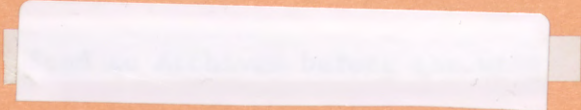


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SPECIAL REPORT NO.6

1963



COMMERCIAL FRUIT PEST Control Guide



UNIVERSITY OF MINNESOTA

AGRICULTURAL EXTENSION SERVICE • U. S. DEPARTMENT OF AGRICULTURE

CONTENTS

	<u>Page</u>
Caution.	1
Protection of Bees.	1
Minnesota Poison Information Centers.	1
Insecticide Uses and Limitations	3
Fungicide Uses and Limitations	5
Herbicide Uses and Limitations.	7
Rodenticide (Endrin) Uses and Limitations	8
Spray Guide for Apples.	8
Notes.	12
Young Apple and Pear Trees	14
Guide to Apple-Thinning Sprays.	15
Stop-Drop Sprays	16
Chemical Weed Control in Apple Orchards	17
Mouse Control in Orchards.	18
Spray Guide for Raspberries	20
Spray Guide for Strawberries	22

SPRAY GUIDE FOR PLUMS, CHERRIES, APRICOTS, CURRANTS,
GOOSEBERRIES, GRAPES.
See Extension Pamphlet 184, "The Home Fruit Spray Guide."

Prepared by members of the University of Minnesota Agricultural Extension Service and the Department of Entomology, Plant Pathology and Botany, and Horticulture.

The information about the control of insects, diseases, and weeds in commercial fruit production is presented in this publication. The recommendations given here are based on the latest and most factual information available. Reference to commercial or trade-marked materials does not imply endorsement by the Minnesota Agricultural Extension Service.

CAUTION

All pesticides must be handled carefully. Effective and safe spray applications can result only by getting the right amount of the right materials on the right places at the right times. Protect yourself by thoroughly reading and following the protective measures given on the labels of chemical containers. Use a respirator or mask and protective clothing when they are recommended on the label.

Do not eat or smoke while spraying or until after washing your hands.

Avoid spilling any pesticides on skin or clothing.

Bathe thoroughly and change to clean clothing immediately after spraying.

PROTECTION OF BEES

The pollination of fruits is dependent almost entirely on bees. To prevent possible injury to the bees, follow recommendations given in this spray guide as to insecticides to use and the timing of applications. Do not apply insecticides to any plants that are in bloom.

MINNESOTA POISON INFORMATION CENTERS

These centers have been established by the Minnesota Department of Health. Their purpose is to provide information for physicians about pesticides and common household poisons, their antidotes and treatments. Most of these centers operate on a 24-hour basis.

<u>Town</u>	<u>Poison Information Center</u>	<u>Telephone</u>
Bemidji	Bemidji Hospital	PL 1-5430
Brainerd	St. Joseph's Hospital	2861
Crookston	Bethesda Hospital	AT 1-4682
	St. Francis Hospital	AT 1-2490
Duluth	St. Lukes Hospital, 915 E. 1st Street	RAndolph 7-6636
Fergus Falls	Lake Region Hospital	523

<u>Town</u>	<u>Poison Information Center</u>	<u>Telephone</u>
Mankato	Immanuel Hospital	MAankato 8-1605
Marshall	Lewis Weiner Memorial Hospital	2263
Minneapolis	State Health Department, Division of Special Health Services	FEderal 9-7751
	Abbott Hospital, 110 E. 18th Street	FEderal 9-8414
	Fairview Hospital, 2312 S. 6th Street	FEderal 6-6691
	Minneapolis General Hospital 619 S. 5th Street	FEderal 3-1178
	North Memorial Hospital 3220 Lowry Avenue North	JUniper 8-9451
Morris	Northwestern Hospital 810 E. 27th Street	FEderal 2-7266
	Stevens County Memorial Hospital	1191
Rochester	St. Mary's Hospital	AT 9-4581
St. Cloud	St. Cloud Hospital	BL 1-2700
St. Paul	Ancker Hospital, 495 Jefferson Avenue	CApital 2-7341
	Bethesda Hospital, 559 Capitol Blvd.	CApital 4-7561
	St. John's Hospital, 403 Maria Avenue	PRospect 1-5521
	St. Joseph's Hospital, 69 W. Exchange	CApital 2-6321
	St. Luke's Hospital, 287 N. Smith Avenue	CApital 2-6644
Virginia	Children's Hospital, 311 Pleasant Avenue	CApital 7-6521
Virginia	Virginia Municipal Hospital	HARwood 1-3340
Willmar	Rice Memorial Hospital	BElmont 5-4543
Worthington	Worthington Memorial Municipal Hospital	WOrthington 2-5601

<p>It is imperative that growers use the materials according to label directions -- on the crops, in amounts, in the manner, and at times specified.</p>

The recommendations are based on current State and Federal registrations and tolerances set by the Food and Drug Administration. Directions given in this guide and on current container labels should be read, understood, and followed carefully in order to control pests and diseases effectively without causing excessive residues to remain on the crops. The following information is up-to-date at the time of this printing. Information regarding any changes that may be made during the 1963 season will be forwarded to all commercial growers.

Keep accurate records of all chemical applications.

INSECTICIDE USES AND LIMITATIONS

Material	Crop	Limitations
<u>Chlorinated Hydrocarbons</u>		
Chlorbenside (Mitox)	apple	7 days
Chlorobenzilate	apple	14 days
DDT	apple	30 days (with no more than 5 cover applications).
	raspberry, strawberry	Not after fruit begins to form.
Dieldrin	apple	35 days
Genite 923	apple	before bloom
Kelthane	apple	7 days
	strawberry	2 days
Methoxychlor	apple	7 days
Ovex	apple	30 days
	strawberry	pre-bloom or post-harvest
TDE	apple	30 days
	strawberry	5 days
	raspberry	14 days
Thiodan	apple	30 days, no more than 2 applications during fruiting.

