

2019

Michigan Chestnut Management Guide



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Extension



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Information presented here does not supersede the label directions.

The information presented here is intended as a guide for Michigan chestnut growers in selecting pesticides and is for educational purposes only. The efficacies of products listed have not been evaluated on chestnuts in Michigan. Reference to commercial products or trade names does not imply endorsement by Michigan State University Extension or bias against those not mentioned. To protect yourself, others, and the environment, always read the label before applying any pesticide. Although efforts have been made to check the accuracy of information presented, it is the responsibility of the person using this information to verify that it is correct by reading the corresponding pesticide label in its entirety before using the product. Labels can and do change—greenbook.net, cdms.com, and agrian.com are free online databases for looking up label and MSDS information.

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Chestnut Pest Scouting Calendar												
	Dormancy	Bud swell	Bud break	Leaf expansion	Shoot elongation and catkin initials	Catkin maturity and pollen shed	Bur formation and catkin senescence	Kernel development	Bur splitting	Nut drop	Leaf senescence	Dormancy
Insects												
Asian chestnut gall wasp	+	+	+	+	+	+	+	+	+	+	+	+
Potato leafhopper		+	+	+	+	+	+	+	+	+	+	
European rose chafer				+	+	+	+					
Japanese beetle						+	+	+	+			
European red mite	+	+	+	+	+	+	+	+	+	+	+	+
Lecanium Scale	+	+	+	+	+	+	+	+	+	+	+	+
Disease												
Chestnut blight	+	+	+	+	+	+	+	+	+	+	+	+
High risk, monitoring and control may be required												
Less risk, monitoring or control may be required												
+ Potential pest activity or visibility, monitoring should occur												

Chestnut Nutrient Management Considerations

Nutrient management in chestnut trees is unique among perennial tree crops. A complete fertilization program based on soil testing, annual leaf analysis and observation of tree growth will maximize the establishment and development of chestnut trees. Many soils in Michigan provide nutrients in sufficient levels for chestnut production. However, before planting it is recommended that growers do a soil test. A soil test provides you with valuable information on soil pH, texture and nutrient status. Chestnut trees require well drained soils and a pH of 5.0-6.5. Even though optimum nutrient levels for phosphorus, potassium, calcium and magnesium are not known for chestnuts, a soil test can provide you with information to base your nutrient and sulfur or lime addition decisions.

Nitrogen Management

Nitrogen is an essential nutrient and plays an essential role in many plant functions and fertilizer application is a necessary part of your orchard maintenance as the nitrogen status of a tree can have a profound effect on health and vigor. When considering how much nitrogen to use, more is not necessarily better. Excessive nitrogen fertilization will over-invigorate vegetative growth on bearing trees, which will result in reduced flower bud formation and reduced fruit yield. It is important to provide enough nitrogen to maintain healthy nutritional status, but to not oversupply nitrogen. Fertilizer use during the first year is not recommended and may cause damage to roots. Fertilizer recommendations for years 2-5 are based off of better-studied systems, including apple. After the fifth year, tree vigor and health as well as trunk diameter are used to determine fertilizer rates.

Nitrogen recommendations, 0-5 years

Using this table, you can select the fertilizer of your choice based on availability and specific needs. Note the difference between actual nitrogen, 'Amount of nitrogen per tree' and product amount as indicated in the 'Urea', 'Ammonium Nitrate', and 'Ammonium Sulfate' columns. These recommendations are based on standard fruit and nut tree nutrient management from Europe. A given site may require more or less depending on soil and leaf analysis. Visual observation of leaf color can also be a useful indicator of tree health. Leaf yellowing may be an indicator that the soil pH is too high at those locations which prohibits the tree from efficiently utilizing the macro and micronutrients you have made available. Growers should be evaluating and adjusting pH via soil testing and visual observation.

