

MN 2000 EF 583

Agricultural Extension Service
University of Minnesota

Extension Folder 583-1981

UNIVERSITY OF MINNESOTA
DOCUMENTS
APR 16 1981
ST. PAUL CAMPUS LIBRARIES



1981 Commercial Apple Pest Control

Leonard B. Hertz, extension horticulturist; Ward Stienstra, extension plant pathologist; and John A. Lofgren, extension entomologist

Troublesome insects and mites in Minnesota orchards include: apple maggot, codling moth, European red mite, plum and apple curculio, aphids, oystershell scale, leafrollers, cankerworm, and leafhoppers.

The major diseases in Minnesota orchards are apple scab, cedar-apple rust, and fire blight. Other diseases include frog-eye leafspot, sooty blotch of fruits, and flyspeck of fruits. Virus diseases also are a problem in apples, but these diseases are not discussed in this publication.

The following guide shows: (1) the times spray applications normally are required; (2) the pests that may be troublesome

at each spray date; and (3) the chemicals that are effective for controlling the major diseases and insects troublesome to apples. All rates are on the basis of dilute spray for hydraulic sprayer.

This guide is intended for commercial growers only. Consult *Home Fruit Spray Guide*, Extension Folder 375, for information on pest control in home orchards.

The Commercial Fruit Pest Control Guide is being published in this abbreviated version because of budget restrictions.

Recommended Apple Spray Schedule (both disease and insect problems)

Timing	Insect problems that may appear	Disease problems that may appear	Remarks
Delayed dormant spray (before leaves are out ½ inch)	Aphids, mites, oystershell scale, leafroller eggs	Apple scab	Use superior oil, 70-second viscosity. Addition of an organophosphorus insecticide to superior oil increases the effectiveness of scale control.
Prepink spray	None, unless tentiform leaf miner is present	Apple scab	Use when there is an extended period between delayed dormant and pink spray.
Pink spray (when fruit buds show pink at tips)	None	Apple scab, cedar-apple rust, fire blight	Mite control may be necessary if superior oil was <i>not</i> applied as a delayed dormant treatment.
Blossom spray	None	Apple scab, cedar-apple rust	Do not apply insecticides during bloom period—protect bees.
Petal fall (after three-fourths of petals have fallen)	Curculio, codling moth, red-banded leafroller, mites, aphids, green fruitworms	Apple scab, cedar-apple rust, fire blight	
First cover spray (7-10 days after petal fall or when fruit is ¼ inch in diameter)	Red-banded leafroller, curculio, codling moth, mites, aphids, oystershell scale (crawlers)	Apple scab, cedar-apple rust, fire blight	
Second cover spray (10 days after first cover)	None	Apple scab, cedar-apple rust, fire blight	Do not continue fire blight control after terminal growth stops. Rust may no longer be a threat after June 15.
Third cover spray (10 days after second cover)	Codling moth, mites, aphids, leafhoppers	Apple scab	
Additional sprays (Use maggot traps or start approximately July 1. A 14-day spray interval is usually adequate.)	Apple maggot, mites, aphids, leafhoppers	Apple scab, sooty blotch of fruit, flyspeck of fruit	Observe time limitations for chemicals used.

Note: Use all pesticides safely. Be sure to follow all precautions listed on labels. Use proper protective clothing and devices. Avoid pesticide drift to nontarget areas. Observe all precautions to protect bees.

Fungicides for Disease Control on Apples

Diseases	Fungicides*	Formulation per 100 gal.†	Limitations and days before harvest	Remarks
Apple scab	Benlate 50WP [∞]	2-6 oz.	0	Do not graze treated areas. Use 6 oz. if infection has occurred. Fruit finish may be affected on Golden Delicious variety if more than 2 oz. is used. The use of oil with Benlate may adversely affect fruit finish on several varieties.
	Difolatan 4F	5 qt.	0	Single application, dormant to green tip stage.
	Captan 50WP	2 lb.	0	
	Cyprex 65WP	3/8 - 1/2 lb.	7	Do not use treated apples in the manufacture of apple pomace for use in livestock feeds. Do not graze livestock in treated orchards.
	Phaltan 50WP	1-2 lb.	0	May cause russetting on sensitive varieties in early season.
	Glyodin	1 qt.	0	
	Polyram 80WP	2 lb.	30	Do not graze treated areas.
Cedar-apple rust	Ferbam 76WP	2 lb.	7	Do not use on Golden Delicious.
	Polyram 80WP	2 lb.	30	Do not graze treated areas.
	Thylate 65WP	1-2 lb.	0	
	Zineb 75WP	1-2 lb.	30	
Fire blight	Bordeaux mixture			Bordeaux mixture suggested when fire blight infection is light.
	copper sulfate	2 lb.		
	hydrated spray lime	6 lb.		
	Streptomycin	50-100 ppm	50	Use 100 ppm for moderate to severe fire blight.
Sooty blotch and flyspeck	Captan 50WP	1 1/2-2 lb.	0	
	Ferbam 76WP	2 lb.	7	Do not use on Golden Delicious.
	Polyram 80WP	2 lb.	30	Do not graze treated areas.
	Zineb 75WP	1-2 lb.	30	
Postharvest	Benlate 50WP [∞]	8 oz.	Before storage	Postharvest dip or spray.
	Captan 50WP	2 lb.	Before storage	Postharvest dip or spray.

