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Fruit Spraying Calendar

Michigan State University Extension Service

A.E. Mitchell, Horticulture; Alfred C. Dowdy, Entomology; Edward J. Klos, Robert H. Fulton, Botany and Plant Pathology

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EXTENSION BULLETIN 154

1959

FRUIT

SPRAYING CALENDAR



By A. E. MITCHELL, ALFRED C. DOWDY,
EDWARD J. KLOS and ROBERT H. FULTON

**COOPERATIVE EXTENSION
SERVICE
MICHIGAN STATE UNIVERSITY
EAST LANSING**

Figure 1—COMPATIBILITY CHART*

	Lead Arsenate	Nicotine	DDT, DDD, TDE	Methoxychlor	BHC, Lindane	Dieldrin	Aramite, Kelthane	Ovex, Genite EM 923	Chlorobenzilate	Parathion, EPN 300	Systox (demeton)	Malathion, Trithion	Diazinon, Guthion	Captan	Glyodin	Phygon XL (dichlone)	Mercuries	Bordeaux	Fixed Copper	Lime-sulfur	Elemental sulfur	Ferbam, Thiram	Ziram, Zineb	Niacide A and M	Lime	Karathane	Rotenone	Ryania	Actidione	Sevin	Tedion, Mitox
Lead Arsenate.....		+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+
Nicotine.....	+		+	+	Q	+	+	+	+	+	+	+	+	+	Q	+	Q	+	+	+	+	+	+	+	+	+	+	+	+	+	Q
DDT, DDD, TDE...	+	+		+		+	+	+	+	+	+	+	+	+	+	+	+	+	+	Q	+	+	+	+	+	+	+	+	+	+	+
Methoxychlor.....	+	+	+			+	+	+	+	+	+	+	+	+	+	+	+	+	+	Q	Q	+	+	+	+	Q	+	+	+	+	+
BHC, Lindane.....	+	Q	+	+		+	+	+	+	+	+	+	+	+	+	+	+	N	N	N	+	+	+	+	N	+	+	+	+	+	+
Dieldrin.....	+	+	+	+		+	+	+	+	+	+	+	+	+	+	+	+	N	N	N	+	+	+	+	N	+	+	+	+	+	+
Aramite, Kelthane...	+	+	+	+		+	+	+	+	+	+	+	+	+	+	+	+	N	N	N	+	+	+	+	N	+	+	+	+	+	Q
Ovex, Genite EM 923	+	+	+	+		+	+	+	+	+	+	+	+	+	+	+	+	N	N	Q	+	+	+	+	N	+	+	+	+	Q	Q
Chlorobenzilate.....	+	+	+	+		+	+	+	+	+	+	+	+	+	+	+	+	N	N	Q	+	+	+	+	N	+	+	+	+	Q	Q
Parathion, EPN 300...	+	+	+	+		+	+	+	+	+	+	+	+	+	+	+	Q	+	+	+	+	+	+	+	+	+	+	+	+	+	+
Systox (demeton)....	+	+	+	+		+	+	+	+	+	+	+	+	+	+	+	Q	Q	Q	Q	+	+	+	+	+	+	+	+	+	+	Q
Malathion, Trithion...	+	+	+	+		+	+	+	+	+	+	+	+	+	+	+	Q	Q	Q	Q	+	+	+	+	+	Q	+	+	+	+	+
Diazinon, Guthion...	+	+	+	+		+	+	+	+	+	+	+	+	+	+	+	Q	Q	Q	Q	+	+	+	+	N	+	+	+	Q	+	+
Captan.....	+	Q	+	+		+	+	+	+	+	+	+	+	+	+	+	N	N	N	N	+	+	+	+	N	+	+	+	+	+	+
Glyodin.....	+	+	+	+		+	+	+	+	+	+	+	+	+	+	+	+	Q	Q	Q	+	+	+	+	Q	+	+	+	+	+	Q
Phygon XL (dichlone)	+	Q	+	+		+	+	+	+	+	+	+	+	+	+	+	+	Q	Q	Q	+	+	+	+	Q	+	+	+	+	+	Q
Mercuries.....	+	+	+	+		+	+	+	+	+	Q	Q	Q	+	+	+	Q	Q	Q	Q	+	+	+	+	Q	+	+	+	+	+	Q
Bordeaux.....	+	+	+	+	N	+	N	+	N	+	Q	Q	Q	+	+	+	Q	Q	+	+	+	+	+	+	Q	+	+	+	+	+	Q
Fixed Copper.....	+	+	+	+	N	+	N	+	N	+	Q	Q	Q	+	+	+	Q	Q	+	N	+	+	+	Q	Q	+	Q	N	+	N	Q
Lime-sulfur.....	+	Q	Q	Q	N	+	N	+	Q	+	Q	Q	Q	+	+	+	Q	N	N	+	+	+	+	Q	Q	+	Q	N	+	N	+
Elemental sulfur.....	+	+	+	+		+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+
Ferbam, Thiram.....	+	+	+	+		+	+	+	+	+	+	+	+	+	+	+	Q	Q	Q	+	+	+	+	+	N	+	+	+	+	+	+
Ziram, Zineb.....	+	+	+	+		+	+	+	+	+	+	+	+	+	+	+	Q	Q	Q	Q	+	+	+	+	N	+	+	+	+	+	Q
Niacide A and M.....	+	+	+	+		+	+	+	+	+	+	+	+	+	+	+	Q	Q	Q	Q	+	+	+	+	N	+	+	+	+	Q	+
Lime.....	+	+	+	Q	N	+	N	+	N	+	+	+	N	N	+	Q	Q	+	+	+	+	+	+	N	+	Q	N	+	N	N	Q
Karathane.....	+	+	+	+		+	+	+	+	+	+	Q	+	+	+	+	Q	Q	Q	Q	+	+	+	+	Q	+	+	+	+	+	Q
Rotenone.....	+	+	+	+		+	+	+	+	+	+	+	+	Q	+	+	N	N	N	N	+	+	+	+	N	+	+	+	+	Q	Q
Ryania.....	+	+	+	+		+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	Q
Actidione.....	+	+	+	+		+	+	+	Q	Q	+	+	+	+	+	+	Q	N	N	N	+	+	+	+	N	+	+	+	+	Q	Q
Sevin.....	+	Q	+	+		+	+	+	+	+	+	+	+	+	+	+	N	N	N	N	+	+	+	+	Q	N	+	Q	Q	Q	Q
Tedion, Mitox.....	+	Q	+	+		+	Q	Q	+	Q	+	+	+	+	Q	Q	+	Q	Q	+	+	+	Q	+	Q	+	Q	+	Q	Q	Q

Q=Questionable; compatibility not clear.

N=Not compatible.

±=Decomposes on standing; residual action reduced.

+=Materials compatible.

*Compatible materials are those which can be mixed together in a spray tank without:
(1) loss of effectiveness of the material, or (2) unfavorable chemical reactions between the materials which might harm the plants.

Streptomycin is most favorably applied as a separate application.

Urea formulated for foliar applications is compatible with the commonly used pesticides. However, it doesn't seem to be compatible with fixed copper or Bordeaux.

1959 FRUIT SPRAYING CALENDAR¹

By A. E. MITCHELL,² ALFRED C. DOWDY,³
EDWARD J. KLOS⁴ and ROBERT H. FULTON⁵

Much goes into the planning of an economical and effective spraying program. In fruit growing, a successful pest control schedule must be based on a knowledge of (1) the life history of the important insects and diseases likely to be encountered; (2) the various kinds of spray chemicals available, and their proper use; and (3) susceptibility of the different kinds and varieties of fruit to insect, disease and spray injury.

In order to provide more complete reference information, three new extension publications dealing with fruit pests are being written by members of the Departments of Entomology and Botany and Plant Pathology at Michigan State University. These publications will become available on or about June 1, 1959 and will have the following titles and bulletin numbers:

1. Tree Fruit Diseases in Michigan by E. J. Klos, Extension Bulletin E-361.

2. Small Fruit Diseases in Michigan by R. H. Fulton, Extension Bulletin E-362.

3. Tree and Small Fruit Insects in Michigan by A. C. Dowdy, Extension Bulletin E-363.

The pest control schedules in this publication (pages 30-48) are merely guides to aid each grower in preparing his own pest control program. The same insects and diseases are not always present or economically important in all orchards and small fruit plantings. Thus, during any single season, each grower has to adjust his pest control program to fit his specific conditions.

The chemicals included in each fruit spray schedule in this publication have been suggested only at the times they may be used without the danger of excessive residues (not to exceed established tolerances)

¹The help and suggestions received from the district horticultural agents, the county agricultural agents, and the Extension and Research personnel in the Departments of Horticulture, Entomology, and Botany and Plant Pathology in preparing this publication have been very valuable and are gratefully acknowledged.

²Professor of Horticulture.

³Extension specialist in Entomology.

⁴Extension specialist in Plant Pathology.

⁵Assistant professor in Botany and Plant Pathology.

on harvested fruit. The allowable chemical residue and required waiting period between last application and harvest are given for each chemical in Table 3 on page 50.

USE CHEMICALS SAFELY

PHOSPHATE INSECTICIDES

Growers using phosphate-type insecticides should obtain a doctor's prescription for 1/100 of a grain of atropine tablets and keep a supply of these for emergency use if and when poisoning symptoms occur. Early symptoms include weakness, headache, nausea, vomiting, and tightness in the chest. Never take atropine before symptoms occur; nor is it safe to give tablets by mouth to an unconscious person.

ALL AGRICULTURAL CHEMICALS

The National Agricultural Chemicals Association has published a 12-point safety code for insecticides and other agricultural chemicals. *Study these 12 rules repeatedly until each is adopted and becomes a habit with you:*

1. Always read the label before using sprays or dusts. Note warnings and cautions each time before opening the container.
2. Keep sprays and dusts out of the reach of children, pets and irresponsible people. They should be stored outside of the home and away from food and feed.
3. Always store sprays and dusts in original containers and keep them tightly closed. Never keep them in anything but the original container.
4. Never smoke while spraying or dusting.
5. Avoid inhaling sprays or dusts. When directed on the label, wear protective clothing and masks.
6. Do not spill sprays or dusts on the skin or clothing. If they are spilled, remove contaminated clothing immediately and wash thoroughly.
7. Wash hands and face and change to clean clothing after spraying or dusting. Also wash clothing each day before reuse.
8. Cover food and water containers when treating around livestock or pet areas. Do not contaminate fishponds.
9. Use separate equipment for applying hormone-type herbicides in order to avoid accidental injury to susceptible plants.

10. Always dispose of empty containers so that they cannot harm humans, animals or valuable plants.

11. Observe label directions and cautions to keep residues on edible portions of plants within the limits permitted by law.

12. If symptoms of illness occur during or shortly after spraying or dusting, call a physician or get the patient to a hospital immediately.

IN CASE OF POISONING:

1. Call your physician. **Note to Physician:** The table below lists *Poison Control Centers* in Michigan which can furnish specific information, including antidotes, for various trade named poisons:

City	Name of center and street address	Telephone	Name of director
Ann Arbor	Poison Control Center University Hospital 1313 E. Ann Street	Normandy 3-1531	George H. Lowery, M.D.
Detroit	Poison Information Center Registrar's Office Herman Kiefer Hospital 1151 Taylor Avenue	Trinity 2-3334	Paul T. Salchow, M.D. William G. Fredrick, M.D.
Coldwater	Poison Control Center Community Health Center of Branch County 274 E. Chicago Street	296	John Etsweiler
Grand Rapids	Poison Control Center Butterworth Hospital 300 Bostwick N.E.	Glendale 1-3591	Mark W. Dick, M.D.
Grand Rapids	Poison Control Center Blodgett Memorial Hospital 1800 Wealthy S.E.	Glendale 6-5301	John Montgomery, M.D.
Grand Rapids	Poison Control Center St. Mary's Hospital 250 Cherry St., S.E.	Glendale 9-3131	Craig E. Booher, M.D.
Midland	Poison Control Center Midland Hospital 4005 Orchard Drive	TE 5-6771	G. Fred Moench, M.D.
Pontiac	Poison Control Center St. Joseph Mercy Hospital 900 Woodward Avenue	Federal 4-3511	Robert J. Mason, M.D.

