

1979 Commercial Fruit Spray Guide

WEED, INSECT, AND DISEASE CONTROL

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The information given in this publication is for education 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.

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1979 Commercial Fruit Spray Guide

Safety Precautions for Using Pesticides

Some pesticides are toxic chemicals; all pesticides can become hazardous if used carelessly. If you use pesticides, it is your obligation to use them safely. Pesticide safety means that: (1) you and your fellow workers will not be injured when applying chemicals; (2) injury to nontarget organisms will be minimal; (3) the fruit trees or plants you treat will not be injured; (4) children, customers, or visitors will not be exposed to needless danger; and (5) the fruit you place on the market will be safe for the consumer. To date, the pesticide safety record is good; do your part to keep it that way.

Follow these rules:

- Plan a pest control schedule using chemicals specifically recommended for fruit and using the appropriate spray equipment.
- Keep your spray equipment operating efficiently and accurately.
- Keep an accurate record of amount and kinds of chemicals used, spraying dates, crop conditions at spraying times, weather conditions at spraying times, and control measures obtained.
- Wear protective clothing while applying chemicals, and operate your equipment so that a minimum of spray contacts your body. Be doubly cautious when using highly toxic materials; employ extra protective devices when you use them.
- Never smoke, eat, or drink while mixing spray materials or operating spray equipment. Remove outer clothing and wash thoroughly as soon as you complete the spraying operation.
- Store pesticides under lock and key. Keep them in a cool, dry place where liquids will not be subjected to freezing temperatures.
- Never store herbicides in the same room with other pesticides.
- Dispose of empty containers in an appropriate manner as soon as they are empty. Never let waste chemicals lie around; get rid of them!
- Protect yourself by carefully reading and following the protective measures on chemical container labels.
- If symptoms of nausea, blurred vision, or headaches occur during or after using a pesticide, call your physician immediately.

EMERGENCY INSTRUCTIONS

The situation and the chemical involved influence the appropriate actions to take after an accident involving a pesticide. But to prevent serious after-effects in any case, you should:

- Call your physician, tell him what poison is involved, and follow his instructions.
- Have the patient remove all contaminated clothing if chemicals have been spilled on it. Have him wash first with clear running water and then with soapy water.
- Take the patient out into fresh air if he has inhaled the chemical. Do your best to comfort him. Be prepared to administer artificial respiration.
- Induce vomiting and administer the correct antidote if the patient has ingested the chemical. Pesticide labels normally include suggestions for inducing vomiting and for antidotes.
- Have a label from the pesticide container available for your physician.

If you are using pesticides in your business, you should consult a local physician now. Discuss with him the types of materials you are using and how often you come in contact with these materials. Be sure your physician knows that a poison information center can give him the information he needs in case of an accidental poisoning. He also may want to have on hand the necessary information and materials to treat a person accidentally poisoned by the chemicals you use.

Your doctor may wish to give you and your workers an examination and a blood test both before you begin your spray program and at various intervals throughout the year. Such tests tell him if effects of certain types of pesticides get too high.

RESTRICTED USE PESTICIDES

State and federal laws require that pesticides with restricted uses may be applied by or under the direct supervision of certified applicators only. Training to meet the requirements for certification in Minnesota is provided by the Agricultural Extension Service. Information is available from local county extension offices.

At the present time pesticides with some restricted uses are: aldicarb (Temik), azinphosmethyl (Guthion), demeton (Systox), endrin, ethyl parathion, methomyl (Lannate, Nodrin), methyl bromide, methyl parathion, mevinphos (Phosdrin), paraquat, picloram (Tordon), strychnine, and tepp. In addition, Lindane is a restricted compound in Minnesota.

Minnesota Poison Information Centers

The centers listed below have been established by the Minnesota Department of Health to provide physicians with information about pesticides and common household

poisons, their antidotes, and treatments. Most of these centers operate on a 24-hour basis.

Town	Poison Information Center	Telephone
Bemidji	Bemidji Hospital	751-5430 Extension 40
Brainerd	St. Joseph's Hospital	829-2861
Crookston	Riverview Hospital	281-4682 Extension 298
Duluth	St. Luke's Hospital 915 E. 1st St.	727-6636
	St. Mary's Hospital 407 E. 3rd St.	727-4551 Extension 359
Fergus Falls	Lake Region Hospital	736-5475 Extension 360 (3 p.m.-7 a.m. and weekends) Extension 361 (7 a.m.-3 p.m.)
Mankato	Immanuel-St. Joseph's Hospital	625-4031
Marshall	Lewis Weiner Memorial Hospital	532-9661
Minneapolis	Fairview Hospital 2312 S. 6th St.	371-6505
	Hennepin County Med. Center, 619 S. 5th St.	347-3141
	North Memorial Hospital 3220 Lowry Avenue N.	588-0616 Extension 341 or 342
	Northwestern Hospital 810 E. 27th St.	874-4234
	Minn. Poison Information Minn. Department of Health 717 Delaware St. S.E.	296-5276

Town	Poison Information Center	Telephone
(Fridley)	Unity Hospital 550 Osborne Road	786-2200 Extension 221
Morris	Stevens County Memorial Hospital	589-1313 Station 1
Rochester	Methodist Hospital S.E. Minn. Poison Control Center	282-4461 or 285-5123
St. Cloud	St. Cloud Hospital	251-2700 Extension 221
St. Paul	Bethesda Hospital 559 Capitol Blvd.	221-2301, 2302, 2303
	Children's Hospital 311 Pleasant Avenue	227-6521
	St. Paul-Ramsey Hospital, 640 Jackson	221-2113
	St. John's Hospital 403 Maria Avenue	228-3132
	St. Joseph's Hospital 69 W. Exchange	291-3000
	St. Luke's Hospital 300 Pleasant Avenue	298-8201 (after 11 p.m.) 298-8341 (before 11 p.m.)
Willmar	Rice Memorial Hospital	235-4543 Extension 291
Worthington	Worthington Regional Hospital	372-2941 Extension 156

CONTROL GUIDE FOR COMMERCIAL APPLE GROWERS

Troublesome insects and mites in Minnesota orchards include: apple maggots, codling moths, European red mites, plum and apple curculios, aphids, oystershell scales, leafrollers, cankerworms, and leafhoppers.

