moderate problem	5 (11)
Big problem	3 (6)
Very big problem	0 (0)
Potato leafhopper (n = 7|15%)	
No problem	40 (85)
Small problem	7 (15)
Moderate problem	0 (0)
Big problem	0 (0)
Very big problem	0 (0)
Spider mites (n = 8|17%)	
No problem	39 (83)
Small problem	7 (15)
Moderate problem	0 (0)
Big problem	1 (2)
Very big problem	0 (0)
Other (n = 7|15%)	
No problem	40 (85)
Small problem	3 (6)
Moderate problem	1 (2)
Big problem	1 (2)
Very big problem	2 (4)

Based on the total number of responses (*n = 47*), the most significant insect problems identified by survey participants were apple maggot (64%), codling moth (57%) , leafrollers (53%) and Japanese beetle (51%). These pests were ranked a “moderate” to “very big problem” by 20 percent or more of respondents (Table 2). Conversely, aphids, potato leafhopper, and green fruit worms were ranked “no problem” by 70 percent or more of survey respondents (Table 2).

Turning to disease issues, growers identified top areas of concern as bitter pit (56%) and apple scab (42%) as well as black rot, cedar apple rust and fly speck (40% each). The first three of these issues were identified as “moderate” to “very big” problems by 15-25% percent of growers surveyed. Alternatively, diseases such as sooty blotch, rust, white rot and powdery mildew were ranked “no problem” by more than 75 percent of Minnesota apple growers surveyed (Table 3).

Table 3. Degree of disease problems on Minnesota apple orchards in 2022

Overall frequency (n = 48)	Frequency (% of overall frequency)
Apple scab (n = 20|42%)	
No problem	28 (58)
Small problem	13 (27)
Moderate problem	6 (13)
Big problem	0 (0)
Very big problem	1 (2)
Bitter pit (n = 27|56%)	
No problem	20 (42)
Small problem	17 (35)
Moderate problem	7 (15)
Big problem	1 (2)
Very big problem	2 (4)
Bitter rot (n = 9|19%)	
No problem	37 (77)
Small problem	8 (17)
Moderate problem	0 (0)
Big problem	1 (2)
Very big problem	0 (0)
Black rot (trunk disease) (n = 19|40%)	
No problem	28 (58)
Small problem	8 (17)
Moderate problem	8 (17)
Big problem	0 (0)
Very big problem	3 (6)
Cedar apple rust (n = 19 |40%)	
No problem	28 (58)
Small problem	17 (35)
Moderate problem	0 (0)
Big problem	1 (2)
Very big problem	1 (2)
Fire blight (n = 15|31%)	
No problem	33 (69)
Small problem	9 (19)
Moderate problem	3 (6)
Big problem	3 (6)
Very big problem	0 (0)
Fly speck (n = 19|40%)	
No problem	29 (60)
Small problem	14 (29)
Moderate problem	3 (6)
Big problem	1 (2)
Very big problem	1 (2)

Table 3 Continued	Frequency (%)

Powdery mildew (n = 4|8%)	
No problem	44 (92)
Small problem	3 (6)
Moderate problem	1 (2)
Big problem	0 (0)
Very big problem	0 (0)
Rust (n = 12|25%)	
No problem	36 (75)
Small problem	11 (23)
Moderate problem	1 (2)
Big problem	0 (0)
Very big problem	0 (0)
Sooty blotch (n = 14|29%)	
No problem	34 (71)
Small problem	11 (23)
Moderate problem	2 (4)
Big problem	1 (2)
Very big problem	0 (0)
White rot (n = 7|15%)	
No problem	41 (85)
Small problem	5 (10)
Moderate problem	0 (0)
Big problem	2 (4)
Very big problem	0 (0)
Other (n = 7|15%)	
No problem	41 (85)
Small problem	4 (8)
Moderate problem	2 (4)
Big problem	0 (0)
Very big problem	1 (2)

5. Pest Management Strategies

Growers were asked several questions (Q13-Q15) about pest management and annual expenditures on control strategies. Survey respondents reported spending an average of $8,769 per farm on pest management in 2022. Expenditure estimates ranged from $0 to $100,000 for the single season; median expenditures were $1,900 per year for the growers surveyed (*n = 51*).

