Tart Cherry
IPM Self-Assessment Guide

Acknowledgements

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Special thanks to the growers and industry representatives who took the time to pilot test the Tart Cherry IPM Framework, as well as those who reviewed the Guidebook. Further thanks to Nikki Rothwell and Erin Lizotte of the Northwest Michigan Horticultural Research Station, who helped pull together focus groups and who always responded to requests for information quicker than could be hoped for.

The development of this assessment guide was completed under the sponsorship of the Board of Trustees of Michigan State University. Funds for the project were made available by the United States Department of Agriculture, Cooperative State Research, Education, And Extension Service.

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Introduction

The Tart Cherry IPM Self-Assessment Guide will help you assess your level of IPM use in your orchards, and it will serve as a compiled resource on tart cherry IPM practices. By identifying areas of strength and areas where improvements can be made, the Guide can serve as the foundation of a plan to improve your operation, and thus it can be a resource for NRCS programs such as EQIP and for MAEAP cropping system verification. Tips on how to succeed with EQIP, developed by the MSU Integrated Pest Management Program, and a copy of the Fruit*A*Syst publication, developed as part of the MAEAP cropping system verification program, are both found at the end of your Guide.

Development of IPM Self-Assessment Guide

The Tart Cherry IPM Self-Assessment Guide (the Guide) grew out of a need to define and measure IPM adoption among tart cherry growers as part of a USDA Risk Avoidance and Mitigation Program (RAMP) grant, which was originally funded in 2003 and renewed for additional funding in 2008. During the final year of RAMP I, a draft framework for defining and measuring tart cherry IPM was developed. The framework operates at three levels: strategies, tactics and tools. The project identified four principal IPM strategies for tart cherry orchards: 1) knowledge and continuing education, which includes staying abreast of new technologies as they come on the scene and applying information from best possible sources; 2) monitoring, the foundation of any IPM program; 3) pest suppression, including insects, mites, weeds, fungi, bacteria, nematodes and viruses; and 4) drift management. Once all the major practices were identified, the hard work of assigning points to practices began (because not all practices were created equal!). The assigned points should be revisited every year as new practices come on the scene.

RAMP II work focused on validating the IPM Framework by researchers, industry representatives and growers, and subsequently calculating IPM scores for 2010 survey respondents to measure their adoption. The process used to finalize the Framework by assigning points to practices included: 1) project researchers negotiated points for each practice at meetings and phone conferences; 2) tart cherry growers and industry representatives discussed the initial ratings during two focus groups in Utah and Michigan; 3) grower and industry comments were brought back to a combined group of project researchers and growers to discuss and reconcile differences. The final draft of the framework includes four strategies, 21 tactics and 71 tools.

During the meetings with growers and industry representatives, participants agreed that the best format for the IPM Framework would be a workbook that could be used for educational purposes as well as measuring adoption. With the help and direction of the RAMP team of researchers, growers and industry representatives, Jean Haley, the evaluation specialist at Haley Consulting Services, developed the initial drafts for review.

How to use this guide

The Guide is composed of three main sections: the reference guide, the tally sheets, and additional resources. The **reference guide** is divided into four chapters, each dedicated to a single strategy. Chapter 1 focuses on knowledge and continuing education, Chapter 2 focuses on monitoring, Chapter 3 focuses on pest suppression, and finally, Chapter 4 focuses on pesticide drift management. Within the chapters, each tactic has one page dedicated to it and includes a brief description of the tools that make up that tactic, along with the corresponding number of points.

The **tally sheets** bring all the strategy, tactics and tools together in a way that facilitates adding up your IPM score. The page numbers in the reference guide that correspond to each tactic and tool are provided for easy reference. In addition, a column has been added to provide the MAEAP Fruit*A*Syst practices that correspond to each of the tools. This will aid you in the process of obtaining MAEAP Cropping Assurance certification. At the end of the tally sheets you will find a summary section that allows you to add up your IPM score. To identify what category of IPM you are currently practicing, simply locate your score on the table provided on the same page. After you have added up your scores for each section and identified your level of IPM, the final section of the tally sheets provides space for creating action plans for improvement. In the tables provided, you can note what tools you would like to start using; where in the reference guide the tool is described; notes on people to contact, reference materials and to-do items; and a projected completion date.

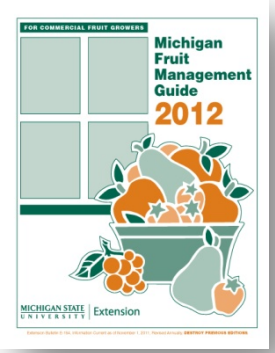
The final section includes **additional resources**, such as tips for succeeding with EQIP, the Fruit*A*Syst publication for MAEAP cropping assurance certification, the Michigan Department of Agriculture *Generally Accepted Agricultural Management Practices for Pesticide Utilization and Pest Control*, and a list of useful websites.

Strategy 1: Knowledge & Continuing Education (48 Points)

Keeping up-to-date on what's new in tart cherry management and in IPM in general is basic maintenance for your orchard management in the same way that keeping up-to-date on oil changes is basic maintenance for your car. Your car will continue to run without regular oil changes, but it will be a lot more efficient if those changes are made at their regularly scheduled times.

A. Attend meetings and workshops, keep up-to-date on new information (28 Points)

Tool	Possible Points	Your Points
Read university / extension publications (1 pt each)	8	
Attend state or regional IPM meetings/ seminars/ demonstrations and field days (2 pts each)	8	
Receive advanced IPM training (3 pts each)	9	
Read & review Ecology/Ecosystem-related publications and websites (non-cumulative)	3	
Total Points	**28**	



Reading and consulting university and extension publications is a good place to start. Some examples include: Weekly pest advisory service (CAT alerts, email). The CAT Alerts offer pest and crop management advice for current conditions. The information is written by MSU faculty and Extension educators. CAT Alerts can be found on the web at: http://ipmnews.msu.edu/fruit/; University fact sheets and/or bulletins can be found at the MSU Extension Bookstore: http://web2.msue.msu.edu/bulletins2/ ; Spray/Fruit management guide which can also be ordered online at the MSUE Bookstore; and Tart Cherry RAMP publications.