The major diseases in Minnesota orchards are apple scab, cedar-apple rust, and fire blight. Other diseases include frogeye 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 University of Minnesota Agricultural Extension Folder 375, *Home Fruit Spray Guide*, for information on pest control in home orchards.

The notes referred to in these tables appear in the "Specific Problems" section of this bulletin.

Apple Spray Schedule

Timing	Insect problems which may appear	Disease problems which may appear	Remarks
1. Delayed dormant spray (before leaves are out ½ inch)	aphids, mites, oystershell scale, leaf-roller eggs	Apple scab	Use an emulsifiable "superior" type dormant oil or oil plus diazinon or ethion as labeled. See notes 1 and 7.
2. Prepink spray	None	Apple scab, cedar-apple rust	Use when there is an extended period between delayed dormant and pink spray. See notes 1 and 2.
3. Pink spray (when fruit buds show pink at tips)	None	Apple scab, cedar-apple rust, fire blight	See notes 1, 2, 3, and 8.
4. Blossom spray		Apple scab, cedar-apple rust, fire blight	Do not apply insecticides during bloom period — protect bees. See notes, 1,2, and 3.
5. Petal fall (after three-fourths of petals have fallen)	Curculio, codling moth, red-banded leafroller, mites, aphids	Apple scab, cedar-apple rust, fire blight	See notes 1, 2, 3, and 8.
6. First cover spray (7-10 days after petal fall or when fruit is ¼ inch in diameter)	Red-banded leaf-roller, curculio, codling moth, mites, aphids, oystershell scale (crawlers)	Apple scab, cedar-apple rust, fire blight	See notes 1, 2, 3, and 8.
7. Second cover spray (10 days after second cover)	None	Apple scab, cedar-apple rust, fire blight	See notes 1,2,3, and 8. Do not continue fire blight control after terminal growth stops.
8. Third cover spray (10 days after second cover)	Codling moth, mites, aphids, leafhoppers	Apple scab, cedar-apple rust, fire blight	Rust may no longer be a threat after June 15.
9. Additional sprays (Use maggot traps or start about 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. See notes 1, 4, 5, and 8.

Fungicides for Disease Control on Apples

Diseases	Fungicides*	Formulation per 100 gal.‡	Limitations and days before harvest	Remarks
Apple scab (See notes 1 and 10.)	benomyl 50WP§	2-6 oz.	NTL†	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 benomyl may adversely affect fruit finish on several varieties.
	captafol 39F captan 50WP dodine 65WP	5 lb. 1½-2lb. ¼-½lb.	NTL 5	Single application, dormant to green tip stage. Do not use treated apples in the manufacture of apple pomace for use in livestock feeds. Do not graze livestock in treated orchards.
	folpet 50WP	1-2 lb.	NTL	May cause russetting on sensitive varieties in early season.
	Glyodin maneb + zinc 80WP	1 qt. 1½-2 lb.	NTL 30	See last page for specific trade names. Do not graze treated areas.
	Polyram 80WP thiram 65WP mancozeb	2 lb. 1-2 lb. 1-2 lb.	30 NTL 30	Do not graze treated areas. Do not graze treated areas.
	Cedar-apple rust (See note 2.)	ferbam 76WP	2 lb.	7
maneb + zinc 80WP		1½-2 lb.	30	See last page for specific trade names. Do not graze treated areas.
Polyram 80WP thiram 65WP mancozeb		2 lb. 1-2 lb. 1-2 lb.	30 NTL 30	Do not graze treated areas. Do not graze treated areas.
zineb 75WP		1-2 lb.	30	Do not graze treated areas.
Fire blight	Copper carbonate Copper oxide Copper oxychloride Copper oxychloride streptomycin formulations	sulfate Follow label directions	50	Follow label directions for dosage and time of application. These are all chemical names having various trade names.
Sooty blotch and flyspeck (See note 4.)	captan 50WP	1½-2 lb.	NTL	
	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	benomyl 50WP§	8 oz.	Before storage	Postharvest dip or spray.
	captan 50WP	2 lb.	Before storage	Postharvest dip or spray.

*Abbreviations used with fungicides and insecticides are: WP = wettable powder, SP = soluble powder, EC = emulsifiable concentrate, F = flowable.

‡"Formulation per 100 gal." is average dosage. See label for details on dosage.

† NTL=no time limitations.

§Always use a protectant fungicide with benomyl. See note 10.