Annual nitrogen recommendations for chestnut trees from planting through year five.						
Field age	Amount of nitrogen per tree (oz.)	Urea, 48% N	Ammonium sulfate, 21% N	Triple 19, 19% N	Triple 16, 16% N	Triple 12 12% N
0	None	0	0	0	0	0
1	2	5 oz	10 oz	11 oz	13 oz	1
2	4	8 oz	1 lb 3 oz	1 lb 5 oz	1 lb 10 oz	2
3	6	13 oz	1 lb 11 oz	2 lb	2 lb 6 oz	3
4	8	1 lb 2 oz	2 lb 5 oz	2 lb 13 oz	3 lb 3 oz	4
5	12	1 lb 10 oz	3 lb 6 oz	4 lb	4 lb 13 oz	6

Nitrogen recommendations, older than 5 years

Fertilizer rates for bearing chestnut trees are determined by tree size and vigor. The diameter of the trunk is multiplied by the nitrogen rate based on the average length of last year's terminal branch growth. See next page for table.

- Low vigor: If tree growth is considered low (under 8 inches per year) then a multiplier rate of 1/6 lb. (2.7 oz.) nitrogen per inch of trunk diameter is used.
- Normal vigor: If tree growth is considered normal (8 to 12 inches per year) then a multiplier rate of 1/8 lb. (2 oz.) nitrogen per inch of trunk diameter is used.
- Excessive vigor: If growth is more vigorous (greater than 12 inches on average) then a multiplier rate of 1/10 lb. (1.6 oz.) nitrogen per inch of trunk diameter

Note: Regardless of the outcome of the nitrogen calculation above, no more than 1 lb. (16 oz.) of actual nitrogen should be applied per tree annually.

Example calculation:

How much ammonium sulfate do you have to apply to get the correct amount of nitrogen for a tree with a 5" trunk diameter, 5" terminal growth average last year and utilizing Ammonium sulfate (21-0-0)?

Answer: Your average terminal growth last year was 5 inches, indicating a low vigor which means that you would need 1/6 lb. (2.7 oz.) nitrogen per inch of trunk diameter.

$$5 \text{ inch trunk diameter} \times 2.7 \text{ oz. N} = 13.5 \text{ oz. actual N needed per tree}$$

Ammonium sulfate is only 21% nitrogen, so to determine the rate of product needed, use the following formula:

$$\text{Actual nitrogen (oz.)} \div \text{by nitrogen in product (\%)} = \text{product needed (oz.)}$$

$$13.5 \text{ oz. actual N} / 0.21 \% \text{ N in ammonium sulfate} = 64.3 \text{ oz. of ammonium sulfate per tree}$$

Annual nitrogen recommendations for bearing chestnut trees 6 years or older.						
Trunk diameter (in.)	Vigor	Terminal growth (in)	Nitrogen (lb.)	Actual N per tree (lb.)*	Urea (46% N)	Ammonium sulfate (21% N)
3	Low	<8	0.17	0.5	1.1	2.4
3	Normal	8-12	0.13	0.4	0.8	1.8
3	High	>12	0.10	0.3	0.7	1.4
4	Low	<8	0.17	0.7	1.4	3.2
4	Normal	8-12	0.13	0.5	1.1	2.4
4	High	>12	0.10	0.4	0.9	1.9
5	Low	<8	0.17	0.8	1.8	4.0
5	Normal	8-12	0.13	0.6	1.4	3.0
5	High	>12	0.10	0.5	1.1	2.4
6	Low	<8	0.17	1.0	2.2	4.8
6	Normal	8-12	0.13	0.8	1.6	3.6
6	High	>12	0.10	0.6	1.3	2.9
7	Low	<8	0.17	1.0	2.2	4.8
7	Normal	8-12	0.13	0.9	1.9	4.2
7	High	>12	0.10	0.7	1.5	3.3
8	Low	<8	0.17	1.0	2.2	4.8
8	Normal	8-12	0.13	1.0	2.2	4.8
8	High	>12	0.10	0.8	1.7	3.8
9	Low	<8	0.17	1.0	2.2	4.8
9	Normal	8-12	0.13	1.0	2.2	4.8
9	High	>12	0.10	0.9	2.0	4.3
10	Low	<8	0.17	1.0	2.2	4.8
10	Normal	8-12	0.13	1.0	2.2	4.8
10	High	>12	0.10	1.0	2.2	4.8
11	Low	<8	0.17	1.0	2.2	4.8
11	Normal	8-12	0.13	1.0	2.2	4.8
11	High	>12	0.10	1.0	2.2	4.8
12	Low	<8	0.17	1.0	2.2	4.8
12	Normal	8-12	0.13	1.0	2.2	4.8
12	High	>12	0.10	1.0	2.2	4.8
13	Low	<8	0.17	1.0	2.2	4.8
13	Normal	8-12	0.13	1.0	2.2	4.8
13	High	>12	0.10	1.0	2.2	4.8
14	Low	<8	0.17	1.0	2.2	4.8
14	Normal	8-12	0.13	1.0	2.2	4.8
14	High	>12	0.10	1.0	2.2	4.8
15	Low	<8	0.17	1.0	2.2	4.8
15	Normal	8-12	0.13	1.0	2.2	4.8
15	High	>12	0.10	1.0	2.2	4.8
16	Low	<8	0.17	1.0	2.2	4.8
16	Normal	8-12	0.13	1.0	2.2	4.8
16	High	>12	0.10	1.0	2.2	4.8
17	Low	<8	0.17	1.0	2.2	4.8
17	Normal	8-12	0.13	1.0	2.2	4.8
17	High	>12	0.10	1.0	2.2	4.8
18	Low	<8	0.17	1.0	2.2	4.8
18	Normal	8-12	0.13	1.0	2.2	4.8
18	High	>12	0.10	1.0	2.2	4.8