2. *For poisons spilled on the skin:* Wash thoroughly with large amounts of soap and warm water. Particles in the eyes may be removed by thorough flushing with plain water. For phosphate materials absorbed through the skin, give atropine by injection or in tablet form.

3. *For poisons that have been inhaled:* Place the patient in the open air. Give atropine as directed above if a phosphate material is responsible. Administer artificial respiration when necessary.

4. *For poisons that have been swallowed,* induce vomiting as soon as possible. To do this, gently stroke the inside of the throat and/or give an emetic such as warm salt water (1 tablespoon in a glass of water). Repeat until the vomit fluid is clear. After the stomach has been emptied, give a demulcent such as raw egg white mixed with water.

5. When the physician arrives, he may inject 1/30 to 1/60 of a grain of atropine sulfate at hourly intervals for phosphate materials, or phenobarbital for chlorinated hydrocarbon chemicals.

CONCENTRATE SPRAYING

The term "concentrate spraying" is used principally when referring to the spraying of fruit trees. It simply means the use of a greater amount of a given chemical per 100 gallons than is used in dilute (conventional) spraying and the application of a correspondingly less quantity of spray mixture per tree.

The dilutions employed in concentrate spraying are referred to as 2x, 3x, 4x, etc. This means that 2, 3, or 4 times the amount of chemicals is used per 100 gallons than is suggested for dilute spraying, and that only one-half, one-third, or one-fourth the amount of spray mixture is applied per tree as is suggested for conventional spraying.

How to Convert to Concentrate Spraying

Before setting up a sprayer for concentrate spraying, you must know the following: (1) The gallons of spray you applied per tree by conventional methods, (2) the average spread of the trees in feet, (3) the rate of travel to be used while spraying, and (4) the new concentration to be used. By applying a simple formula to these figures, you can figure the gallons per minute to be delivered by one side of the sprayer which will deposit the same amount of chemicals on the tree as when you used conventional spraying. This formula, along with an example of its use, is given below:

$$A = \frac{B \times C}{D \times E \times F}$$

A = The new spray delivery rate for one side of the sprayer in gallons per minute, to be determined.

B = The amount of spray per tree used in dilute spraying. We will assume this to be 12 gallons per tree.

C = The rate of travel you wish to use while spraying. Assume this to be 3 miles per hour or 264 feet per minute. (88 feet per minute = 1 mile per hour. $88 \times 3 = 264$ feet per minute.)

D = Always is 2. Only one-half the tree is sprayed when passing.

E = The grower wishes to use "4x" concentration, thus $E = 4$.

F = Average spread of the trees to be sprayed; assume this to be 30 feet.

Thus, the formula will be as follows:

$$A = \frac{12 \times 264}{2 \times 4 \times 30} = \frac{3168}{240} = 13.2 \text{ gallons per minute}$$

The delivery rate for one side of the sprayer should be 13.2 gallons per minute. For two-way spraying, each side of the sprayer should deliver 13.2 gallons per minute. This would make a total delivery of 26.4 gallons per minute, using the banks of nozzles on both sides of the sprayer.

If you plan to use concentrate spraying, be prepared to do some night spraying, since best results from spraying are obtained when air movement is less than 7 miles per hour.

CHEMICAL THINNING OF APPLES

The continued demand for apples of certain varieties with a minimum size of not less than 2½ inches has made blossom and fruit thinning a "must" in Michigan. High labor costs and the need for thinning during the period *Petal Fall* to 14 days after *Petal Fall* to induce annual bearing have stimulated the practice of thinning with chemicals.

The two chemicals currently suggested for use in Michigan are the naphthaleneacetic acid compounds, referred to as NAA, and naphthaleneacetamide, sold as Amid-Thin. NAA is available in acid form and as a sodium salt and is sold under such tradenames as App-L-Set, Fruitone, and Stafast.

Thinning with NAA

Varieties differ greatly in their response to NAA thinning sprays. On this basis, they are divided into three groups: (1) easy to thin; (2) intermediate; and (3) hard to thin.

Listed below are the varieties and the suggested concentrations of NAA to use 5 to 7 days after *Petal Fall* as a guide when first starting a thinning program:

1. *Varieties Easy to Thin*: McIntosh, Delicious, Jonathan, Northern Spy, and Rhode Island Greening: 4 grams of *actual* NAA per 100 gallons (10 parts per million).

2. *Intermediate Group*: Grimes Golden, Oldenburg (Duchess), Fameuse (Snow), Hubbardston, and Wagener: 6 grams of *actual* NAA per 100 gallons (15 parts per million).

3. *Varieties Hard to Thin*: Yellow Transparent, Wealthy, Golden Delicious, Rome Beauty, and Baldwin: 8 grams of *actual* NAA per 100 gallons (20 parts per million).

If the first application of NAA (made 5 to 7 days after *Petal Fall*) does not give enough thinning, increase the concentration 2 to 5 parts per million and follow with a second application 7 to 10 days later.

Thinning with Amid-Thin

Under Michigan conditions, Amid-Thin is suggested for use at 60 parts per million at *Petal Fall*. Concentrations lower than this, as recommended by the manufacturer, have not given adequate thinning. Applying Amid-Thin *after Petal Fall* has resulted in *no* thinning; and it has caused the fruit to stick fast to the tree so that no "June drop" occurred. When this happens, there is nothing but a large crop of valueless, small apples.

Amid-Thin is suggested especially for early varieties which ripen before McIntosh, and for varieties likely to be injured by NAA applications. These include Yellow Transparent, Oldenburg (Duchess), Early McIntosh, Wealthy, and Northern Spy. Amid-Thin can also be used on all other varieties. However, there are cases where the material did not thin Delicious but, led, instead, to a large crop of undersized, distorted apples.

Fruits affected by the Amid-thinning spray do not grow but remain the same size as when the spray was applied. Fruits *not affected* will continue to grow and become larger. This difference in fruit size is very apparent 7 to 10 days after application, making it possible

for you to determine the results of the thinning spray and to follow with an application of NAA if you wish to do so.

Cautions

- As a general rule, apply NAA under fast-drying conditions, when the temperature is between 70 to 75° F. On the other hand, Amid-Thin gives best results when applied under slow drying conditions. Amid-Thin is often applied in the evening.

- Weak trees are thinned more easily than vigorous ones.

- Thinning with NAA and Amid-Thin is much more effective when weather conditions during bloom do not favor good pollination or fertilization.

- If the weather during the week preceding bloom or the week after bloom is cloudy, wet, and humid, thinning is accomplished more easily than if the weather during these periods has been fair and sunny.

- When freezing temperatures (32° F. and lower) occur after *Pre Pink* and before applying the thinning sprays, NAA may cause excessive thinning. Reduce the concentration 2 or 3 parts per million.

- Each grower must work out the concentrations of NAA best suited for his orchard conditions. Sprays of NAA will remove all the fruit and severely damage the leaves when too high concentrations are used. When conditions exist which might result in injury or loss of crop from overthinning with NAA, Amid-Thin is safer for widespread use. These decisions have to be made by the grower.

Suggestions for Thinning with Concentrated Mixtures

Fruit-thinning sprays can be applied in concentrate form with airblast equipment. A 2x concentration is suggested in the beginning whereby you use one-half the amount of spray per tree as you would use in conventional spraying.

If higher concentrations are tried, a good starting point is a 3x concentration—applying only one-fourth the amount of spray per tree that you would use in conventional spraying.

Here, also, to obtain the amount of thinning desired, you must work out the concentration and gallonage per tree or per acre best suited to your orchard conditions.

CHEMICAL THINNING OF PEACHES

At the present time, no reliable chemicals are available for thinning peaches. Some growers are using DN compounds in early

bloom, but results differ so greatly from orchard to orchard and from year to year that they cannot be suggested generally.

Both 3-Chloro IPC and Peach-Thin 322 have been tried experimentally and by growers in Michigan and other states. Peach-Thin 322 has performed erratically, while 3-Chloro IPC has caused injury by distorting the shape of the Haven varieties of peaches. Neither can be suggested for peach thinning in Michigan.

PESTICIDE CHEMICALS AND THEIR USE

Pesticide chemicals may be classified according to use into three groups: (1) *Fungicides*—materials used to control fungous diseases; (2) *Insecticides*—materials used to control insects; and (3) *Accessory Materials (Adjuvants)*—materials used as correctives, stickers, spreaders, activators, flocculators, and emulsifiers.

COPPER FUNGICIDES

Fungicides

Copper fungicides are usually divided into two groups: (1) Bordeaux; (2) proprietary or low-soluble copper compounds.

Bordeaux

Bordeaux is a tank-mix of copper sulfate (bluestone or blue vitriol), hydrated lime, and water. It is identified by a characteristic formula, an example of which is 4-6-100. The “4” means 4 pounds of copper sulfate; the “6” means 6 pounds of hydrated lime; and the “100” means that the total volume of spray mixture is 100 gallons.

There are various formulae for bordeaux mixtures, such as 1-6-100, 4-2-100, 4-4-100, etc. When bordeaux is suggested in the spraying schedules in this publication, the first figure always refers to the amount of copper sulfate in pounds, the second figure to the amount of hydrated lime in pounds, and the third figure to the quantity of spray mixture in gallons, with the liquid always water.

Copper sulfate can be obtained in several forms, based on size of particles. The rather fine, granular, and pulverized forms are easier to use in making tank-mix bordeaux. These forms are referred to by the trade as “powdered”, “snow”, “small crystals”, and “large crystals”. The powdered or snow forms are recommended for convenience.

Preparation of Bordeaux.—There are several methods for preparing bordeaux. The one most common is the “instant bordeaux” method. It is convenient to use and the mixture is entirely satisfactory. *One precaution should always be remembered in making bordeaux: Never mix concentrated solutions of copper sulfate and hydrated lime.* Such a mixture is coarse and does not adhere well to the fruit or foliage.

The "instant method" requires the use of copper sulfate in the "powdered" or "snow" forms. The hydrated lime should be fresh (see page 27). Make "instant bordeaux" as follows:

1. Fill the spray tank almost full of water (12 to 14 inches from the top of the tank).
2. Dissolve the amount of copper sulfate to be used in the tank of spray in a pail of water, using a porcelain pail.
3. With the agitator running, pour the dissolved copper sulfate into the tank.
4. Remove the screen of the spray tank and, with the agitator running, slowly pour the required amount of hydrated lime into the tank.
5. Add any other chemicals to be included with the bordeaux.
6. Replace the screen in the spray tank and finish filling the tank with water.

Proprietary Copper Compounds are fungicides or bactericides containing copper in a low-soluble, slowly available form. They are sold under various trade names, such as Basicop, COCS, Spray-Cop, Tennessee 26, Tribasic Copper, Coposil and Tennessee 34. In general, they are not as effective as bordeaux for control of diseases, but they are less injurious to fruit and foliage.

Because they vary in copper content, these compounds should be used at manufacturers' directions. To guard against possible injury from soluble copper, include 1 pound of fresh hydrated lime with each 0.24 to 0.26 of a pound of actual metallic copper used in the spray mixture.

SULFUR FUNGICIDES

Elemental Sulfur means sulfur in pure form. For disease control, the sulfur is reduced to extremely small particles by mechanical grinding or by other processes. Dry, powdered sulfur which is used for dusting contains an inert material to improve the flowing properties of the sulfur. Wettable powdered sulfur is elemental sulfur with a wetting agent added, so that the particles of sulfur can be wetted and dispersed in water. Sulfur pastes are finely divided sulfur particles, less than 5 microns, combined with enough water and wetting agent to make a paste. "Bentonite sulfur" is elemental sulfur fused chemically with bentonite clay; it is considered a form of wettable sulfur in this bulletin.