<u>Material</u>	<u>Crop</u>	<u>Limitations</u>
<u>Chlorinated Hydrocarbons (continued)</u>		
Thiodan (continued)	strawberry	8 days (do not retreat within 35 days when fruit is present).
<u>Organic Phosphates</u>		
Diazinon	apple	14 days
	strawberry	5 days
Guthion	apple	15 days (not over 8 applications).
	strawberry	5 days
Malathion	apple, strawberry	3 days
	raspberry	1 day
Parathion	apple, strawberry	14 days
	raspberry	15 days
Phosdrin	apple, strawberry	1 day
	raspberry	3 days
Trithion	apple	30 days
	strawberry	3 days
Phosphamidon (Dimecron)	apples	60 days
<u>Other</u>		
Dintro (Elgetol, DN 289)	apple	dormant application only
Lead arsenate	apple	30 days
	strawberry	not after edible parts form
Sevin	apple	1 day (important, do not apply until 20 days after petal-fall because of possible fruit thinning.)

FUNGICIDE USES AND LIMITATIONS

Material	Crop	Limitations
Captan	apple	No time limitations. Post-harvest dip or spray (0.12% solution). Not over 5 pounds actual per acre per application.
	raspberry	No time limitations. Not over 2.5 pounds actual per acre per application.
	strawberry	No time limitations. Not over 3.8 pounds actual per acre per application.
Dinitro-o-cresol (Elgetol)	raspberry	Dormant application only. Not over 1.0 pounds actual per acre per application.
Dodine (Cyprex)	apple	Up to 7 days before harvest. Not over 4.0 pounds actual per acre per application. Up to 5 days before harvest not over 1.6 pounds per acre per application. Do not use treated apples in the manufacture of apple pomace for use in livestock feeds.
	strawberry	14 days before harvest. Not over 1.3 pounds per acre per application.
Dyrene	strawberry	5 days before harvest. Not over 3.0 pounds actual per acre per application.
Ferbam	apple	7 days before harvest. Not over 11.4 pounds actual per acre per application.

Material	Crop	Limitations
Ferbam (continued)	raspberry	40 days before harvest. Not over 3.0 pounds actual per application.
folpet (Phaltan)	strawberry	No time limitations. Not over 2 pounds actual per acre per application.
Glyodin	apple	Not over 3.0 pounds per acre per application through petal-fall. Not over 1.8 pounds per acre per application for cover sprays. No limitations.
Karathane or Mildex	apple	21 days before harvest. Not over 30 pounds per acre per application.
	raspberry	7 days before harvest. Not over 0.63 pounds per acre per application.
	strawberry	21 days before harvest. Not over 0.38 pounds per acre per application.
Limé sulfur	apple	No time limitations. Not over 2.5 gallons per 100 gallons water.
	raspberry	Delayed dormant appli- cation only. Not over 12 gallons per 100 gal- lons water.
Phenyl mercury	apple	Do not apply after petal- fall. Not over 0.5 pounds actual per acre per appli- cation.
	strawberry	Dormant application only in spring. Post-harvest. Not more than 250 gallons per acre per application when made up according to label directions. Not over 0.5 pint of 10% solu- tion per 100 gallons water.

Material	Crop	Limitations
Thiram	strawberry	Remove residues by washing if applications are made within 3 days of harvest. Not over 3.3 pounds actual per acre per application.
Zineb	apple	No time limitations. Not over 7.6 pounds actual per acre per application.
	strawberry	7 days before harvest. Not over 2.5 pounds actual per acre per application.

HERBICIDE USES AND LIMITATIONS

Material	Crop	Limitations
Amitrole	apple (non-bearing)	Do not allow spray to come in contact with foliage, stems or trunks of trees. Keep livestock off treated areas.
CIPC (Chloro-IPC)	raspberries	Pre-emergence
DCPA (Dacthal)	strawberries (new plantings)	Soil application immediately after transplanting.
Dalapon (Dowpon)	apples	Spray area within 3 feet radius of tree trunk. Do not graze livestock on treated areas. Not to trees younger than 4 years old.
DNBP amine	strawberry	Apply in late fall or early spring while crop is dormant.

Material	Crop	Limitations
SES (Sesone)	strawberry	Treat after well established (usually about 10 days after planting) and monthly thereafter following cultivations. Avoid application when first runner plants are rooting.
2,4-D	raspberry	Apply to first year plantings and in nonfruiting stands. Do not apply to growing tips, flowers, or fruiting canes.
	strawberry	Dormant season and before blossom, and after harvest before runners form. Do not apply during bud, flower, or fruit stage.

RODENTICIDE (Endrin) USES AND LIMITATIONS

Pest	Dosage (actual)	Precautions
Pine Mice	0.6 lb. per 100 gals. of water (emulsifiable concentrate or wettable powder)	Post treated areas. Do not treat areas where runoff will contaminate water used for domestic purposes or contaminate lakes, streams, or ponds containing fish.
Meadow Mice	0.4 lb. per 100 gals. of water (emulsifiable concentrate or wettable powder)	Do not graze orchards, cut for hay, or allow livestock to clean up drops. Application may produce some injury to birds and certain small animals.

SPRAY GUIDE FOR APPLES

IMPORTANT - Read the notes on pages 12 - 14.

All rates of materials are given in amount per 100 gallons of water. This guide is intended for the commercial grower. For information on the farm and home orchard, refer to Extension Pamphlet 184, "The Home Fruit Spray Guide."