* Based on tree uptake, nitrogen applications should never exceed 1 lb actual nitrogen per tree annually.

Fertilizer timing and placement

There are several standard ways available to apply nitrogen and other nutrients to your trees in your orchard and probably dozens of less than standard ways that work. The guidelines below are based on soil application of the nitrogen. While some people may apply it to the leaves, there is no precedent for foliar applications on chestnut.

Timing of nitrogen fertilizer applications to the soil surface influences the type of response that trees are likely to exhibit. With most tree crops, early season growth potential and strength of flower buds are largely determined by the nitrogen reserves that the buds contain when growth begins that season. This is a standard statement used for most fruit trees. However, most fruit trees flower in the spring. Chestnut flowers in the very late spring or early summer. We may be able to have some influence with our spring nitrogen application on the strength of the flower bud with spring application of nitrogen.

With most tree crops, nitrogen fertilizers applied during the dormant season as soon as the snow clears will stimulate vegetative growth and generally do not influence the nitrogen status or strength of current season flower buds or fruit set. This may be true for chestnut, too.

Applications during the summer, particularly after current season shoot growth has been completed, are more likely to result in improved nitrogen status of the buds for the next season. However, applications of nitrogen late in the summer may delay or reduce fruit development, increase the pre-harvest fruit drop, delay maturation of buds and woody tissues and/or stimulate late season growth, thus increasing susceptibility of woody tissues and buds to cold injury. In regions where cold injury is of concern, summer applications of nitrogen must be carefully managed to ensure the tree properly shuts down in preparation for winter. Fall applications of nitrogen may delay hardening of buds and woody tissues and increase the potential for desiccation during the winter, particularly if made before trees have become completely dormant.

For most efficient use, nitrogen fertilizers should be spread over the area where the herbicide treatment eliminated the weeds (weed-free zone) or along the cultivated tree-row strips where the majority of the active tree roots are located. Application to weeds or grasses will act to fertilize the weeds and the tree roots will get the leftovers. For this reason broadcasting over the entire orchard floor is less efficient, requires considerably greater rates of application, and is more likely to benefit ground covers than the trees.

Soil testing

Soil testing is an important diagnostic tool in evaluating nutrient imbalances and in understanding plant growth problems. Soil test results help growers adjust fertilizer application to provide nutrients that are lacking in the trees. Also, soil testing helps growers maintain soil pH within an optimum range (5.5-6.5 for chestnut), which keeps nutrients available for plant uptake. The soil test section is usually placed with the fertilizer section of a report like this, but we place it here to inform you that it should be used before you even plant your orchard. The soil test report includes soil pH, lime index, available phosphorus, potassium, calcium, and magnesium, liming and /or fertilizer recommendations based on the crop to be grown and soil test results. Michigan State University recommendations are given in "pound of nutrients needed," not pounds of commercial fertilizer to be applied. You can pick up soil testing kits at your local county Extension office or buy a soil test online at the Bookstore.

