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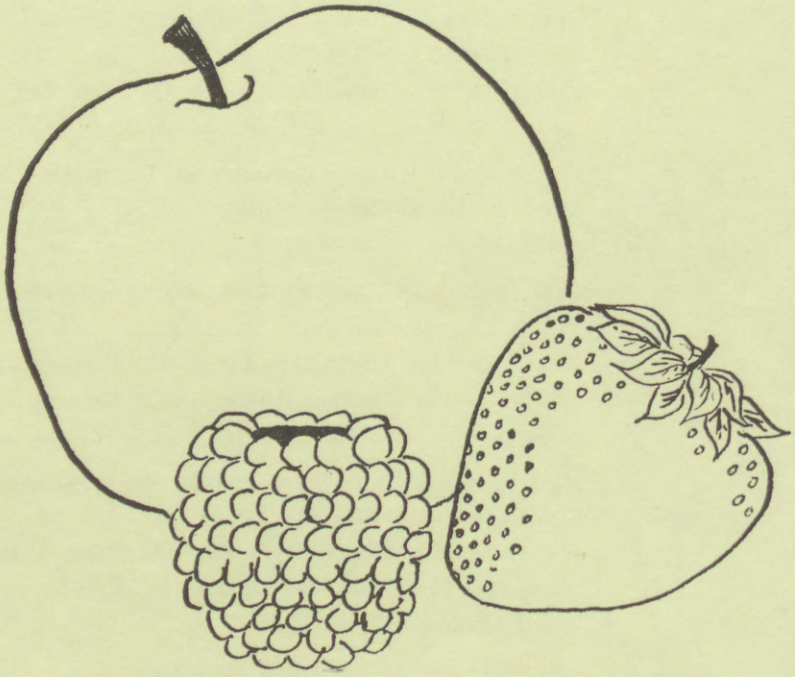
PEST CONTROL GUIDE for commercial fruit growers



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Contents

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PEST CONTROL GUIDE FOR COMMERCIAL FRUIT GROWERS

This publication contains information about the control of insects, diseases, and weeds in commercially produced fruit. The recommendations are based on the latest and most factual information available.

Caution: All pesticides must be handled carefully. Effective and safe spray applications result only when you use the right amount of the right materials on the right places at the right times. Protect yourself by reading and carefully following the protective measures given on chemical container labels. For a complete discussion of pesticide precautions, see the safety precautions section on pages 18-19 of this bulletin and see University of Minnesota Agricultural Extension Bulletin 263, *Insecticides and Their Uses in Minnesota.*

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. Apply no insecticides to plants in bloom; avoid drift onto blossoming legumes.

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
Brainerd	St. Joseph's Hospital	2861
Crookston	Bethesda Hospital	281-4682
	St. Francis Hospital	281-2490
Duluth	St. Luke's Hospital 915 E. 1st St.	727-6636
Fargo, N. Dak.	St. Luke's Hospital	235-3161
Fergus Falls	Lake Region Hospital	736-5475 Night, 736-3255
Mankato	Immanual Hospital	628-1605
Marshall	Lewis Weiner Memorial Hospital	532-2263
Minneapolis	State Health Department, Division of Special Health Services	339-7751 Night, 339-1411
	Abbott Hospital, 110 E. 18th St.	339-8414 Extension 226
	Fairview Hospital, 2312 S. 6th St.	332-0282 Extension 331
	Hennepin County General Hospital, 619 S. 5th St.	330-3930
	North Memorial Hospital, 3220 Lowry Avenue N.	588-9451
	Northwestern Hospital, 810 E. 27th St.	332-7266
Morris	Stevens County Memorial Hospital	1191
Rochester	St. Mary's Hospital	282-4425 Extension 591
St. Cloud	St. Cloud Hospital	251-2700
St. Paul	Bethesda Hospital 559 Capitol Blvd.	227-8611
	Children's Hospital, 311 Pleasant Avenue	227-6521
	Ramsey County General Hospital, 640 Jackson	223-0353 Extension 217
	St. John's Hospital, 403 Maria Avenue	776-8595 Extension 351
	St. Joseph's Hospital, 69 W. Exchange	222-2861
	St. Luke's Hospital, 300 Pleasant Avenue	222-6644
Virginia	Virginia Municipal Hospital	741-3340
Willmar	Rice Memorial Hospital	235-4543
Worthington	Worthington Memorial Municipal Hospital	376-4141 Night, 376-4142

Use chemical materials according to label directions. Use them on the crops, in amounts, in the manner, and at times specified. Keep accurate records of all chemical applications.

For trade names and other information on fungicides, see University of Minnesota Agricultural Extension Bulletin 312, *Fungicides, Bactericides, and Nematocides.*

The recommendations are based on current state and federal registrations and tolerances set by the Food and Drug Administration. In order to control pests and diseases effectively and avoid excessive residues on crops, you must read, understand, and follow carefully the directions given in this guide and on current container labels. The following information was up to date at the time of this printing; information regarding any changes during the 1967 season will be made available to all commercial growers.

Pest Control Guide For Commercial Apple Growers

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

The major diseases in Minnesota orchards are apple scab, cedar-apple rust, and fireblight. 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 chemicals that are effective for controlling the major diseases and insects troublesome to apples, (2) the times spray applications normally are required, and (3) the pests that may be troublesome at each spray date.