Dormant Spray

(before buds show silver tips)

Insecticides: For control of aphids, mites, oystershell scale, leaf roller eggs DN-289, or Elgetol 318 - 2 quarts or Emulsifiable Dormant Oil - 3 gallons

Delayed Dormant Spray

(before leaves are out 1/2 inch)

Fungicides: For apple scab control - 2 pounds captan 50 percent wettable powder, or 1/2 pound dodine 65 percent wettable powder (see note no. 2).

Insecticides: Add 2 pounds 25 percent wettable powder of malathion, or 1 1/2 pounds 15 percent wettable powder of parathion or 1 1/4 pounds 25 percent wettable powder Guthion or 1/4 to 1/2 pint 4 pound emulsifiable phosphamidon if aphids become abundant before blossom. (See petal-fall spray for concentration, and page 1 for precautions.)

Pre-Pink Spray

In case of an extended period between Delayed Dormant and Pink stages, caused by cool weather, make an application as given for Pink Spray.

Pink Spray

(when fruit buds show pink at tips)

Fungicides: For apple scab - 2 pounds captan 50 percent wettable powder, or 1/2 strength phenyl mercury, plus 1/2 strength captan 50 percent wettable powder, (see note no. 1); or 1/2 pound dodine 65 percent wettable powder (see note no. 2). When cedar-apple rust is a problem, see note no. 3.

Insecticides: For cankerworms - 3 pounds lead arsenate, or 2 pounds 50 percent DDT wettable powder. For mites - 1/2 pound 50 percent ovex (Ovatran) wettable powder; 1 pound 40 percent Mitox; or 1 1/2 pints Genite 923 (25 percent emulsion) or 1 to 1/2 pounds of the 50 percent wettable powder. (Do not use Genite 923 in later sprays or Mitox within 7 days of harvest.)

Blossom Spray

Fungicides: For apple scab control - 2 pounds captan 50 percent wettable powder; or 1/2 pound dodine 65 percent wettable powder (see nos. 1 and 2). When cedar-apple rust is a problem, see note no. 3.

Insecticides: None

Petal-Fall Spray

(after 3/4 of petals have fallen)

Fungicides: For apple scab control - 2 pounds captan 50 percent wettable powder, or 1/2 strength phenyl mercury, plus 1/2 strength captan (see note no. 1); or 1/2 pound dodine 65 percent wettable powder (see note no. 2). When cedar-apple rust is a problem, see note no. 3.

Insecticides: Dieldrin for plum curculio and apple curculio. Add DDT for control of codling moth. Add TDE for red-banded leaf roller. Guthion may be used to control red-banded leaf roller; Guthion may be used for curculio control by making an additional application during first-cover spray.

Use these rates:	<u>Dieldrin</u> , 50% wettable powder	- 1/2 lb.
	<u>DDT</u> , 50% wettable powder	- 2 lbs.
	<u>Guthion</u> , 25% wettable powder	- 1 1/4 lbs.
	<u>TDE (DDD)</u> , 50% wettable powder	- 2 lbs.

First-Cover Spray

(5 to 7 days after Petal-Fall, or when fruit is 1/4 inch in diameter)

Fungicides: For control of apple scab - 1 1/2 to 2 pounds captan 50 percent wettable powder, or 1/2 pound dodine 65 percent wettable powder (see note no. 2). Captan may be reduced to 1 1/2 pounds for cover sprays if scab has been controlled in earlier sprays (see note no. 1). When cedar-apple rust is a problem, see note no. 3.

Insecticides: Use DDT as in Petal-Fall, and add TDE for red-banded leaf roller, or if curculio continues to be a serious problem apply Guthion as in petal-fall for curculio, codling moth, red-banded leaf roller, and for mite control. The inclusion of DDT also insures control of crawlers of oystershell scale. If mites are serious add one of the following:

<u>ovex</u> , 50% wettable powder	- 1/2 lb.
<u>Kelthane</u> , 18 1/2% wettable powder	- 1 1/2 lbs.
<u>parathion</u> , 15% wettable powder	- 1 1/2 lbs.
<u>chlorobenzilate</u> , 25% wettable powder	- 1 1/2 lbs.
<u>tedion</u> , 25% wettable powder	- 1 lb.
<u>Miltox</u> , 40% wettable powder	- 1 lb.

Second-Cover Spray

(7 to 10 days after First-Cover)

Fungicides: See First-Cover Spray

Insecticides: For codling moth and leafhoppers - 2 pounds DDT 50 percent wettable powder. For aphids - 3 pounds malathion 25 percent wettable powder, or 1 1/2 pounds parathion 15 percent wettable powder. (See precautions, page 1). For mite control see directions under First-Cover Spray.

Third-Cover Spray

(7 to 10 days after Second-Cover)

Fungicides: Same as in First-Cover Spray.

Insecticides: For codling moth - 3 pounds lead arsenate, or 1 1/4 pounds 25 percent wettable powder Guthion, or 1 pound 25 percent wettable powder Trithion or 2 pounds 50 percent wettable Sevin. Follow mite and aphid recommendations given in Second-Cover when lead arsenate, DDT, or Sevin is used. Guthion and Trithion will control mites and aphids but Trithion should not be used more often than every 30 days.

Apple Maggot Sprays

During the first two weeks of July, watch for announcements on farm radio programs and in local newspapers that the flies have started to emerge; or contact your county agricultural agent for this information. Information on activity of maggot flies is made available to these sources by the Division of Plant Industry, Minnesota Department of Agriculture, Dairy and Food. The first maggot spray should be applied as soon as the initial emergence is detected. When there is a threat of severe apple maggot damage such as in 1957, 1958, 1959, and 1960, a minimum of four maggot sprays is needed at intervals of 7 to 10 days (see notes nos. 6 and 7).

Fungicides: Same as in First-Cover Spray. Do not use dodine within 7 days of harvest. When sooty blotch is a problem, see note no. 5.