Insecticides for Insect Control on Apples

Insects	Insecticides*	Formulation per 100 gal.‡	Limitations and days before harvest	Remarks
Aphids	carbophenothion (Trithion) 25WP	½ lb.	30	May injure Cortlands.
	demeton (Systox)	¾ pt.	21	No more than 3 times per season.
	diazinon 50WP	1 lb.	14	
	dimethoate (Cygon 400)	1 pt.	28	
	"Superior" oil (70 sec. viscosity)	2 gal.		Use from dormant to delayed dormant. Can be combined with diazinon or ethion. Do not apply to McIntosh or Wealthy.
	methomyl (Lannate 90)SP	¼-½ lb.	8	
	parathion 15WP	1½ lb.	14	
	phosphamidon (Dimecron) 8EC	½ pt.	30	
Apple maggot	aziphosmethyl (Guthion) 50WP	⅝ lb.	7	To avoid thinning, delay use at least 30 days following full bloom.
	carbaryl (Sevin) 80WP	1½ lb.	1	
	diazinon 50WP	1 lb.	14	
	phosmet (Imidan) 80WP	1-1½ lb.	7	
Codling moth	aziphosmethyl (Guthion) 50WP	⅝ lb.	7	No more than 8 applications per season.
	carbaryl (Sevin) 80WP	1 ¼ lb.	1	Do not apply within 30 days after full blooming to avoid thinning.
	diazinon 50WP	1 lb.	14	Do not apply to McIntosh or Wealthy.
	methomyl (Lannate) 90SP	¼-½ lb.	8	
	methylparathion (Penncap M)	1 pt.	14	
	phosmet (Imidan) 50WP	1-1½ lb.	7	2 applications, 40 days until harvest. 4 applications, 60 days until harvest.
Leafhoppers	aziphosmethyl (Guthion) 50WP	⅝ lb.	7	No more than 8 applications per season.
	carbaryl (Sevin) 80WP	1 ¼ lb.	1	
	diazinon 50WP	1 lb.	14	
	dimethoate (Cygon 400)	1 pt.	28	
Mites (See note 8.)	carzol 92SP	4-8 oz.	7	No more than 4 lb. per acre per season.
	chlorobenzilate (Acarben)	½-¾ pt.	14	Do not use on Delicious, Jonathan, or McIntosh.
	dicofol (Kelthane) 35WP	¾ lb.	7	
	1.6 EC	1½ pt.		Apply at delayed dormant at temperature above 40°F. Very important for European red mite suppression.
	"Superior" oil (70 sec. vis.)	2 gal.		
	Morestan 25WP	½-1 lb.		
	Omite 30WP	1½ lb.	7	Apply before bloom or after harvest.
	ovex 50WP	½ lb.	30	Not more than 3 applications per season.
	Plictran 50WP	4-6 oz.	14	Do not apply more than 4 times per season. Not more than 4 applications after petal fall. Do not feed pomace from treated apples to livestock.
	tetradifon (Tedion) 25WP	1 lb.	NLT†	
Some of the insecticides (Aziphosmethyl, carbophenothion, demeton, diazinon, dimethoate, parathion, phosphamidon, Imidan) will help suppress mites.				

*Abbreviations used with fungicides and insecticides are: WP = wettable powder, SP = soluble powder, EC = emulsifiable concentrate, F = flowable.

‡"Formulation per 100 gal." is average dosage. See label for details on dosage.

†NLT = No time limitations.

Insecticides for Insect Control on Apples (continued)

Insects	Insecticides*	Formulation per 100 gal.‡	Limitations and days before harvest	Remarks
Oystershell scale	diazinon 50WP "Superior" oil (70 sec. vis.)	1 lb. 2 gal.	14	For use when crawlers are present. Dormant spray at temperature above 40°F.
	ethion superior 70 oil	2½ qt.	40	Do not apply after delayed dormant.
Plum and apple curculios	azinphosmethyl (Guthion) 50WP	⅝ lb.	7	No more than 8 applications per season.
	methylparathion (Penncap M)	1-2 pts.	14	No more than 8 applications per season.
	phosmet (Imidan) 50WP	1½ lb.	7	
Leafrollers	Azinphosmethyl (Guthion) 50WP	⅝ lb.	7	No more than 8 applications per season.
	diazinon	1 lb.	14	
	methomyl (Lannate) 90SP	½ lb.	8	Do not apply to McIntosh or Wealthy.
	phosmet (Imidan) 50WP	1½ lb.	7	

*Abbreviations used with fungicides and insecticides are: WP = wettable powder, SP = soluble powder, EC = emulsifiable concentrate, F = flowable.
‡"Formulation per 100 gal." is average dosage. See label for details on dosage.

A Suggested Apple Insect Schedule* (An example using information from pp. 5, 7 and 8.)

Time	Pest problems	Chemicals (See pp. 7 and 8 for rates and limitations)
Delayed dormant to early pink	Red mites, aphids, scales	Superior oil (70 sec./viscosity)
Petal fall	Curculio, red-banded, leafroller, fruit tree leafroller, aphids	Guthion, or Imidan
Cover sprays (10- to 14-day intervals and as indicated by traps.)	Codling moth, red-banded leafroller, apple maggot	Guthion, or Imidan, or diazinon, or Sevin (may be rotated)
	Mites, red and two-spotted (if necessary)	Carzol, Plictran, or Kelthane

*See note 8, p. 14.

WEED CONTROL IN APPLE ORCHARDS

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
		Pounds active ingredient	Commercial product		
NEWLY PLANTED (first growing season)					
Annuals and perennials (top growth only)	Paraquat CL	½-1	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 (Princep)	4	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	Diuron (Karmex)	3.2	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	Dichlobenil (Casaron 4G)	6	150 lb.	Late fall or early spring	Apply when temperatures are below 60°F. to increase effectiveness.
Annuals and quackgrass	Terbacil (Sinbar)	1.6-2.4	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	½-1	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	Glyphosate (Roundup)	1½	2 qt.	Growing weeds	Use on trees which will not bear fruit. This herbicide will not prevent weeds coming up from seeds.
Poison ivy, dandelion	2,4-D (Dacamine 4D or Weedone 638)	1	1 qt.	When weeds are growing rapidly	Use as a spot spray to wet weed plants. Prevent drift.
Quackgrass and emerged weeds	Simazine (Princep) plus Paraquat	4 plus ½ to 1	5 plus 1 to 2 qt.	Growing weeds	

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

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 available in acid form or as a sodium salt and 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.

The following table of recommendations is presented as a guideline for spraying normal, reasonably vigorous trees. Orchard conditions, weather conditions, and your experience will determine the exact timing and concentration of chemical to use.

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.

Research data indicate that Haralson fruits often are under-thinned by Sevin, and its use on this variety is not recommended.