*WP = wettable powder; F = flowable.

† "Formulation per 100 gal." is average dosage at approximately 300 gal./acre. See label for details on dosage for concentrate sprays.

[∞] Always use a protectant fungicide such as Captan with Benlate.

Insecticides for Insect Control on Apples

Insects	Insecticides*	Formulation per 100 gal. †	Limitations and days before harvest	Remarks
Aphids	Trithion 4E	½ pt.	30	May injure Cortlands. Do not apply to McIntosh or Wealthy.
	Diazinon 50WP	1 lb.	14	
	Cygon 25WP	2 lb.	28	
	Lannate 90 SP	½ lb.	28	
	Penncap M	1 pt.	14	
	Zolone 3EC	1 pt.	14	
Apple maggot	Guthion 50WP	½ lb.	7	To avoid thinning, delay use at least 30 days following full bloom.
	Sevin 80WP	1½ lb.	1	
	Diazinon 50WP	1 lb.	14	
	Imidan 80WP	1 lb.	7	
	Zolone 3EC	1 pt.	14	
Codling moth	Guthion 50WP	½ lb.	7	No more than 8 applications per season. Do not apply within 30 days after full blooming to avoid thinning. Do not apply to McIntosh or Wealthy.
	Sevin 80WP	1½ lb.	1	
	Diazinon 50WP	1 lb.	14	
	Lannate 90SP	½ lb.	8	
	Penncap M	1 pt.	14	
	Imidan 50WP	1 lb.	7	
	Zolone 3EC	1 pt.	14	
Leafhoppers	Guthion 50WP	½ lb.	7	No more than 8 applications per season.
	Sevin 80WP	1½ lb.	1	
	Diazinon 50WP	1 lb.	14	
	Cygon 25WP	2 lb.	28	
Mites	Carzol 92SP	6 oz.	7	No more than 4 lb. per acre per season. Apply at delayed dormant at temperature higher than 40° F. Very important for European red mite suppression. Apply before bloom or after harvest. Not more than 3 applications per season. Do not apply more than 4 times per season. Some of the insecticides such as Guthion, Trithion, Diazinon, Cygon, Parathion, Imidan will help suppress mites.
	Acaralate 2EC	1 qt.	14	
	Kelthane 35WP	3/4 lb.	7	
	"Superior" oil (70 sec. vis.)	2 gal.		
	Morestan 25WP	½-1 lb.	non-bearing	
	Omite 30WP	1½ lb.	7	
	Plictran 50WP	4-6 oz.	14	
	Vendex 50WP	¼-½ lb.	14	
Oystershell scale	Diazinon 50WP	1 lb.	14	For use when crawlers are present. Dormant spray at temperature higher than 40°F. Do not apply after delayed dormant.
	"Superior" oil (70 sec. vis.)	2 gal.		
	Ethion	2½ qt.	40	
	Superior 70 oil			
Plum and apple curculios	Guthion 50WP	½ lb.	7	No more than 8 applications per season. No more than 8 applications per season. Toxic to bees.
	Penncap M	1-2 pts.	14	
	Imidan 50WP	1 lb.	7	
	Zolone 3EC	1 pt.	14	
Leafrollers	Guthion 50WP	½ lb.	7	No more than 8 applications per season. Do not apply to McIntosh or Wealthy.
	Diazinon	1 lb.	14	
	Lannate 90SP	½ lb.	28	
	Imidan 50WP	1 lb.	7	
	Zolone 3EC	1 pt.	14	
Tentiform	Lannate 90SP	½ lb.	28	Do not apply to McIntosh or Wealthy.
Leafminer	Vydate L	1-2 pts.	14	Do not apply within 30 days after bloom to prevent thinning.