Next, growers were asked to identify all organic and non-organic pest management strategies used in 2022. Fifty-one growers responded (*n = 51*). On average, growers used 3.47 different strategies to control pests; the most common strategies applied were integrated pest management (75%), conventional chemicals (69%) and traps to monitor pests and determine spray timing (61%) (Figure 5). Cultural practices, such as the removal of excess fruit after harvest, also ranked high with 51 percent of growers having used this strategy in 2022. Among “other” strategies specified, several growers reported using the Network for Environmental and Weather applications (NEWA). NEWA collects data from weather stations located on numerous farms, including several in Minnesota, and generates real-time IPM forecasts (www.newa.cornell.edu).

Anticipating that chemical sprays would be one of the primary pest management strategies employed, the survey included a question about the number of different sprays used and the number of sprays applied during the 2022 production season. Twenty-four percent of growers used organic controls (*n = 12)*; they reported applying 1-5 different active ingredients (brands) and applied pesticides two times on average during the season. Alternatively, those growers who used non-organic insecticides (*n = 37*), reported using seven active ingredients or sprays and applying these 7.2 times, on average, throughout the season. Growers typically alternate sprays to address different pests and maintain efficacy by reducing insecticide resistance that comes from using only one type or brand of spray.

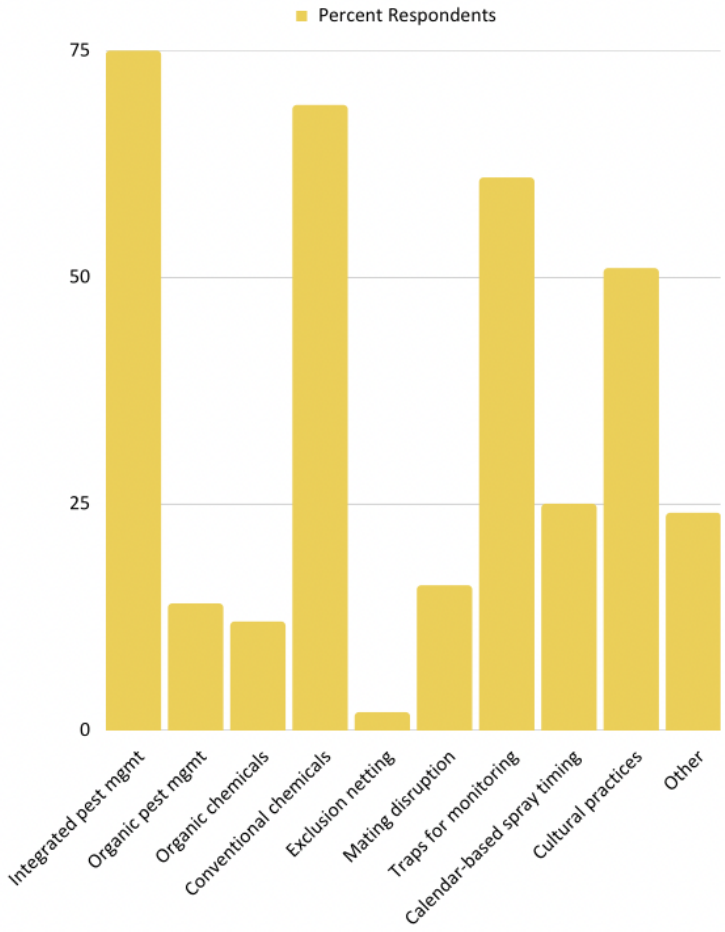

Figure 5. Pest management strategies used by Minnesota growers in 2022

6. Attitudes Towards Insecticide Alternatives

Growers were asked three questions to gauge their attitudes toward and interest in insecticide alternatives such as biological controls, organic-certified insecticides and codling moth mating disruption (Q16-Q18). The first question asked whether growers, generally, would be interested in using insecticide alternatives in the future. Of the respondents (*n=51*), 47 percent answered "yes" and another 45 percent responded "maybe, if I had more information." Only eight percent indicated that they would not be interested in using insecticide alternatives.