Regional IPM meetings, seminars, demonstrations and field days are held throughout each state where tart cherries are grown. These meetings provide opportunities for growers to bring examples of pests and damage they have in their orchards, as well as observe demonstrations of new IPM practices available to them. These are perhaps some of the best ways for growers to remain up-to-date on IPM practices specific to tart cherries. For a list of meetings sponsored by the Northwest Michigan Horticultural Research Station, go to http://agbioresearch.msu.edu/nwmihort/cal.html

Every two years, MSU Extension conducts the Tree Fruit IPM School, which provides advanced IPM training. The program has been designed to take an in-depth look at problematic pests and diseases in Michigan orchards and highlight the new and innovative research that helps develop effective control strategies.

The *Fruit Crop Ecology and Management* manual published by MSU Extension (Bulletin E-2759) is a good example of ecosystem-related literature that can help with managing tart cherry orchards. This is also available for order online at the MSUE Bookstore.

B. Consult with and use the services of knowledgeable people for pest management decisions (12 points)

Tool	Possible Points	Your Points
Chemical rep trained in IPM	2	
University / extension personnel	4	
Independent crop consultant (employed throughout the season)	6	
Total Points:	**12**	

Consulting with others within and outside of your operation is part of the daily life of tart cherry producers. When doing so, it is important to seek advice from individuals who are knowledgeable about the latest science available on pest management in tart cherry orchards. This includes chemical representatives who have been trained in IPM (2 points), rather than representatives whose sole objective is to sell product; university and extension personnel who work in tart cherry research (4 points); and independent consultants who are employed throughout the season (6 points). To be awarded the 6 points for consulting with independent crop consultants, the consultant must be employed throughout the season, not simply consulted on a one-time basis.

C. Participate in USDA Natural Resources Conservation Service (NRCS) and Michigan Agriculture Environmental Assurance programs (8 points)

Tool	Possible Points	Your Points
Environmental Quality Incentives Program (EQIP)	4	
Conservation Security Program (CSP)	2	
Wildlife Habitat Incentives Program (WHIP)	2	
MAEAP Cropping System Verification Program	4	
Total Points:	**12**	

NRCS works with landowners through conservation planning and assistance to benefit the soil, water, air, plants, and animals for productive lands and healthy ecosystems. Science and technology are critical to good conservation. NRCS experts from many disciplines come together to help landowners conserve natural resources in efficient, smart and sustainable ways. (http://www.nrcs.usda.gov/about/)

The Environmental Quality Incentives Program (EQIP) is a voluntary program that provides financial and technical assistance to agricultural producers through contracts up to a maximum term of ten years in length. These contracts provide financial assistance to help plan and implement conservation practices that address natural resource concerns and for opportunities to improve soil, water, plant, animal, air and related resources on agricultural land and non-industrial private forestland. In addition, a purpose of EQIP is to help producers meet Federal, State, Tribal and local environmental regulations. For more information, go to their website at http://www.nrcs.usda.gov/programs/eqip/.

The Conservation Stewardship Program (CSP) is a voluntary conservation program that encourages producers to address resource concerns in a comprehensive manner by: undertaking additional conservation activities; and improving, maintaining, and managing existing conservation activities. The program provides equitable access to all producers, regardless of operation size, crops produced, or geographic location. For more information, go to their website at http://www.nrcs.usda.gov/programs/new_csp/csp.html.

The Wildlife Habitat Incentive Program (WHIP) is a voluntary program for landowners who want to develop and improve wildlife habitat on agricultural land, nonindustrial private forest land, and Tribal land. NRCS administers WHIP to provide both technical assistance and financial assistance to establish and improve fish and wildlife habitat. WHIP cost-share agreements between NRCS and the participant generally last from one year after the last conservation practice is implemented but not more than 10 years from the date the agreement is signed. For more information, go to their website at http://www.nrcs.usda.gov/programs/whip/.

The MAEAP Cropping System focuses on field-related environmental issues, such as irrigation and water use, soil conservation, and nutrient and pest management. Crop*A*Syst helps develop and implement a plan to prevent water resource contamination while maintaining economic crop production. Plans conform to applicable Michigan Right-to-Farm guidelines and comply with applicable state and federal environmental regulations. For more information about this program, go to their website at http://www.maeap.org/maeap/cropping/description.

Strategy 2: Monitoring (78 Points)

Monitoring is the cornerstone of any IPM program. This section describes the various components of a good monitoring program for tart cherries. Much of the information was developed from the publication A Pocket Guide for IPM Scouting in Stone Fruits by David Epstein, et al (MSU Publication E-2840).

A. Pest scouting during the season (16 points)

Tool	Possible Points	Your Points
Orchard inspection by paid crop consultant trained in IPM	5	
Orchard inspection by self or employee trained in IPM	5	
Each block of orchard inspected once per week by qualified individual (trained in IPM)	6	
Each block of orchard inspected every two weeks by qualified individual (trained in IPM)	3	
Total Points:	**16**	

The importance of pest scouting during the season cannot be overstated. As early as March, orchards should be scouted for European Red Mite and for borers. As the season progresses, it is important to scout on a weekly basis. It is also preferable to inspect each orchard block, as pest pressure can change significantly from block to block.

Ten possible points are scored in this section by having your orchards inspected by a paid crop consultant who is trained in IPM and whose services are retained throughout the season (5 points), and by scouting the orchards yourself or an employee if you or the employee have received IPM training (5 points).

Weekly inspection of the orchards is ideal and scores 6 points; scouting each block every two weeks will earn 3 points. In both cases, the orchards must be scouted by qualified individuals trained in IPM.