This spray schedule is only a suggested one; existing orchard conditions will determine the exact spray schedule you should use. This guide is intended for commercial growers only. Consult University of Minnesota Agricultural Extension Pamphlet 184, *Home Fruit Spray Guide,* for information on pest control in home orchards.

The notes referred to in these tables appear on pages 8-9.

Apple Spray Schedule

Timing	Insect problems	Disease problems	Remarks
1. Dormant spray (before buds show silver tips)	Aphids, mites, oystershell scales, leaf roller eggs	None	Use an emulsifiable dormant oil or DN-289 or Elgetol 318, or use dormant oil plus diazinon or ethion as labeled.
2. Delayed dormant spray (before leaves are out ½ inch)	Aphids (if they appear)	Apple scab	See note 1.
3. Prepink spray	Cankerworms, mites, aphids	Apple scab cedar-apple rust	Use when there is an extended period between delayed dormant and pink spray. See notes 1 and 2.
4. Pink spray (when fruit buds show pink at tips)	Cankerworms, aphids, mites	Apple scab, cedar-apple rust	See notes 1 and 2.
5. Blossom spray	None (protect bees)	Apple scab, cedar-apple rust	Do not apply mercury sprays. Do not apply insecticides during bloom period—protect bees. See notes 1 and 2.
6. Petal fall (after three-fourths of petals have fallen)	Curculios, codling moths, red-banded leaf rollers, mites, aphids	Apple scab, cedar-apple rust	Guthion may be used instead of dieldrin at this stage if an additional application is made during first cover spray. See notes 1 and 2.
7. First cover spray (5 to 7 days after petal fall or when fruit is ¼ inch in diameter)	Red-banded leaf rollers, curculios, codling moths, mites, aphids, oystershell scales (crawlers)	Apple scab, cedar-apple rust	Mercury must not be used after petal fall. See notes 1 and 2.
8. Second cover spray (7 to 10 days after first cover)	Codling moths, leafhoppers, mites, aphids, oystershell scales (crawlers)	Apple scab, cedar-apple rust	See notes 1 and 2.
9. Third cover spray (7 to 10 days after second cover)	Codling moths, mites, aphids, leafhoppers	Apple scab, cedar-apple rust	Rust may no longer be a threat after June 15. See notes 1 and 2.
10. Additional sprays (when maggot flies have started to emerge)	Apple maggots, mites, aphids, leafhoppers	Apple scab, sooty blotch fruit, and flyspeck of fruit	Observe time limitations for chemicals used. See notes 1, 4, and 5.

Fungicides For Disease Control On Apples

Diseases	Fungicides	Dosages (amount of formulation per 100 gallons water)	Limitations (days before harvest)	Remarks
Apple scab (See note 1.)	captan 50WP	1½-2 lb.	NTL*	
	dodine 65WP (Cyprex)	¼-½ lb.	5 days	Do not use treated apples in the manufacture of apple pomace for use in livestock feeds.
	folpet 50WP	1-2 lb.	NTL	Summer sprays.
	Glyodin	1 qt.	NTL	3 lb. actual per acre through petal fall; 1.8 lb. actual per acre as cover spray.
	lime sulfur	2 gal. liquid or 8 lb. dry	NTL	Prepink spray. (Last application.)
	methyl mercury hydroxquinolate (Ortho LM)	Follow label directions	Through petal fall only.	See note 1.
	phenyl mercuri ethylene-diamine (Coromerc)	Follow label directions	Through petal fall only.	See note 1.
	phenyl mercuri monoethanol ammonium lactate (Puratized Apple Spray)	Follow label directions	Through petal fall only.	See note 1.
	phenyl mercuri acetate	Follow label directions	Through petal fall only.	See note 1.
	maneb + zinc	2 lb.	NTL	May inhibit mite buildup.
	thiram 50WP (Thylate)	2 lb.	NTL	
Cedar-apple rust (See note 2.)	ferbam 76WP	2 lb.	7 days	Do not use on Golden Delicious.
	thiram 50WP	2 lb.	NTL	
	zineb 75WP	2 lb.	NTL	
	maneb + zinc	2 lb.	NTL	
	Niacide M	2 lb.	NTL	
Sooty blotch and flyspeck (See note 4.)	captan	1½-2 lb.	NTL	Postharvest dip or spray, 0.12% solution. (See note 6.)
	ferbam	2 lb.	7 days	Do not use on Golden Delicious.
	zineb	2 lb.	NTL	
Fireblight (See note 3.)	Bordeaux mixture	½-2-100 or 1-2-100	NTL	½ or 1 lb. copper sulfate and 2 lb. hydrated lime in 100 gal. water. Do not mix with other chemicals.
	streptomycin formulations	Follow label directions	Do not apply after fruit is visible.	

* NTL = no time limitations.