Insecticides: For apple maggot, any one of the following: 2 pounds 25 percent wettable powder Diazinon, 1 1/2 pounds 25 percent wettable powder Guthion, or 2 pounds 50 percent wettable powder Sevin. DDT may also be used at rates given previously subject to rules governing multiple applications as explained in note 6. Lead arsenate or methoxychlor, may be used but are not as effective as the above materials. (See limitations in table on pages 3 and 4.)

Post-Harvest Dip or Spray

A post-harvest dip or spray may be used on apples that are being prepared for market. The maximum permissible dosage is a dip or spray with a 0.12 percent suspension of captan fungicide. This dosage figures out to 2 pounds of captan 50 percent wettable powder per 100 gallons of water. This treatment has been found to reduce certain types of rotting. Some new formulations of captan are available that have a higher percentage of active ingredient. These materials should leave a less distinct residue than the 50 percent material. Follow label directions in using these materials.

NOTES

1. When conditions are favorable for scab:

If trees were not adequately protected before a rainy(infection) period or if control is doubtful during prolonged rainy periods, one-half strength phenyl mercury will usually "burn out" scab infection if applied within 40 hours after start of an infection period, or full-strength application if applied within 72 hours after start of an infection period. Phenyl mercury may be used in combination with captan. Generally, phenyl mercury is used at 1/2 rate the manufacturer recommends for its use alone, in addition to 1/2 strength captan. Under extremely severe conditions for infection, both phenyl mercury and captan may be used at full strength in combination. The controlling factors are severity of conditions and cost of material. Phenyl mercury is approved for use on apples from Delayed Dormant through Petal-Fall stages of growth. During severe scab seasons of when bud development is delayed due to weather, extra fungicide applications in addition to those listed may be needed from Delayed Dormant through Petal-Fall.

Phenyl mercury has been found to be toxic to bees in some tests; therefore, if a long bloom period exists and it seems necessary to use this material, do so early in the morning or in the evening, at which time the bee activity is at a minimum. Dodine should be a logical replacement for phenyl mercury in bloom stage.

2. Use of dodine (Cyprex) for control of scab:

Dodine is a local systemic. For example, the chemical penetrates leaf tissue to a limited extent, destroying some previous infection and protecting surrounding leaf area. Experiments have shown that if the chemical is applied to the lower surface of the leaf, the upper surface is also protected from infection.

Manufacturer's recommendations for use are as follows:

Apple: Scab - Protection Schedule - Use 1/4 to 1/2 pound of dodine 65-W in 100 gallons of spray at 5 to 7 day intervals or as needed to maintain scab control from pre-bloom through the first cover applications. Use 1/8 to 1/4 pound dodine 65-W in subsequent cover sprays as needed.

"After-Infection" applications - After an infection period has occurred, use 3/4 pound of dodine 65-W per 100 gallons of spray during or following a rain from pre-bloom through first cover applications and in later cover sprays as needed. While timing of the spray may vary considerably depending upon temperatures, it is recommended that application be applied within 36 hours from the beginning of the rain or wet period which caused the infection.

Do not apply within 7 days of harvest.

Freezing or near freezing temperature, particularly when accompanied by slow drying conditions, may injure fruit or pre-dispose the fruit to chemical injury. Do not apply dodine 65-W immediately before, during or immediately after occurrence of such conditions. Dodine-treated apples should not be used in the manufacture of apple pomace for use in livestock feeds. Such use may result in illegal residues in milk or meat.

3. Control of cedar-apple rust:

Two of the most effective fungicides for control of cedar-apple rust on apple are ferbam and zineb. These materials also control scab, but are generally inferior to captan or dodine in that respect. Captan or dodine should be used at full strength if scab is a serious problem. Ferbam at the rate of 1/2 to 1 pound, or zineb at the rate of 1 pound, may be used also in combination with full-strength captan or dodine if rust is also a problem. Ferbam at the rate of 1 1/2 pounds, or zineb at the rate of 2 pounds, may be used alone for the control of scab and rust if scab is not a serious problem. Spray for control of rust should begin with the Pink Stage and continue through first-cover, or until the gelatinous spore horns on galls on cedar trees have dried up for the season. New crops of these spore horns on cedar are produced successively for several weeks during warm, rainy weather. By the middle of June, generally, they are through. Removal of all red cedar trees within a radius of 1/2 mile of the orchard will prevent infection by cedar rust on susceptible apple varieties. Varieties that are not susceptible or are tolerant to cedar-apple rust should be planted where this is a serious problem.

See Plant Pathology Fact Sheet No. 4, "Cedar-Apple Rust" for additional information.

4. Control of fireblight:

Fireblight is one of the most difficult diseases to control in the apple orchard. Infection occurs during the entire growing season. High nitrogen fertilization and severe pruning will increase the susceptibility of apple trees to fireblight. Therefore, these practices should be reduced or eliminated entirely until fireblight has ceased to be a problem. Fireblight tolerant varieties should be planted when possible.

Pruning to eliminate infected branches should be done during the dormant period in late fall, winter, or early spring which corresponds to the regular pruning period of the trees. Cuts on infected branches should be made at least 6 inches below infected areas if possible. Any active cankers (those showing the bacterial ooze) found during the spring should be removed. Pruned infected branches should be burned before leaf buds begin to break. Pruning tools must be disinfected with a chemical between cuts made during the growing season. Formaldehyde, denatured alcohol, or liquid household chlorine bleach mixed half and half with water are suitable chemicals for this purpose.

Various reports indicate that antibiotic formulations applied as sprays in three applications during the blossom period will reduce the blossom phase of fireblight infection. Applications during blossoming or later have shown little effect on total shoot infection. In Minnesota very little blossom infection has been observed.

5. Control of sooty blotch:

This disease occurs as black-to-brown spots on the fruit. It occurs only on the surface of the fruit, and may reduce the market value if present. Ferbam and zineb fungicides give good control. Captan used alone may not control sooty blotch; therefore, ferbam and zineb should be alternated or used in combination with captan if the disease is a problem. Do not use ferbam on Golden Delicious.