B. Monitor for beneficials (8 points)

Tool	Possible Points	Your Points
Use yellow sticky traps, beating tray or sweep net	4	
Visually check leaves/limbs/buds for predatory and parasitic insects or mites	4	
Total Points:	**8**	

Yellow sticky traps use glue that does not dry out to trap insects and mites. A pheromone lure is used to attract the insects to the trap. A beating tray uses a light colored cloth stretched on a frame. Placed beneath the tree, the tray catches arthropods as the tree is shaken. A sweep net is used for collecting insects in long grasses between rows or on the edge of the orchard.

Yellow sticky trap

Beating tray

sweep net

In addition to the above tools, visually checking the leaves, limbs and buds for predatory and parasitic insects and mites increases your understanding of what beneficials are present in the orchard. The tables below list common predators and parasites found in fruit crops.

Common predators and some of their prey	
Predators	**Prey**
Amoebae	Soilborne fungi, bacteria
Anthocorid bugs	Spider mites, thrips, aphids, pear psylla, young scale, various insect eggs
Bigeyed bugs	Lygus bugs, aphids, leafhoppers, spider mites
Collembola	Fungi
Ladybird beetles	Aphids, scale insects, pear psylla, mealybugs, other soft-bodied prey
Lacewings	Aphids, scale insects, mealybugs, pear psylla leafhoppers, thrips, mites
Mirid bugs	Spider mites, aphids, leafhoppers, pear psylla, scale insects
Mycophagous mites	Fungi, eg. grapevine powdery mildew
Nematodes	Soilborne fungi, bacteria, other nematodes
Predatory mites	Plant-feeding mites
Spiders	Pear psylla, aphids, leafhoppers
Syrphid flies or flower flies	Aphids, scale insects

Common parasites and some of their hosts	
Parasites	**Hosts**
Aphelinid wasps	Aphids
Tachinid flies	Caterpillars, beetles
Trichogramma wasps	Moth eggs
Bacillus thuringiensis (bacterium)	Butterfly/moth larvae
Pseudomonas fluorescens (bacterium)	Fungi
Polyhedrosis virus	Butterfly/moth larvae
Beauveria bassiana (fungus)	Many insects
Trichoderma harzianum (fungus)	*Pythium, Rhizoctonia* and other pathogens
Ampelomyces quisqualis (fungus)	Powdery mildew
Arthrobytris (nematode-trapping fungus)	Nematodes
Steinernema (nematode)	Insect larvae
Pasteuria penetrans (bacterium)	Nematodes

C. Use sampling & monitoring for insect & disease management decisions (15 points)

Tool		Possible Points	Your Points
Use cherry fruit-fly traps	Block-specific	5	
	Non block-specific	2	
Use pheromone-baited traps for monitoring insect pests (leafrollers, borers, green fruit worm)	Block-specific	6	
	Non block-specific	2	
Use plum curculio traps and/or monitor with visual inspection	Block-specific	4	
	Non block-specific	2	
	Total Points:	**15**	

The date of first emergence, as well as subsequent activity, of CFF can be monitored using yellow sticky traps baited with ammonium acetate. The greater the number of traps deployed per acre (at least one trap per 2.5 acres), the greater the confidence level in basing treatment decisions on fly catch. Proper trap maintenance is crucial to trap effectiveness. Use on-farm fly catches along with regional trapping information to determine control treatment timing. Basing treatment decisions solely on regional information may lead to unnecessary insecticide applications. (excerpted from *A Pocket Guide for IPM Scouting in Stone Fruits*).

Sex pheromones are powerful chemical attractants emitted by female insects. These chemicals are detected by the males, assisting them in locating unfertilized females for mating. Some pheromones attract only one type of insect, while others attract several related species. Pheromone traps are not intended for controlling pests alone, but aid in determining if a pest is present and whether a population is increasing, peaking, or decreasing. This information is essential in determining when and how often to time control actions.

Traps come in several designs, capitalizing on certain behaviors of some insects, such as a tendency to fly upward or search for protected sites. Color may also influence attractiveness. (excerpted from *Pheromone Traps for Insect Pest Management*, revised by Thomas Kowalsick (Cornell Cooperative Extension Horticulture Leaflet, 2008).

Pyramid traps are the most efficient means of monitoring plum curculio activity early in the season. These traps outperform in-tree screen traps in adult capture about 2:1 in many seasons. Baiting traps with lures (plum essence or benzaldehyde) significantly increases trap catch, but the addition of pheromone baits only slightly increase (1.2:1) plum curculio captures in either trap.

Traps are a good indicator of likely plum curculio pressure in the area and should be placed on the borders of orchards where producers or scouts have observed damage in past years. Forecast models for plum curculio are available at Enviro-weather (http://www.enviroweather.msu.edu/home). Select a weather station from the map that is closest to your location.

D. Use monitoring and sampling for mite management decisions (4 points)

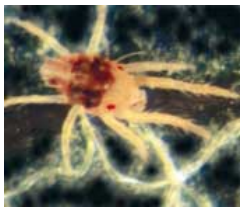
Tool	Possible Points	Your Points
Use economic thresholds for mite management decisions	4	
Total Points:	**4**	

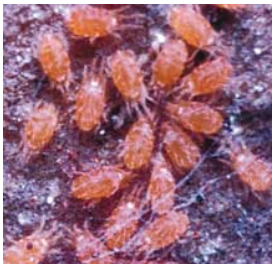
Excerpted from *A Pocket Guide for IPM Scouting in Stone Fruits*:
Mite feeding turns leaves brown (referred to as bronzing). Severe infestations can reduce overwintering carbohydrate levels, cause trees to defoliate and stunt young tree growth. Two key mites to look for include the Twospotted spider mites (TSSM), and European red mites (ERM).