Next growers were asked to identify any "concerns" they had about using insecticide alternatives (Q17). They were offered four multiple answer responses (expense, effectiveness, training, and labor requirements) as well as a write-in "other" option. Growers reported being concerned that insecticide alternatives would be "ineffective" (57%), "too expensive" (41%) and require too much labor (39%) (*n=51*) (Figure 6).

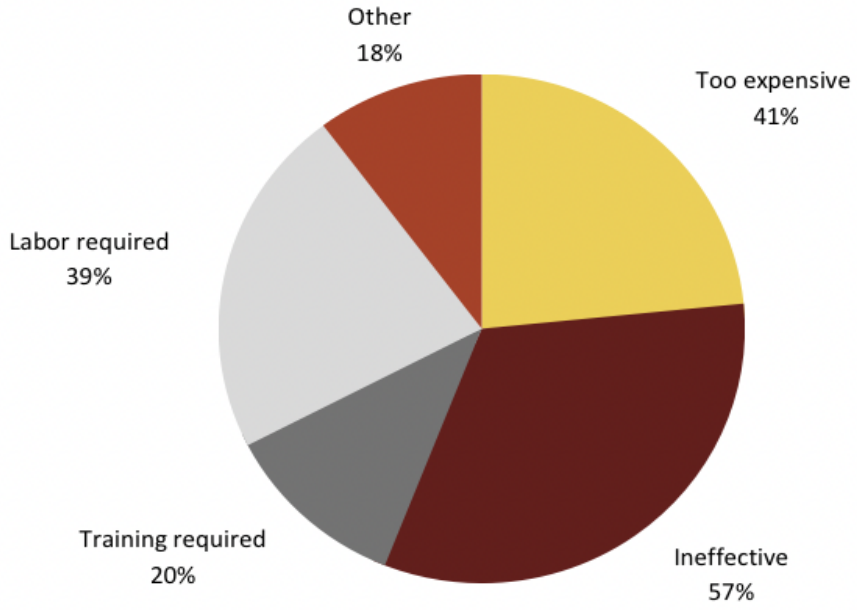

Figure 6. Minnesota apple grower concerns about using insecticide alternatives

Lastly, survey respondents were asked to identify any perceived "benefits" of using insecticide alternatives in their orchard (Q18). Five multiple answer responses as well as a write-in "other" option were offered: worker safety, customer preferences, price premiums, environmental benefits and cost savings. The most important benefits identified by respondents (*n=51*) were "environmental benefits" (70%) followed by "customer preferences" (67%) and "worker safety" (59%) (Figure 7). Somewhat surprisingly, price premiums ranked the lowest, with only 16 percent of growers viewing these as a potential benefit from the use of insecticide alternatives. Research has shown that Minnesota consumers are willing to pay a substantial premium for food produced without conventional insecticides (Yue and Tong, 2009[1]).

[1] Yue, C. and Tong, C. 2009. Organic or local? Investigating consumer preference for fresh produce using a choice experiment with real economic incentives. Hort Science 44(2): 366-371