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.

Thinning Spray Recommendations

Materials	When to apply	Concentration (ppm)*	Varieties	Remarks
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	10	McIntosh, Minjont, Haralson†, Jonathan, Red Delicious, Prairie Spyt, Golden Delicious†, Redwell†	Use on varieties ripening with or later than McIntosh. In some regions, NAA is preferred for almost all varieties.

*ppm=parts per million.

†These apple varieties are difficult to thin. A concentration of 20 ppm is recommended.

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 about 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 harvest date. Since it has an effective stop-drop action for about 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. For late maturing varieties, apply ⅔-1 pint of Ethrel per 100 gallons of water (3 pints per acre) 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 overripe on the trees. Color, alone, is not always an adequate indicator of fruit maturity. Other methods, such as undercolor or a pressure gauge, should be used frequently. If overmature apples are harvested and stored, the fruit may soften sooner than would nontreated fruit.

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 phos-

phide 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 nonuniform 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. 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 baits 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 about 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.

SPECIFIC PROBLEMS

1. **Control of Apple Scab** — Apple scab is controlled primarily by preventive spraying — by having a suitable fungicide cover the foliage and fruit throughout the time when infection can occur. Entry of the scab organism into plant tissues thereby is prevented. During long rainy periods, trees are not adequately protected and penetration and establishment of the scab organism (infection) occur. Systemic fungicides (benomyl and dodine) will control much of the infection that has occurred. The apple scab fungus has developed resistance to benomyl fungicide in some cases; therefore, a protectant-type fungicide should always be used at full strength with benomyl for good control and to delay or prevent the build-up of resistance.

2. **Control of Cedar-Apple Rust** — Cedar-apple rust fungus overwinters on eastern red cedar trees and on closely related species. Infection of the apple occurs during spring when spores are carried by wind to the apple leaves and fruits from the gelatinous spore horns on galls of infected red cedar trees. The disease can be controlled if all red cedar trees within ½ mile of the orchard can be eliminated. Varieties differ in their susceptibility to the disease.

Varieties tolerant to this disease should be planted where cedars in the vicinity of the orchard cannot be eliminated. Certain fungicides can effectively control cedar-apple rust. See table on apple fungicides. Begin spraying at the pink stage and continue through second cover (about mid-June). Successive crops of gelatinous spore horns are produced on infected cedars during this period.

Rust controlling fungicides also control scab, but they are inferior to some scab fungicides. Continue to use a scab fungicide when controlling cedar-apple rust. Do not use ferbam on Golden Delicious. For additional information, see University of Minnesota Plant Pathology Fact Sheet 4, "Cedar-Apple Rust."

3. **Control of Fire Blight** — Fire Blight is a bacterial disease of apples, pears, and occasionally other fruits. It is

one of the most difficult diseases to control, since no reliable method for preventing or eradicating it is known. Infection can occur in the blossom period and at any time that new growth occurs on the trees.

The disease is spread by insects (including bees), wind, and rain. Infection occurs most readily under warm, moist conditions and on trees that are growing vigorously. Since varieties vary in their susceptibility to the disease, you can eliminate considerable trouble by planting varieties that show a resistance to fire blight. Control recommendations emphasize cultural methods, sanitation, and a chemical spray program.

Cultural Control Methods — Encouraging lush growth increases the susceptibility of trees to fire blight. When the fire blight threatens an orchard, any cultural practice that encourages hardening of the tissues will reduce the threat of disease. Thus, it is helpful to reduce nitrogen fertilization, to allow grasses and orchard floor vegetation to consume excess moisture, by keeping tillage or mowing at a minimum, and to minimize maintenance pruning.

Orchard Sanitation — Pruning out infected branches reduces the source of inoculum for the following growing season. The preferred pruning time is late fall or early winter. If you delay the pruning operation until late winter or early spring, disinfect your pruning tools between pruning cuts. Use formaldehyde, denatured alcohol, or liquid household bleach mixed with equal parts of water.

Make the pruning cut on infected branches 6 inches below the lowest canker. Haul prunings from the orchard and burn them before bud break in the spring. **Note:** Pruning does not assure that an orchard will be free of fire blight the following year.

Chemical Control Methods — The 50-day restriction for last application before harvest for antibiotics gives emphasis for the use of these chemicals. For blossom blight control, apply antibiotics at 4-day intervals starting when blossoms appear. For shoot blight control, start about June 1 and apply at 7- to 14-day intervals up to 50 days before harvest for each variety treated. Suggested dosage is 50 ppm for night application and 100 ppm for day application. Antibiotics may be more effective when applied alone rather than in combination with other pesticides. The use of spreaders is likely to reduce effectiveness also. Weather conditions that favor fire blight are average 24-hour temperatures above 65°F. and relative humidity above 60 percent. Temperatures of 90°F. and above are unfavorable for infection. (For further information, see Plant Pathology Fact Sheet 17, "Fire Blight.")

4. **Control of Sooty Blotch and Flyspeck** — These two diseases appear as black or brown spots on the surface of apple fruits. They reduce the market value of the fruit. Both sooty blotch and flyspeck generally are found on the same fruits, and the methods for controlling them are similar. Normally, the spray program for controlling scab will control them. But if these diseases have been a problem or if prolonged wet, cool weather occurs (especially toward the end of the growing season), you should take additional

Cedar-apple rust



protective measures. Add either zineb, ferbam, captan, or Polyram to the spray mixtures. Do not use ferbam on Golden Delicious.

5. Control of Apple Maggot — To control apple maggot, all foliage and fruit surfaces must be covered with a suitable insecticide from the time the maggot flies emerge until they no longer are present in orchards. During the first 2 weeks of July, listen to farm radio programs and watch your local newspapers for announcements that flies have started to emerge, or contact your county agricultural agent. Information on maggot fly activity is made available to these sources by the Division of Plant Industry, Minnesota Department of Agriculture. Or you may use maggot fly traps in your orchard to detect the first appearance of the flies.