Registered Insecticides

2019 Insecticide efficacy ¹ of registered products on edible chestnuts in Michigan.							
Chemical Class (IRAC insecticide group)	Active Ingredient	Products Labeled	Pesticide Efficacy ²				
			Potato leafhopper	Rose chafer	Japanese beetle	Two-spotted spider mite	European red mite
Multisite, Organophosphates(1B)	Malathion	Cheminova Malathion 57%, Malathion 57 EC, Malathion 8 Aquamal	N	F-G	F-G	U	U
	Phosmet	Imidan 70W	G-E	G	E	N	N
Avermectins(6)	Abamectin**	Abacus, Abba 0.15EC, Abamectin 0.15EC, Abba Ultra, Agri-Mek SC, Agri- Mek 0.15SC, Epi-mek 0.15 EC, Reaper 0.15 EC, Reaper Clearform, Reaper Advance, Zoro	U	G	N	E	E
	Emamectin benzoate**	Proclaim	N	N	N	F	U
Carbamates(1A)	Carbaryl	Carbaryl 4L, Sevin 4F, Sevin XLR Plus, Sevin SL	E	G	G	U	U
Diacylhydrazines(18)	Methoxyfenozide	Intrepid 2F	N	N	N	N	N
	Tebufenozide	Confirm 2F	N	N	N	N	N
Diamides(28)	Chlorantraniliprole	Altacor	N	N	N	N	N
	Flubendiamide	Belt SC	N	N	N	N	N
	Cyantraniliprole	Exirel	N	N	U	N	N
Buprofezin(16)	Buprofezin	Centaur	G	N	N	N	N
METI(21A)	Fenpyroximate	Portal XLO	G	N	N	G	E
	Pyridaben	Nexter	N	N	N	G	E
Pyrethroids(3)	Bifenthrin**	Bifenture 10DF, Bifenture EC, Bifen 2AG Gold, Brigade WSB, Brigade 2EC, Fanfare ES, Fanfare 2 EC, Hero EW, Sniper	G	U	E	U	U
	Beta-cyfluthrin**	Baythroid XL	E	G	G	U	U
	Cyfluthrin**	Tombstone, Tombstone Helios	U	N	U	N	N
	Gamma-cyhalothrin**	Declare, Proaxis	U	G	G	U	N
	Lambdacyhalothrin**	Grizzly Z, Kendo, Lambda T, Lambda- CY EC, Lambda-CY AG, Lambdastar, Lambdastar 1CS, Lamcap, Nufarm Lambda-Cyhalothrin 1EC, Paradigm, Province, Silencer, Warrior II with Zeon, Lambda-CY 1EC	U	G	G	U	N
	Pyrethrins	EverGreen EC60-6*, Pyganic EC 1.4*, Pyganic EC 1.4 II*, Pyganic EC 5.0 II*	U	F	F	U	U
	Deltamethrin**	Delta Gold	U	N	U	N	N
	Alpha-cypermethrin Fenpropathrin**	Fastac EC Danitol 2.4EC Spray	G	U	G	U	G
Neonicotinoids	Imidacloprid(4A)	Advise 2FL, Alias 4F, Macho 2.0 FL, Macho 4.0, Malice 2F, Mana Alias 4F, Montana 2F, Montana 4F, Nuprid 2SC, Nuprid 4.6F Pro, Nuprid 4F Max, Pasada 1.6F, Provado 1.6F, Provoke, Sherpa, Trimax Pro, Widow, Wrangler	G	G	G	N	N
	Acetamiprid(4A)	Assail 30SG, Assail 70WP	E	G	G	N	N
	Clothianidin(4A)	Belay	E	G	G	N	N
	Flupyradifurone (4D)	Sivanto Prime	N	N	N	N	N
	Sulfoxaflor(4C)	Closer SC	U	U	U	U	U

1. Pesticide efficacy ratings; E-excellent, G-good, F-fair, P-poor, U-unknown, N-pest not included on label. 2. Pesticide efficacy based on trials in fruit crops with products containing the same active ingredient, as reported in the E154 Fruit Management Guide, Michigan State University Extension.