Proprietary sulfur products vary in particle size and in sulfur content. Thus, it is favorable to follow the recommendations of the manu-

facturer. In general, 4 to 8 pounds of wettable sulfur are used per 100 gallons of spray. "Flotation paste" contains 32 to 42 percent elemental sulfur, compared to 95 to 98 percent elemental sulfur for the common, dry wettable form. Flotation paste is generally used at the rate of 8 to 10 pounds of paste per 100 gallons of spray. A sulfur paste common in Michigan is Magnetic 70 Paste. This product contains 70 percent elemental sulfur and is used at the rates of 5 to 8 pounds per 100 gallons of spray.

The amount of sulfur paste or wettable sulfur used per 100 gallons of spray depends on the disease to be controlled and the season. The higher amounts are used early in the season for the control of apple scab, and for the control of brown rot on peach and plum. The lower amounts are used when diseases are more easily controlled, and during those periods favorable for sulfur burn.

The adhesiveness and fungicidal value of wettable and paste sulfurs depend, within limits, upon the size of the sulfur particles and the content of sulfur in the product. Sulfur, referred to as 325-mesh sulfur is coarse, with a maximum allowable particle size of 40 microns (A micron is equal to 1/25,000 of an inch). Paste sulfur and some of the wettable sulfurs have particles which range in size from 1 to 4 microns.

Wettable sulfurs and paste sulfurs are principally protective in their action against disease organisms. All parts of the fruit and foliage must be kept covered during infection periods.

Wettable and paste sulfurs are virtually noninjurious to apple fruit and foliage at cool temperatures. At temperatures above 85° F., sun scald may occur on the fruit and scorch on the foliage of apple trees. This is especially likely to happen in warm, humid weather. However, wettable sulfurs and paste sulfurs are safe to use in all applications on peaches, plums, and cherries even under conditions injurious to apple.

Lime-sulfur is available in both the liquid and dry forms. In this bulletin, the term lime-sulfur refers to commercial concentrated solutions testing 32° to 33° Baume. Liquid lime-sulfur is a true solution consisting of caustic calcium polysulfides and thiosulfates as the toxic ingredients. The caustic action of the polysulfides kills certain fungous spores which are germinating or partly established, giving the material some eradicative as well as protective properties. Soon after being exposed on the leaf surface, the polysulfides and thiosulfates break down into finely divided sulfur, which has a protective action similar to elemental sulfurs.

Lime-sulfur, because of its caustic property, is more injurious to fruit and foliage than elemental sulfurs and must be used with caution.

ORGANIC FUNGICIDES

Dithiocarbamates

Ferbam (ferric dimethyldithiocarbamate) is a black, bulky powder sold under such trade names as Fermate, Karbam, and Coromate. This material is suggested to control leaf spot on sour cherries, black rot on grapes, currant leaf spot, and is as effective as elemental sulfur in controlling scab on apples. It may be used also with glyodin and with actidione as a safening agent when these chemicals are used with lead arsenate. One-fourth pound of ferbam is required to safen one pound of lead arsenate.

Thiram (tetramethylthiuram disulfide) is sold under the name of Thylate. In Michigan it is suggested for the control of scab on apples, including Golden Delicious. In research plots, Thylate has given good control of strawberry fruit rots and may be cleared for use on strawberries in 1959. Thylate is not a favorable safening agent for lead arsenate.

Zineb (zinc ethylenebisdithiocarbamate) is a formulated wettable powder sold under the tradenames Dithane Z-78 and Parzate. It may be used on apples as a protective fungicide to control scab. It is suggested also for the control of black rot on grapes.

Other Organic Fungicides

Actidione (B-[2-(3,5-dimethyl-2-oxocyclohexyl)-2,2 hydroxyethyl] glutarimide) is an exceptionally efficient antibiotic fungicide in killing established infections of cherry leaf spot fungus. This material is marketed in pill form, with one pill containing 0.38 of a gram or 380 milligrams of actidione. One pill in 100 gallons of spray mixture equals one part per million.

Actidione is suggested at rates of 1 to 2 parts per million to control cherry leaf spot. To avoid fruit injury, do not use it stronger than 1 part per million on bearing trees until the cherries are at least $\frac{3}{8}$ of an inch in diameter, or 4 to 6 weeks after bloom. When lead arsenate is included with actidione, add one-fourth pound of ferbam for each pound of lead arsenate in the spray mixture to guard against possible arsenical injury.

Captan (N-trichloromethylmercapto-4,4 cyclohexene-1, 2-dicarboximide) is a 50 percent wettable powder sold as Orthocide 50 Wettable and Stauffer's Captan Fungicide. This material has given good con-

trol of apple scab, cherry leaf spot, brown rot on stone fruits, and fruit rots on strawberries.

Captan is suggested specifically for use on Golden Delicious during the period *Pre-Pink* through *Second Cover* to aid in the development of good fruit finish. Captan has caused leaf injury on Delicious in some orchards when applications have been too heavy or when used with incompatible materials. It requires one-half pound of captan to safen one pound of lead arsenate.

Dichlone or Phygon XL (2,3-dichloro-1, 4-naphthoquinone) Phygon XL is a trade name for dichlone, a naphthoquinone fungicide with both protective and eradivative properties. It is used against apple scab in cases where control has been difficult either alone or in combination with a protective fungicide. It is suggested in blossom sprays to control brown-rot blossom blight on peaches, plums, and cherries. Phygon is a caustic, irritating chemical and should be handled carefully. Operators who are sensitive to this material can obtain special non-oily ointments to overcome skin irritation.

Glyodin (2-heptadecylglyoxalidine acetate) is a liquid fungicide sold as Crag Fruit Fungicide 341 for use as a protective fungicide on apples to control scab and on cherries to control leaf spot. It has resulted in good finish of apples of all varieties, except Golden Delicious. It should not be used on Golden Delicious during the period *Pre-Pink* through *Second Cover*. When lead arsenate is used with glyodin, include one-fourth pound of ferbam for each pound of lead arsenate in the spray mixture to guard against arsenical injury. Glyodin and the combination of glyodin plus ferbam have performed creditably on sour cherries for the control of leaf spot.

Mercury Compounds—The phenyl mercurial compounds such as Tag 331, Puratized Apple Spray, Coromerc, and Phix are useful in eradicating newly established infections of apple scab. Sprays containing mercury at the rate of one-fourth to one-half pound, or one-fourth to one-half pint of 10 percent mercury are suggested for use on apples within 36 to 72 hours after an infection-producing rain, when protection from previously applied fungicides is questionable. Actually, these mercuries may have a longer period of action if temperatures remain low (below 50° F.) after the rain.

Some growers who have sufficient spray and dust equipment may wish to handle at least a portion of their apple scab control program on an eradication basis, rather than by using protective methods. To eradicate longstanding (2 to 3 weeks) apple scab infection with mer-

curial compounds is a questionable practice; in some cases, heavy leaf drop has resulted. *Mercurial compounds should not be used after an application of ferbam unless ferbam is included with the mercury. Do not use them in hot weather.*

Mercury sprays are suggested as a dormant application on strawberries for eradicating the leaf blight (*Dendrophoma*) fungus. Mercury sprays may injure or kill old leaves, but these leaves are replaced by new leaves and will not be missed. Make the dormant application *before new growth is visible*. See strawberry Spraying Schedule, page 44.

Niacide A (formerly Vancide A) is a mixture of the following: 31.2 percent ferbam, 26.8 percent manganous dimethyldithiocarbamate, 6.8 percent thiram, 2.8 percent ferric benzothiazylmercaptide, 1.3 percent benzothiazyl disulfide, and 1.1 percent manganous benzothiazylmercaptide. It is designed for use on apples through *Third Cover*; after *Third Cover*, Niacide M is suggested. Niacide A has performed well under Michigan conditions and is suggested on all varieties of apples, except Golden Delicious. It is not suggested for Golden Delicious because of its dark-grey residue and its possibility of causing fruit russetting.

Niacide M (formerly Vancide M) is a mixture containing the following: 53.9 percent manganous dimethyldithiocarbamate, 10.9 percent thiram, 2.9 percent benzothiazyl disulfate, and 2.3 percent manganous benzothiazylmercaptide. It is suggested for use on apples any time throughout the growing season. In contrast to Niacide A, the "M" form is white or light gray in color, and leaves no undesirable visible residue on the harvested fruit. Niacide M has performed well throughout the season on Golden Delicious with no unfavorable russetting.

Phybam S is a mixture of Phygon, ferbam, and sulfur containing 3 percent dichlone, 9.5 percent ferbam and 71 percent elemental sulfur. It is suggested for use on apples at 4 pounds per 100 gallons. At this strength, the spray will contain about one-eighth pound of actual dichlone (equivalent to one-fourth pound of Phygon XL), one-third pound of ferbam, and 3 pounds of sulfur. Phybam S is effective in controlling powdery mildew and as a protective fungicide against apple scab. Its value for the eradication of apple scab has not been clearly established.

NEW FUNGICIDES

Cyprex (*n*-dodecylguanidine acetate) is a new fungicide that has given outstanding control of apple scab and cherry leaf spot in experi-

mental plots in Michigan during 1956, 1957, and 1958. With the following precautions in mind and if approved for use, Cyprex is worthy of a trial by growers in a limited way on apples and sour cherries in 1959. It should be used at the rate of one-half to three-quarters of a pound per 100 gallons in a protective spraying schedule for apples, and at one-half pound on sour cherries. Do not use Cyprex on Golden Delicious or Rhode Island Greening as it has russeted the fruit of these varieties in each of the past two years. Cyprex is *not* compatible with lime. Read the manufacturer's label carefully before using Cyprex.

DISEASES DIFFICULT TO CONTROL

POWDERY MILDEW ON PEACHES

In 1958, powdery mildew was found in several orchards on the fruit of Rio Oso Gem and Redskin varieties of peaches. The disease may be identified by the small white areas on young developing fruit which are present shortly after *Shuck Split*. Later the enlarged spots turn brown and are free of fuzz.

To control this disease in problem orchards, use wettable sulfur at the rate of 5 pounds per 100 gallons starting with *Petal Fall* and repeating the application at weekly intervals for 3 to 4 weeks. These spray applications will also control brown rot and peach scab.

GREEN RING MOTTLE ON SOUR CHERRIES

In the last 3 years, bearing Montmorency trees with *green ring mottle* symptoms have been found in several Michigan orchards.

The symptoms of this virus disease show up on Montmorency trees 4 to 5 weeks after "petal fall" as green rings, spots, or arcs over a yellow background. The infected leaves drop over a period of 10 to 14 days after the symptoms become visible.

In a few rare cases, pitted fruit has been found on trees infected with green ring mottle. This pitting is caused by the killing of fruit cells just under the skin. This results in slight depressions (about 1/32 inch across) on the surface of the fruit.

Any grower finding these fruit symptoms should contact his county agricultural agent to have the suspected trees diagnosed by a plant pathology specialist.

There is no control for *green ring mottle* on established trees. Buy disease-free trees for new plantings.

APPLE SCAB

Apple scab is the only serious fungous disease generally confronting the Michigan apple grower, and good control of scab is necessary

for a profitable season. Scabby apples are culls. Also, the fungus, if not controlled, can cause early fruit and leaf drop which may seriously reduce yields.