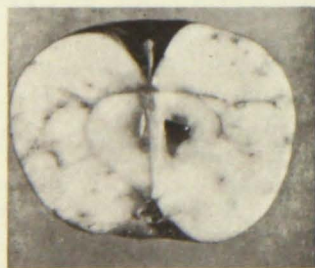
Apply the first maggot spray as soon as initial emergence is detected. A threat of severe apple maggot damage requires a series of maggot sprays at 7- to 10-day intervals.

You should shorten the suggested time intervals between sprays during weather and growing conditions that will (a) hasten the removal of spray materials or (b) result in exposure of unprotected plant tissues during critical periods of disease infection or insect infestation.

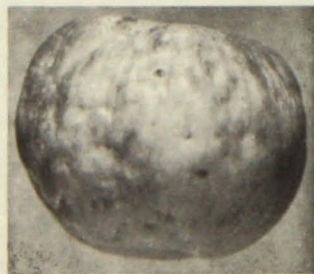
Be especially mindful of tolerance limitations. You must apply the last spray early enough to avoid excessive residue on or in the fruit at harvest. Residues can be a difficult problem on early varieties.

For additional information, see University of Minnesota Entomology Fact Sheet 20, "The Apple Maggot."

6. Spray Guide for Young Apple Trees — Young trees will be injured if you fail to control damaging insects and diseases. Cankerworms and tent caterpillars may be abundant in early spring and may require control; apply methoxychlor as in the pink spray. You can also use methoxychlor to control treehoppers. Control grasshoppers with malathion or diazinon when they become numerous. Use malathion or diazinon to control aphids as they appear.



Apple maggot injury



Apple scab and cedar-apple rust are troublesome on young trees. Where rust is a problem, follow recommendations for controlling rust on bearing trees. Scab often is a problem during periods of high humidity and when foliage is wet for an extended time. Under these conditions and during spring growth, you should protect the foliage with a suitable fungicide.

7. Control of Mites — Some of the insecticides listed for other pests also may control or suppress mite problems. However, under some spray schedules, mites may increase to damaging numbers during the summer so that specific miticides should be applied.

It is urged that an early season application of oil be used each year. Then, at midsummer, if mites begin to build up to over two per leaf, use miticides of a particular chemical group. The following year select miticides from another chemical group, and so on, to delay the development of resistance. The major groups of miticides are (1) chlorinated hydrocarbons (dicofol, chlorobenzilate), (2) sulfur compounds (ovex, Omite, tetradifon), (3) carbamates (Carzol), and (4) Plictran. It is very important to obtain thorough coverage with the sprays to control mites.

8. Timing of Sprays — Most growers still follow a spray schedule based on the stage of development of the crop or calendar. As reliable methods of pest detection are developed, it may be possible to time more accurately applications of specific treatments for pests actually present in the orchard. This may eliminate unnecessary spray applications or will indicate when additional treatments are needed.

Traps are available now for detecting several important fruit pests. Sticky traps utilizing synthetic pheromones (sex attractants) may be used to monitor the presence of codling moths and red-banded leafroller moths. Sticky traps baited with ammonia compounds, such as ammonium carbonate, or round croquet ball-sized "decoys" covered with tangle-foot will catch apple maggot flies as they emerge in the summer.

Control measures directed against scales, aphids, mites, etc. may be timed according to the visual detection of the pests on the trees. Scales and aphids are easy to detect on the twigs, buds, and foliage. Mites are more difficult to see and a hand lens should be used. Develop a program in which insecticides are used only when needed in your orchard.

9. Drift Control — Control of drift of pesticides is the responsibility of the applicator. Although drift cannot be prevented entirely, it can be minimized to the point where it will do no appreciable harm.

- Do not spray during periods of high wind velocity.
- Keep spray equipment precisely calibrated and in good operating condition.

10. Apple Scab Tolerance — Some cases of tolerance of the apple scab fungus to Benlate have resulted in the following recommendation. This tank mix is intended to maintain the beneficial effects of benomyl and prevent the

establishment of races of the scab fungus which may be tolerant to Benlate.

Benlate fungicide plus Captan 50WP fungicide (or Captan 80WP) is recommended for use as a tank mixture on apples for the control of scab, powdery mildew, black rot, bitter rot, fly speck, and sooty blotch.

Use 2-3 ounces Benlate plus 12-16 ounces Captan 50WP (7-10 ounces Captan 80WP) per 100 gallons of water. Apply at ½-inch green tip and repeat at 7- to 14-day intervals (or as needed) through the cover sprays. Under

severe disease conditions, use the shorter interval and the higher rates.

If a spray application is missed and an infection period has occurred, apply the higher rate as soon as possible after the infection period in order to deactivate scab and to prevent further infection.

With Golden Delicious, adverse effects on fruit finish and color may result; if finish and color are of primary importance, do not use more than 2 ounces Benlate per 100 gallons.

CONTROL GUIDE FOR COMMERCIAL RASPBERRY GROWERS

Proper culture is important for a good pest control program for raspberries. For a vigorous planting with minimal insect and disease problems, plant virus-free stock, provide proper winter protection, and space and prune plants correctly.

To produce a crop and to prevent a rapid decline of the planting by viruses, you must have a thorough spray program. The main insects requiring chemical control are aphids, leafhoppers, mites, sawfly larvae, fruit worms, and strawberry weevils.

The main raspberry diseases are anthracnose, Septoria leaf spot, spur blight, powdery mildew, and fruit rot. Virus diseases are serious. Control them by planting certified stock, using an effective insect control program, and roguing out infected plants.