* OMRI approved for organic production.** Products containing these active ingredients are classified as a restricted use pesticides and require the

Registered Insecticides, continued

2019 Insecticide efficacy ¹ of registered products on edible chestnuts in Michigan.							
Chemical Class (IRAC insecticide group)	Active Ingredient	Products Labeled	Pesticide Efficacy ²				
			Potato leafhopper	Rose chafer	Japanese beetle	Two-spotted spider mite	European red mite
Spinosyns(5)	Spinosad	Entrust*, Entrust SC*, GF-120 NF*, Seduce*, SpinTor 2SC*	N	N	N	U	N
	Spinetoram	Delegate WG	N	G	N	N	N
Tetramic acids(23)	Spirodiclofen	Envidor 2SC	N	N	N	E	E
	Spirotetramat	Movento	N	N	N	U	U
Fonicamid(9C)	Fonicamid	Beleaf 50SG	N	N	N	N	N
Biopesticides	<i>Bacillus thuringiensis</i> (11A)	Dipel DF*, Xentari	N,U	N,U	N,U	N,U	N,U
	<i>Myrothecium verrucaria</i>	Ditera DF*	N,U	N,U	N,U	N,U	N,U
	Potassium salts of fatty acids	M-Pede*	N	N	N	U	U
	<i>Chromobacterium subsugae</i>	Grandevo*	U	N	N	U	U
	Extract of <i>Chenopodium ambrosioides</i>	Requiem EC	U	N	N	U	U
	Kaolin	Surround WP	U	F	F	N	N
Beta-ketonitrile derivatives(25)	Cyflumetofen	Nealta	N	N	N	U	U
Insect growth regulators	Etoazole	Zeal Miticide 1	N	N	N	E	E
	Hexythiazox(10A)	Onager, Savey 50 DF	N	N	N	R	R
	Pyriproxyfen(7C)	Esteem 0.86EC, Esteem 35WP, Pitch 0.86EC, Pitch 35WP	N	F,U	N	N	N
	Diflubenzuron(15)	Dimilin 2L	N	N	N	N	N
	Azadirachtin (IGR)	Aza-Direct*, Azaguard, Ecozin Plus 1.2% ME*, Molt-X, Neemix 4.5*	U	F	F	U	U
Premixed products	Azadirachtin + Pyrethrin (3)	Azera	U	U	U	U	U
	Chlorantraniliprole(28) + Lambdacyhalothrin(3)**	Voliam Xpress	G	G	G	N	N
	Bifenthrin(3)** + Zeta- cypermethrin(3)**	Hero EW, Steed	U	N	U	U	N
	Zeta-cypermethrin(3)** + Avermectin(6)**	Gladiator	U	G	G	E	E
	Lambdacyhalothrin(3)**; Thiamethoxam(4A)	Endigo ZC	U	E	G	E	N
	Bifenthrin(3)** + Imidacloprid(4A)	Tempest	N	U	U	U	U
	Lambdacyhalothrin(3) + Imidacloprid(4A)	Kilter	U	U	U	U	N
Not classified	Acequinocyl	Kanemite 15SC	N	N	N	G	G
	Bifenazate	Acramite 50WS	N	N	N	E	G

1. Pesticide efficacy ratings; E-excellent, G-good, F-fair, P-poor, U-unknown, N-pest not included on label. 2. Pesticide efficacy based on trials in fruit crops with products containing the same active ingredient, as reported in the E154 Fruit Management Guide, Michigan State University Extension.

* OMRI approved for organic production.** Products containing these active ingredients are classified as a restricted use pesticides and require the

Registered Fungicides

Fungicides labeled for use on edible chestnuts in Michigan, 2019		
Activity	Active Ingredient (FRAC fungicide group)	Products Labeled
Single site	Fluopyram (7)	Luna Privilege
	Propiconazole (3)	Bumper 41.8 EC, Fitness, Propi-Star EC, Propicure 3.6F, Propimax EC, Tilt, Topaz
	Trifloxystrobin (11)	Gem 500 SC
	Tebuconazole (3)	Toledo 45 WP
	Azoxystrobin (11)	Abound
Premixes	Sulfur (M2); Tebuconazole (3)	Unicorn DF
	Azoxystrobin (11) + Difenconazole (3)	Quadris Top
	Azoxystrobin (11) + Propiconazole (3)	Quilt Excel
	Boscalid (7) + Pyraclostrobin (11)	Pristine
	Fluopyram (7) + Tebuconazole (3)	Luna Experience
	Fluopyram (7) + Trifloxystrobin (11)	Luna Sensation
Potassium based defense inducers	Phosphorous acid, mono and dibasic sodium, potassium, and ammonium salts (33)	Phostrol
	Potassium phosphite (NC ¹)	Fosphite, Rampart
Biopesticides	Neem oil (NC ¹)	Trilogy*
	Trichoderma asperellum (ICC 012); Trichoderma gamsii (ICC 080) (NA ²)	Tenet WP*
	Bacillus subtilis strain QST 713 (44)	Serenade ASO*, Serenade Max*
	Extract of Reynoutria sachalinensis (P5)	Regalia*