TABLE 1—The approximate number of hours of continued wet foliage required for primary apple scab infection at different air temperature ranges

Air temperature range during wet period	Number of hours of continuous wet period required for primary apple scab infection
32°—40° F.	48 hours
40°—42° F.	30 hours
42°—45° F.	20 hours
45°—50° F.	14 hours
50°—53° F.	12 hours
53°—58° F.	10 hours
58°—76° F.	9 hours
76°—	11 hours

TABLE 2—The effect of temperature following primary apple scab infection on the length of time required for the development of conidia (summer spores)

Average temperature following primary apple scab infection	Approximate period of time required for conidia (summer spore) development following primary apple scab infection
30°—40° F.	18 days
41°—45° F.	16 days
46°—50° F.	14 days
51°—55° F.	13 days
56°—60° F.	12 days
61°—65° F.	10 days
66°—70° F.	8 days
71°—75° F.	7 days

The apple scab fungus develops during the winter and early spring in the old leaves on the ground that were infected the previous season. Ascospores, similar to small seeds, are produced and are usually ripe about the time the first green apple tissue is exposed in the spring. Rain is necessary for spore discharge, and enough rain to wet the surface of the leaves will cause some of the ascospores to be shot into the air. The air currents then carry these spores upward into adjoining trees; or the wind may carry the spores long distances. If they land on green apple foliage or fruit, they cause infection when they stay wet for a few hours. Ascospores may continue to be discharged as late as 2 to 4 weeks after Petal Fall in some seasons, but are usually all gone by First Cover.

The spores (ascospores or conidia) will germinate and penetrate into the green tissue — if the green tissue is wet, and if the spores on the green tissue remain wet long enough. The time required for the discharged ascospore to germinate and cause infection depends upon the temperature during the wet period. This relationship is shown in Table 1.

Primary apple scab infection is soon followed by the formation of secondary spores that are produced abundantly in established scabbed spots. Table 2 gives the time of expected appearance of the secondary spores (called conidia) after primary scab infection. Once primary infection is established, it is possible to have both ascospores and conidia present at the same time. The conidia or summer spores are not scattered by the wind, but are spread only by dropping or splashing water. Therefore, conidia reinfect only nearby fruit and foliage. Infection by conidia requires a wet period about 3 hours shorter than that given for ascospore infection in Table 1. The 3-hour lag in ascospore infections is based on the time the ascospores spend floating around in the air.

SUGGESTIONS FOR CONTROL

By knowing the temperature from the time the green tissue first becomes wet until it dries again, you can determine (from Table 1) if infection is likely and judge whether spray materials already applied are adequate for the control of scab. If weather predictions indicate that the wet period will extend beyond the time given for apple scab infection in Table 1, it is advisable to apply a protective cover before or during the wet period, or an eradication spray immediately after the wet period. Renewed protection or eradication is particularly necessary if the protective cover already present is questionable.

To protect against apple scab infection, protective fungicides such as sulfurs or ferbam must be on the foliage before infection occurs. However, eradicated fungicides — such as lime-sulfur or phenyl-mercury compounds — kill the fungus after it has entered and penetrated for some distance into the apple leaf or fruit tissue; at full strength, these materials are usually effective for about 72 hours after the infection has taken place. Phygon XL is an effective eradicated fungicide when used at one-fourth pound per 100 gallons within 30 to 36 hours from the beginning of an infection period and in combination with a protective fungicide.

The performance expected of the several types of fungicides for scab control is illustrated, for all practical purposes, in Fig. 1. In

this diagram, the organic mercuries — such as Tag, Coromerc, Phix, and Puratized Apple Spray — are shown eradicating infections that were established during the 3 days previous, or about 72 hours before the time of application. These organic mercuries are not, however, considered reliable for much further continued protection.

Lime-sulfur has an eradicated action equal to that of the mercuries, but the eradicated action of Phygon is considered to be somewhat less — or about 36 hours when used at one-half pound per 100 gallons. In addition, lime-sulfur and Phygon leave protective fungicidal deposits.

The fungicides, such as the wettable sulfurs, ferbam, and glyodin, are considered to be protective only, having rather limited or no eradicated properties. Captan is classed as a protectant, but does have eradicated action from 18 to 24 hours, depending on the prevailing air temperature.

For a protective spray program to be effective, the developing fruit and leaves must be covered before an infection period of wet weather. The effective period of protection for the different fungicides is variable, depending on the amount of spray coating washed off by rains and the amount of new unprotected growth developed since the last spray. In general, a protectant spray coating in the prebloom period should be considered insufficient after a period of over 7 days, or after 1 inch of rainfall.

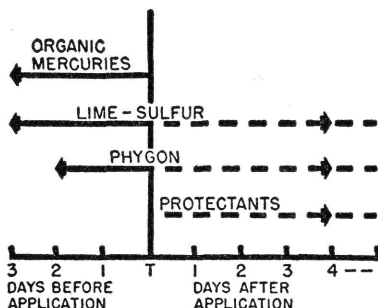


Fig. 1. Approximate periods of control of apple scab by different kinds of fungicides. (T = time of application.) The time to the left of the vertical line indicates the approximate period of eradicated action; that to the right indicates the approximate period of protective action.

INSECTICIDES

UNRELATED MATERIALS

Lead Arsenate was the standard stomach poison used in Michigan orchards before the introduction of DDT. Unless otherwise stated, lead arsenate referred to in this bulletin is the acid form.

Acid lead arsenate should not be used on peaches, cherries, plums, or after Second Cover on apples without a corrective. (See page 28.) Acid lead arsenate may be used safely with most pesticides. It should not be combined with weak concentrations of lime-sulfur (less than 1

gallon of lime-sulfur in 100 gallons of water, or less than 4 pounds of dry lime-sulfur) without the addition of hydrated lime, using equal amounts of lime and lead arsenate.

DN Compounds—Elgetol, Elgetol-318, and DN-289—are effective against aphids, bud moth, and mineola moth as dormant applications. Follow the manufacturers' directions carefully. Foliar applications of DN compounds are now largely supplanted by other materials and are no longer generally suggested.

Dormant Oils can be used to control European red mite, scale insects, and pear psylla. In general, the amount of oil in a spray varies from 3 to 4 percent. Oils should be used at manufacturers' directions. Dormant oils should have a viscosity (Salboldt at 100° F.) of 90 to 120 seconds; a minimum viscosity index (Kinematic) of 65; a minimum gravity (A.P.I. degrees) of 28; a pour point not greater than 30° F., and an unsulfonated residue of above 78 percent. DN compounds should not be used in the same spray mixtures with 3 or 4 percent oil emulsions.

At present, practically all insects that were once controlled by dormant oils can be controlled by foliar applications of newer insecticides.

Genite EM-923 (2,4-dichlorophenyl ester benzene sulfonic acid) is a specific miticide which may be used during *Pink* on apples to prevent a build-up of European red mites. In some orchards, Genite Em-923 has eliminated the need for a miticide later.

Rotenone is an insecticide derived from the roots of certain plants (*derris* from the East Indies and Malaya and *cubé* from South America). Being relatively safe, rotenone is exempt from the requirement of a tolerance. On fruits, its major usage is against pests immediately before or during harvest.

CHLORINATED HYDROCARBONS

BHC (benzene hexachloride) is a contact and stomach poison suggested in the Spraying Calendar at the time of *Pre-Pink* and *Pink* to control aphids on apples. This material should not be used after *Pink* since it may create an off-flavor in the harvested fruit.

The active portion of BHC is the gamma isomer. Amounts of BHC suggested in this publication are based on 10 percent gamma isomer content.

Chlorobenzilate (ethyl-4, 4-dichlorobenzilate) is a specific miticide and has been labeled for use on apples and pears. It has been very effective against mites which show resistance to phosphate materials. Some states have reported fruit injury when Chlorobenzilate was used on Delicious and Jonathan.

DDT (dichlorodiphenyltrichloroethane) is used on fruits as a wettable powder and may be combined with other spray materials, except oils and strongly alkaline mixtures. DDT controls codling moth, oriental fruit moth, leafhoppers, grape berry moth, peach tree borer, and cutworms.

Dieldrin (hexachloroepoxyoctahydrodimethanonaphthalene) has proved very effective against the plum curculio on tree fruits and spittle bug on strawberries. It has a persistent residue and should not be applied after *First Cover* spray on peaches, plums, or cherries nor after *Third Cover* on apples. Do not use Dieldrin after *Bloom* on strawberries.

Kelthane (1, 1-bis (chlorophenyl) trichloroethanol) is a specific miticide that has performed well in Michigan during the past three years. The residual action of this material is sufficiently long to control mite infestations with one application in many instances. For best results, apply Kelthane when the average temperature is predicted to be above 70° F. for 5 to 7 days.

Methoxychlor (1, 1, 1-trichloro-2, 2-bis (paramethoxyphenyl) ethane), a close relative of DDT, is also sold under the trade-name Marlate. It exercises control against such pests as the plum curculio, codling moth, apple maggot, spittlebug, and cherry fruit fly. It is available as a wettable powder and as a liquid emulsion. The wettable form is best for tree fruits, while the emulsion works better against spittlebug on strawberries. Do not use the emulsion form in the same spray mixture with fungicides.

Mitox (p-chlorobenzyl, p-chlorophenyl sulfide), a specific miticide, has proved very effective for the control of European red mites in the pre-bloom period. Its action is primarily against eggs and newly hatched mites. Mitox exhibits long residual effectiveness and is relatively non-toxic to humans.

Ovex (para-chlorophenyl para-chlorobenzenesulfonate) is a specific miticide sold under the trade name Orotran. It is highly effective

against eggs and young mites. Ovex is virtually non-toxic to warm blooded animals and may be used as late as 30 days before harvest on apples, pears, peaches, and plums.

ORGANIC PHOSPHATES

Demeton (O-(2-ethylmercapto) ethyl)-O, O-diethyl thiophosphate) commonly called Systox, is a systemic aphicide and miticide formulated as an emulsion concentrate. Do not use it more than three times during the growing season nor within 21 days of harvest. At present, the only fruit crops for which demeton has been cleared are apple, pears, and strawberries. Like parathion, this chemical is highly toxic to man and precautions on the label should be followed.

Diazinon (O, O-diethyl-O-(2-isopropyl-4-methyl-pyrimidyl (6) thiophosphate) is intermediate between parathion and malathion in toxicity to humans. It is effective against a wide range of insect pests, and has a residual action of 11 to 14 days. Diazinon is now cleared for use on apples, pears, cherries, peaches, plums and strawberries.

EPN-300 (ethyl p-nitrophenyl thionobenzene phosphate) is similar to parathion in its effectiveness against many insects. It is superior to parathion for mite control and is effective for approximately 20 days against forms of mites non-resistant to phosphate materials.

Malathion (S-(1, 2-dicarbethoxyethyl) O, O-dimethyl dithiophosphate) is useful against many insect pests and is especially effective against many forms of aphids. Its period of effectiveness is only 2 to 3 days. Because of its short residual action, it can often be used to good advantage in late season sprays.

Parathion (O, diethyl O-p-nitrophenylthiophosphate) is highly toxic to man and animals. It has been widely used since 1949 and has given good control of the following pests: mites, red-banded leafroller, aphids, bud moth, pear psylla curculio, codling moth, oriental fruit moth, and grasshoppers. Parathion permits effective foliage treatment against insects that, in the past, have required dormant sprays. No injury from this material has been observed on peaches, plums, or cherries. Apples have been injured when parathion was used in amounts greater than the dosages suggested in the Apple Spraying Schedule. Parathion can often be used to good advantage in combination with other insecticides.

TEPP (tetraethylpyrophosphate) has been used commercially against certain insects for several years. Its main value is that it may

be applied as late as 72 hours before harvest without creating a residue problem. TEPP is highly toxic to man and should be used with extreme caution.

RECENTLY INTRODUCED INSECTICIDES

Guthion (\bar{O} , O-Dimethyl S-(4-oxo-1,2,3-benzotriazinyl-3-methyl) phosphorodithioate) continued to show exceptional promise in research and grower trial plots in 1958. Almost all common fruit insects and mites were controlled well with sprays applied at 14-day intervals. One apparent weakness of Guthion occurred late in the 1958 season when high populations of two-spotted mites were not completely controlled on apples.