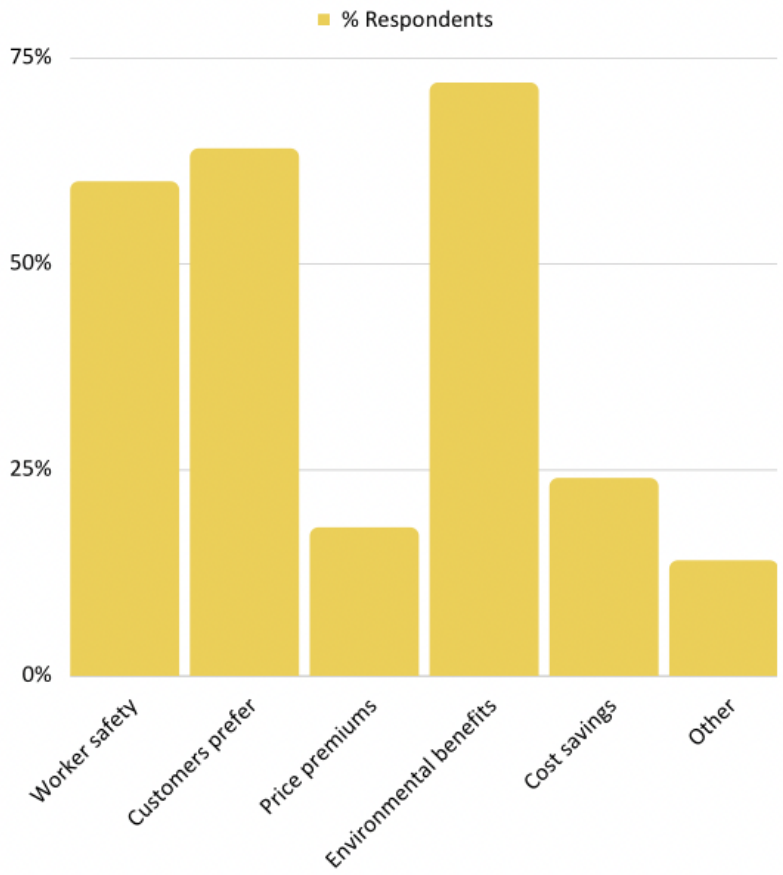

Figure 7. Minnesota apple growers' expected benefits from using insecticide alternatives.

7. Information Needs

The final survey questions (Q19-Q20) addressed grower information needs. From a list of 14 topics, growers were asked to identify and rank the top five issues they would like more information about from Extension educators. They also were given the opportunity to provide a detailed write-in response. Forty-nine growers responded (*n = 49*). Integrated pest management was ranked the top issue with 76 percent of respondents choosing this option. Other important topics, ranked number one or number two by growers, were disease management (63%), crop load management (57%), fruit quality (53%), fertility management (51%) and insecticide alternatives (43%). The full continuum of responses is shown in Table 4. Additional write-in response topics (Q20) are summarized below:

- Storage equipment and facilities
- Retail sales regulations and GAP tutorials
- Pollinator-friendly understory options
- Effects of climate change
- Cider apple selection, processing, marketing
- Orchard rejuvenation and variety selection
- Grafting and rootstock selection
- Organic pest management

Table 4: Top Five Priorities for Extension Educators as Identified by Minnesota Apple Growers*

Overall Frequency (n = 49)	Frequency

	(% of n for each response)
Integrated pest management (n = 37|76%)	
#1	14 (38)
#2	5 (14)
#3	7 (19)
#4	5 (14)
#5	6 (16)
Marketing (n=15|31%)	
#1	4 (27)
#2	1 (7)
#3	4 (27)
#4	2 (13)
#5	4 (27)
Succession planning (n = 11|22%)	
#1	0 (0)
#2	1 (9)
#3	4 (36)
#4	1 (9)
#5	5 (45)
Pricing (n = 12|24%)	
#1	1 (8)
#2	3 (25)
#3	3 (25)
#4	2 (17)
#5	3 (25)
Insecticide alternatives (n = 21|43%)	
#1	5 (24)
#2	7 (33)
#3	3 (14)
#4	5 (24)
#5	1 (5)
Fruit quality (n = 26|53%)	
#1	7 (27)
#2	8 (31)
#3	4 (15)
#4	2 (8)
#5	5 (19)
Variety selection (n = 14|29%)	
#1	3 (21)
#2	1 (7)
#3	2 (14)
#4	4 (29)
#5	4 (29)

Table 4 Continued	Frequency (% of n for each response)
Disease management (n = 31|63%)	
#1	6 (19)
#2	11 (35)
#3	5 (16)
#4	6 (19)
#5	3 (10)
Crop load management (n = 28|57%)	
#1	5 (18)
#2	8 (29)
#3	5 (18)
#4	5 (18)
#5	5 (18)
Fertility management (n = 25|51%)	
#1	4 (25)
#2	2 (5)
#3	9 (2)
#4	2 (0)
#5	8 (32)
Pruning (n =22|45%)	
#1	5 (23)
#2	3 (14)
#3	5 (23)
#4	8 (36)
#5	1 (5)
Budgeting and finances (n = 8|16%)	
#1	1 (13)
#2	1 (13)
#3	2 (25)
#4	1 (13)
#5	3 (38)
Managing surpluses (n = 7|14%)	
#1	1 (14)
#2	1 (14)
#3	2 (29)
#4	2 (29)
#5	1 (14)
Hiring and training labor (n = 12|24%)	
#1	1 (8)
#2	0 (0)
#3	4 (33)
#4	3 (25)
#5	4 (33)

*Percent totals may not add to 100 as a result of rounding.