6. Multiple applications of certain insecticides:

The recommended waiting period for DDT is 30 days before harvest so it may be used for the first maggot spray in most cases. Exception: When any chlorinated hydrocarbons (DDT, TDE, methoxychlor, etc.) have been used in 5 or more cover sprays then none of them should be used within 40 days of harvest.

7. Weathering and effectiveness of spray residues:

Of the suggested materials for apple maggot, DDT, Guthion, Diazinon, or Sevin may give up to 10 days protection.

Suggested time intervals between sprays should be shortened during certain weather and growing conditions which will (a) hasten the removal of spray materials or (b) result in the exposure of unprotected plant tissues during critical periods of disease infection or insect infestation.

YOUNG APPLE AND PEAR TREES

Young trees may be injured if you fail to control the buffalo treehopper, grasshoppers, aphids, or scab. Treehoppers can be controlled with 5 percent DDT dust or a spray prepared from 50 percent or 75 percent wettable DDT. Apply in late July, or when the treehoppers first appear. Repeat 2 weeks later. Grasshoppers should be controlled with malathion when they become numerous. Cankerworms and tent caterpillars may be abundant enough in early spring to require control; apply DDT as recommended in Pink Sprays. Aphids may be controlled with malathion. Follow recommendations on bearing trees for control of scab.

GUIDE TO APPLE-THINNING SPRAYS

These growth regulators came under the "Miller Amendment" in August 1959. A residue tolerance of 1 ppm is in effect for NAA (naphthalene acetic acid) whether the chemical is used for fruit thinning or as a stop-drop spray. NA amide (naphthalene acetamide) has been registered on a "no residue basis" for thinning. 2,4,5-TP (2,4,5-trichlorophenoxy propionic acid) has been registered on a no residue basis as a stop-drop spray.

Chemical thinning is not an exact operation. Considerable variation may be expected from year to year in the amount of thinning obtained on the same variety in the same block, even though the concentration and timing appear to be identical. These differences may be due largely to weather conditions and to differences in the condition of the trees. For example, near-freezing temperatures during or after bloom are likely to increase absorption and call for lower concentrations. Poor pollination or reduced seeds per fruit increase thinning action. Bright days with temperatures of 70° to 80° F. also increase thinning action. On the other hand, vigorous trees require higher concentrations than trees of lower vigor.

Naphthalene acetamide (NA amide) is milder in its action than naphthalene acetic acid (NAA) and seems to absorb best when weather conditions favor slow drying. It seldom causes foliage injury at concentrations up to 75 ppm. NAA is generally most satisfactory if applied under fast drying conditions with temperatures of from 65° to 75° F. The following schedule is suggested as a guide for spraying normal and reasonably vigorous trees about 12 years old or older. Haralson and Minjon are early bearing varieties and may require thinning at an earlier age.

The need for additional thinning after using the amide can be determined by examining the trees 7 to 10 days after spraying. Fruits that will drop usually do not enlarge significantly after spraying. Use NAA if additional thinning is needed. Spray thoroughly in the same manner as for pest control. Apply as a separate spray, do not combine with petal-fall or cover sprays. Leave unsprayed check trees of each variety in order to evaluate results.

Growers without previous experience in chemical thinning, or those thinning varieties of unknown response to thinning sprays, are cautioned to limit the sprays to a trial basis in their orchards.

The recommendations for the use of the thinning sprays on Haralson and Minjon are based on rather limited experience, but are included to emphasize the need for thinning these varieties so that information can be accumulated which will permit the best possible recommendations. Haralson tends to be a difficult variety to thin. Concentrations nearly twice those recommended in the table have been used with good success in some cases. Growers who have had consistent under-thinning of Haralson at the recommended rates might try heavier concentrations at least on a trial basis.

When to apply	Materials to use	Concentration* parts per million (ppm)	Varieties	Remarks
Petal-Fall to 2 1/2 weeks after full bloom +	Naphthalene acetamide (Amid-Thin)	50	Haralson, Duchess, Wealthy, other early varieties	Use, if possible, when weather conditions favor relatively slow drying. NA amide is often applied in the evening.
14 to 21 days after full bloom	Naphthalene acetic acid (NAA)	10	Delicious, Jonathan, McIntosh, Minjon	Use on varieties ripening with McIntosh or later. In some regions the amide is preferred for almost all varieties.
		20	Golden Delicious, Wealthy, Haralson	

* Check the container for amounts of material to use to get the required concentration in parts per million.

+ Information on the time to apply NA amide under local conditions is very limited. Work carried out in apple growing regions of other states has sometimes given results favoring applications made near the petal-fall stage and at other times better results were obtained when applied 2 to 3 weeks after full bloom.

STOP-DROP SPRAYS

IMPORTANT - See statement on "Miller Amendment" under Apple-Thinning Sprays

All growers of apples suffer losses as a result of fruit falling from trees at harvest time. Such losses may be heavy or light depending on variety and conditions but, in nearly all cases, can be reduced through the use of chemical stop-drop sprays. Oriole, Beacon, Wealthy, Haralson, McIntosh, and others have a tendency to drop excessively under conditions in Minnesota.

Materials: Several growth-regulating substances are in use at the present time for various varieties and conditions. Two of these are most generally used and satisfactory on apples. These are NAA and 2,4,5-TP. Both are effective on all apples varieties.