Twospotted spider mites (TSSM) have 2 distinct spots located on the front half of the dorsum behind the eyes. Males are much smaller than females, and have a distinctly pointed abdomen. Color can vary from pale yellow to green. The overwintering adults turn orange in September. TSSM can be found in the tree canopy from tight cluster through harvest. They typically construct webbing on the underside of leaves.

European red mite (ERM) eggs begin hatching at tight cluster stage of bud development and are found on leaves or bark the rest of the year.

ERM overwinter as eggs on rough bark. The eggs are most commonly found near buds, fruit spurs, and in the fork of two branches. The female ERM (below on the left) is red or brownish-red with conspicuous white spots at the bases of their white bristles. The adult male (below on right) is smaller than the female, has a tapered abdomen, and is reddish-yellow.





Immature ERM often feed in groups within unfolding leaves.

For summer populations of both mite species, examine leaves from several locations in the orchard using 50% spur leaves, 50% shoot leaves. Treat based on the following thresholds:

- 2-3 mites/leaf from petal fall to mid-June
- 5-7 mites/leaf from mid-June through July
- 10-15 mites/leaf in August

Presence of predaceous mites (>1/leaf) may justify delaying a treatment and repeating the cycle the following week.

E. Monitor for weeds before making herbicide decisions (4 points)

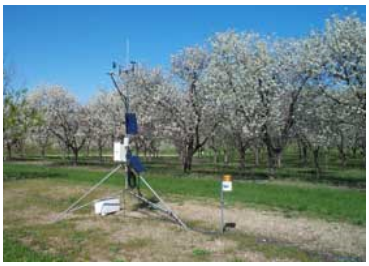
Tool	Possible Points	Your Points
Make herbicide decisions based on systematic survey of orchard for weed identification	4	
Total Points:	**4**	

Weeds compete for soil moisture and nutrients in newly planted and mature orchard crops, they sometimes host pests including plant viruses, and they can compete for pollinating bees in spring. A list of common weeds found in Michigan cherry orchards follows. Complete descriptions of these weeds can be found at http://cherries.msu.edu/pest.htm#weeds.

Annual sowthistle	Field horsetail	Redroot pigweed
Barnyardgrass	Giant foxtail	Scouringrush
Blackseed plantain	Giant ragweed	Slender speedwell
Broadleaf dock	Green foxtail	Smooth crabgrass
Broadleaf plantain	Ground ivy	Smooth pigweed
Buckhorn plantain	Hedge bindweed	Spiny sowthistle
Bull thistle	Horsenettle	Spotted napweed
Canada goldenrod	Horseweed	Swamp smartweed
Canada thistle	Ladysthumb	Tumble pigweed
Common chickweed	Large crabgrass	Velvetleaf
Common lambsquarters	Purslane speedwell	Venice mallow
Common mallow	Marestail	Vetches
Common milkweed	Mouseear chickweed	Virginia creeper
Common purslane	Pale smartweed	Western ragweed
Common ragweed	Pennsylvania smartweed	Wild grapes
Corn speedwell	Perennial sowthistle	Wild mustard
Curly dock	Poison ivy	Wild proso millet
Dandelion	Powell amaranth	Witchgrass
Eastern black nightshade	Prickly lettuce	Yellow foxtail
Fall panicum	Prostrate pigweed	Yellow nutsedge
Field bindweed	Quackgrass	

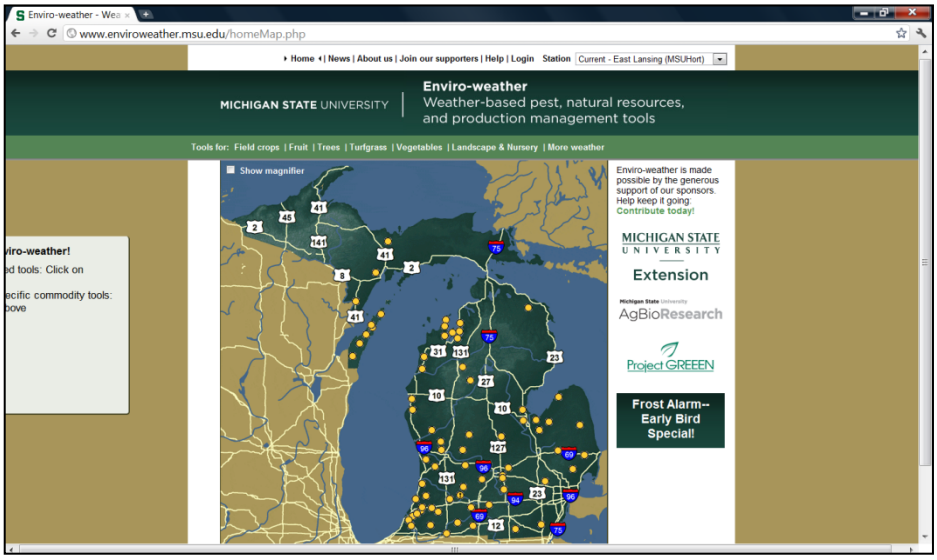
F. Monitor the weather for disease & insect management decisions (12 points)

Tool		Possible Points	Your Points
On-farm weather station (4 pts each; max 8)		8	
Consult Enviro-weather or other weather-based models (credit for one or the other)	Before every spray decision	4	
	About every week during the season	2	
	Total Points:	**12**	



Using weather data can help with insect pest and disease management decisions. In general, the more accurate the data collected for specific orchards, the better the decisions. This is why many growers choose to install their own on-farm weather stations. Models for predicting fungal infections and insect growth (Growing Degree Day – GDD) aid in timing pesticide applications.

Enviro-weather is a sustainable weather-based information system that helps users make pest, plant production, and natural resource management decisions in Michigan. Users can view weather-based information about crop maturity, irrigation needs, growing degree days, forecasts, weather conditions, disease and insect predictions, and much more on the Enviro-weather website (www.Enviroweather.msu.edu). Enviro-weather includes 64 weather stations throughout Michigan that continuously collect data on air and soil temperature, precipitation, soil moisture, wind speed and direction, and leaf wetness. Specific to tart cherries, Enviro-weather has Plum Curculio and Cherry leaf spot models.