Most research data and growers' experiences in Michigan have been obtained with wettable powder formulations. However, the 25 percent emulsifiable concentrate will probably be in greater supply than wettable powder during 1959. Until more information is available on Guthion emulsion, the wettable powder formulation is suggested for growers using this material.

To avoid prohibitive residues, do not use more than eight applications of Guthion per season on apples, and do not use it later than 15 days before harvest. Guthion is similar to parathion in toxicity to humans.

Phosdrin (alpha isomer of 2-carbomethoxy-1-methylvinyl dimethyl phosphate) showed outstanding effectiveness against the red-banded leafroller in 1958. Although phosdrin controls a wide range of pests, its effectiveness lasts only about 24 hours. From this standpoint, it is more useful as a clean-up material than as a protective insecticide. Phosdrin is now labeled for most Michigan fruits. Since it is highly toxic to humans, all safety precautions and a special mask are necessary when phosdrin is used. Information on suitable respirators may be obtained from:

1. The Shell Chemical Corp., Agricultural Chemical Sales Division, 460 Park Avenue, New York 22, N. Y.
2. Acme Protection Equipment Co., 1201 Kalamazoo Street, South Haven, Mich.
3. American Optical Co., Safety Division, Southbridge, Mass.

Sevin 1-naphthyl N-methylcarbamate) again gave excellent results on Michigan fruits in 1958. A wide range of fruit insects were effectively controlled with dosage rates from 1 to 2 pounds of 50 percent

wettable Sevin per 100 gallons. Effectiveness was about 14 days. Mites, however, required additional materials for control. In 1958 the use of Sevin was limited largely to experimental trials on apples. It will likely gain clearance for use on additional crops by growers in 1959. Sevin is compatible with most other pesticides. It offers a high degree of safety to animals and plants, and gives good control of certain pests resistant to other frequently used insecticides.

Trithion (O, o-diethyl S-p-chlorophenylthiomethyl phosphorodithi-
cate) is a relatively new phosphate material showing long residual effectiveness against certain pests. In experimental plots, aphids, scales, and mites have been controlled for periods longer than three weeks with one application. Research studies indicate that trithion is effective against other fruit pests, but the protection is for a shorter period of time—approximately 10 days. Trithion is cleared for use on most fruits. It is suggested for trial in apple and cherry orchards where serious aphid, scale, and European red mite problems exist. However, Trithion has injured the leaves of Delicious and has russeted the fruit of Jonathan and Golden Delicious in Michigan when used after *Bloom*. Its present suggested usage on apples is in the *Dormant or Delayed Dormant periods*. Should growers wish to try Trithion after *Bloom* on apples, the following precautions are given:

- Repeat applications of Trithion should be spaced at least 30 days apart.
- Do not use Trithion on apples during the period of *Bloom* through *Second Cover*.

Tedion 2,4,5,4'-tetrachlorodiphenyl sulphone), a new material, specific against mites, gave excellent results in 1958 trial plots. Its long residual effectiveness, high degree of safety to man and plants, and wide range of compatibility makes Tedion an especially promising new miticide. As of Jan. 1, 1959, it is cleared for usage only in *Prebloom*.

INSECTS HARD TO CONTROL IN 1958

SCALE INSECTS

Forbes scale and European fruit lecanium scale were troublesome in many Michigan orchards in 1958. Forbes scale caused most injury on red cherries (sour cherries) in southwestern Michigan. The European fruit lecanium scale was more widespread and found on peaches, plums, and blueberries.

Scale crawlers can be controlled with parathion, Diazinon, Guthion, or malathion. However, applications must be made before the insects start secreting their hard waxy "scale" covering. For lecanium crawlers, the first application should be made when 70 percent of the eggs have hatched (usually late in June or early in July). A second application may be required 10 to 12 days later if crawlers are still active. Forbes scale, found on red cherries, may be controlled by using parathion or Diazinon in the first and second cover sprays.

Scales may also be controlled with an application of a dormant oil at manufacturer's directions.

RED-BANDED LEAF ROLLER

Late season injury from red-banded leaf roller larvae was serious in many apple orchards in 1958. To avoid this injury, it is important to keep the first brood in check during May and June. DDD, lead arsenate, parathion, Guthion, and Sevin are effective materials against this pest. Make frequent observations from middle July until harvest to determine if egg masses or the small larvae are present. If developing larvae are found in numbers, use either DDD, Guthion, Sevin, or phosdrin at manufacturer's directions.

APHIDS

Rosy apple aphids caused considerable damage last season. This was largely due to cool weather in the *Pre-bloom* period when BHC is suggested for use. Apparently many eggs did not hatch until after BHC residues lost their effectiveness. Although a *Pre-bloom* application of BHC ordinarily controls rosy aphids, growers should continue to be on the lookout for aphids during and after bloom. A *Petal-fall* application of some phosphate material may be used if aphids continue to be present.

Remember that the cool weather early in the 1958 season also produced a fruit condition often mistaken as aphid injury. Observations to determine aphid activity are necessary to determine need for control and to avoid mistaking other types of injury for that caused by aphids.

Grain aphids and green apple aphids can be controlled any time during the growing season with some phosphate compound.

MITES

Both European red mites and two-spotted mites continued to be troublesome during 1958. Most of the injury occurred on apples and plums. For the control of European red mites, a pre-bloom applica-

tion of Mitox, Genite-923, Tedion, or ovex is suggested in orchards where numerous overwintering eggs are found. Diazinon used in the *Pink* and such materials as Systox, Guthion, and Diazinon used in the early *Post-bloom* period also cut down on mite problems. If European red mite or two-spotted mite populations build up during the summer, use ovex, Kelthane, or some other specific miticide at manufacturer's directions.

ROSE CHAFER

Rose chafers continue to be a perennial problem in many Michigan orchards. Frequent applications of DDT (50 percent wettable), 2 pounds per 100 gallons, are needed during heavy beetle flights. The addition of parathion, or some other phosphate material, aids in beetle knock-down.

WORMS IN CHERRIES

The cherry fruitworm, a small caterpillar similar to the oriental fruit moth, was a serious pest in the light 1958 red cherry (sour) crop. Other worms occasionally found were curculio larvae, cherry fruit fly maggots, and various caterpillars. To effectively control the cherry fruitworm and other caterpillars, use parathion, methoxychlor, or Diazinon in the *Petal-Fall*, *First* and *Second Cover* sprays on red cherries.

ACCESSORY MATERIALS

"Accessory materials" are those materials added to fungicides and insecticides to make them less injurious to the foliage and fruit or to improve their wetting and adhesive properties, making them more effective in disease and insect control.

WETTING AGENTS OR SPREADERS

Years ago, experience indicated that the action of many orchard sprays was improved by the addition of wetting agents or spreaders. Common materials—such as dried milk, casein, eggs, dried blood, fish-oil soap, laundry soap, soybean flour and lime—were used for that purpose. In recent years, synthetic chemicals have replaced these older wetting agents.

At the same time, it has become common practice for the manufacturer to add wetting agents to the spray materials during the manufacturing process. At present, it is seldom necessary for the orchardist to add such materials in the field. Occasionally—if the water is unusually hard, if hard-to-wet plants such as plum fruits are involved,

or if hard-to-wet insects such as waxy aphids are to be controlled—it may be helpful to add a small amount of wetting agent to the tank. Too much will cause excessive runoff.

Some materials act as spreaders (wetting agents) when wet, and as stickers after they dry. Such “sticker-spreaders” usually increase retention or adhesiveness more than they increase deposit.

Like wetting agents or spreaders, stickers are often included by the manufacturer in the formulation of the spray material. Occasionally the use of additional amounts of sticker-spreader is advised. Excessive use of stickers may cause *excessive* residues at harvest.

SPRAY LIME

There are several grades of hydrated lime — “mason’s hydrate,” “finishing hydrate,” “agricultural lime,” “chemical hydrate lime,” and “spraying lime.” The first three mentioned grades are nearly always undesirable for spraying purposes. Special spraying or chemical hydrate lime should be used.

Do not use old lime for spraying purposes. Lime that is freshly hydrated in the spring should be satisfactory for 10 to 12 weeks if stored in a dry place and not exposed to the air. Lime carried over from last season can more profitably be added to the soil than put in the spray tank. Brands of lime vary in fineness and physical properties.

Finely ground limes, with the least amount of grit or coarse material, are the best. Limes vary in their chemical composition as well as their physical properties. Lime made from limestone composed almost entirely of calcium carbonate is called “high-calcium lime”; lime made from limestone containing a mixture of calcium and magnesium carbonates is called “dolomitic lime.” Both the “high calcium” and the “dolomitic” forms are satisfactory for spraying purposes.

CORRECTIVES FOR SPRAY INJURY

COPPER INJURY

When using copper sulfate (blue vitriol) or “fixed” copper as a fungicide or bactericide, add hydrated lime to the spray mixture to prevent injury to leaves and fruit from any soluble copper that may be in solution. By adding hydrated lime to spray mixtures of copper sulfate, the resulting product is bordeaux (see bordeaux, page 10). When using “fixed” copper, one pound of lime is added to the mixture for every 0.24 to 0.26 pound of *actual* copper. For example, when using

3 pounds of Tennessee 26 per 100 gallons (Tennessee 26 contains 0.26 pound of *actual* copper per pound), you would add also 3 pounds of hydrate lime per 100 gallons of spray.

ARSENICAL INJURY

Hydrated lime may be used with lead arsenate to safen against arsenical injury to leaves and fruit. (See lead arsenate, page 19.) However, organic fungicides which also safen against arsenical injury are replacing hydrated lime.

The following organic fungicides safen against arsenical injury when used in the same spray mixture with lead arsenate:

- One-fourth pound of ferbam will safen one pound of lead arsenate.
- One-half pound of captan will safen one pound of lead arsenate.
- One-fourth pound of Cyprex will safen one pound of lead arsenate.
- One-half pound of Niacide A or M will safen one pound of lead arsenate.

Glyodin or Thylate will *not* safen lead arsenate. When using these two fungicides with lead arsenate, reduce the amount suggested per 100 gallons and add either ferbam, captan or Niacide M in quantities required to safen the lead arsenate being used. For example, if using glyodin at 1½ pints per 100 gallons with 2 pounds of lead arsenate, you could reduce the amount of glyodin to one pint and use with it one-half pound of ferbam as the arsenical safening agent.

SPRAY CHEMICALS FOR THE CONTROL OF APPLE SCAB

<i>Protective fungicides</i>	<i>Eradicative fungicides</i>	<i>Fungicide mixtures with both eradivative and protective properties</i>
Lime-sulfur	Lime-sulfur	Sulfur, Ferbam, Glyodin, or Captan at half-strength combined with one-fourth pound of Phygon.
Copper compounds	Mercurial compounds	
Wettable sulfur		
Sulfur paste	Phygon (dichlone)	
Ferbam		Sulfur, Glyodin, Ferbam or Captan at half-strength combined with mercurial compounds.
Glyodin		
Captan		
Phygon (dichlone)		

Precautions in Selecting Chemicals to Control Apple Scab

Newly-established apple scab infection can be eradicated effectively within 30 to 36 hours from the beginning of an infection

period—using either one-quarter pound of dichlone (Phygon) with a protective fungicide at half-strength — or within 72 hours from the beginning of an infection period, using full-strength mercury. When mercury is used at half-strength in combination with a protective fungicide, the effective period for eradication is usually reduced to 40 to 45 hours. However, the period of effective eradication may be somewhat longer for all concentrations of eradivative fungicides if the temperature during the time of infection is under 50° F. Remember also that liquid lime-sulfur has effective eradivative properties if used at 2 gallons per 100 gallons of spray within 72 hours from the beginning of the infection period.