NAA is generally used at 10 ppm, but may be effective at rates down to 5 ppm on summer or early fall varieties sprayed when temperatures are relatively high. On late maturing varieties, rates up to 15 or 20 ppm may prove more effective than 10 ppm. The chemical should be applied 4 to 5 days before natural fruit dropping for the variety is expected to begin, and 14 days or more before harvest. Do not make more than two applications. Do not apply within two days of harvest. Its effectiveness is for a relatively short time, usually not more than 2 weeks. 2,4,5-TP is used at a maximum strength of 20 ppm; on some varieties a 10 ppm solution has been adequate. Ten ppm for Delicious and Golden Delicious is recommended for most conditions. Early varieties generally respond to lower concentrations better than do late varieties. It should be applied 2-3 weeks prior to the expected harvesting date and have an effective stop-drop action for a period of about 4 weeks. Thus this chemical has some advantages over NAA in that it may be sprayed earlier and it has a more lasting effect. However, it does not become effective as quickly after spraying.

Coverage: It is important to apply sufficient spray to obtain thorough and even coverage of the foliage. Several varieties can be sprayed at the same time if the same concentrations and time for application is suitable for all of them. Combining the stop-drop sprays with disease or pest control sprays is often less effective than a separate spray, and particularly so, if such a spray contains lime.

Weather: Warm temperatures at spraying time are an advantage, as greater effectiveness is obtained. Moisture in the form of dew or humid conditions will also increase effectiveness, while drouth will reduce it. Occasionally heavy drops may occur in spite of weather or treatment, indicating clearly that there is yet much to be learned about fruit-dropping and the action of these chemicals.

Caution: Do not allow apples to become over-mature before harvesting. Fruit maturity may be hastened as a result of treatment and is never delayed; hence the fruit should be carefully checked for maturity and picked when optimum maturity has been attained. When these chemicals have been used, ease of picking or dropping from the tree cannot be used as an indication of maturity. In addition, sprays which are too concentrated may lead to undesirable hastening of maturity. The maximum concentrations given above should, therefore, not be exceeded as some injury could result.

CHEMICAL WEED CONTROL IN APPLE ORCHARDS

Grasses have been controlled under apple trees four years old or older, by application of a lightly wetting spray containing 10 pounds of Dalapon (13 pounds Dowpon) in 100 gallons of water (equivalent to 10 pounds per acre). For best control apply in spring when grasses are four to six inches tall. Re-treatment may be necessary. On young non-bearing trees, one year or older, amitrol at 4 pounds (8 pounds Weedazol or Amino Triazole Weed Killer) per acre applied in spring will control most weeds. Do not wet tree foliage.

MOUSE CONTROL IN ORCHARDS

The control of orchard mice is a continuing problem and should be considered a regular orchard practice. The different methods of controlling orchard mice will be discussed.

Mechanical and Cultural Aids

Protective wire guards are generally restricted for use on young trees. Hardware cloth cylinders having three or four wires to the inch placed around the base of newly planted fruit trees is usually effective in protecting the tree against mouse injury for 5 to 7 years. However, do not rely on wire guards entirely as it is not unusual for mice to either climb over or tunnel beneath the guard and girdle the tree. The hardware cloth should be 18 inches high and embedded in the ground at least two inches or on top of the tree's root crown. Aluminum wrap, tar paper, or other similar material wrapped around the tree also offers protection against mice and rabbits during the winter months.

Removal of ground vegetation limits the living area for mice and usually reduces mouse damage. The most important cultural practice is the clearing of a 3-foot radius around the base of the tree. This can be accomplished by scalping with mechanical equipment, by hand, or killing the vegetation with chemical weed killers. Mowing, disking, or sod chopping helps limit mice but care should be used not to leave heavy cover directly around the tree base. Where pine mice or red-bellied meadow mice (prairie voles) are involved, the destruction of surface cover may have little influence on their underground activities. Snow cover for long periods can also give the mice needed shelter. Cultural practices, although having limitations, should be considered whenever the mouse population is high.

Lethal Baits

Zinc phosphide treated apples are the baits to apply in the early fall. Cut apples, preferably firm, sweet varieties, into 1/2 inch cubes. The pieces are measured into a bucket or large pan and sprinkled with one level teaspoonful of zinc phosphide rodenticide to each quart of apples. Tumble the baits until they are evenly coated with the poison. Apple bait should be mixed just before placement and not held for over a day. A one ounce can of 66 percent zinc phosphide rodenticide treats 20 quarts of apples--enough for about 8-10 acres. Wash hands and utensils carefully after mixing. Grain baits, treated with either zinc phosphide or strychnine, may be used in the fall or winter.

Home preparation of zinc phosphide or strychnine grain baits is not recommended. Experience has shown that uniform mixtures are not obtained resulting in a poor kill. Zinc phosphide grain is applied at the rate of 3 pounds per acre as a trail bait and 6 to 10 pounds per acre using the broadcast system. Strychnine grain bait is applied also as a trail bait at about 3 pounds per acre. Ready-mixed grain baits and the zinc phosphide rodenticide can usually be obtained from commercial sources. If not commercially available, contact your county agricultural agent.

Trail Baiting

Examine the orchard floor systematically for the distinctive trails mice make under heavy cover. Activity can be determined by the presence of fresh grass clippings and feces. Abandoned runs may have thread-like fungus growth, green grass shoots, and fine roots. When baiting, glance ahead to pick out probable spots for bait placement. Clumps of grass, old fertilizer bags, apple crates, bales of hay, etc., are usually good locations. Examine one side of a tree at a time looking for runs under the drip line. Move in toward the base until a run is found or a tree location is considered inactive. Disturb the area as little as possible.

When an active run is located, place an apple cube or a teaspoonful of grain bait in the runway. Use both baits where pine mice occur. Usually 3 or 4 baits per tree base are ample. Pull the grass back in position over the baits. When runways are found between tree rows, bait these, too. Pine mice emerge and feed to some extent on surface baits, but where holes are evident, drop baits into them.