Insecticides For Insect Control On Apples

Insects	Insecticides	Rate per 100 gallons water	Tolerances (p.p.m.)*	Limitations (days before harvest)	Remarks
Aphids	azinphosmethyl† (Guthion)	1-1¼ lb. 25% WP‡	2.0	15 days	
	carbophenothion (Trithion)	½ lb. 25% WP	0.8	30 days	
	diazinon	1 lb. 50% WP	0.75	14 days	
	DN-289	1½ pt.-2 qt.	.....	Prebloom or dormant	Recommended for dormant sprays.
	Elgetol 318	1½ pt.-2 qt.	.....	Prebloom or dormant	Recommended for dormant sprays.
	ethion	1 lb. 25% WP	2.0	40 days	
	malathion	3 lb. 25% WP	8.0	3 days	
	parathion†	1½ lb. 15% WP	1.0	14 days	
	phosphamidon† (Dimecron)	½ pt.	.....	60 days	
Apple maggots (See note 5.)	azinphosmethyl† (Guthion)	1¼ lb. 25% WP	2.0	15 days	
	carbaryl (Sevin)	1½ lb. 80% WP	10.0	1 day	
	DDT	2 lb. 50% WP	7.0	30 days	
	diazinon	1 lb. 50% WP	0.75	14 days	
	lead arsenate	3 lb.	7.0	30 days	Remove excess residue at harvesttime. Do not graze livestock on treated areas.
	methoxychlor	2 lb. 50% WP	14.0	7 days	
Cankerworms	carbaryl (Sevin)	1½ lb. 80% WP	10.0	1 day	Carbaryl is toxic to bees.
	DDT	2 lb. 50% WP	7.0	30 days	
	lead arsenate	3 lb.	7.0	30 days	Remove excess residue at harvesttime. Do not graze livestock on treated areas.
Codling moths	azinphosmethyl† (Guthion)	1¼ lb. 25% WP	2.0	15 days	
	carbophenothion (Trithion)	½-1 lb. 25% WP	0.8	30 days	
	DDT	2 lb. 50% WP	7.0	30 days	
	diazinon	1 lb. 50% WP	0.75	14 days	
	lead arsenate	3 lb.	7.0	30 days	Remove excess residue at harvesttime. Do not graze livestock on treated areas.
Leafhoppers	DDT	2 lb. 50% WP	7.0	30 days	
	diazinon	1 lb. 25% WP	0.75	14 days	
	malathion	3 lb. 25% WP	8.0	3 days	
	methoxychlor	2 lb. 50% WP	14.0	7 days	
Mites	azinphosmethyl† (Guthion)	1¼ lb. 25% WP	2.0	15 days	
	binapacryl (Morocide)	½ lb. 50% WP	.....	60 days	Do not apply more than four times during fruiting.
	carbophenothion (Trithion)	1 lb. 25% WP	0.8	30 days	
	chlorbenside (Mitox)	1 lb. 40% WP	3.0	7 days	
	chlorobenzilate	1½ lb. 25% WP	5.0	14 days	

* p.p.m. = parts per million. † Highly toxic. ‡ WP = wettable powder.

Insecticides For Insect Control On Apples (continued)

Insects	Insecticides	Rate per 100 gallons water	Tolerances (p.p.m.)*	Limitations (days before harvest)	Remarks
Mites (continued)	diazinon	1 lb. 25%WP	0.75	14 days	
	dicofol (Kelthane)	1½ lb. 18½% WP	5.0	7 days	
	DN-289	1½ pt.	.....	Prebloom or dormant	Recommended for dormant sprays.
	Elgetol 318	1½ pt.	.....	Prebloom or dormant	Recommended for dormant sprays.
	ethion	1 lb. 25% WP	2.0	40 days	Do not apply more than four times during fruiting period or at rates higher than 2.5 lb. actual per acre.
	Genite 923	1½ pt.	.....	Prebloom or dormant	
	Morestan	½ lb. 25% WP	.....	35 days	Do not apply more than five times and at not more than 1½ lb. per acre.
	parathion†	1½ lb. 15% WP	1.0	14 days	
	phosphamidon (Dimecron)†	½ pt.	.....	60 days	
	tetradifon (Tedion)	1 lb. 25% WP	5.0		Use no more than three applications after petal fall or at rates higher than 2.5 lb. actual per acre.
	ovex	½ lb. 50% WP	3.0	30 days	
Oystershell scale	DDT	2 lb. 50% WP	7.0	30 days	For use when crawlers are present.
	diazinon	1 lb. 50% WP	0.75	14 days	For use when crawlers are present.
	DN-289	1½ pt.	.....	Prebloom or dormant	Recommended for dormant sprays.
	Elgetol 318	1½ pt.	.....	Prebloom or dormant	Recommended for dormant sprays.
	ethion	1 lb. 25% WP	2.0	40 days	For use when crawlers are present. Do not apply more than four times during fruiting period or at rates higher than 2.5 lb. actual per acre.
Plum and apple curculios	azinphosmethyl† (Guthion)	1¼ lb. 25% WP	2.0	15 days	
	dieldrin	½ lb. 50% WP	0.25	45 days	Dieldrin is toxic to bees.
Red-banded leaf rollers	azinphosmethyl† (Guthion)	1¼ lb. 25% WP	2.0	15 days	
	diazinon	1 lb. 50% WP	0.75	14 days	
	DN-289	1½ pt.	.....	Prebloom or dormant	For use as a dormant spray.
	Elgetol 318	1½ pt.	.....	Prebloom or dormant	For use as a dormant spray.
	ethion	1 lb. 25% WP	2.0	40 days	Do not apply more than four times during fruiting period or at rates higher than 2.5 lb. actual per acre.
	TDE	2 lb. 50% WP	7.0	30 days	

* p.p.m. = parts per million. † Highly toxic. ‡ Wettable powder.

Notes

1. Controlling Scab Infections. 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. So the scab organism has to be "burned out" with a chemical such as dodine (Cyprex) or a mercury fungicide (use it at one-half strength when you can apply it within 40 hours after the start of an infection period and at full strength when you apply it within 72 hours).