*WP = wettable powder; SP = soluble powder; EC = emulsifiable concentrate.

† "Formulation per 100 gal." is average dosage at approximately 300 gal./acre. See label for details on dosage for concentrate sprays.

Apple Weed Control

Herbicides can save you considerable labor in the culture of fruit crops. Under some conditions they are more effective than mechanical or hand weeding control methods, but special care is required when using them.

Herbicides are effective only within a limited range of application rates; too low rates result in insufficient control, while too high rates may injure apple trees. The amount of material to use varies with the kinds and sizes of weeds present, soil type and condition, weather, application method, and formulations.

To prevent injury, use a herbicide only on a trial basis until you are familiar with its reaction on the trees. And don't contaminate crops with spray drift or by using herbicide spray equipment for applying insecticides and fungicides. Follow these rules for the proper method of applying herbicides on fruit crops:

- **Select herbicides with specific label clearance** that have been favorably tested in your area.
- **Read, understand, and follow label directions.**
- **Mix herbicides accurately and thoroughly** so you apply them uniformly and at proper rates.
- **Apply herbicides at low pressure** (20-40 pounds), using calibrated equipment that functions properly. Hand equipment usually is unsatisfactory.
- **Use low-volume spray equipment** that applies 40-60 gallons of water per acre.
- **Have separate spray equipment** for herbicides unless you can thoroughly clean the spray tank, pump, hoses, and nozzles before applying insecticides or fungicides.
- **Store herbicides safely** in a locked storeroom, separated from other pesticides.

Apple Weed Control

Weed problem	Herbicide*	Rate/acre sprayed**		Time of application	Remarks
		Commercial product			
NEWLY PLANTED (first growing season)					
Annuals and perennials (top growth only)	Paraquat		1-2 qt.	After planting trees	A second application may be needed for season-long control. Do not allow spray to contact apple foliage or fruit.
ESTABLISHED TREES					
Annuals and quackgrass	Simazine 80WP		5 lb.	Early spring before weeds emerge	Use only on trees that have been established for 1 or more years. On sandy soils reduce rate to 4 lb. of commercial product.
Annuals	Karmex 80WP		4 lb.	Early spring before weeds emerge	Do not apply more than 4 lb. commercial product per season. Use only on trees established for 1 or more years. Do not treat dwarf varieties.
Annuals and quackgrass	Casoron 4G or 50WP		150 lb. 12 lb.	Late fall or early spring	Apply when temperatures are less than 60°F. to increase effectiveness.
Annuals and quackgrass	Sinbar 80WP		2-3 lb.	Spring	Use only on trees that have been established for 3 or more years. Use lowest rate on sandy soils.
Annuals and knockdown perennials (top growth only)	Paraquat		1-2 qt.	Growing weeds	A second application may be needed for season-long control. Do not allow spray to contact foliage or fruit.
Growing weeds	Roundup		2 qt.	Growing weeds	This herbicide will not prevent annual weeds coming up again from seeds. Do not allow spray to drift.
Dandelion, poison ivy, birdweed	2,4-D Dacamine 4D		1 qt.	When weeds are growing rapidly	For dandelions, apply to bloom or after harvest. Prevent drift to trees.
Quackgrass and emerged weeds	Simazine + Paraquat		5 plus 1-2 qt.	Growing weeds	Paraquat gives quick knockdown of weeds, while Simazine provides long-term control.

*G = granular; WP = wettable powder.

** Rates given are on an acre basis, but only treat the area beneath trees.

Control of Rodents in Apple Orchards

ORCHARD MICE CONTROL

Mice are troublesome in orchards primarily because they feed on tree bark, thereby girdling trunks near or below the ground line. The two species of mice concerned are the meadow mouse and the pine mouse.

Damage by the meadow mouse usually is done at or above the soil surface, so if you discover the damage in spring you often can repair it. The pine mouse feeds below the soil on the bark of roots. Although the pine mouse causes the most damage, its presence has not been reported in Minnesota.

Mouse damage is costly; you must consider mouse control as a regular orchard practice. To control mice, use mechanical and cultural aids and rodenticides.