Appendix: Survey Questionnaire

University of Minnesota

Apple Survey, 2023

Greetings!

We hope that you are enjoying a well-deserved break this winter with a bit of time to rest, reflect and prepare for the season ahead. As you do so, we invite you to participate in a survey about apple production, marketing and pest management. Survey results will be used to assess the value of our state's apple industry (apple production and agritourism) and to guide research efforts about pest management. The survey is being conducted by the University of Minnesota with funding from the Minnesota Department of Agriculture (Grant # 3005-11506UMSPR-00090681-1).

The survey is voluntary and consists of 20 questions about apple production and marketing. If you consent to participate in the survey, please allow approximately 20 minutes to complete. At the end of the survey you will have the opportunity to opt into a drawing for one of four $25 VISA gift cards.

Please note: If you are not the primary decision maker with regards to apple management on your farm, we ask that you pass the survey on to the person best able to answer questions about 2022 apple production, sales and insect management.

We sincerely thank you for your time and assistance. Please contact Gigi DiGiacomo, Department of Applied Economics, University of Minnesota with any questions or concerns: gigid@umn.edu; 612-710-1188.

UNIVERSITY OF MINNESOTA
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SURVEY START **Survey #___**

Q1. Do you grow apples?

- ○ Yes (1)
- ○ No (2)

***** *Skip to Q23 if you do NOT grow apples.***

Q2. Where is your apple orchard located? (Enter ZIP code) _____

Q3. How many years have you been growing apples? (Enter number of years) _____

Q4. How many people do you employ on your apple farm? (Enter number)

- ○ Full time, year-round _____
- ○ Part-time, year-round _____
- ○ Full time, seasonal _____
- ○ Part time, seasonal _____
- ○ Other _____

Q5. What was the gross value of sales at your farm in 2022 from each of the enterprises listed? (Enter value in dollars, round to nearest dollar)

- ○ Fresh apples _____
- ○ Processed apples _____
- ○ Agritourism _____
- ○ Other _____

Q6. How many acres did you manage on your farm in 2022? (Enter number of acres, round to nearest 1/10th of acre)

○ Apples, bearing _____

○ Apples, non-bearing _____

Q7. Tell us about your apple production for each variety grown on your farm in 2022. If you did not grow the variety listed, leave the response blank.

	Total Yield (bu)	Marketable Yield (bu)	Certified organic (Y or N)
Chestnut Crabapple			
Cortland			
Fireside/Connell Red			
First Kiss (MN95/Rave)			
Frostbite			
Haralson			
Honeycrisp			
Honeygold			
Macintosh			
Regent			
Snowsweet			
SweeTango (Minnieska)			
Sweet 16			
Triumph			
Zestar!			
Other			

Q8. How did you market apples in 2022? (Enter percent sold to each market segment where the total percent for "fresh apples" adds to 100 percent and the total percent for "processed apples" adds to 100 percent)

	On Farm	Farmers Market	CSA	Wholesale	Direct to Retailer	Direct to Schools & Institutions
Fresh Apples						
Processed Apples						

Q9. What percent of your apple harvest was unmarketable in 2022 due to major diseases, insects/mites, and weather? (Enter percent of estimated yield loss for each issue)

- ○ Major diseases _____
- ○ Insects and/or Mites _____
- ○ Weather _____
- ○ Other _____

Q10. Tell us, generally, about any production problems that you experienced on your apple farm in 2022 by entering a number that represents the degree of the problem where 0 = no problem, 1 = small problem, 2 = moderate problem, 3 = big problem, 4 = very big problem. If you did not experience the problem, write "NA" in the box (not applicable).