Note: To control raspberry cane borers, red-necked cane borers, and tree cricket injury, prune out infested canes in early fall. Raspberry cane borers cause cane tips to wilt; shoots are girdled with two rings an inch apart. Since larvae burrow downward, cut off wilted tips a few inches below the gridle and destroy them. The red-necked cane borer causes a gall-like enlargement on the cane due to a spiral burrowing of the larva. Crickets cause egg-laying scars that weaken canes.

The following tables list (1) times to spray, (2) pests that may be troublesome at each spray date, and (3) chemicals that effectively control major raspberry insects and diseases.

Raspberry Spray Schedule

Timing	Insect problems	Disease problems	Remarks
When buds show green tips ¼-½ inch long		Anthracnose, Septoria leaf spot, spur blight	Use dormant spray mixtures.
When leaves are fully expanded	Sawfly larvae, strawberry weevil	Anthracnose, spur blight, powdery mildew, Septoria leaf spot	
When blossom buds first show	Fruit worm, spider mite, aphids, leafhoppers	Anthracnose, spur blight, powdery mildew, Septoria leaf spot	Do not apply insecticides to plants in bloom.
Additional preharvest sprays	Aphids, fruit worm, leafhoppers	Fruit rot	Watch tolerance limitations.
Postharvest	Aphids, leafhoppers	Anthracnose, spur blight, powdery mildew, Septoria leaf spot	Apply at 10- to 14-day intervals or as needed.

Fungicides For Controlling Diseases On Raspberries

Diseases	Fungicides*	Formulation per 100 gal.‡	Limitations and days before harvest	Remarks
Anthracnose and spur blight	lime sulfur	8-12 gal. or equivalent	Delayed dormant application only	Use 8 lb. copper sulfate, 8 lb. hydrated lime, and 100 gal. water. Dissolve copper sulfate and then add lime water. Use immediately. Do not mix with other chemicals. Total of 5 applications.
Septoria and Botrytis	Bordeaux mixture	(See remarks.)	NLT† Delayed dormant application only	
	benomyl§	12 oz./acre	3	
	captan 50WP	2 lb.	NLT	
	Dyrene 50WP	2-4 lb.	14	
	ferbam 76WP	1½-3 lb.	40	
	folpet 50WP	2 lb.	NLT	
	zineb 75WP	1½ lb.	14	
Powdery mildew	Sulfur	Label directions	NLT	May burn during high temperatures.

*Abbreviations used with fungicides and insecticides are: WP = wettable powder, SP = soluble powder, EC = emulsifiable concentrate, F = flowable.
‡"Formulation per 100 gal." is average dosage. See label for details on dosage.

†NLT=no time limitations.

§Always use a protectant fungicide with benomyl. See note 10.

Insecticides For Controlling Insects On Raspberries

Insects	Insecticides*	Formulation per 100 gal.‡	Limitations and days before harvest
Aphids	malathion 25WP	3 lb.	1
Fruit worm	malathion 25WP	3 lb.	1
Leafhoppers	methoxychlor 50WP	2 lb.	3
Mites	diazinon 50WP	1 lb.	7
	dicofol	¾ lb.	2
	(Kelthane) 35WP		
	malathion 25WP	3 lb.	1
Sawfly larvae	methoxychlor 50WP	2 lb.	3
	carbaryl	1¼ lb.	7
	(Sevin) 80WP		
Sap beetle	carbaryl	1¼ lb.	7
	(Sevin) 80WP		
	malathion 25WP	3 lb.	1

*Abbreviations used with fungicides and insecticides are: WP = wettable powder, SP = soluble powder, EC = emulsifiable concentrate, F = flowable.

‡"Formulation per 100 gal." is average dosage. See label for details on dosage.

Weed Control in Raspberries

Weed problem	Herbicide	Rate/acre sprayed**		Time of application	Remarks
		Pounds active ingredient	Pounds commercial product		
Annuals and quackgrass	Simazine (Princep)	4	5	Early spring starts.	Do not apply after budbreak of raspberry canes. Use half-rates on sandy soils and new plantings.
Annuals and quackgrass	Dichlobenil (Casoron 4G)	4	100	Late fall or early spring	Effective against several difficult-to-control weeds. Apply when temperatures are less than 60°F. to increase effectiveness.
Annual weeds	Diuron (Karmex)	3.2	4	Early spring before growth starts	Use half rates on sandy soils and new plantings.

**Rates given are on an acre basis of area actually treated.

CONTROL GUIDE FOR COMMERCIAL STRAWBERRY GROWERS

Strawberries are well adapted to Minnesota. For the most efficient production, however, select disease-free and insect-free plants, use proper cultural techniques, and follow a timely, effective pest control program.

The principal pests requiring chemical control are strawberry weevil, cyclamen mites, white grubs, tarnished plant bugs, sawflies, aphids, leafrollers, and leafhoppers. The main diseases are leaf spot, leaf scorch, leaf blight, blossom and fruit rots, and powdery mildew. Virus diseases are also major problems; you must control them by planting virus-free stock.

Soil Treatment for White Grubs — White grubs often are serious pests in new strawberry plantings, particularly in areas that were in permanent grasses. When grubs are present, treat the soil with chlordane before setting out strawberry plants.

Apply a concentrate containing 8 pounds of chlordane per gallon, using 1 quart of concentrate per 100 gallons of

water. One hundred gallons should cover about one-fourth of an acre.

You can apply the insecticide to the soil as a wettable powder in water or in the dry granular form. Use 6-8 pounds of actual chlordane per acre; the lower dose provides satisfactory control on light soils, but the heavier dose is necessary on clay soils or soils with high organic matter.

Shortly after applying chlordane, disk or harrow the top 2-4 inches of the soil. This procedure incorporates the insecticide into the area where grubs are present. Although late fall is the preferred application time, early spring — before planting — also is acceptable. Chlordane registrations have been cancelled by the Environmental Protection Agency (EPA). However, use as a soil treatment in this manner is legal until August 1, 1979, by certified applicators.

