

Appendix 1. Timeline of Worker Activities in North Central Region Vineyards

(Note: In southernmost areas of North Central Region, these activities may begin about a month before listed here.)

Early Season Activities (no pesticides applied during this time period):

January/February: Pruning & trimming, equipment repair

March: Pruning, equipment repair, push & chop brush, dormant scouting (diseases, ERM)

April: Pruning, equipment repair, push & chop brush, planting, scouting for early insects – grape berry moth, CW, GFB), disease scouting (Phomopsis).

In-Season Activities (Pesticides applied & residues present during this time period)

- There are no aerial pesticide applications in regional vineyards
- Pest management activities from bud swell (April) to harvest in Sept-October
- Pesticides generally applied using covered cab tractors
- Alternate row application is common and volumes of water used are 20-50 per acre.
- Vineyards are scouted by growers, consultants or independent scouts. Scouting intensity varies widely among farms, but weekly scouting is recommended.
- Average time raking/pushing brush: In wine grapes 30 hrs/10 acres pushing and raking brush. This is generally not done in juice grapes. In juice grapes prunings are left in row middles and chopped with a mower.
- Herbicide applications performed on average 2-4 times per year during residue window; average application time = 3 hrs/10 ac; 90% applied with closed cab
- Irrigation activities = Used rarely in juice grapes (only on very sandy sites). Not widely used in wine grapes but becoming more common.
- In juice grapes, harvest is primarily by over the row machine. Average of 15 to 25 hrs per 10 acres (depending on crop load), with 2-3 people (driver, person directing the outflow, and additional tractor driver for transferring harvested grapes out of the vineyard).
- Crop load adjustment usually not done in juice grapes but it is becoming more common. If done, this is done mechanically, using a harvester without the grape catching mechanisms.
- In wine grapes hand harvesting is more common, and harvesting takes 10 to 100 worker hours per acre depending on crop load.
- Mowing in juice grapes takes 2 hrs per 10 acres; most vineyards are mowed 3 to 6 times per year. In wine grapes mowing is generally slower, 10 hrs per 10 acres, and most vineyards are mowed 5 to 10 times per season.

May: weekly insect and disease scouting begins, frost protection as needed (wind machines), mowing of drive rows

Potential Spray Applications (99% with closed cab)

1. Fungicides for black rot, Phomopsis, powdery mildew, downy mildew applied prophylactically at pre-bloom and bloom growth stages, also sprays for mildews if weather conditions are favorable for disease development. May weather is generally favorable for disease development with wet weather.
2. Insecticides for cutworm, flea beetle, potato leafhopper and rosechafer if needed in winegrapes.
3. Herbicides if weather conditions favorable for weed development

June: weekly insect and disease scouting continues, mowing of drive rows, check irrigation lines

Potential Spray Applications (99% with closed cab)

1. Fungicides for black rot, phomopsis, powdery mildew, downy mildew if weather conditions favorable for disease development
2. Insecticides for grape berry moth, grape leafhopper, potato leafhopper, GP if populations require control
3. Herbicides (clean-up sprays)

July: weekly insect and disease scouting continues, mowing.

Potential Spray Applications (99% with closed cab)

1. Fungicides for powdery and downy mildew if conditions favorable for disease
2. Insecticides for grape berry moth, Japanese beetle, grape leafhopper if needed
3. Herbicides (clean-up sprays)

August: weekly insect and disease scouting continues, mowing. Harvest begins in southernmost part of the region.

Potential Spray Applications (99% done with closed cab)

1. Fungicides for downy mildew, powdery mildew and developing cluster diseases
2. Insecticides for grape berry moth, Japanese beetle, leafhoppers
3. Herbicides (can help with air movement through canopy)
4. Netting applied before harvest as fruit ripens to minimize bird damage

Sept-October: weekly insect and disease scouting continues, mowing. Prepare machinery for harvest which typically begins in early September for juice grapes in MI and OH, with winegrapes starting later in the month.

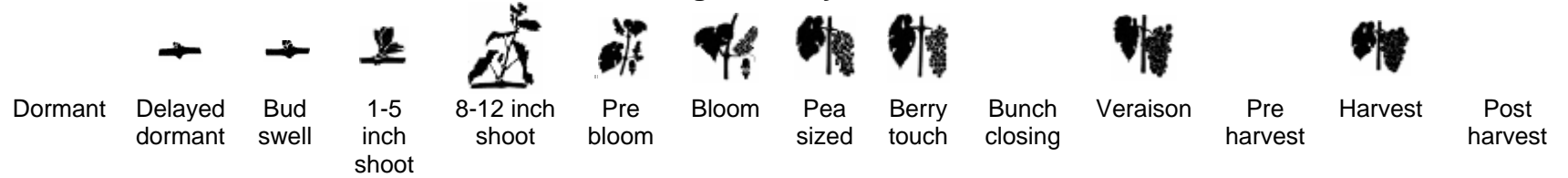
Potential Spray Applications (99% done with closed cab)

1. Fungicides for Botrytis, mildews
2. Insecticides for grape berry moth, multicolored Asian ladybeetle, yellowjackets
3. Herbicides (applications if needed at this time to ensure air movement through canopy)

October: There is little pest management activity after harvest. Some late weed control and mowing may be done in preparation for winter.