The best time for baiting is during October and early November. When signs indicate that mice are not numerous, thorough coverage of that orchard block may not be necessary. Treat the adjacent areas along with the portions of the orchard in which trouble usually occurs. During heavy, persistent snow cover, a few mice can cause serious damage. It may be necessary to rebait in midwinter using strychnine grain. Place bait in snow tunnels, air holes and near fresh bark damage.

Trail Builder

The trail builder which makes artificial burrows 3 inches below the ground surface is an effective method of mouse control. Its results compare favorably with trail baiting and cuts labor costs and effort considerably. Instructions for making the trail builder can be obtained from your county agricultural agent or the U. S. Fish and Wildlife Service.

Broadcasting Bait

Broadcasting grain bait by hand or machine produces good results. The bait is applied at the rate of 6 to 10 pounds per acre. It can be spread by airplane, tractor-drawn seeder, or fertilizer spreader. However, broadcasting by hand is preferred as it permits concentration of bait along the tree row. To distribute bait, walk down the orchard row, hurling a small handful of bait into the most likely mouse cover. Wear a glove when handling the bait and reserve a bucket exclusively for poisoned baits. Broadcasting compares favorably with the other methods as to effectiveness. Its cost is considerably below that of trail baiting and toxic sprays.

Ground Sprays

The U. S. Fish and Wildlife Service does not recommend the use of endrin as a ground spray for field mouse control.

Three parts per billion will kill fish and at the concentrations used for mouse control instances of wildlife and livestock losses have occurred. If endrin is used the area should be posted with warning signs. Do not use where runoff will contaminate farm ponds, streams, or other water supplies. Livestock should be excluded and should not be fed drops or hay cut from the treated orchard. Recommendations on the label must be strictly followed.

SPRAY GUIDE FOR RASPBERRIES

Unless otherwise noted, all rates of materials are given in amount per 100 gallons of water. This guide is intended for the commercial grower. For information on the home garden refer to Extension Pamphlet 184, "The Home Fruit Spray Guide."

Buds Show Green Tips 1/4 to 1/2 inch Long

Fungicides: For control of anthracnose and spur blight, use 8 gallons of liquid lime sulfur, or 1 gallon of Dinitro (see pages 4 and 5). Do not use DN-289 or Elgetol 318 or any other Dinitro that contains over 30 percent active material.

Insecticides: None

When Leaves are Fully Expanded

Fungicides: For control of anthracnose and spur blight--2 pounds ferbam, or 2 pounds captan 50 percent wettable powder. For control of powdery mildew--1 pound Karathane or Mildex 25 percent wettable powder.

Insecticides: For control of sawfly larvae and strawberry weevil, use 2 pounds DDT 50 percent wettable powder.

When Blossom Buds First Show

Fungicides: For control of anthracnose and spur blight--2 pounds captan 50 percent wettable powder. For control of powdery mildew--1 pound Karathane or Mildex 25 percent wettable powder. (See pages 4 and 5 for limitations on use of ferbam, captan, Karathane, and Mildex.)

Insecticides: For fruit worms, spider mites, and aphids--1 1/2 pints 50 to 57 percent malathion emulsion, or 2 1/2 pounds 25 percent malathion wettable powder. For mites alone--1 1/2 pints 18 1/2 percent Kelthane emulsion concentrate, or 1 1/2 to 2 pounds of 18 1/2 percent Kelthane wettable powder. See page 3 for limitations on use of DDT, malathion, Kelthane. For additional spray for fruit worms, use malathion as at blossom bud time. Plan treatments early so that none will be necessary during the harvesting period.

Additional Fungicide Applications

Fungicides: Captan may be applied at any time including harvest period. Some additional applications following bud stage may be beneficial in preventing fungus infection that can result in failure of fruit to develop or rot of developed fruit.

Post-Harvest Spray

Fungicides: Same as second spray when leaves are fully expanded. Apply at 10 to 14 day intervals if needed.

Other Control Measures

For raspberry and red-necked cane borers and tree cricket injury, the affected stalks are pruned out. Raspberry cane borers cause tips of canes to wilt and the shoots are girdled with two rings an inch apart. Since the larva burrows downward, the wilted tips should be cut off a few inches below the girdle and destroyed. The red-necked cane borer causes a gall-like enlargement on the cane caused by a spiral burrow of the larva. Crickets cause egg-laying scars that weaken canes. Infested canes should be pruned out early in the fall. See section on strawberry insect control for recommendations on white grub control.

Weed Control in Raspberries

Small weeds can be effectively controlled in early spring with basal sprays of one-half pound of 2,4-D per acre. Such applications must be applied before new shoots have emerged. SES at three to four pounds (3-4 pounds Sesone) per acre applied in summer has given good pre-emergence control of broad-leaved weeds.

CIPC at six pounds (1 1/2 gallons Chloro-IPC) per acre applied in early spring when the canes are dormant is effective in suppressing common chickweed and fall germinating grasses.

SPRAY GUIDE FOR STRAWBERRIES

Unless otherwise noted, all rates of materials are given in amount per 100 gallons of water. This guide is intended for the commercial grower. For information on the home garden refer to Extension Pamphlet 184, "The Home Fruit Spray Guide."

Soil Treatment

White grubs are often serious pests in new strawberry plantings. This situation is usually the most troublesome when strawberries are planted in areas which were in grasses the year before. When grubs are present, the most effective chemical treatment should be made prior to setting out strawberry plants.

Any one of the following insecticide concentrates can be used effectively: An emulsion concentrate containing 2 pounds of aldrin per gallon; a concentrate containing 1 1/2 pounds of dieldrin per gallon; or a concentrate containing 4 pounds of chlordane per gallon. Each of these concentrates may be applied using 2 quarts of the concentrate to 100 gallons of water per 10,000 square feet of soil, or 1 tablespoon per gallon for each 100 square feet of soil.