G. Maintain pesticide and scouting reports (6 points)

Tool	Possible Points	Your Points
Electronic or Written records	6 5	
Review report histories to inform management decisions`	2	
Total Points:	**8**	

Beyond being a good business practice in general, pesticide record keeping aids in management decisions from year to year, provides liability protection, and is needed in order to develop a pest management plan for NRCS and MAEAP. In addition, the federal pesticide recordkeeping regulations, the federal worker protection standards, and the Michigan Right to Farm GAAMPs all have requirements related to pesticide recordkeeping. The following table helps clarify which programs require which records (from *Generally Accepted Agricultural and Management Practices for Pesticide Utilization and Pest Control*, 2010, Michigan Department of Agriculture).

Data to Record	Federal Record Keeping	Worker Protection Standards	Michigan Right to Farm
Month/day/year	x	x	x
Time of application		x	
Pesticide brand/product name	x	x	x
Pesticide formulation			x
EPA registration number	x	x	x
Active ingredient(s)		x	
Restricted-entry interval (REI)		x	
Rate per acre or unit			x
Crop, commodity, stored product, or site that received the application	x		x
Total amount of pesticide applied	x		x
Size of area treated	x		x
Applicator's name	x		x
Applicator's certification number	x		x
Location of the application	x	x	x
Method of application			x
Target pest			x
Carrier volume per acre			x

Using computer software to record monitoring and pesticide applications makes it easier to summarize data and look for trends in pest pressure. You can set up your recordkeeping using a spreadsheet, like Microsoft Excel, or several software packages exist on the market for tracking monitoring, pesticide application, and general farm operations. In the absence of computer programs, paper files are still a good alternative as long as they are consulted each year.

H. Monitor soil & leaf health/quality (8 points)

Tool	Possible Points	Your Points
Conduct soil samples & lab tests at least every 3 years	4	
Conduct leaf samples & lab tests at least every 3 years	4	
Total Points:	**8**	

Soil testing is an important diagnostic tool to evaluate nutrient imbalances and understand plant growth. Soil test results provide information about the soil's ability to supply nutrients to plants for adequate growth, and are the basis of deciding how much lime and fertilizer are needed. The regular soil test at the MSU Soil and Plant Nutrient Laboratory includes determination of soil pH, available phosphorus, potassium, calcium, and magnesium levels as well as recommendations for lime and fertilizer. Other soil tests are available at supplemental costs, such as, organic matter, zinc-manganese, etc. MSU recommends testing soil every 3 years. If recent results are not consistent with past results, notify your county MSU Extension agent or the lab within one month to rerun the questioned test. For more information, look at the Soil and Plant Nutrient Laboratory's website at http://www.css.msu.edu/SPNL/

The following is from a CAT-Alert article, Time to collect leaf samples for nutrient management (Vol. 23, No. 15, August 5, 2008) written by Eric Hanson.

> Leaf analysis is the best way to monitor the nutrition of fruit plantings. This procedure provides a direct measure of the nutritional health of plants as soil tests only provide an estimate. Leaf analyses can be used to diagnose nutritional problems and to identify developing problems before growth or yield is affected. Sample young plantings every one to two years and established plantings every two to four years. The whole farm can be sampled every three to five years, or portions sampled more frequently.
>
> - **Define sampling units.** Divide the farm into sampling units or areas that have uniform soil types, management history and variety. Farms with variable soils or history will require more sampling units to provide an accurate picture of the nutritional health. If the farm is very uniform with large blocks of the same age and varieties, define units no larger than 10 to 15 acres.
> - **Sampling.** Sample leaves in late July to early August. Collect at least 50 leaves from different plants throughout the sampling unit. Select healthy leaves from the middle of this year's shoots. If the leaves are dusty, rinse them briefly in tap water, and lay them out on a table top until they are dry to the touch.
> - **Submitting samples**. Package leaves in clearly labeled paper bags, and send them to a reputable laboratory.
> - **Diagnosing nutritional problems.** If you wish to diagnose a suspected nutritional problem, collect one sample from plants beginning to develop symptoms of the problem, and a second from nearby healthy plants. These samples can be collected at anytime during the season.

I. Monitor the tree-vigor (5 points)

Tool	Possible Points	Your Points
Monitor shoot-growth	2	
Visually monitor leaf-to-fruit ratio for management decisions	3	
Total Points:	**5**	

From *Fruit Crop Ecology and Management:*

> Shoot growth builds the structure of the tree, which supports fruit and leaves. The rate of shoot growth peaks after fruit set and decreases when fruit starts the phase of fast growth. …Vegetative and reproductive growth can be adjusted through management of water, nutrients and pruning. (page 15)
>
> Pruning is probably the most important operation to maintain plant vigor and productivity, achieve large fruit size and superior quality, reduce insect and disease pressure, and develop appropriate growth habits for harvesting. … Proper pruning balances good fruit production with growth of vigorous new vegetation. (page 20)

Crop production and quality are dependent upon the supply and demand for carbon. The leaves are the primary organs responsible for photosynthesis in cherry. The carbon produced is utilized to produce fruit, leaves, stems, roots, and buds for the next year. Since leaves are only on the tree about 7 months out of the year, any damage to the leaves will reduce the supply of carbon.

Cherry trees should have at least 2 leaves per fruit, and the leaves should be functional. If you have damaged leaves, then the number increases in relation to the amount of damage. For example if you have 50% damage to leaves, then the threshold would be 4 leaves per fruit.

Strategy 3: Pest suppression (insects, mites, weeds, fungi, bacteria, nematodes and viruses) **(78 Points)**

Many pest suppression tactics and tools correspond to monitoring tactics in the previous section. Monitoring is only worthwhile if you use it to make and implement management decisions in your orchards.