You can fortify the effectivenes of the mercury fungicide by using it in combination with captan, but rarely can you use both at full strength. The cost of the chemicals and the severity of conditions favoring scab infection determine how much you can use.

Mercury fungicide is approved for use through petal fall, but it should not be used during the bloom period. (Mercury fungicide can be toxic to bees.)

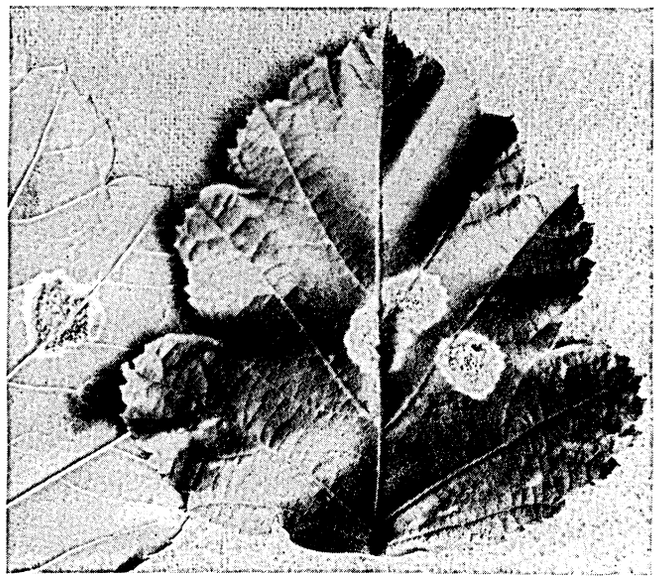
Dodine (Cyprex), a local systemic fungicide, can penetrate short distances into apple tissues and destroy some established infections. It is a logical replacement for mercury fungicide in bloom stage. The manufacturer recommends using ¾ pound of dodine 65W per 100 gallons of spray for controlling scab when infection possibility exists during a rainy period. Although the timing will vary with temperature, you should apply dodine within 36 hours of the beginning of the rain or wet period.

In a scab-protection schedule, the manufacturer recommends ¼ to ½ pound dodine 65W per 100 gallons of spray at 5- to 7-day intervals or as needed to maintain scab control from prebloom through first cover applications. Use ⅛ to ¼ pound dodine in subsequent cover sprays as needed. Do not apply dodine within 5 days of harvest.

Freezing or near-freezing temperatures injure fruit or predispose fruit to chemical injury, particularly when these temperatures are accompanied by slow drying conditions. Do not apply dodine 65W immediately before, during, or immediately after the occurrence of such conditions.

2. Controlling Cedar-Apple Rust. Cedar-apple rust 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. Varietal differences do affect 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; ferbam and zineb are recommended.



Cedar-apple rust

Begin spraying at the pink stage and continue through first cover (about mid-June). Successive crops of gelatinous spore horns are produced on infected cedars during this period.

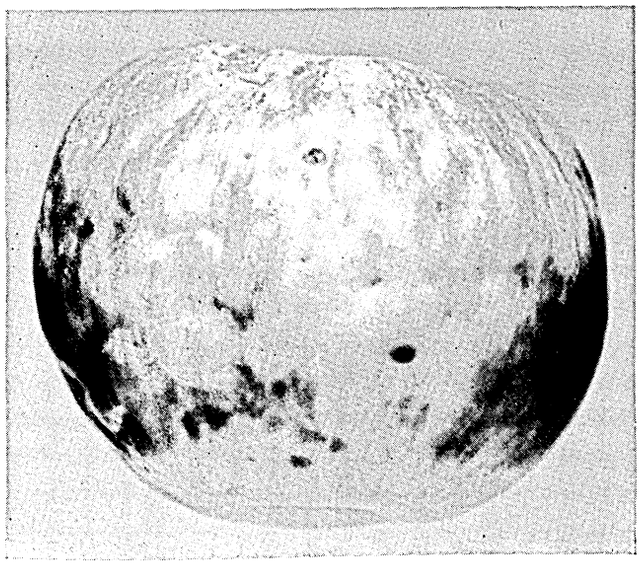
Rust controlling fungicides also control scab, but generally they are inferior to captan or dodine. Continue to use a scab fungicide at full strength when controlling cedar-apple rust. Do not use ferbam on Golden Delicious. For additional information, see University of Minnesota Plant Pathology Fact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

3. Controlling Fireblight. Fireblight 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 fireblight. Control recommendations emphasize cultural methods, sanitation, and a chemical spray program.

Cultural Control Methods. Encouraging lush growth increases the susceptibility of trees to fireblight. When fireblight 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



Apple maggot injury

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 fireblight the following year.

Chemical Control Methods. There is evidence that copper or antibiotic sprays give some control of blight on flowers and spurs if the materials are applied before the infection spreads. Bordeaux mixture or streptomycin is recommended. Apply either material in four applications at 4-day intervals starting when blossoms appear. **Caution:** Bordeaux mixture is incompatible with many other pesticides.

Note: Chemical methods have never approached full control of fireblight disease. Before you decide to use either or both of the recommended chemicals, consider their cost, the amount of inoculum present, the favorability of weather conditions for fireblight infection, and the severity of the potential crop loss.

4. Controlling 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 protective measures. Add either ferbam or zineb to the spray mixtures. Do not use ferbam on Golden Delicious.