The insecticides may also be applied to the soil as wettable powder in water or in the dry granular form. The rates of actual amount of insecticide per acre are 2 to 3 pounds of aldrin or dieldrin; and 6 to 8 pounds of chlordane. The lower doses provide satisfactory control on light soils, but heavier doses are usually necessary for heavy soils or soils containing considerable organic matter.

Shortly after applying insecticides to the soil, work the top 2 to 4 inches of the soil by disking or harrowing. This will get the insecticide into the area where the grubs will be present. This treatment may be made in late fall or early spring, preferably during the fall before planting.

Pre-Bloom Spray

This is the most important spray for strawberries

Fungicides: For control of leaf spot and Botrytis fruit rot, use 2 pounds captan 50 percent wettable powder (not over 3.8 pounds actual captan per acre), or 2 pounds zineb 65 percent wettable (not over 2.5 pounds actual zineb per acre), or 1 1/2 pounds thiram (Thylate 65 percent wettable powder) (not over 3.3 pounds actual thiram per acre). For trial: dodine, Dyrene and folpet. Follow label directions. See pages 4 and 5 for limitations.

Insecticides: For strawberry weevil, tarnished plant bugs, or strawberry "slugs" or sawflies - 2 pounds 50 percent DDT or methoxychlor wettable powder, or 25-30 pounds 5 percent DDT or methoxychlor dust per acre. Apply a second time if heavy rains occur shortly after application.

For control of cyclamen mites (especially on everbearers) - 2 pounds Kelthane 18 1/2 percent wettable powder, or 2 pints Kelthane 18 1/2 percent emulsion concentrate. If only spider mites are present, use 1 1/2 pounds Kelthane; or 2 pints 50-57 percent malathion emulsion concentrate. A drenching spray must be forced into the crowns of the plants. Thiodan at 1 pound 50 percent wettable powder per 100 gallons applied at 300 gallons per acre pre-bloom or post-harvest will control cyclamen mite. If less than 300 gallons are used per acre 1 1/2 pounds actual Thiodan should be applied per acre as a drenching spray.

For control of aphids use malathion at 1 to 2 pints of 50-57 percent malathion emulsion concentrate or 2 pounds of 25 percent wettable powder.

Bloom Spray

Fungicides: For control of blossom infection and fruit rot - 2 pounds captan 50 percent wettable powder (up to 7 pounds may be used), 2 pounds zineb 65 percent wettable powder (up to 4 pounds may be used), or 1 1/2 pounds thiram (Thylate 65 percent wettable powder) (up to 5 pounds may be used).

Maximum rates are per acre per application.

Do not use insecticides in this application.

Additional Sprays Between Bloom and Harvest

Fungicides: For control of leaf spot and fruit rot - 2 pounds captan 50 percent wettable powder, or 2 pounds zineb 65 percent wettable powder, or 1 1/2 pounds thiram (Thylate 65 percent wettable powder) at weekly intervals. See pages 4 and 5 for limitations on use of captan, zineb, and thiram. For trial: dodine, Dyrene, and folpet. Follow label directions. See pages 4 and 5 for limitations.

For control of powdery mildew, use 1 pound Karathane or Mildex, 25 percent wettable powder, at weekly intervals. See page 5 for limitations on use of Karathane and Mildex.

Insecticides: If aphids or spider mites become serious just before or during the harvest period, use malathion at rates recommended. See page 3 for limitations.

Strawberry leaf roller and leafhoppers may be controlled with 1 to 2 pints 50 to 57 percent malathion emulsion concentrate or 2 pounds 25 percent wettable powder. May be used up to 3 days before harvest.

During Harvest

Fungicides: For control of leaf spot and fruit rot, use 2 pounds captan 50 percent wettable powder. This treatment should be made at intervals immediately after ripe fruit has been picked. This treatment is approved provided limitations on dosage rate of chemical are followed (maximum of 3.8 pounds of actual captan per acre per application).

Post-Harvest Spray

Sprays for mite control can be made as post-harvest treatments, at rates given for pre-bloom spray. Refer to pre-bloom sprays for use of Thiodan to control cyclamen mite after harvest.

Late Fall Spray

Fungicides: For control of leaf diseases and fruit rot, use 0.5 pint of 10 percent phenyl mercury acetate solution, or equivalent. Some 1963 labels on mercury fungicides give specific rates for strawberry application. Use no more than 250 gallons per acre. No application is permitted while fruits are present. Apply post-harvest or in the fall after plants are dormant and about 10 days before mulching.

Weed Control in Strawberries

In new plantings the following herbicides have given effective weed control: (1) 2,4-D at one pound per acre applied during the period from three to eight weeks after planting; (2) SES at three pounds (3 pounds Sesone) per acre applied before weed emergence at any time after planting and repeated monthly. Avoid application when first runner plants are forming; (3) DCPA at 8 pounds (10 pounds Dacthal W-75) per acre following transplanting before emergence of weeds, has effectively controlled many annual grasses. Retreatment later in summer may provide good control of non-emerged weeds. Dacthal has little effect on emerged weeds.

In fruiting plantings 2,4-D at one and a half pounds per acre gives good control of overwintering weeds when applied at the time of mulch removal in the spring. Applications of 1 1/2 pounds of 2,4-D also give good weed control when applied shortly after berry harvest or after renovation following harvest but before runners form. Treatment at the time of runner formation usually causes marked inhibition of runners. SES at 3 pounds (3 pounds Sesone) has also been used successfully in fruiting plantings before flowering and after harvest. However, since SES kills only germinating seeds, it is not effective when applied to weedy strawberry fields.

Late fall applications of 2,4-D at 1 1/2 pounds or DNBP amine at 6 pounds (2 gallons Premerge or Sinox PE) per acre control fall germinating weeds which would otherwise live over winter under the mulch to cause trouble in the spring. To avoid injury to the developing fruit buds, these late fall applications must be delayed until just before the berry patch is mulched for the winter.

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