Mechanical and Cultural Aids

Wire guards partially protect young trees. Place a cylinder of hardware cloth (three to four wires to the inch), 6 inches in diameter and 18 inches in height, around the young tree soon after planting. Set the cylinder at least 2 inches into the soil. A plastic guard, sold under the trade name of "Arborgard," is available for mouse control. It is easily installed and has effectively protected young trees from mouse damage.

Cultural practices also can decrease the threat of damage by field mice. Remove the vegetation within a 3-foot radius of the tree trunk to eliminate the cover for mice. Either scalp the soil with mechanical equipment or kill vegetation with herbicides. Mowing the grass and disking or chopping the sod also reduce the protective cover. Then the orchard loses some of its desirability as a nesting place for mice.

Lethal Baits

You can coat apple cubes with zinc phosphide rodenticide and use them as lethal bait in early fall. Use apple pieces cut into ½-inch squares and preferably, from firm, sweet varieties. A 1-ounce can of 66 percent zinc phosphide rodenticide treats 20 quarts of apple cubes—enough for 8-10 acres. Tumble cubes until they are evenly covered with poison.

Grain baits are treated with either zinc phosphide or strychnine. Buy ready-mixed baits; home preparation results in non-uniform mixtures and a poor kill.

Be especially cautious when using these materials. They are toxic to humans. Wear proper protective clothing when mixing or applying them; wash hands and utensils thoroughly after working with treated baits.

Trail Baiting—You can apply zinc phosphide grain as a trail bait at 3 pounds per acre or in a broadcast system at 6-10 pounds per acre. Use strychnine grain at about 3 pounds per acre.

Examine the orchard floor systematically for distinctive trails made by mice under heavy cover. When you locate an active runway, place an apple cube or a teaspoon of grain in it. Then pull the grass back in position over the bait. Usually, three or four baits per tree are needed. Heavy grass, apple crates, and hay bales are logical places for runways.

Beginning at the drip line and working inward toward the trunk, examine one side of the tree at a time until you find a run. You may find that the area is inactive. Disturb the area as little as possible.

October-November is the best time for baiting. You may have to rebait an area in midwinter if there is a heavy, persistent snow cover. Place strychnine grain in snow tunnels, air holes, and near fresh bark damage.

Trail Builder—The trail builder makes artificial burrows 3 inches below the soil surface. It provides an effective method of mouse control. Results compare favorably with trail baiting, and labor costs are reduced. Obtain instructions for making a trail builder from your county agricultural agent or the U.S. Fish and Wildlife Service.

Broadcasting Bait—Broadcasting grain bait by hand or machine also produces good results and is less expensive than trail baiting. Although you can spread bait by airplane, tractor-drawn seeder, or fertilizer spreader, broadcasting by hand is recommended.

To apply the bait, hurl a small handful of poisoned grain into the most likely mouse cover under each tree. Wear protective clothing and guard against accidental poisoning of nontarget animals or humans.

POCKET GOPHER CONTROL

Pocket gophers live in an underground burrow system, often a network of several hundred feet ranging in depth from a few inches to several feet. Their activity in an orchard can be identified by the presence of fresh mounds of dirt. Most mounds are made in late summer and fall when gophers are digging shallow burrows to get roots—including roots of apple trees—for the winter.

Control methods are more effective during the spring and fall when pocket gophers are most active. This activity can be noted by the presence of fresh mounds of dirt.

Traps and poisoned baits are the most practical methods of control. On small areas having a few animals, trapping or hand baiting is effective. In large and heavily infested areas, baiting with a burrow builder is more efficient.

Control by Trapping—To locate the runway, use a stout garden trowel or shovel. Scrape the dirt from a fresh mound until a round circle of fresh dirt is found plugging the lateral runway. Open the lateral and put in one trap with the claws away from the opening. However, it is usually better to dig down the lateral into the main runway and then place two traps back to back in the main runway. Secure the traps with a piece of flexible wire attached to a stake. The hole can be left either open or closed.

Control with Poisoned Bait—Two toxicants are registered for use in treating bait materials for the control of pocket gophers. In the finished bait, they are strychnine at 0.25-0.6 percent, and Gophacide at 0.1-0.2 percent in the finished bait. Two baiting methods are effective. One method involves dropping baits by hand into the underground runways. With the

other method, a tractor-drawn machine called a "burrow builder" makes artificial burrows and automatically drops bait into them.