1. Not classified as belonging to a particular mode of action. 2. Not listed or classified by the Fungicide Resistance Action Committee. *OMRI approved for organic production.

Registered Herbicides

Herbicides registered for use on edible chestnuts in Michigan, 2019			
Application timing ¹	Crop labeled	Active ingredient (trade names ²)	Notes
Pre-emergent	All tree nuts	Flumioxazin (Chateau SW)	Controls most broadleaves and grasses. Fall application is most effective. Apply to trees established at least 1 year. Weak on horseweed. Apply before bud swell. Moisture is necessary to activate herbicide. Sixty day PHI.
	Chestnuts	Oxyfluorfen (Goal 2XL)	Controls most annual broadleaves and grasses. Apply before bud swell in the spring.
	All tree nuts	Rimsulfuron (Matrix SG)	Apply to trees that have been established for one year or more. Controls grasses and broadleaves. Fourteen day PHI.
	All tree nuts	Pendimethalin (Prowl H2O)	Controls annual grasses and some broadleaves. Apply before bud swell or only in non-bearing trees. Do not apply to newly transplanted trees until ground has settled and no cracks are present. Sixty day PHI.
	All tree nuts	Oryzalin (Surflan AS)	Controls annual grasses and some broadleaves for 4-6 weeks. Apply in spring before weeds emerge. Needs rainfall to activate.
	All tree nuts	Isoxaben (Trellis or Trellis SC)	Controls broadleaves for 4-6 weeks. Apply to established bearing and non-bearing trees. Needs rainfall of 0.5 inch to activate. Sixty day PHI.
Post-emergent	All tree nuts	Glyphosate (Roundup WeatherMax)	Apply with a pre-emergent herbicide in spring for control of emerged annual and perennial weeds. Reapply during the season as needed. Avoid contact with crop foliage or green bark. Three day PHI.
	All tree nuts	Carfentrazone (Aim EC) ²	Controls small broadleaf weeds. Include NIS in tank mix. Three day PHI.
	All tree nuts	Paraquat (Gramoxone SL2)	Desiccates green foliage. Make applications prior to shaking for harvest. Include NIS. Maximum of 5 applications per year.
	Nuts	Pelagronic acid (Scythe Herbicide)	Broad-spectrum burn down for site prep and spot treatments, and as shielded application. See label for use-based PHI.
	All tree nuts	Sethoxydim (Poast)	Kills grasses. Use high rate for perennial grasses. Maximum of 10 pt/acre/year. Include NIS. Fifteen day PHI.
	All tree nuts	Pyraflufen (Venue)	Use with other post-emergent herbicides to improve broadleaf weed desiccation. Include NIS. Zero day PHI.
	All tree nuts	2, 4-D (Weedar 64)	Controls most annual and perennial broadleaf weeds. For filberts, apply a maximum of 2.1 pt of product per acre. Allow at least 30 days between applications. Sixty day PHI.
Pre/Post Emergent	All tree nuts	Halosulfuron (Sanda 75DF)	Controls nutsedge and broadleaf weeds. Apply to nut trees that have been established 1 year or more. One day PHI.

1. Pre-emergent herbicides should be applied to control weeds before germination takes place. Post-emergent herbicides may be applied to actively growing weeds. 2. Trade names are provided as an example and not endorsement. Many active ingredients are available under multiple trade labels.

Relative impact of pesticides on beneficial insects.