A. Protect/conserve natural enemy populations & pollinators (12 Points)

Tool	Possible Points	Your Points
Select insecticides to protect insect natural enemies	4	
Select pesticides to protect mite natural enemies	4	
Select pesticides to protect pollinators	4	
Total Points:	**12**	

Although pesticide sprays are generally targeted against one or a few pest populations, they often influence other pest and non-pest species. Some insecticides are very toxic to predators and parasitoids. Destroying these natural enemies often results in target pest resurgence or secondary pest outbreaks. Some pesticides have a greater impact on the natural enemies than the target pest. Target pest resurgence can result when the unfavorable ratio of pests to natural enemies permits a rapid increase or resurgence of the pest population. For example, biological control of twospotted spider mite by predatory mites is common in many fruit crops. Insecticides that are applied for control of pest mites and insects are often highly toxic to predatory mites. Some pest mites survive the spray, but most predators are killed. The population of twospotted spider mites is able to quickly rebound, reaching economically damaging levels before its natural enemy can re-colonize from unsprayed areas (excerpted from *Fruit Crop Ecology and Management*, p.61).

The article, *Functional Ecology for Fruit Agro-ecosystems* by Mark Whalon, found in the 2012 Michigan Fruit Management Guide provides some background on the ecosystem benefits, and subsequently the benefits to your bottom line, of selecting pesticides to protect natural enemies and pollinators. Also included is a table of chemistries and their corresponding level of toxicity or relative safety for bees and other beneficials.

Refer to page 7 on *Monitoring for beneficials* for a discussion of pest parasites and predators.

B. Practice resistance management (24 points)

Tool	Possible Points	Your Points
Rotate insecticide modes of action	4	
Rotate fungicide modes of action	4	
Rotate herbicide modes of action	4	
Review insect & chemical histories in the orchard for resistance management decisions	2	
Review disease & chemical histories in the orchard for resistance management decisions	2	
Review weed & chemical histories in the orchard for resistance management decisions	2	
Test for resistance for disease mgmt as part of a university study/program	1	
Test for resistance for insect mgmt as part of a university study/program	1	
Test for resistance for weed mgmt as part of a university study/program	1	
Develop a resistance management plan & implement it in the orchard	3	
Total Points:	**24**	

From *Fruit Crop Ecology and Management:*

Insecticide resistance
Selection for resistance can occur if a small proportion of the insect population is able to survive treatment with insecticide. These rare resistant individuals can reproduce and pass on their resistance to the offspring. If an insecticide with the same mode of action is repeatedly used against this population, an even greater proportion will survive. Ultimately, the once-effective product no longer controls the resistant population.

Fungicide resistance
Single-step pesticide resistance arises suddenly in the field. A single gene or physiological function changes so that an individual becomes highly resistant to the pesticide. With just one or two sprays of the pesticide, the population shifts from mostly sensitive to mostly resistant individuals.

Multi-step pesticide resistance arises slowly in the field over many years. Rather than having distinct groups of sensitive and resistant individuals, the population consists of individuals with a range of sensitivities to the pesticide. With each pesticide application, those individuals at the more resistant end of the spectrum survive and reproduce. Over the years, the proportion of the population that can survive a pesticide spray increases, until that pesticide eventually becomes ineffective. The shift toward resistance leads to a gradual erosion of control.

Resistance management
Growers can help delay the development of resistance by applying pesticides only when they are needed, by rotating between different chemical classes, and by using rates of pesticides within the labeled range. Integrating non-chemical approaches such as pheromone mating disruption and cultural controls can also help delay resistance. (Pages 19-20)

The 2012 Michigan Fruit Management Guide contains an insecticide compatibility chart for resistance management on page 263.

C. Manage & maintain tree vigor (9 Points)

Tool	Possible Points	Your Points
Apply soil micro & macro nutrients based on test results	3	
Apply foliar micro & macro nutrients based on test results	3	
Prune for bud initiation, to maintain adequate ratio of leaf to fruit buds, & improved spray coverage	2	
Use Giberillic acid	1	
Total Points:	**9**	

Refer to Strategy 2 (Monitoring), Tactic H on page 13 for a discussion of conducting soil and leaf testing. These test results are only worthwhile if they are used for micro and macro nutrient applications.

Gibberellic acid (GA) is used in young tart and sweet cherries to reduce flowering and fruiting which maximizes growth and minimizes pollen transmitted virus infection. GA is used in mature tart cherries to increase the fruiting capacity by stimulating the development of lateral shoots and spurs (Nugent, 2006). Gibberellic acid should be applied in 50-150 gallons in water. For best results, apply gibberellic acid when the temperature is 70ºF or above. At lower temperatures, the uptake has not been adequate, and the applications were less successful. Do not use surfactants because they can cause phytotoxicity. (MSU CAT Alert Vol. 22, No. 7, May 22, 2007)