The following tables list (1) times to spray, (2) pests that may be troublesome at each spray date, and (3) chemicals that effectively control major insects and diseases.

Strawberry Spray Schedule

Timing	Insect problems	Disease problems	Remarks
Preplanting	White grub		See section on soil treatment.
Early bud change just after uncovering.	Strawberry weevil, tarnished plant bug, sawfly, mites, aphids	Leaf diseases.	} These are the most important sprays.
Prebloom spray	Strawberry weevil, tarnished plant bug, sawfly, mites, aphids	Leaf blight, leaf scorch, leaf spot, powdery mildew, fruit rot	
Bloom spray		Blossom blight, fruit rot	Fungicides only. Do not use insecticides. Protect bees.
Additional sprays between bloom and harvest	Aphids, mites, leafroller, leafhoppers, sap beetle	Leaf blight, leaf scorch, leaf spot, powdery mildew, fruit rot	Spray weekly up to harvest, but observe limitations of pesticide.
During harvest season	Sap beetle	Fruit rot, leaf blight, leaf scorch, leaf spot, powdery mildew	Apply approved fungicides immediately after any harvest.
Postharvest spray	Aphids, mites, leafhoppers	Leaf blight, leaf scorch, leaf spot, powdery mildew	Apply as needed; 10-14 day schedules are effective.
Late fall spray		Leaf blight, leaf scorch, leaf spot	

Fungicides For Controlling Diseases On Strawberries

Diseases	Fungicides*	Formulation per 100 gal.‡	Limitations (days before harvest)	Remarks
Transplants Botrytis	benomyl 50WP§	8 oz.	NLT†	Immerse plants and drain before planting.
Blossom blights, fruit rots	benomyl 50WP	½-1 lb.	NLT	Apply 1 lb. per acre at 10% bloom and at full bloom; continue at 10- to 14-day intervals, using ½ lb. per acre.
	captan 50WP	2 lb.	NLT	
	folpet 50WP	2 lb.	NLT	
	thiram 65WP	2-3 lb.	3	
	zineb 75WP	1½-2 lb.	7	Remove excess by washing if applied within 3 days of harvest.

*Abbreviations used with fungicides and insecticides are: WP = wettable powder, SP = soluble powder, EC = emulsifiable concentrate, F = flowable.

‡"Formulation per 100 gal." is average dosage. See label for details on dosage.

† NLT=No time limitations.

§Always use a protectant fungicide with benomyl. See note 10.

Fungicides For Controlling Diseases On Strawberries (continued)

Diseases	Fungicides*	Formulation per 100 gal.‡	Limitations (days before harvest)	Remarks
Leaf blight, leaf scorch, leaf spot	benomyl§	½-1 lb.	NLT†	Apply 1 lb. per acre at 10% bloom and at full bloom; continue at 10- to 14-day intervals, using ½ lb. per acre.
	captan 50WP	2 lb.	NLT	
	dodine 65WP	½-¾ lb.	14	Effective for leaf scorch.
	Dyrene 50WP	2-3 lb.	5	
	ferbam 76WP	1-1½ lb.	14	
	folpet	2 lb.	NLT	
thiram 65WP	2-3 lb.	3	Remove excess by washing if applied within 3 days of harvest.	
zineb 75WP	1½-2 lb.	7		
Powdery mildew	benomyl§	½-1 lb.	NLT	Apply 1 lb. per acre at 10% bloom and at full bloom; continue at 10- to 14-day intervals, using ½ lb. per acre.
	Sulfur	Label directions		
Bacterial angular leaf spot	Bordeaux mixture	See remarks	NLT	Begin with new growth. Repeat at 10- to 14-day intervals until berries are half grown, after harvest, and 3 weeks later. Use 4 lbs. copper sulfate, 4 lbs. hydrated lime, and 100 gallons water. Dissolve copper sulfate and then add to lime water. Use immediately. Do not mix with other chemicals.

Copper fungicides
The following are registered for control of leaf scorch and leaf spot control on strawberries: Copper (Ammoniacal); Copper hydroxide; Copper oleate; Copper oxide; Copper oxychloride; Copper oxychloride sulfate; Copper sulfate (basic); Copper sulfate (monohydrate); Copper tetra; Copper calcium oxychloride; Copper-zinc-chromate complex.

*Abbreviations used with fungicides and insecticides are: WP = wettable powder, SP = soluble powder, EC = emulsifiable concentrate, F = flowable.

‡"Formulation per 100 gal." is average dosage. See label for details on dosage.

†NLT=no time limitations.

§Always use a protectant fungicide with benomyl. See note 10.

Insecticides For Controlling Insects On Strawberries

Insects	Insecticides*	Formulation per 100 gal.‡	Limitations and days before harvest	Remarks
Aphids	malathion 25WP	3 lb.	3	
Leafhoppers	diazinon 50WP	½ lb.	5	
	malathion 25WP	3 lb.	3	
Leafroller	methoxychlor 50WP	1¾ lb.	3	
	diazinon 50WP	1½ lb.	5	
	azinphosmethyl (Guthion) 50WP	1 lb.	5	
	malathion 25WP	3 lb.	3	
Mites	carbaryl (Sevin) 80WP	1¼ lb.	1	
	diazinon 50WP	1 lb.	5	
	dicofol (Kelthane) 35WP	¾ lb.	2	
	malathion 25WP	3 lb.	3	Two-spotted mite only. Do not reapply within 15 days or more than twice within a 35-day period when fruit is present.
endosulfan	1 lb.	4		
Sap beetle	(Thiodan) 50WP			Cyclamen mite only.
	ethion 25WP	2 lb.	2	
	carbaryl (Sevin) 80WP	1½ lb.	1	Two-spotted mite only.
Sawfly, strawberry weevil, tarnished plant bug	malathion 25WP	3 lb.	3	Methoxychlor is preferred for weevil ("clipper") and should be used in combination with endosulfan if both weevil and plant bug are problems.
	endosulfan	1 lb.	4	
White grub, root weevil larvae	(Thiodan) 50WP			Make soil preplant treatment, incorporate.
	methoxychlor 50WP	2 lb.	3	
	chlordane 4 lb. EC	2 qts.		