In Michigan, mercurial compounds may be most valuable as an emergency measure after rains, when protection against possible apple scab infection is questionable. Use a protective fungicide with the mercury.

RUSSETING OF APPLES BY COLD AND CHEMICALS

Golden Delicious and Jonathan are the commercially important apple varieties most easily russeted by spray chemicals and freezing air temperatures (32° F. or lower) which occur frequently in Michigan after *Pre-Pink*.

Golden Delicious:—If smooth finish on Golden Delicious is important, do not use ferbam, mercury, glyodin, or Cyprex during the time of *Pre-Pink* through *Second Cover*. These pesticides may russet Golden Delicious even in years when no freezing temperatures occur after *Pre-Pink* if used during the period of *Pre-Pink* through *Second Cover*. Mercury, ferbam, glyodin, or Cyprex may be used safely on Golden Delicious before *Pre-Pink* and ferbam, glyodin, or Cyprex after *Second Cover* without danger of added fruit russetting. From studies thus far, captan, Niacide M, and Thylate may be used safely on Golden Delicious at any time during the growing season.

Jonathan:—Do not use Phygon XL plus glyodin, ferbam alone, or ferbam with another fungicide on Jonathan when a freezing air temperature (32° F. or below) occurs after *Pre-Pink*. However, such combinations as Phygon XL plus captan, Phygon plus wettable sulfur, Phygon XL plus Niacide M, or mercury with either glyodin, captan, Niacide M. Thylate, or wettable sulfur, or these protective fungicides alone, may be used any time without danger of injury to the fruit. In Michigan, Phygon XL is suggested at no more than *one-fourth* pound per 100 gallons on apples, except prior to *Pre-Pink*.

Beginning with *Third Cover*, any fungicide or any fungicide combination may be used on Jonathan at the rates suggested in the Apple Spraying Schedule without danger of increasing fruit russetting.

Also, the use of bordeaux or fixed copper and hydrated lime on Jonathan for the control of fireblight following freezing temperatures (32° F. or lower) after *Pre-Pink* may cause unfavorable fruit russetting.

APPLE SPRAYING SCHEDULE—1959

(See Table 3, page 50, for Pesticide Residue Information)

Time	Materials per 100 gallons	To control
DORMANT	DN-289 or Elgetol-318—2 quarts	Rosy aphids
This application is suggested only when rosy aphids are a serious problem. Ordinarily aphids are readily controlled in the Pink application with such materials as BHC, malathion, Diazinon, or Systox.		
FIRST sign of GREEN TISSUE to PRE-PINK	Lime-sulfur—2 gallons or Either keep covered with protective fungicides just before rains according to expanding growth, or use eradicative fungicides immediately after rains.	Sepal and leaf scab
PRE-PINK to BLOOM	Protective fungicides applied before rains wetttable sulfur—6 pounds, or ferbam—1½ pounds, or captan—2 pounds, or glyodin—1 quart or Eradicative fungicides applied after rain as follows: Half-strength protective fungicide with either Phygon at one-quarter pound, or mercury at half or full strength. (See page 28.)	Fruit and leaf scab

Powdery Mildew has been present in certain orchards during the past 2 years. Of the varieties grown in Michigan, Jonathan, Cortland and Rome are the most susceptible to this disease. Either lime-sulfur or 3 pounds of wetttable sulfur or sulfur paste per 100 gallons with half-strength organic fungicide from Green Tip through Petal Fall will control mildew on apples. If the spray mixture does not wet the fungous growth thoroughly, add a commercial wetting agent.

The use of half-strength wetttable sulfur or sulfur paste as suggested above will not cause economic injury to fruit or foliage. Lime-sulfur throughout the period Green Tip through Petal Fall could be unfavorable physiologically, particularly on Northern Spy and Delicious.

One application of BHC (10 percent gamma isomer) at 2 pounds per 100 gallons at the time of Pink helps prevent aphid and leaf roller problems later. In orchards where both aphids and European red mites are a problem, the use of Systox (25 percent emulsion) at ¾ pint, malathion (25 percent wetttable) at 2 pounds, or Diazinon at 2 pounds per 100 gallons in the Pink stage may be favorable. When only European red mite is a problem, ovex, Genite-923, Mitox or Tedion at the manufacturer's directions may be included with the fungicide at the time of Pink to help prevent build-up of European red mites later in the season.

BHC is not compatible in the same spray tank with lime-sulfur. However, it can be used before and after applications of lime-sulfur.

Time	Materials per 100 gallons	To control
PERIOD OF BLOOM	Bordeaux 2-6-100, <i>or</i> Streptomycin—50 to 100 parts per million (trial basis when maximum temperature is above 65° F.)	Fire blight

For varieties susceptible to fire blight—First application of fire blight spray should be made as soon as 25 percent of the blossoms are open. Two or three sprays at 4-day intervals may be necessary, depending on weather conditions. Damp, rainy weather or high humidity favors development of fire blight. To avoid fruit russetting when bordeaux is used on bearing trees, spray during quick-drying conditions. Fog the spray into the trees; do not drench. Bordeaux is effective against scab infection. Streptomycin has no value for the control of scab and is suggested against fire blight only on a trial basis. In addition to spraying, a thorough job of pruning out the larger overwintering cankers in the dormant season is a *must* in controlling fireblight.

Scab sprays with protective fungicides may be needed if wet weather occurs during bloom. Mercury should not be used during bloom because it is highly toxic to bees.

PETAL FALL (When three-fourths of the petals have fallen)	Protective fungicides applied before rains wetttable sulfur—5 pounds, <i>or</i> ferbam—1½ pounds, <i>or</i> glyodin—1 quart, <i>or</i> captan—2 pounds <i>or</i> Eradicative fungicides applied after rain Half-strength protective fungicide <i>with</i> either Phygon at one-quarter pound, <i>or</i> mercury at half or full strength. (See page 28.) <i>plus either</i> Parathion—one-half to 1 pound, <i>or</i> Dieldrin—one-half pound, <i>or</i> Methoxychlor (50 percent wetttable)—2 pounds	Fruit and leaf scab Curculio
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Do not use mercury later than *Petal Fall* because of possible mercury residue on the fruit at harvest.

FIRST COVER (7 days after Petal Fall)	Same fungicides suggested as for Petal Fall except for mercury <i>or</i> Phygon XL. <i>plus either</i> Effective for only 7 days parathion—½ to 1 pound, <i>or</i> methoxychlor—2 pounds Effective for 14 days Guthion (25% wetttable)—1 to 1¼ pounds	Scab Curculio Curculio, red-banded leaf roller
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In orchards where parathion or methoxychlor is used, check for signs of red-banded leaf roller. If you find this pest, include DDD or TDE at 2 pounds per 100 gallons in the spray mixture.

SECOND COVER (7 days after First Cover)	Protective fungicides only ferbam—1 to 1½ pounds, <i>or</i> glyodin—three-fourths to 1 quart, <i>or</i> captan—1½ to 2 pounds <i>plus either</i> Parathion—1 pound +DDT (50% wetttable) 1 pound, <i>or</i> Methoxychlor—2 pounds	Scab Codling moth, curculio
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(Continued on next page)

An insecticide is needed at this time only if parathion or methoxychlor was used in First Cover. If Guthion was used in First Cover, omit the insecticide at Second Cover. Single applications of Guthion give protection against insects for approximately 14 days.

If *mildew* starts building up on any variety, include 2 pounds of wettable sulfur (325 mesh) or Karathane at $\frac{1}{2}$ pound per 100 gallons. Continue checking orchard for signs of *red-banded leaf roller*. If this pest is present, include DDD or TDE as suggested in First Cover. If *green apple aphids* become excessive, add an aphicide to the spray mixture to keep them in check. *Green apple aphids* may continue to migrate into the planting, and a single application may fail to control them.

THIRD COVER (7 days after Second Cover)	The same fungicides are suggested as for Second Cover <i>plus</i> DDT (50 percent wettable)—1 pound + parathion (15 percent wettable) one-half pound, <i>or</i> Dieldrin (50 percent wettable)—one-half pound + DDT (50 percent wettable)— 2 pounds, <i>or</i> Methoxychlor (50 percent wettable)—2 pounds, <i>or</i> Diazinon (25% wettable)—2 pounds, <i>or</i> Guthion (25% wettable)—1 to 1 $\frac{1}{4}$ pounds	Apple scab Codling moth, curculio
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The use of parathion with DDT controls codling moth and curculio and tends to hold down a buildup of red-banded leaf roller, mites, aphids and other pests. Used alone, methoxychlor controls codling moth and late-emerging curculio. DDT alone controls only codling moth, while dieldrin alone controls only curculio. Diazinon and Guthion control all these pests with the exception that *Diazinon will not adequately control heavy infestations of curculio or leaf roller*.

FOURTH COVER (10-14 days after Third Cover)	The same fungicides and insecticides are suggested as for Third Cover	Apple scab, codling moth, curculio
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Mites may be controlled with such materials as ovex, Aramite, Kelthane, or Systox used at manufacturer's directions, when they start to build up.

FIFTH COVER (Time is announced during the period of June 25 and July 15)	Glyodin—1 pint, <i>or</i> Ferbam—three-fourths pound + liquid spreader, <i>or</i> Captan—1 pound <i>plus either</i> Lead arsenate—2 pounds, <i>or</i> Parathion—1 pound + DDT (50% wettable) —1 pound, <i>or</i> Diazinon (25% wettable)—2 pounds, <i>or</i> Guthion (25% wettable)—1 to 1 $\frac{1}{4}$ pounds	Apple scab Apple maggot
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Timing for *apple maggot* and *second brood codling moth* spray is announced by your county agricultural agent.

When *glyodin* is used in July and August with *lead arsenate* for the control of *apple maggot*, include $\frac{1}{2}$ pound of *ferbam* per 100 gallons of spray to correct against possible arsenical injury.

The period to protect against apple maggot injury extends for approximately 6 weeks. The insecticides listed above give protection for 12 to 14 days. Thus, repeat applications at 12- to 14-day intervals.

SIXTH COVER (12-14 days after Fifth Cover)	The same fungicides and insecticides are suggested as for Fifth Cover.	Apple scab Apple maggot codling moth
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It is often favorable to alternate insecticides used during July and August based on the insects to be controlled at each 12- to 14-day interval.

Start looking for leaf rollers beginning with Sixth Cover. In orchards where leaf roller is serious, use Guthion or include DDD with the other suggested insecticides.

In orchards heavily infested with mites, use a specific miticide, such as Kelthane, or over at manufacturer's directions. Systox controls both mites and aphids.

Parathion, Diazinon, and Guthion are only partially effective against mites, especially two-spotted mites. Lead arsenate has no value against mites.

Time	Materials per 100 gallons	To control
SEVENTH COVER (10-14 days after Sixth Cover)	The same fungicides and insecticides are suggested as for Fifth Cover.	Apple scab Apple maggot, codling moth
EIGHTH COVER (10-14 days after Seventh Cover)	The same fungicides and insecticides are suggested as for Fifth Cover.	Apple scab Apple maggot, codling moth

Consult Table 3, page 50, for information on the number of days between last application and harvest for each material. Base your choice of materials on this information.

PEAR SPRAYING SCHEDULE—1959

(See Table 3, page 50, for Pesticide Residue Information)

Time	Materials per 100 gallons	To control
DORMANT (Before buds swell)	Liquid lime-sulfur—6½ gallons	Blister mite

This application is needed only if pear leaf blister mite is a problem.

PRE-BLOOM (When buds of blossom clusters begin to separate)	Ferbam—1½ pounds, or Bordeaux 3-8-100	Pear scab, leaf spot
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Additional fungicide sprays may be necessary before bloom if wet weather prevails.

PERIOD OF BLOOM (Beginning when 25 percent of the blossoms are open)	Bordeaux 2-6-100, or Streptomycin—50 to 100 parts per million (trial basis when maximum temperature is above 65° F.)	Fireblight
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Streptomycin may be used at 50 to 100 p.p.m. However, this material is still *in the trial stage* because exact dosage and timing for continually good results are not clearly known.