Burrow Builder—In large and heavily infested areas, use a burrow builder to make artificial burrows 20 feet apart across the field at the same depth as the natural burrows. Drop strychnine baits mechanically at 9-12 inch intervals in the artificial burrow. One to 2 pounds of this bait material will treat 1 acre.

Hand Baiting—Remove the earth plug from the lateral tunnel of a fresh mound of dirt. With a long-handled spoon,

insert a tablespoonful of strychnine-treated bait into the main runway. Cover the opening to exclude light and loose dirt. The main runway can also be located by probing with a stick or metal rod approximately 8-18 inches back from the plug mark in the mound. When the runway is found, enlarge the hole to put in the bait and cover as before. After 48 hours, scrape over mounds and retreat those still active. One pound of strychnine bait material will treat 5-8 acres.

For extensive hand baiting, good probes can be made of 3/4-inch pipe welded to a blunt point and cut to 34 inches in length. A footrest can be made 16 inches from the end.

Apple Growth Regulator Sprays

CHEMICAL THINNING OF APPLE FRUITS

Many apple varieties frequently set more fruits than is optimum for good apple production. As a result, fruit size and quality are reduced, as is the effectiveness of a pest control program. Blossoming generally is sparse the year after a heavy crop, so trees develop a biennial or alternate bearing cycle.

Hand thinning fruits is costly and does not increase the return bloom the following year. Certain growth regulators effectively reduce the concentration of fruits on a tree. The return bloom the following year also is increased by the thinning procedure.

Materials Recommended—NAA (naphthalene acetic acid) and NA amide (naphthalene acetamide) are the chemicals most often used for thinning apples. NAA is sold under such trade names as Fruitone and Stafast or as naphthalene acetic acid. NA amide is sold as Amid-Thin.

Precautions—Chemical thinning is not an exact operation. Even though concentration and timing appear to be identical, the amount of thinning obtained on the same variety in the same block may vary considerably from year to year. These differences may be due to weather or to the condition of the trees. Vigorous trees (requiring high concentrations) are more difficult to thin than trees of low vigor (requiring low concentrations).

Recommendations for Use—Under Minnesota conditions the use of NAA results in more thinning of fruits than use of NA amide. Foliage injury can occur with NAA, especially if it is used on early varieties. NAA is most active when applied under fast drying conditions with 65°-70° F. temperatures.

NA amide is absorbed best when weather conditions favor slow drying. Since its action is milder than that of NAA, NA amide seldom causes foliage injury at concentrations up to 75 ppm.

You can determine the need for additional thinning of fruits treated with NAA by examining trees 7-10 days after spraying. Use NAA if additional thinning is necessary.

Spray trees thoroughly in the same manner as for pest control. Apply NAA or NA amide as a separate spray; do not combine it with petal fall or cover sprays for pest control. In

order to evaluate results, leave unsprayed check trees of each variety. If you have not had experience in chemical thinning or if you are thinning varieties of unknown response to sprays, limit sprays to a trial basis.

Use of Sevin—The insecticide Sevin may be useful for thinning fruits, especially in areas where temperatures are warm early in the postbloom period. If you use Sevin, apply it at the rate of 1½ pounds of 50WP per 100 gallons of water; make the application 7 days after petal fall. Varying the concentration of Sevin has not appreciably changed the degree of thinning obtained.

Caution: *To avoid the possibility of excessive fruit thinning, do not use Sevin as an insecticide until 14 days after petal fall.*

Defruiting Young Apple Trees—Sevin (1½ pounds 50WP per 100 gallons of water) in combination with NAA (10 ppm) causes severe thinning. The combination has been useful for removing all fruits from young trees.

STOP-DROP SPRAYS FOR APPLES

Preharvest fruit drop is a problem in nearly all orchards. You can reduce losses by using stop-drop or "sticker" sprays. Oriole, Beacon, Wealthy, Haralson, Fireside, McIntosh, and Connell Red drop excessively.

Materials Recommended—Both NAA (naphthalene acetic acid) and 2,4,5-TP (2,4,5-trichlorophenoxy propionic acid) have been used effectively on most apple varieties in Minnesota.

NAA is recommended at the rate of 10 ppm. However, rates as low as 5 ppm may be effective on summer or early fall varieties if you spray when temperatures are relatively high. On late maturing varieties, 15-20 ppm may be needed.

Apply NAA 3-4 days before you expect heavy fruit dropping to begin. It becomes effective in approximately 2 days. Do not make more than 2 applications and do not make applications within 2 days of harvest. NAA is effective for a relatively short time, usually not more than 7-10 days.