5. Controlling Apple Maggots. To control apple maggots, 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.

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. Of the suggested materials for controlling apple maggot, DDT, Guthion, diazinon, or carbaryl (Sevin) may give up to 10-day protection.

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. Postharvest Dip Or Spray. You may use a postharvest dip or spray to reduce certain types of rotting on apples being prepared for market. The maximum permissible dosage is a 0.12 percent suspension of captan fungicide (2 pounds of 50W per 100 gallons of water). Some formulations of captan with a higher percentage of active ingredient will leave a less distinct residue. Follow label directions.

7. 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 DDT as in the pink spray. You can control treehoppers with DDT in late July or as soon as the insects first appear. Repeat the application 2 weeks later. Control grasshoppers with malathion or diazinon when they become numerous. Use malathion, parathion, azinphosmethyl (Guthion), diazinon, or phosphamidon to control aphids as they appear.

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.

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. A residue tolerance of 1 part per million (p.p.m.) has been set for NAA. NA amide has been approved on a "no residue" basis.

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).

The thinning action is increased when:

- Freezing temperatures occur during or shortly after bloom.
- Pollination is poor or seed set per fruit is low.
- Days are bright with temperatures of 70°-80° F.

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°-75° 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 p.p.m. Information on the time to apply NA amide under local conditions is limited. The best application time in Minnesota appears to be about 2 weeks after full bloom.

In Michigan, the use of NA amide is recommended at petal fall. Later applications have caused fruit to stick and remain small and valueless. Good results have been obtained in some states when NA amide was applied 2 or 3 weeks after full bloom.

You can determine the need for additional thinning of fruits treated with NA amide 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 varities of unknown response to sprays, limit sprays to a trial basis.

The following recommendations are presented as guidelines for spraying normal, reasonably vigorous trees 12 years old or older. Orchard conditions, weather conditions, and your experience will determine the exact timing and concentration of chemical to use.

Using Carbaryl. The insecticide carbaryl (Sevin) may be useful for thinning fruits, especially in areas where temperatures are warm early in the postbloom period. If you use carbaryl, apply it at the rate of 1½ pounds of 50W per 100 gallons of water; make the application 10-20 days after full bloom. Varying the concentration of carbaryl has not appreciably changed the degree of thinning obtained.

Thinning Spray Recommendations

Materials	When to apply	Concentration (p.p.m.)*	Varieties	Remarks
Naphthalene acetamide (NA amide)	Petal fall to 2½ weeks after full bloom	50-60	Duchess, Wealthy, other early varieties	If possible, use when weather conditions favor relatively slow drying. NA amide often is applied in the evening.
Naphthalene acetic acid (NAA)	14-21 days after full bloom	10	Delicious, Jonathan, McIntosh, Minjon†	Use on varieties ripening with or later than McIntosh. In some regions, NAA is preferred for almost all varieties.

* p.p.m. = parts per million.

† Recommendations for thinning sprays on Haralson and Minjon are based on limited experience. Both varieties frequently overcrop and need thinning; Haralson is difficult to thin. Concentrations twice those recommended in the table have been used experimentally with success. If you consistently underthin Haralson at the recommended rates, try heavier concentrations on a trial basis.

Local information on this chemical is limited. Research data indicate that Haralson fruits are thinned by carbaryl. But, because it is not consistently reliable, carbaryl is not recommended.

Thinning Young Trees. Carbaryl (1½ pounds per 100 gallons of water) in combination with NAA (10 p.p.m.) causes severe thinning. The combination has been useful for removing all fruits from young trees.

Caution: To avoid excessive fruit drop, do not use carbaryl as an insecticide until at least 20 days after petal fall.

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, McIntosh, and other varieties drop excessively.

Materials Recommended. Both NAA (naphthalene acetic acid) and 2,4,5-TP (2,4,5-trichlorophenoxy proprionic acid) have been used effectively on most apple varieties in Minnesota. NAA has a residue tolerance of 1 p.p.m.; 2,4,5-TP is registered on a "no residue" basis as a stop-drop spray.

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

Apply NAA 4-5 days before you expect natural fruit dropping to begin. Do not make more than two applications and do not make applications within 2 days of harvest. NAA is effective for a relatively short time, usually not more than 2 weeks.

The maximum strength for using 2,4,5-TP is 20 p.p.m.; 10 p.p.m. 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 2-3 weeks prior to the expected harvesting date. Since it has an effective stop-drop action for about 4 weeks, you can spray this chemical earlier than NAA. But NAA becomes effective more quickly after spraying than does 2,4,5-TP.

Obtain 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 or high humidity also increases their effectiveness, but drought reduces it. Occasionally, heavy drops may occur in spite of weather or treatment.

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

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

Vegetation Control In Apple Orchards[1]

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 plants. The amount of material to use varies with the kinds and sizes of weeds present, the crop planted, soil type and condition, weather, application method, and formulations.

To prevent crop injury, use an herbicide only on a trial basis until you are familiar with its reaction on that specific crop. 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 uniformily 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.
- **Make applications prior to bloom** unless there is specific label approval for other uses.
- **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.
- **Separate herbicides from other pesticides** during storage. This practice prevents contamination of insecticides and fungicides and prevents possible confusion of herbicides with other pesticides.

[1] Rates given are for the actual area treated. Calibrate your sprayer on an acre basis, but only treat the area beneath trees. If you treat only one-tenth of the area, use only one-tenth the amount required for an acre.