Apply first spray when about 25 percent of the blossoms are open; make second application at the time of full bloom. In some years, three sprays at 3- to 4-day intervals may be necessary during the period of bloom if wet weather prevails. To avoid fruit russetting when using bordeaux on bearing trees, make the spray applications during quick-drying conditions and fog the spray into the trees rather than drench them. Streptomycin has no value for the control of pear scab.

In addition to spraying, a complete pruning out of overwintering cankers in the dormant season is a *must* in the control of fireblight.

(Continued on next page)

Time	Materials per 100 gallons	To control
PETAL FALL (When three-fourths of the petals have fallen)	Ferbam—1½ pounds, <i>or</i> Bordeaux 3-8-100 <i>plus</i> Parathion (15 percent wettable)—1 pound, <i>or</i> Guthion (25% wettable)—1 to 1¼ pounds	Pear scab, leaf spot Pear psylla, tarnished plant bug, curculio

Guthion is *not* compatible with bordeaux.

FIRST COVER (12-14 days after Petal Fall)	The same materials are suggested as for Petal Fall	Pear scab, leaf spot Pear psylla, curculio
SECOND COVER (12-14 days after Petal Fall)	Ferbam—1½ pounds Bordeaux 2-6-100 <i>plus</i> Parathion—(15% wettable) 1 pound + DDT (50% wettable)—1 pound	Pear scab, leaf blight Pear psylla, codling moth
THIRD COVER (10-14 days after Second Cover)	The same materials are suggested as for Second Cover	Pear scab, leaf blight Pear psylla, codling moth
FOURTH COVER (10-14 days after Third Cover)	Ferbam—1½ pounds, <i>or</i> Bordeaux 2-6-100 <i>plus</i> DDT (50 percent wettable)—2 pounds	Leaf blight, pear scab Codling moth

Fungicides are not necessary in late cover sprays when good early control of scab and blight has been achieved.

FIFTH COVER (Time to be announced, based on second brood codling moth emergence)	The same fungicides are suggested as for Fourth Cover <i>plus</i> DDT (50% wettable)—2 pounds, <i>or</i> Diazinon (25% wettable)—2 pounds, <i>or</i> Guthion (25% wettable)—1 to 1¼ pounds	Leaf blight, pear scab Codling moth
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Do not use DDT on pears later than 30 days before harvest.

Where codling moth has been a problem in pears for processing, use a preharvest application of malathion (25 percent wettable) at 2 pounds per 100 gallons 3 to 7 days before picking. Consult Table 3, page 50 for information on the number of days between last application and harvest for each material. Base your choice of materials on this information.

PEACH SPRAYING SCHEDULE—1959

(See Table 3, page 50, for Pesticide Residue Information)

Time	Materials per 100 gallons	To control
DORMANT (In the fall after leaf drop, or in the spring before buds swell)	Use either in fall or spring Ferbam—1½ to 2 pounds, <i>or</i> Bordeaux 6-6-100, <i>or</i> In spring only Lime-sulfur—5 gallons	Peach leaf curl

Peach twig borer may be controlled at this time with lime-sulfur by increasing the concentration to 6 gallons per 100 gallons of spray.

Time	Materials per 100 gallons	To control
BLOOM (Beginning with balloon pink and continuing through Bloom)	At time of balloon pink Lime sulfur—2 gallons, <i>or</i> Phygon (dichlone)—one-half pound, <i>or</i> sulfur paste—6 pounds, <i>or</i> wetttable sulfur—5 pounds	Brown rot (blossom blight)
<i>Continue applications through Bloom at 2- to 4-day intervals when wet, rainy weather prevails</i> <i>Use either:</i>		
	Phygon (dichlone)—one-half pound, <i>or</i> sulfur paste—6 pounds, <i>or</i> wetttable sulfur—5 pounds	Brown rot (blossom blight)
Lime-sulfur at 2 gallons per 100 gallons of spray may be used through bloom when heavy fruit set is expected. Its use throughout bloom may injure some blossoms, but it has not reduced the final crop in Michigan tests. Dusting or spraying with elemental sulfur fungicides in the early stages (first 10 hours) of each rain during the period of bloom has given good results.		
PETAL FALL (When three-fourths of the petals have fallen)	Parathion (15 percent wetttable)—1½ pounds, <i>or</i> EPN 300—1 pound, <i>or</i> DDT (50 percent wetttable)—1½ pounds	Curculio, oriental fruit moth, tarnished plant bug
DDT controls only tarnished plant bug and oriental fruit moth. If brown rot blossom blight has not been controlled, <i>include:</i>		
	Sulfur paste—6 pounds, <i>or</i> Wetttable sulfur—5 pounds	
SHUCK SPLIT (Usually 10 to 12 days after Petal Fall)	Dieldrin (50 percent wetttable)—one-half pound <i>plus</i> DDT (50 percent wetttable)—1½ pounds, <i>or</i> Parathion (15 percent wetttable)—1½ pounds, <i>or</i> EPN 300—1 pound	Curculio Oriental fruit moth
If brown rot blossom blight has not been controlled, <i>include:</i>		
	Sulfur paste—6 pounds, <i>or</i> Wetttable sulfur—5 pounds	Brown rot
FIRST COVER (10 to 12 days after Shuck Split)	Sulfur paste—6 pounds, <i>or</i> Wetttable sulfur—5 pounds <i>plus</i> Dieldrin (50 percent wetttable)—one-half pound <i>plus</i> DDT (50 percent wetttable)—1½ pounds, <i>or</i> Parathion (15 percent wetttable)—1½ pounds, <i>or</i> Guthion (25 percent wetttable)—1 to 1¼ pounds, <i>or</i> EPN 300—1 pound, <i>or</i> DDT (50 percent wetttable)—1 pound + parathion (15 percent wetttable)—1 pound	Peach scab, brown rot Curculio Oriental fruit moth
SECOND COVER (14 days after First Cover)	DDT (50 percent wetttable)—1½ pounds, <i>or</i> Parathion (15 percent wetttable)—1½ pounds, <i>or</i> EPN 300—1 pound, <i>or</i> DDT (50 percent wetttable)—1 pound + parathion (15 percent wetttable)—1 pound, <i>or</i> Guthion (25 percent wetttable)—1 to 1¼ pounds	Oriental fruit moth

(Continued on next page)

Certain sprays are needed to control one or more of the following pests each year throughout Michigan:

To control *peach tree borer*, spray trunks of trees (from just below crotches to ground line) with a gun and reduced pressure, using either DDT (50 percent wettable) at 3 pounds, or parathion (15 percent wettable) at 2 pounds per 100 gallons, on or about July 12. Follow with a second spraying in 12 to 14 days.

To control *lesser peach borer*, spray crotches and cankers on branches with a gun, using parathion (15 percent wettable) at 2 pounds per 100 gallons. Make three applications at 12- to 14-day intervals starting on or near July 1. (Note—You can also control the peach tree borer with these sprays. Direct some of the material near the ground during the later sprayings.)

To control *lecanium scale*, spray infested areas with parathion (15 percent wettable) at 1½ pounds per 100 gallons when the scales are in the crawler stage. Apply once when 70 percent of the eggs have hatched (usually June 25 to July 15). Apply again 10 to 12 days later if there are many crawlers left.

Time	Materials per 100 gallons	To control
THIRD COVER (Usually July 15-25)	Wettable sulfur—5 pounds, <i>or</i> Sulfur paste—6 pounds, <i>or</i> Captan—2 pounds	Brown rot
	<i>plus</i> DDT (50 percent wettable)—1½ pounds, <i>or</i> Parathion (15 percent wettable)—1½ pounds, <i>or</i> DDT (50 percent wettable)—1 pound + parathion (15 percent wettable)—1 pound, <i>or</i> Guthion (25 percent wettable)—1 to 1¼ pounds	Oriental fruit moth

Do not make more than one application of DDT within 6 weeks of harvest. *Because of possible excessive DDT residue*, do not use DDT on peaches within 30 days of harvest if they are to be sold as fresh fruit or are to be transported outside the State of Michigan

FOURTH COVER (7-10 days after Third Cover)	Wettable sulfur—5 pounds, <i>or</i> Sulfur paste—6 pounds, <i>or</i> Captan—2 pounds, <i>or</i> Lime-sulfur—2 quarts with wettable sulfur—3 pounds	Brown rot
	<i>plus</i> Parathion (15 percent wettable)—1½ pounds <i>or</i> Guthion (25 percent wettable)—1 to 1¼ pounds	Oriental fruit moth

Both DDT and parathion may be used as late as 7 days before harvest on Amber Gem and other varieties grown for processing *if* the peaches are not transported outside Michigan to be processed.

PRE-HARVEST COVERS (7 to 10 days after Fourth Cover and continuing at 7- to 10-day intervals until harvest)	Captan—2 pounds, <i>or</i> Lime-sulfur—2 quarts + wettable sulfur—3 pounds, <i>or</i> Wettable sulfur—5 pounds, <i>or</i> Sulfur paste—6 pounds	Brown rot
	<i>plus</i> A wetting agent used at manufacturers' directions <i>plus</i> Parathion (15 percent wettable)—1½ pounds, <i>or</i> Malathion (50 percent wettable)—2 pounds	Oriental fruit moth

See note under Fourth Cover if peaches are being grown for the processing market. Consult Table 3, page 50 for information on the number of days between last application and harvest for each material. Base your choice of materials on this information.

RED TART (SOUR) CHERRY SPRAYING SCHEDULE—1959

(See Table 3, page 50, for Pesticide Residue Information)

Time	Materials per 100 gallons	To control
DORMANT	For orchards in Manistee County and farther north, when necessary— DN-289—2 quarts, <i>or</i> Elgetol 318—2 quarts	Case-bearers, mineola moth, bud moth, peach twig borer

For orchards north of Ottawa County along Lake Michigan following seasons in which European brown rot has been injurious, use the following about 1 to 2 weeks before buds break dormancy:

Monocalcium arsenite—3 pounds	European brown rot
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If it is necessary to control both European brown rot and insects, monocalcium arsenite and DN compounds may be applied together in the same spray mixture. However, the *application* should be *timed* to control European brown rot and the trees should be *strictly dormant*.

For orchards in southwestern Michigan where Forbes scale is serious, use a dormant 3 percent oil emulsion spray, or a mixture of oil emulsion plus Trithion at manufacturer's directions.

EARLY BLOOM THROUGH BLOOM (Beginning when first blossoms open)	In orchards with a European brown rot history, use— Bordeaux 4-6-100	European brown rot
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In orchards with a common brown rot blossom blight history, use either—

Phygon XL—one-half pound, <i>or</i> Sulfur paste—6 pounds, <i>or</i> Wettable sulfur—5 pounds	Common brown rot blossom blight
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If weather is wet during bloom, more than one application of Phygon XL, sulfur paste, or wettable sulfur may be necessary. Phygon or sulfur dusts are also effective for the control of brown rot blossom blight during bloom.

PETAL FALL (When three-fourths of the petals have fallen)	Fixed copper to give 0.75 of a pound <i>actual copper</i> +hydrated lime—3 pounds, <i>or</i> Ferbam—1½ pounds, <i>or</i> Glyodin—1½ pints+ferbam—½ pound, <i>or</i> Captan—2 pounds <i>plus</i> Parathion (15 percent wettable)—1½ pounds, <i>or</i> Methoxychlor (50 percent wettable)—2 pounds, <i>or</i> Lead arsenate—3 pounds, <i>or</i> Dieldrin (50 percent wettable)—one-half pound	Leaf spot Curculio
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In orchards troubled with cherry fruit worm, mineola moth, case-bearers, bud moth, or peach twig borer in 1958, use parathion, methoxychlor or Diazinon in the Petal Fall, First, and Second Cover applications.