The maximum strength for using 2,4,5-TP is 20 ppm; 10 ppm are recommended for Delicious and Golden Delicious under most conditions. Generally, early varieties respond to low concentrations better than late varieties.

Apply 2,4,5-TP 7-10 days prior to the expected harvesting date. Since it has an effective stop-drop action for approximately 3-4 weeks, you can spray this chemical earlier than NAA. But NAA becomes effective more quickly after spraying than does 2,4,5-TP.

Sufficient Coverage—When applying stop-drop sprays, you must obtain thorough and even coverage of foliage. If you combine stop-drop sprays with pest control sprays, the effectiveness of the stop-drop sprays is reduced, particularly if the pest control spray contains lime.

Weather Conditions—Stop-drop sprays are more effective during warm than cool temperatures. Dew and high humidity also increase their effectiveness, but drought reduces it. Occasionally, heavy drops may occur in spite of weather or treatment.

Precautions—Fruit maturity may be hastened by stop-drop sprays, but never delayed. Do not allow apples to become overmature before harvesting. Carefully check fruit for maturity; pick it when optimum maturity is attained. Ease of picking or dropping from the tree cannot be used as a sign of maturity.

Sprays that are too concentrated also can lead to an undesirable hastening of maturity. Do not exceed maximum recommended concentrations.

TO PROMOTE APPLE COLOR AND UNIFORM RIPENING

Ethrel (ethephon) can be applied before the normal harvest period to promote early development of red color and ripening. For apples maturing earlier than McIntosh, use ½ pint per 100 gallons of water applied 10-14 days before normal harvest. Because Ethrel promotes fruit drop, use in combination with a preharvest stop-drop spray, such as NAA (Fruitone) or 2,4,5-TP (Fruitone-T).

Apples treated with Ethrel must be harvested at proper maturity, and the fruit must not be allowed to become over-ripe on the trees. Color, alone, is not always an adequate indicator of fruit maturity. Other methods, such as under-color or a pressure gauge, should be used frequently. If over-mature apples are harvested and stored, the fruit may soften sooner than would nontreated fruit.

ALAR ON APPLES

Alar-85 can produce several fruit and vegetative modifying responses, depending on the time and rate of application. The fruit-modifying effects include stimulation of apple color, increased fruit firmness, and a reduction in apple drop and water core.

When only fruit-modifying effects are desired, Alar should be applied 60 to 70 days before normal harvest. Rates of application of 3/4 to 1½ lb./100 gal. are suggested. The rate does depend upon tree vigor, variety, and crop load. Trees low in vigor should not receive Alar; with moderate vigor use 3/4 lb. Trees with high vigor receive the high rate, 1½ lb. Uniform and thorough tree coverage is essential. Don't apply Alar more than once during the growing season.

Thinning Minnesota Apple Varieties

Materials	When to apply	Concentration (ppm)*			Varieties	Remarks
		Easy to thin (10 ppm)	Intermediate (15 ppm)	Hard to thin (20 ppm)		
Naphthalene acetamide (NA amide)	Petal fall	50			Beacon, Wealthy, other early varieties	If possible, use when weather conditions favor relatively slow drying. NA amide often is applied in the evening. Use on varieties earlier than McIntosh.
Naphthalene acetic acid (NAA)	7-10 days after petal fall	Easy to thin (10 ppm)	Intermediate (15 ppm)	Hard to thin (20 ppm)	Hard to thin (25 ppm)	Use on varieties ripening with or later than McIntosh. In some regions, NAA is preferred for almost all varieties.
		McIntosh, N.W. Greening, Red Delicious, Jonathan, Fireside, Connell Red	Cortland	Golden Delicious	Haralson, Minjon, Redwell, Prairie Spy	

*ppm = parts per million.

The information given in this publication is for educational purposes only. Reference to commercial products or trade names is made with the understanding that no discrimination is intended and no endorsement by the Minnesota Agricultural Extension Service is implied.

Issued in furtherance of cooperative extension work in agriculture and home economics, acts of May 8 and June 30, 1914, in cooperation with the U.S. Department of Agriculture. Norman A. Brown, Director of Agricultural Extension Service, University of Minnesota, St. Paul, Minnesota 55108. The University of Minnesota, including the Agricultural Extension Service, is committed to the policy that all persons shall have equal access to its programs, facilities, and employment without regard to race, creed, color, sex, national origin, or handicap.