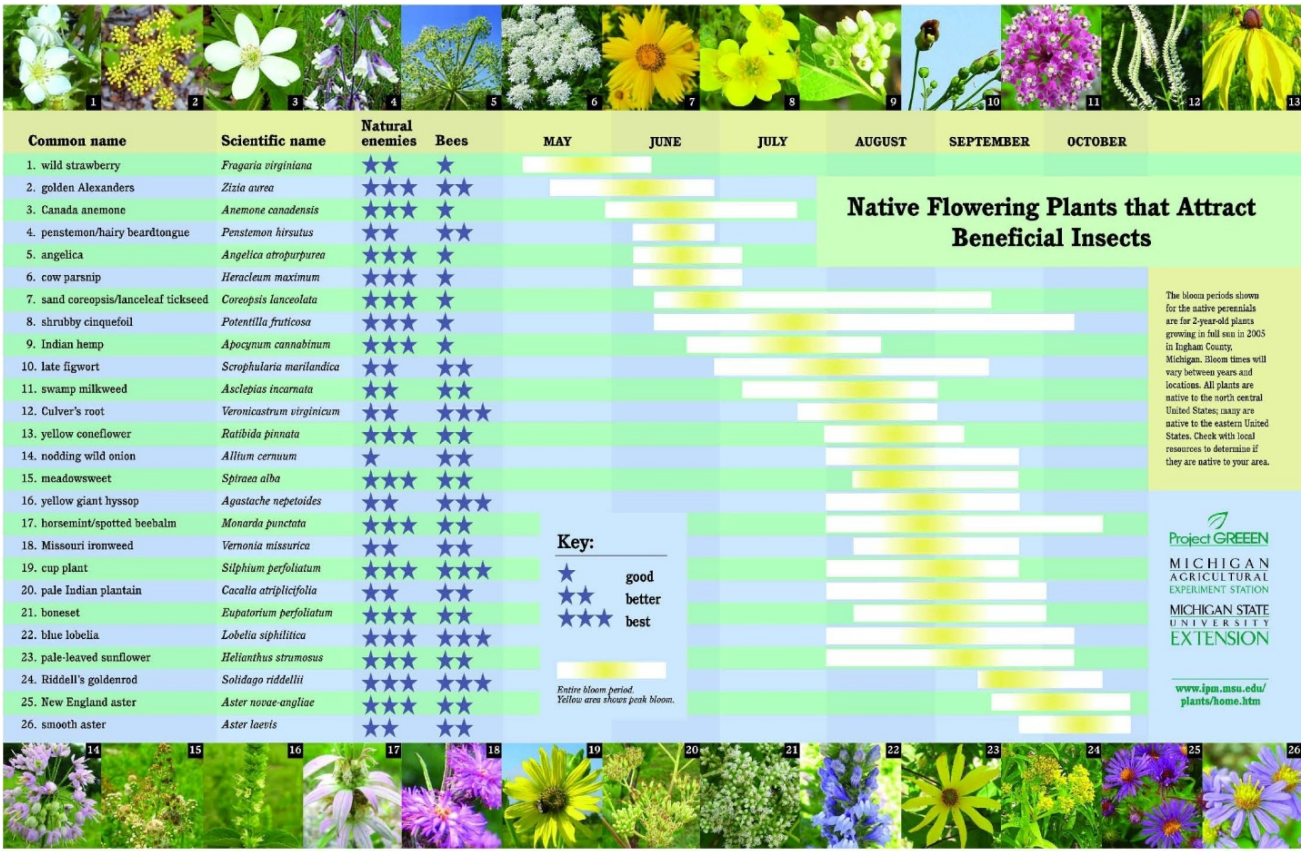
D. Use cover crops and/or companion plantings (12 points)

Tool	Possible Points	Your Points
Plant cover crops to suppress weed pests and/or enhance soil nutrients and quality	4	
Maintain plants and/or cover crops to support insect natural enemies	4	
Maintain companion plantings outside the orchard to augment natural enemies and/or natural pollinators	4	
Total Points:	**12**	

Cover crops help control soil erosion, increase soil health, protect water resources, decrease dependence on commercial fertilizers and decrease pesticide use. All of these benefits add up to financial as well as environmental savings on the farm.

The availability of flowering plants within the orchard can help conserve beneficials because the adult stage of many predators and parasites feeds on nectar and pollen.

The following table provides a list of flowering plants that are native to Michigan and a rating for how well they attract natural enemies and bees.



From: Fiedler, A. J. Tuell, R. Isaacs, and D. Landis. *Attracting Beneficial Insects with Native Flowering Plants.* MSU Extension Bulletin Inventory Number E2973.

E. Manage and conserve moisture in the orchard (9 points)

Tool	Possible Points	Your Points
Use drip/trickle irrigation and/or mini/micro sprayers	3	
Schedule irrigation based on soil water monitoring	4	
Practices that maintain or improve/increase soil organic matter under the tree" e.g., mulching	2	
Total Points:	**9**	

The advantages of using drip/trickle irrigation or mini/micro sprayers are many. It minimizes soil erosion and weed growth; it helps maintain moisture within the root zone; foliage remains dry, which helps reduce the risk of disease; and it allows a more efficient use of water.

Monitoring the soil moisture is a critical step to optimizing irrigation scheduling.

Mulching, using cover crops and other organic amendments are good for nutrients, moisture and weed suppression.

F. Orchard floor management (8 points)

Tool	Possible Points	Your Points
Flailing, chopping & pruning for soil organic matter improvement	2	
Use mulching for weed suppression	2	
Use cultural practices to select for plant species that help with insect & mite management	2	
Maintain permanent vegetation between rows	2	
Use cultural practices for inoculum suppression (flail mowing of prunings, shredding of leaf litter, urea or manure applications in drive row)	2	
Total Points:	**10**	

The above practices for orchard floor management are all geared towards providing the trees with the appropriate moisture and nutrients, and towards managing weed, insect, mite and disease pests in the orchards. Flailing, chopping and pruning can improve soil organic matter, thus providing essential nutrients for the trees. Mulching provides a good option for suppressing weeds, which compete for nutrients and water.