If an apple tree has been in a location for at least 1 year, you can control the vegetation underneath it with simazine. Use 4 pounds actual material per acre. To control most annual weeds and grasses, apply simazine before vegetation emerges.

Amitrole (2 pounds actual material per acre) applied in combination with simazine (4 pounds actual material per acre) gives good control of emerged weeds and grasses. Do not apply amitrole after bloom; avoid contact with branches or foliage.

If your orchard is at least 4 years old, you can control quackgrass with dalapon at 10 pounds actual material per acre. For best results, spray in spring when grasses are 4-6 inches tall. Apply dalapon only within a 3-foot radius of tree trunks and, if necessary, make a second application.

Pest Control Guide For Commercial Stone Fruit Growers

Apricots, cherries (sour), plums (European and native hybrids), cherry plums, and Nanking cherries are popular stone fruits in Minnesota. Under Minnesota conditions, these fruits do not require an intensive spray program. But an effective pest control program is necessary for producing high quality fruits.

The major insects that attack stone fruits are plum curculios, aphids, mites, leaf rollers, and scale insects. Brown rot is the principal disease affecting these crops; cherry leaf spot, plum pocket, and a few other diseases may cause damage.

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

Stone Fruit Spray Schedule

Timing	Insect problems	Disease problems	Remarks
Dormant	Mites, scales, leaf roller eggs	Plum pocket	Use "Superior" dormant oils for insect problems.
Pink	Mites		
Petal fall	Plum curculios, mites, aphids, leaf rollers		Be certain that bee activity has ceased before applying spray.
Shuck fall (when shucks split and fall)	Plum curculios, aphids, mites, leaf rollers	Brown rot	
First cover	Plum curculios, aphids, mites, borers	Brown rot	Make second borer spray 3 weeks later.
Second cover	Aphids, mites, apple maggots	Brown rot	
Additional cover	Aphids, mites, apple maggots	Brown rot	Apply as needed but watch time limitations.
Preharvest		Brown rot	Apply suitable fungicides 1-5 days before harvest.
Postharvest	Aphids, mites		Apply as needed.

Fungicides For Controlling Diseases On Stone Fruits

Diseases	Fungicides	Dosages (amount per 100 gallons water)	Limitations (days before harvest)	Remarks
Brown rot	captan 50WP*	1½-2 lb.	NTL†	
	ferbam 76WP	2 lb. (apricots)	21	
		2 lb. (cherries)	NTL	
		½-1 lb. (plums)	7	
	Zineb 75WP	2 lb. (apricots)	Through petal fall	
		2 lb. (cherries)	7	
		2 lb. (plums)	30	
Powdery mildew	dinocap 50WP (Karathane)	½-1 lb. (apricots)	45	

* WP = wettable powder. † NTL = no time limitations.

Fungicides For Controlling Diseases On Stone Fruits (continued)

Diseases	Fungicides	Dosages (amount per 100 gallons water)	Limitations (days before harvest)	Remarks
Powdery mildew (continued)	sulfur	4-8 lb.	NTL	Do not apply if temperature above 75° F. will occur within 2 or 3 days.
Cherry leaf spot	captan	2 lb.	NTL	
	Cycloheximide	1-2 p.p.m.‡	4	Use on cherries only.
	dodine	½ lb.	NTL	Use on sour cherries only.
	ferbam	2 lb.	See limitations under brown rot.	
	glyodin	¾-1¼ qt. (cherries)	7	
Plum pocket	Bordeaux mixture	(See remarks.)	NTL	Use 8 lb. copper sulfate, 4 lb. hydrated lime, and 100 gal. water. Dormant application.
	lime sulfur	1 gal.	NTL	Dormant application.

‡ p.p.m. = parts per million.

Insecticides For Controlling Insects On Stone Fruits

Insects	Insecticides	Tolerances (p.p.m.)*	Limitations (days before harvest)	Remarks
Aphids	diazinon	0.75 (apricots, plums)	10	Full coverage spray.
		0.75 (cherries)	Postharvest	
	ethion	..... (apricots)	Delayed dormant	
		..... (cherries)	Postharvest	
		2.0 (plums)	21	Do not apply more than three times during fruiting period.
	malathion	8.0 (apricots)	7	
		8.0 (cherries, plums)	3	May injure foliage on some cherry varieties.
	parathion†	1.0 (cherries, apricots)	14	Do not apply until danger of bee poisoning is past.
	azinphosmethyl (Guthion)	2.0 (apricots)	21	
		2.0 (cherries, plums)	15	
	carbophenothion (Trithion)	0.8	30	
Apple maggots	carbaryl (Sevin)	10.0 (apricots)	3	
		10.0 (cherries, plums)	1	
	DDT	7.0 (plums)	30	Full coverage spray.
	diazinon	0.75	10	Full coverage spray.
	azinphosmethyl (Guthion)	2.0 (apricots)	21	
		2.0 (cherries, plums)	15	
Borers	DDT	7.0	42	Apply to trunks, crotches, and lower limbs at no more than 16 lb. per acre.
	endosulfan (Thiodan)	2.0 (plums)	7	
	azinphosmethyl (Guthion)	2.0 (apricots)	21	
		2.0 (cherries, plums)	15	
Leaf rollers	azinphosmethyl (Guthion)	2.0 (apricots)	21	
		2.0 (cherries, plums)	15	
	diazinon	0.75 (apricots, plums)	10	Full coverage spray.
	TDE	7.0	30	
Mites	dormant oils	.....	Dormant spray	Apply when temperature is above 40° F.
	Genite-923	..... (cherries, plums)		Do not apply later than pink stage.
	tetradifon (Tedion)	5.0		Make no more than two applications after shucks fall and use only 1 lb. per acre or less per application.