Fungicides		Beneficial arthropod IOBC rankings ¹			
Active Ingredient	Signal Word	Trade Name	Predatory mites	Lady beetles	Lacewing larvae
<i>Bacillus pumilus</i>	Caution	Sonata	1	ND	ND
boscalid	Caution	Pristine	1	ND	ND
copper	Caution	Various formulations	1	ND	ND
cymoxanil	Warning	Curzate 60DF	ND	ND	ND
dimethomorph	Caution	Acrobat (renamed Forum)	ND	ND	ND
famoxadone & cymoxanil	Caution	Tanos	ND	ND	ND
fosetyl-Al	Caution	Aliette WDG	ND	ND	ND
kaolin	Caution	Surround	3	ND	ND
mandipropamid	Caution	Revus	OK ²	OK ²	ND
mefenoxam	Caution	Ridomil	ND	ND	ND
metalaxyl	Warning	MetaStar	ND	ND	ND
mineral oil/petroleum distillate	Caution	Various formulations	2	ND	ND
phosphorous acid	Caution	Fosphite & other formulations	ND	ND	ND
pyraclostrobin	Caution	Pristine	ND	ND	ND
quinoxifen	Caution	Quintec	1	ND	ND
sulfur	Caution	Various formulations	2	ND	ND
tebuconazole	Caution	Folicur 3.6F	1	ND	ND
Herbicides					
2,4-D	Danger	Weedar 64 & other formulations	ND	ND	ND
carfentrazone	Caution	Aim EC	1	ND	ND
clethodim	Warning	Select Max	1	ND	ND
clopyralid	Caution	Stinger	1	ND	ND
flumioxazin	Caution	Chateau	OK ²	OK ²	ND
glyphosate	Caution	Roundup & other formulations	1	ND	ND
norflurazon	Caution	Solicam	ND	ND	ND
pelargonic acid	Warning	Scythe	ND	ND	ND
trifluralin	Caution	Treflan & other formulations	2	ND	ND

1. International Organization for Biological Control (IOBC) has categorized pesticides using a ranking of 1 to 4. Rankings represent relative toxicity based on data from studies conducted with tree fruit, hop, mint and grape. 1= less than 30% mortality following direct exposure to the pesticide; 2 = 30 to 79% mortality; 3 = 79 to 99% mortality; and 4 = greater than 99%. ND = not determined.

2. IOBC rankings not available for this newly registered product. Tests in 2009/2010 determined these compounds safe on predatory mites and *Stethorus*.

Pacific Northwest Hop Handbook 2010

Relative impact of pesticides on beneficial insects.

Insecticides/Miticides		Beneficial	arthropod	IOBC	rankings ¹
Active Ingredient	Signal word	Trade Name	Predatory mites	Lady beetles	Lacewing larvae
abamectin	Warning	Agri-Mek & other formulations	3	3	ND
<i>B. thuringiensis</i> subsp. aizawal	Caution	Xentari & other formulations	1	2	ND
<i>B. thuringiensis</i> subsp. kurstaki	Caution	Dipel & other formulations	1	2	ND
beta-cyfluthrin	Warning	Baythroid XL	4	4	4
bifenazate	Caution	Acramite-50WS	1	2	ND
bifenthrin	Warning	Brigade & other formulations	4	4	4
cyfluthrin	Danger	Baythroid 2E	4	4	4
dicofol	Caution	Dicofol	1	1	ND
etoxazole	Caution	Zeal	OK ²	OK ²	ND
fenpyroximate	Warning	Fujimite	1	3	ND
hexythiazox	Caution	Savey 50DF	1	1	ND
imidacloprid	Caution	Various formulations	1	3	3
malathion	Warning	Various formulations	2	4	3
naled	Danger	Dibrom	2	4	3
pymetrozine	Caution	Fulfill	1	1	1
pyrethrin	Caution	Pyganic & other formulations	2	2	2
spinosad	Caution	Success & other formulations	2	2	1
spirodiclofen	Caution	Envidor	2	2	1
spirotetramat	Caution	Movento	1	1	1
thiamethoxam	Caution	Platinum Insecticide	1	1	ND

1. International Organization for Biological Control (IOBC) has categorized pesticides using a ranking of 1 to 4. Rankings represent relative toxicity based on data from studies conducted with tree fruit, hop, mint and grape. 1= less than 30% mortality following direct exposure to the pesticide; 2 = 30 to 79% mortality; 3 = 79 to 99% mortality; and 4 = greater than 99%. ND = not determined.

2. IOBC rankings not available for this newly registered product. Tests in 2009/2010 determined these compounds safe on predatory mites and *Stethorus*.

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