Cherry orchard floor management

Opportunities to improve profit and stewardship

Highlighted findings

For more detailed information on orchard floor management, refer to the MSU Extension Bulletin E-2890, titled: *Cherry Orchard Floor Management: Opportunities to improve profit and stewardship.* This report can be downloaded online at: http://www.ipm.msu.edu/pdf/E2890CherryReport.pdf

G. Maximize pesticide efficacy (2 points)

Tool	Possible Points	Your Points
Test water for pH levels	1	
Check tank mix compatibility	1	
Total Points:	**2**	

From *The Effect of water pH on the stability of pesticides*, CAT Alert prepared by Annemiek Schilder:

> The pH of water can negatively affect the stability of some pesticides. Under alkaline conditions, alkaline hydrolysis occrs which degrades the pesticide to non-toxic (inactive) forms. In general, insecticides (particularly organophosphates and carbamates) are more susceptible to alkaline hydrolysis than are fungicides, herbicides or growth regulators. The end result is less active ingredient applied and poor pesticide performance. …
>
> Check the pH of the water used for spraying pesticides frequently throughout the season. If you know that your water has a pH of 7.5 or greater, consider lowing the pH, especially if you are applying a pesticide that is sensitive to hi pH. The fasted way to determin the pH level of water is to test it with a pH meter or test paper. …
>
> Adjust the water pH by using a commercially available acidifying/buffering agent before adding the pesticide.

The complete CAT Alert, along with a table that lists several pesticides and their optimal pH, is available online at:
http://ipmnews.msu.edu/fruit/Fruit/tabid/123/articleType/ArticleView/articleId/795/Effect-of-water-pH-on-the-stability-of-pesticides.aspx

Review the label before opening a pesticide container so that you are familiar with current mixing and usage directions. If two or more pesticides are to be mixed, they must be compatible and mixed in the proper order. The 2012 Michigan Fruit Management Guide includes a compatibility chart on page 262. This chart is primarily for apples, so it may be incomplete for tart cherries, but it is still a useful resource to consult.

H. Bonus: Participate in on-farm experiments / Use experimental practices (18 points)

Tool	Possible Points	Your Points
Use entomopathogenic nematodes for insect control	3	
Use entomopathogenic fungi for insect control	3	
Use GF-120 bait	3	
Relocate or introduce generalist predators (e.g., ladybird beetles, parasitic wasps)	3	
Relocate or introduce predatory mites	3	
Use bird or bat boxes to encourage vertebrate predators of rodent pests (e.g., mice and voles)	3	
Total Points:	**18**	

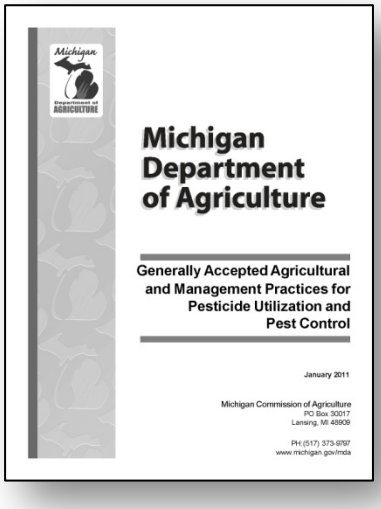
The bonus points earned in this section can be used to boost your overall score. These points all reflect experimental practices that may still require further research. Most of these tools were researched during the RAMP I and II projects. As further research is conducted, these practices will gradually migrate into the approved and suggested IPM practices, or they will be removed from this list. You can check with the Northwest Horticultural Research Station for the latest recommendations for these practices.

Strategy 4: Drift Management (9 Points)

Spray drift is the movement of spray droplets in the air. The spray droplets are carried in the air beyond the application site. A concentrated dose of droplets that moves off-target can cause damage or leave illegal residues. To minimize off-target spray drift, labels state specific precautions.

A. Minimize pesticide drift (9 points)

Tool	Possible Points	Your Points
Follow a drift management plan	2	
Calibrate your sprayer annually	2	
Maintain windbreaks around your orchards	1	
Consult the forecast before spraying	1	
Avoid spraying on windy days	1	
Use a sensor-controlled sprayer	1	
Use a sprayer that improves uniformity and droplet size	1	
Total Points:	**9**	

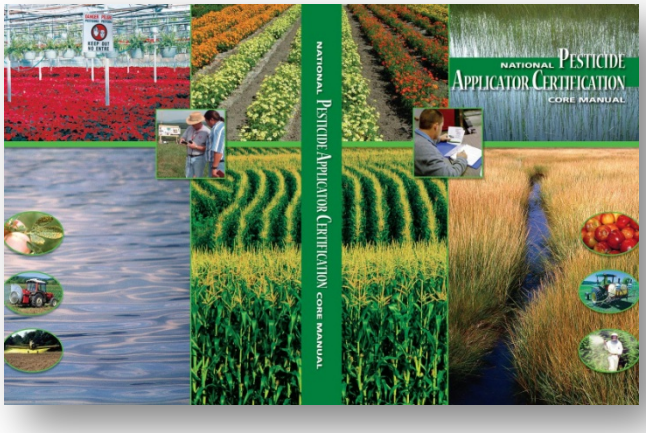


According to the Michigan Department of Agriculture's Generally Accepted Agricultural Management Practices, "All pesticide applications are required to be made in a manner that minimizes off-target drift. When pesticide off-target drift is anticipated due to the nature of the application, a Drift Management Plan shall be utilized by the applicator to minimize the occurrence and adverse effects of off-target drift. … A Drift Management Plan shall be in writing, and MDA will consider the presence and use of a written Drift Management Plan as a factor in determining appropriate enforcement action in the event of drift."

Calibrating your equipment annually is critical for making sure you are applying pesticides at the intended rate and distribution pattern.

Key things to look for when consulting the weather include temperature, humidity, wind speed and direction, and whether or not heavy rain is in the forecast. Drift occurs more readily on hot days where there is low humidity. Knowing the wind speed and direction will help plan for how to deal with what's downwind.

For a more comprehensive discussion of drift management, you can consult Chapter 7 in the National Association of State Departments of Agriculture's *National Pesticide Certification Core Manual.* The manual can be consulted and downloaded online at: http://www.nasda.org/?ID=31088



Additional Resources

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- Cherry Marketing Institute: http://www.choosecherries.com/
- Common weeds found in Michigan cherry orchards: http://cherries.msu.edu/pest.htm#weeds
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- MAEAP Cropping System Certification: http://www.maeap.org/maeap/cropping/description
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