*Abbreviations used with fungicides and insecticides are: WP = wettable powder, SP = soluble powder, EC = emulsifiable concentrate, F = flowable.

‡"Formulation per 100 gal." is average dosage. See label for details on dosage.

Weed Control in Strawberries

Weed problem	Herbicide	Rate/acre sprayed**		Time of application	Remarks
		Pounds active ingredient	Pounds commercial product		
NEW PLANTINGS					
Annual weeds, especially broadleaves	chloroxuron (Tenoran) (Norex)	4	8	After planting and in summer or fall	May be applied to emerged broad-leaf weeds if less than 2 inches tall. Do not apply more than twice in a season.
Annual grasses and some broad-leaved weeds	DCPA (Dacthal)	9	12	After planting but before weeds emerge	Retreatment will be necessary in fall to control winter annual weeds. Particularly effective on sandy soils.
Annual weeds, good against grasses	diphenamid (Enide) (Dymid)	4-6 4-6	8-12 5-7½	About 21 days after planting and in fall, just before mulching	Use lower rate on sandy soil. Apply to a weedfree soil. Plants should be well-established. Good for control of winter annuals in late fall.
Both grasses and broadleaved weeds	chloroxuron + diphenamid	Use a combination of chloroxuron and diphenamid at the rates suggested above for each herbicide.		About 21 days after planting and in fall	Most effective control is realized if weeds are allowed to germinate and emerge but before broadleaves reach 2 inches or grasses ½ inch. Use low rate of diphenamid on sandy soils.
ESTABLISHED PLANTINGS					
Annual weeds, especially broadleaves	chloroxuron (Tenoran) (Norex)	4	8	Immediately after renovation	Do not apply within 60 days of harvest. May be used with DCPA or diphenamid where both grasses and broadleaves are a problem.
Annual weeds, good against grasses.	diphenamid (Enide) (Dymid)	4-6 4-6	8-12 5-7½	Immediately after renovation or just before mulching	Use lower rate on sandy soil. Do not apply within 60 days of harvest. Not effective on many broadleaved weeds or established weeds. Good for control of winter annuals in late fall.
Annuals	DCPA (Dacthal)	9	12	Spring or immediately after renovation	Not effective on many broadleaved weeds or established weeds. Do not apply after first bloom.
Growing broadleaf weeds	2,4-D amine	1	1 qt.	After harvest at renovation	Do not apply after August 10 or misshapen fruit may develop. 2,4-D will not control grassy weeds.
Annuals	terbacil	.4 to 1.0 lb.	½ to 1¼ lb.	Immediately after post-harvest renovation or in fall just before mulching	Do not use on sand, loamy sand, or gravelly soils. Old leaves should be removed.

**Rates given are on an acre basis of area actually treated.

Fungicides Listed in this Publication

Common names	Trade names
benomyl —	Benlate.
Bordeaux mixture —	Several trade name materials of prepared mixtures, or can be made fresh from copper sulfate and fresh hydrated lime.
captafol —	Difolatan, Sulfonamide.
captan —	Orthocide, Stauffer Captan.
copper fungicides —	Check trade names for chemicals listed.
dodine —	Cyprex.
Dyrene —	Trade name.
ferbam —	Fermate, Ortho Ferbam, Stauffer Ferbam, and others with Ferbam in the trade name.
Folpet —	Phaltan, Stauffer Folpet.
Glyodin —	Trade name.
lime sulfur —	Orthodix spray.
mancozeb —	Dithane M-45, Manzate 200.
maneb + zinc —	Dithane M-22 Special, Manzate D.
Polyram —	Trade name.
streptomycin formulations —	Agrimycin 17, Agri-Strep Type A, Agri-Strep Type D, Ortho Streptomycin Spray, Phytomycin.
sulfur —	Corosul S., Kolofog, Magnetic Sulfur, others.
thiram —	Thylate.
zineb —	Dithane Z-78, Ortho Zineb Wettable, Parzate C, Stauffer Zineb, and others with Zineb in the trade names.

Protection of Bees

The pollination of fruit depends almost entirely on bees. To prevent possible injury to them, follow the recommendations in this guide concerning which insecticides to use and the application timing. Do not apply insecticides to plants in bloom. This applies to dandelions and clovers, as well as fruit bloom. Mowing dandelions and clover in the fruit area helps. Where there is a choice, use insecticides least harmful to bees. (See table below.)

INSECTICIDES HIGHLY TOXIC TO HONEY BEES

Arsenicals	Malathion
Azinphosmethyl (Guthion)	Methyl parathion
Carbaryl (Sevin)	Naled (Dibrom)
Diazinon	Parathion
Imidan	Phosphamidon (Dimecron)

INSECTICIDES MODERATELY TOXIC TO HONEY BEES

Carbophenothion (Trithion)	Endosulfan (Thiodan)
Chlordane	Oxydemetonmethyl (Meta-Systox R)
Demeton (Systox)	

INSECTICIDES WITH LOW TOXICITY TO HONEY BEES

Bacillus thuringiensis (Thuricide, Biotrol)	Ethion (Nialate)
Binaparacryl (Morocide)	Methoxychlor
Chlorbenside (Mitox)	Oxythioquinox (Morestan)
Chlorbenzilate (Acaraben)	Omite
Dicofol (Kelthane)	Ovex (Ovotran)