* p.p.m. = parts per million. † Highly toxic.

Insecticides For Controlling Insects On Stone Fruits (continued)

Insects	Insecticides	Tolerances (p.p.m.)*	Limitation (days before harvest)	Remarks
Mites (continued)	chlorobenside (Mitox)	3.0	7	
	dicofol (Kelthane)	10.0 (apricots)	14	
		5.0 (cherries, plums)	7	Do not repeat application within 30 days.
Plum curculios	azinphosmethyl (Guthion)	2.0 (apricots)	21	
		2.0 (cherries, plums)	15	
Scale insects	dormant oils	.....	Dormant spray	Apply when temperature is above 40° F.
	DDT	7.0 (apricots)	42	
		7.0 (cherries, plums)	30	Full coverage spray.
	diazinon	0.75 (cherries, plums)	10	Full coverage spray.

* p.p.m. = parts per million.

Controlling Mice In Commercial Orchards

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.

Mice 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. But do not rely entirely on wire guards; mice can climb over the top, especially when snow is deep.

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.

Rodenticides

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 a 66-percent zinc phosphide rodenticide treats 20 quarts of apple cubes—enough for 8-10 acres. Tumble cubes until they are evenly coated 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. 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. As a trail bait, use strychnine grain at about 3 pounds per acre.

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. 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 and 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.

Pest 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 problems. 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 girdle 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) chemicals that effectively control major raspberry insects and diseases, (2) times to spray, and (3) pests that may be troublesome at each spray date.

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 weevils	Anthracnose, spur blight, mildew, Septoria leaf spot	
When blossom buds first show	Fruit worms, spider mites, aphids, leafhoppers	Anthracnose, spur blight, mildew, Septoria leaf spot	
Additional preharvest sprays	Aphids, fruit worms, leafhoppers	Fruit rot	Watch tolerance limitations.
Postharvest	Aphids, leafhoppers	Anthracnose, spur blight, mildew, Septoria leaf spot	Apply at 10- to 14-day intervals or as needed.

Insecticides For Controlling Insects On Raspberries

Insects	Insecticides	Tolerances (p.p.m.)*	Limitations (days before harvest)	Remarks
Aphids	malathion	8	1	
Fruit worms	malathion	8	1	
Leafhoppers	methoxychlor	14	14	
	DDT	7	.....	Do not apply after edible parts start to form.
Mites	dicofol (Kelthane)	5	2	
	malathion	8	1	
Sawfly larvae	methoxychlor	14	14	
	DDT	7		Do not apply after edible parts start to form.
Strawberry weevils	DDT	7	.....	Do not apply after edible parts start to form.

* p.p.m. = parts per million.

Fungicides For Controlling Diseases On Raspberries

Diseases	Fungicides	Dosages (amount per 100 gallons water)	Limitations (days before harvest)	Remarks
Anthracnose	lime sulfur	8 gal. or equivalent	Delayed dormant application only	May be used with 3 percent dormant oil.
	Bordeaux mixture	(See remarks.)	NTL* Delayed dormant application only	May be used with 3 percent dormant oil. Use 8 pounds copper sulfate, 8 pounds hydrated lime, and 100 gallons water.
	captan 50WP†	2-4 lb.	NTL	
	Dyrene 50WP	2-4 lb.	14	
	ferbam 76WP	2 lb.	40	
	folpet 50WP	1-2 lb.	NTL	
	zineb	2 lb.	14	
Powdery mildew	dinocap 50WP (Karathane)	½-1 lb.	7	
Septoria leaf spot	Same chemicals as used for anthracnose			
Spur blight	Same chemicals as used for anthracnose			

* NTL = no time limitations. † WP = wettable powder.

Weed Control In Raspberries

You can obtain good control of annual weeds by applying simazine at 2 pounds actual material per acre in fall or before weeds emerge in early spring. Do not apply simazine after bud-break of raspberry canes.

An early spring basal spray application of 2,4-D can control small weeds effectively. Use ½ pound acid equivalent per acre. Do not apply after new raspberry shoots emerge. Summer applications of SES at 3-4 pounds of actual material per acre give preemergence control of broad-leaved weeds.

Common chickweed and fall-germinating grasses are suppressed by CIPC. Apply CIPC in early spring when canes are dormant. Use 4-6 pounds actual material per acre.

Pest Control Guide For Commercial Strawberry Growers

Of all commercial fruits grown in Minnesota, strawberries probably can be produced with the least intense spray program. For the most efficient production, select disease-free and insect-free plants, use proper cultural techniques, and follow a timely, effective pest control program.

The principal insects requiring chemical control are strawberry weevils, cyclamen mites, white grubs, tarnished plant bugs, sawflies, aphids, leaf rollers, 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. You also can use chlordane in established plantings if white grubs become troublesome. But do not apply chlordane after fruits begin to form.

Apply a concentrate containing 4 pounds of chlordane, using 2 quarts of concentrate per 100 gallons of water. One hundred gallons should cover about one-fourth of an acre.