	Degree of Problem (1-5)
Pre-mature apple drop	
Damaged skin	
Damaged fruit	
Low yields	
Small fruit size	
Hail damage	

Q11. Tell us, generally, about any insect problems that you experienced on your apple farm in 2022 by entering a number that represents the degree of the problem where 0 = no problem, 1 = small problem, 2 = moderate problem, 3 = big problem, 4 = very big problem. If you did not experience the problem, write "NA" in the box (not applicable).

	Degree of Problem (1-5)
Aphids	
Apple curculio	
Apple maggot	
Borers	
Codling moth	
Green fruitworms	
Japanese beetle	
Leafrollers	
Plum curculio	
Potato leafhopper	
Spider mites	
Other	

Q12. Tell us, generally, about any disease problems that you experienced on you apple farm in 2022 by entering a number that represents the degree of the problem where 0 = no problem, 1 = small problem, 2 = moderate problem, 3 = big problem, 4 = very big problem. If you did not experience the problem, write "NA" in the box (not applicable).

	Degree of Problem (1-5)
Apple scab	
Bitter pit	
Bitter rot	
Black rot (trunk disease	
Cedar apple rust	
Fire blight	
Fly speck	
Powdery mildew	
Rust	
Sooty blotch	
White rot	
Other	

Q13. Which control strategies did you use to manage damage from weather, pests and diseases in your apple orchard in 2022? (Check all that apply)

☐ Integrated Pest Mangement (IPM) approach

☐ Organic pest management approach

☐ Chemicals, certified organic

☐ Chemicals, conventional

☐ Exclusion netting

☐ Mating disruption for Codling moth

☐ Traps to monitor pests (e.g. pheromone traps) to decide timing of sprays

☐ Calendar-based insecticide spray timing

☐ Cultural practices (e.g., removal of excess fruit dropped after harvest)

☐ Other (describe): _____

Q14. If you use insecticides, describe the type(s) of products used in the 2022 growing season. (Enter number of each type)

	Organic Insecticides	Synthetic Insecticides
Total Number of Brands Used in 2022		
Total Number of Applications in 2022		

Q15. How much did you spend on pest management in 2022? (Estimate the cost of materials only; do not include labor costs)

Pest management material expenses ($) _____

Q16. Are you interested in using insecticide alternatives in the future? Examples of insecticide alternatives include biological control, organic-certified insecticides, codling moth mating disruption.

- ○ Yes
- ○ No
- ○ Maybe, if I had more information

Q17. What concerns do you have about using insecticide alternatives? Examples of insecticide alternatives include biological control, organic-certified insecticides and codling-moth mating disruption. (Check all that apply)

- ☐ Too expensive
- ☐ Ineffective
- ☐ Training required
- ☐ Labor required
- ☐ Other

Q18. What do you feel are the benefits of using insecticide alternatives on your orchard? (Check all that apply)

- ☐ Worker safety
- ☐ Customers prefer
- ☐ Price premiums
- ☐ Environmental benefits
- ☐ Cost savings
- ☐ Other

Q19. What are the five most important topics that Extension educators and researchers can work on to help you be more successful with your apple business? Choose five topics and indicate order of importance by numbering from 1-5 where 1 = most important and 5 = least important.

Top Five Issues	**Order of Importance (1-5)**
Integrated Pest Management	
Marketing	
Succession planning	
Pricing	
Insecticide alternatives	
Fruit quality	
Variety Selection	
Disease management	
Crop load management	
Fertility management	
Pruning	
Budgeting and finances	
Managing surpluses	
Hiring and training labor	

Q20. Is there other information that you would like to see Extension educators and researchers provide to help improve your apple orchard management and profitability?

_____

_____

_____

_____

_____

_____

Would you like to be entered into a random drawing for one of four $25 VISA gift cards?

- ○ Yes
- ○ No

If you would like to be entered into the gift card drawing, please enter your email address and telephone number. We will use this information to contact you if your name is drawn for the $25 VISA gift card.

- ○ Email address _____
- ○ Telephone number _____

SURVEY END

THANK YOU FOR COMPLETING THE APPLE GROWER SURVEY!

Please place your completed survey in the self-addressed, stamped envelope and return by March 30, 2023.