Appendix 2. Calendar of Worker Activities in North Central Region Vineyards

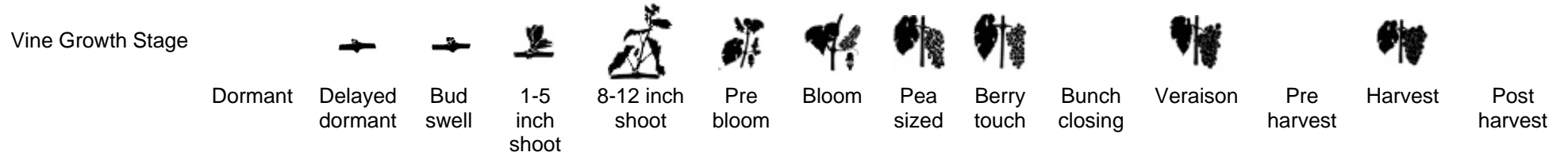
Vine Growth Stage



	March	April/ May	May	May	June	June	July	July	July	August	Sept	Sept	Oct
Fungicide spray													
Insecticide spray													
Herbicides - wine													
Herbicides - juice													
Scouting													
Pruning													
Shoot positioning													
Leaf pulling													
Weed Control-Mechanical													
Cluster Thinning													
Mowing													
Hand harvest													
Machine harvest													
Hedging													
Vertebrate Control													
Netting													
Foliar Fertilization													
Soil Fertilization													

Table developed from group discussions during the PMSP Meeting

Appendix 3. Calendar for Scouting Major Insect and Disease Pests of Vineyards in the North Central Region †



	March	May	May	May	June	June	July	July	July	August	Sept	Sept	Oct
Insects													
Cutworm			+	+									
Rose Chafer						+	+	+					
Grape berry moth						+	+	+	+	+	+	+	+
Grape leafhopper						+	+		+	+	+	+	
Potato leafhopper					+	+	+		+	+	+		
Japanese beetle								+	+	+	+	+	

Diseases													
Phomopsis				+	+	+	+	+	+	+	+	+	+
Black rot				+	+	+	+	+	+	+	+		
Downy mildew					+	+	+	+	+	+	+	+	+
Powdery mildew				+	+	+	+	+	+	+	+	+	+
Botrytis bunch rot							+			+	+	+	+

Usual time for monitoring and control + Potential period of insect activity or disease infection risk
 Lesser risk, but monitoring and control may still be required

†Adapted from A Pocket Guide for Grape IPM in the North Central and Eastern U.S. Michigan State University Extension Bulletin E-2889.

Appendix 4. Classification of Pesticides and their Human Toxicity Risk

Chemical group	Human Risk Assessment
Organochlorine	GABA-gated chloride channel antagonists
Carbamate	Acetylcholinesterase inhibitor; disrupts the nervous system.
Organophosphate	Acetylcholinesterase inhibitor; disrupts the nervous system.
Pyrethroid	Sodium channel modulators, disrupts the nervous system.
Neonicotinoid	Nicotinic Acetylcholine receptor agonists / antagonists
METI acaricide	Mitochondrial complex I electron transport inhibitors
Avermectin	Chloride channel activators, disrupts the nervous system.
Spinosad (No Class)	Nicotinic acetylcholine receptor agonists, disrupts the nervous system.
Juvenile hormone mimic	no effect on humans
Ecdysone agonist / molting disruptor	no effect on humans
B2 carcinogen	Likely human carcinogen.
C carcinogen	Possible human carcinogen for which there is limited animal evidence.
D carcinogen	There is inadequate evidence to determine carcinogenicity in humans.
E chemical	Evidence of non-carcinogenicity in humans.

Appendix 5. Reference Material and Additional Resources

MSU Grape Website – www.grapes.msu.edu

Isaacs, R., A. Schilder, T. Zabadal, and T. Weigle. A Pocket Guide for Grape IPM in the North Central and Eastern U.S. Michigan State University Extension Bulletin E-2889.

Michigan Fruit Management Guide 2007, Michigan State University Extension Bulletin E-154.

Midwest Grape Production Guide, Ohio State University Extension Bulletin 919.

Midwest Commercial Small Fruit and Grape Spray Guide, 2007. edited by: Bruce Bordelon, Purdue University; Mike Ellis, Ohio State University; and Rick Foster, Purdue University
<http://www.hort.purdue.edu/hort/ext/sfg/>

Anderson, N., R. Bessin, M. Brown, W. Burr, J. Cranney, E. Dabaan, L. Giannessi, H. Hogmire, L. Hull, M. Lynd, B. Reid, J. Walgenbach, T. White. The Foundation for a Transition Strategy for Lessening Dependency on Organophosphate Insecticides in the Mid-Atlantic/Appalachian/Southeastern Apple Production Region,
<http://www.epa.gov/oppfead1/trac/appltran.pdf>

Galvan, T.L., E.C. Burkness, and W.D. Hutchison. 2006 Wines grapes in the Midwest: Reducing the risk of the Multicolored Asian Lady Beetle. Public 08232. Univ. of Minnesota Extension Service, St. Paul MN.

NY State IPM Grape leafhopper fact sheet
<http://www.nysipm.cornell.edu/factsheets/grapes/pests/qlh/qlh.asp>

Information about the IR-4 Pesticide Testing Program
<http://www.cook.rutgers.edu/~ir4>