You also 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.

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

Strawberry Spray Schedule

Timing	Insect Problems	Disease Problems	Remarks
Preplanting	White grubs		See section on soil treatment.
Prebloom spray	Strawberry weevils, tarnish plant bugs, sawflies, mites, aphids	Leaf blight, leaf scorch, leaf spot, powdery mildew, fruit rot	*This is the most important spray.*
Bloom spray		Blossom blight, fruit rot	Fungicides only. Do not use insecticides. Protect bees.
Additional sprays between bloom and harvest	Aphids, mites, leaf rollers, leafhoppers	Leaf blight, leaf scorch, leaf spot, powdery mildew, fruit rot	
During harvest season		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.
Late fall spray		Leaf blight, leaf scorch, leaf spot	Use mercury sprays. Apply after plants are dormant and about 10 days before mulching.

Insecticides For Controlling Insects On Strawberries

Insects	Insecticides	Tolerances (p.p.m.)*	Limitations (days before harvest)	Remarks
Aphids	malathion	8	3	
	diazinon	0.75	5	
Leafhoppers	malathion	8	3	
	DDT	7	.....	Do not apply after fruits begin to form.
	methoxychlor	14	14	
	diazinon	0.75	5	
Leaf rollers	malathion	8	3	
	TDE	7	5	
Mites	dicofol (Kelthane)	5	2	
	malathion	8	3	
	endosulfan (Thiodan)	2	4	Do not reapply within 15 days or more than twice within a 35-day period when fruit is present.
Sawflies, strawberry weevils, tarnish plant bugs	DDT	4	.....	Do not apply after fruits begin to form.
	methoxychlor	14	14	
White grubs	chlordane	0.3	.....	Make soil treatment, usually preplanting, but do not apply after fruits begin to form.

* p.p.m = parts per million.

Fungicides For Controlling Diseases On Strawberries

Diseases	Fungicides	Dosages (amount per 100 gallons water)	Limitations (days before harvest)	Remarks
Blossom blights, fruit rots	captan 50 WP*	2-4 lb.	NTL†	
	dichloran (Botran)	2 lb.	NTL	Primarily late sprays for fruit rot control.
	zineb 65 WP	2-4 lb.	7	
	thiram 65 WP	1½-3 lb.	3	Remove excess by washing if applied within 3 days of harvest.
Leaf blight, leaf scorch, leaf spot	captan 50 WP	2-4 lb.	NTL	
	dodine 65 WP	¼-½ lb.	14	

* WP = wettable powder.

† NTL = no time limitations.

Fungicides For Controlling Diseases On Strawberries (continued)

Diseases	Fungicides	Dosages (amount per 100 gallons water)	Limitations (days before harvest)	Remarks
Leaf blight, leaf scorch, leaf spot (continued)	Dyrene 50 WP	2-4 lb.	5	
	ferbam 76 WP	2 lb.	14	
	folpet 50 WP	1-2 lb.	NTL	
	methyl and phenyl mercury materials	Follow label directions	Do not apply while fruit is present	Use dormant application only.
	thiram 50 WP	1½-3 lb.	3	Remove excess by washing if applied within 3 days of harvest.
	zineb 65 WP	2-4 lb.	7	
Powdery mildew	dinocap 50 WP (Karathane)	½-¾ lb.	21	

Weed Control In Strawberries

New Plantings. The following herbicides are effective in new plantings.

- **2,4-D** at 1 pound acid equivalent per acre controls emerged broad-leaved weeds when applied 3-8 weeks after planting.
- **SES** at 3 pounds actual material per acre gives preemergence weed control. Apply after planting and before weeds appear; repeat application at monthly intervals. Don't apply herbicide when first runner plants are forming.
- **DCPA** at 9 pounds (12 pounds Dacthal W-75) per acre controls annual grasses. Apply after planting and before weeds emerge. Retreatment in late summer usually is necessary. DCPA has little effect on emerged weeds.

Fruiting Plantings. You can reduce weed populations in established beds with the following herbicides.

- **2,4-D** at 1½ pounds acid equivalent per acre applied at mulch removal time controls overwintering broad-leaved weeds. You also can use 2,4-D after renovation to kill existing broad-leaved weeds. But do not apply 2,4-D after runners develop, as it inhibits rooting of runner plants.
- **SES** at 3 pounds actual material per acre provides preemergence weed control. Apply it before flowering or after harvest. Since SES kills only germinating weeds, it is not effective when applied to "weedy" strawberry fields.
- **DCPA** at 9 pounds (12 pounds Dacthal W-75) per acre may be applied as a broadcast soil application in the fall and early spring. Do not apply it after first bloom. DCPA has little effect on emerged weeds.

Late Fall Applications. To avoid injury to developing fruit buds, delay late fall applications until just before you mulch the strawberry bed for winter. The following herbicides control fall-germinating weeds that would otherwise overwinter under the mulch.

- **2,4-D** at 1½ pounds acid equivalent per acre controls broad-leaved weeds.
- **DNBP amine** at 4½-6 pounds actual material per acre controls annual weeds.

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 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 subfreezing temperatures.
- Never store herbicides or other hormone-type sprays 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 lay around—get rid of them!
- If symptoms of nausea, blurred vision, or headaches occur during or after using a pesticide, call your physician immediately.

If An Accident Occurs

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 can tell him when the levels of certain types of pesticides are getting dangerously high.