When using lead arsenate with glyodin, include one-half pound of ferbam per 100 gallons. Ferbam, captan, and fixed copper with hydrated lime are safening agents for lead arsenate.

(Continued on next page)

Time	Materials per 100 gallons	To control
FIRST COVER (10 days after Petal Fall)	The same materials are suggested as for Petal Fall	Leaf spot, curculio
SECOND COVER (10 days after First Cover. The time of this application usually coincides with cherry fruit fly emergence)	Fixed copper to give 0.75 of a pound <i>actual</i> copper + hydrated lime—3 pounds, <i>or</i> Ferbam—1½ pounds, <i>or</i> Glyodin—1½ pints + ferbam—½ pound, <i>or</i> Glyodin—1½ pints, <i>or</i> Captan—2 pounds, <i>or</i> Actidione—1 part per million <i>plus</i> Lead arsenate—2 pounds, <i>or</i> Methoxychlor (50 percent wettable)—3 pounds, <i>or</i> Diazinon (25% wettable)—2 pounds	Leaf spot Cherry fruit fly, curculio

The emergence of cherry fruit flies will be announced by your county agricultural agent.

Methoxychlor gives effective protection against cherry fruit fly for about 7 days; lead arsenate and Diazinon are effective for about 14 days. Thus, two applications of methoxychlor are needed to give protection equal to one application of lead arsenate or Diazinon.

In orchards troubled with cherry fruit worm, add one pound of parathion to the mixture if lead arsenate is used.

When actidione or glyodin is used with lead arsenate, include one-half pound of ferbam to safen against possible arsenical injury.

Do not use actidione at more than 1 part per million *until* the fruit is $\frac{3}{8}$ inch in diameter or *until* the announcement of the cherry fruit fly spray, because of possible injury to the fruit.

THIRD COVER (10 to 14 days after Second Cover)	The same materials are suggested as for Second Cover.	Leaf spot, Cherry fruit fly
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If leaf spot threatens, actidione may be used at one to two p.p.m. up to 4 days before harvest. See note under Second Cover regarding use of actidione with lead arsenate. Do not use lead arsenate on cherries within 30 days of harvest if they are to be sold on the fresh market or to be transported outside Michigan, because of possible excessive lead arsenate residue.

However, lead arsenate may be used on cherries to be processed in Michigan as late as 14 days before harvest. Fruit sprayed with lead arsenate as late as 30 days before harvest may require washing to be within the established tolerance if it is to be sold as fresh fruit.

Consult Table 3, page 50 for information on the number of days between last application and harvest for each material used on cherries for the fresh market. Base your choice of materials on this information.

AFTER-HARVEST COVER (Immediately after harvest)	Bordeaux 4-6-100, <i>or</i> Fixed copper to give 0.75 of a pound <i>actual</i> copper with hydrated lime at 3 pounds, <i>or</i> Actidione—2 parts per million	Leaf spot
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SWEET CHERRY SPRAYING SCHEDULE—1959

(See Table 3, page 50, for Pesticide Residue Information)

Time	Materials per 100 gallons	To control
Dormant	DN-289—2 quarts Elgetol-318—2 quarts	Black cherry aphid

The dormant application is usually not necessary as black cherry aphids are readily controlled with either parathion at one pound *or* malathion (25% wettable) at 2 pounds per 100 gallons, when they first appear.

PRE-BLOSSOM THROUGH BLOOM	Use any <i>one</i> of the following: 4-6-100 bordeaux, <i>or</i> Phygon at one-half pound, <i>or</i> wettable sulfur at 5 pounds, <i>or</i> sulfur paste at 6 pounds per 100 gallons when first blossoms open. Follow by one or more applications of Phygon (dichlone) at one-half pound, <i>or</i> sulfur paste at 6 pounds, <i>or</i> wettable sulfur at 5 pounds per 100 gallons <i>during bloom</i> when wet weather prevails. Both Phygon (dichlone) and elemental sulfur materials may be applied either as a dust <i>or</i> a spray.	Brown rot (common form blossom blight)
PETAL FALL (When three-fourths of the petals have fallen)	Ferbam—1 pound + wettable sulfur—3 pounds, <i>or</i> Captan—2 pounds <i>plus</i> Dieldrin (50 percent wettable)—one-half pound, <i>or</i> Parathion (15 percent wettable)—1½ pounds, <i>or</i> Methoxyehlor (50 percent wettable)—2 pounds	Leaf spot, brown rot Curculio

Dieldrin has an effective period against curculio of about 14 days, compared to about 7 days for parathion, EPN 300, and methoxychlor. Thus, these latter insecticides must be applied more often to give control equal to dieldrin. If black aphids, red-banded leaf roller *or* insects other than curculio are present when using dieldrin, include parathion at 1 pound per 100 gallons in the spray mixture.

FIRST COVER (14 days after Petal Fall)	The same materials are suggested as for Petal Fall.	Brown rot, leaf spot Curculio
SECOND COVER (14 days after First Cover)	The same materials are suggested as for Petal Fall, except do not use dieldrin later than First Cover.	Brown rot, leaf spot, Curculio
THIRD COVER (Timing based on cherry fruit fly emergence)	Captan—2 pounds, <i>or</i> Ferbam—1 pound + wettable sulfur—3 pounds, <i>or</i> Wettable sulfur—5 pounds, <i>or</i> Sulfur paste—6 pounds <i>plus</i> Lead arsenate—2 pounds <i>with corrective</i> , <i>or</i> Methoxyehlor (50 percent wettable)—3 pounds, <i>or</i> Diazinon (25 percent wettable)—2 pounds	Brown rot, leaf spot Brown rot Cherry fruit fly

(Continued on next page)

When lead arsenate is used with wettable sulfur and sulfur paste, include equal parts of hydrated lime and lead arsenate. *No arsenical corrective is needed when using captan or ferbam.*

The emergence of cherry fruit flies will be announced by the department of entomology, Michigan State University, and the timing of the spray applications will be announced by your county agricultural agent.

Methoxychlor gives effective protection against *cherry fruit fly* for about 7 days. Lead arsenate and Diazinon are effective for 14 days. Thus, two applications of methoxychlor are necessary to give protection equal to one application of lead arsenate or Diazinon.

Time	Materials per 100 gallons	To control
FOURTH COVER (12 to 14 days after Third Cover)	The same materials are suggested as for Third Cover	Brown rot, leaf spot Cherry fruit fly

Do not use lead arsenate within 30 days or Diazinon within 10 days of harvest if cherries are to be sold on the fresh market or are to be transported outside the State of Michigan, because of possible excessive residue. Cherries to be processed in Michigan may be sprayed with lead arsenate as late as 14 days before harvest. If it is necessary to control cherry fruit fly as late as 7 days before harvest on fruit for fresh market, use methoxychlor (50 percent wettable) at 3 pounds, or malathion (25 percent wettable) at 2 pounds per 100 gallons.

Consult Table 3, page 50, for information on the number of days between last application and harvest for each material. Base your choice of materials on this information.

AFTER- HARVEST APPLICATION	Fixed copper—0.37 pounds <i>actual</i> copper + fresh hydrated lime—3 pounds + wettable sulfur—3 pounds, <i>or</i> Ferbam—1½ pounds, <i>or</i> Captan—2 pounds, <i>or</i> Actidione at 1-2 parts per million	Leaf spot
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PLUM SPRAYING SCHEDULE—1959

(See Table 3, page 50, for Pesticide Residue Information)

Time	Materials per 100 gallons	To control
GREEN-TIP	Lime-sulfur—10 gallons	Black-knot

This spray is suggested only for plantings in which black-knot is a problem. To be of value, it must be accompanied by the pruning out and burning all of the "*knot*".

BLOOM (Beginning with balloon stage and continuing through bloom)	Lime-sulfur—2 gallons <i>or</i> Phygon (dichlone)—one-half pound, <i>or</i> Sulfur paste—6 pounds, <i>or</i> Wettable sulfur—5 pounds	Black-knot, brown rot (blossom blight)
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Continue applications through Bloom at 2- to 4-day intervals when wet weather prevails. Use either:

Phygon (dichlone)—one-half pound, <i>or</i> Sulfur paste—6 pounds, <i>or</i> Wettable sulfur—5 pounds	Brown rot (Blossom blight)
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Dusting or spraying with elemental sulfur fungicides in the early stages (first 10 hours) of each rain during the period of bloom has given good results.

Time	Materials per 100 gallons	To control
PETAL FALL (When three-fourths of the petals have fallen)	Ferbam—1 pound + wettable sulfur—3 pounds <i>plus</i> Dieldrin (50 percent wettable)—one-half pound, <i>or</i> Parathion (15 percent wettable)—1½ pounds, <i>or</i> EPN-300—1 pound, <i>or</i> Methoxychlor (50 percent wettable)—2 pounds	Brown rot, leaf spot Curculio
SHUCK SPLIT (Usually 10 to 14 days after Petal Fall)	Ferbam—1½ pounds, <i>or</i> Ferbam—1 pound + wettable sulfur—3 pounds <i>or</i>	Leaf spot, brown rot

If black-knot and/or brown rot blossom blight has not been controlled, use—

Lime-sulfur—2 gallons <i>plus</i> Dieldrin (50 percent wettable)—one-half pound, <i>or</i> Parathion (15 percent wettable)—1½ pounds, <i>or</i> EPN-300—1 pound, <i>or</i> Methoxychlor (50 percent wettable)—2 pounds	Brown rot, black-knot Curculio
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At least one application of either parathion, EPN-300, or the inclusion of ovex is suggested with dieldrin or methoxychlor in the Shuck Split or First Cover spray in order to suppress mite populations.

FIRST COVER (10 days after Shuck Split)	The same materials are suggested as for Shuck Split.	Leaf spot, curculio
SECOND COVER (14 days after First Cover)	DDT (50 percent wettable)—1½ pounds, <i>or</i> Methoxychlor (50 percent wettable)—2 pounds	Leafhopper

Specific sprays are needed to control one or both of the following pests in many orchards throughout Michigan:

To control *peach tree borer* on plum trees with peach seedling roots, spray trunks of trees (from just below crotches to ground line) with a gun and reduced pressure, using either DDT (50 percent wettable) at 3 pounds, or parathion (15 percent wettable) at 2 pounds per 100 gallons on or about July 12. Apply again in 12 to 14 days.

To control *lecanium scale*, spray infested areas with parathion (15 percent wettable) at 1½ pounds per 100 gallons when the scales are in the crawler stage. Make one application when 70 percent of the eggs have hatched (usually June 25 to July 15). Apply again 10 to 12 days later if crawlers are still numerous. This parathion application also controls leafhoppers, aids in the control of mites and aphids, and may be substituted for DDT or methoxychlor suggested in Second Cover.

THIRD COVER (About 1 month before harvest)	Captan—2 pounds, <i>or</i> Sulfur paste—6 pounds, <i>or</i> Wettable sulfur—5 pounds, <i>or</i> Lime-sulfur—2 quarts + wettable sulfur—3 pounds	Brown rot
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If mites become numerous, include with the fungicide a miticide such as Kelthane or EPN-300 as suggested by the manufacturer. Note—Kelthane is not compatible with lime-sulfur.

(Continued on next page)

Time	Materials per 100 gallons	To control
FOURTH COVER (10 to 14 days before harvest)	Captan—2 pounds, <i>or</i> Sulfur paste—6 pounds, <i>or</i> Wettable sulfur—5 pounds, <i>or</i> Lime-sulfur—2 quarts + wettable sulfur—3 pounds	Brown rot

Consult Table 3, page 50, for information on the number of days between last application and harvest for each material. Base your choice of materials on this information.

GRAPE SPRAYING SCHEDULE—1959

(See Table 3, page 50, for Pesticide Residue Information)

Economic control of grape pests depends on good coverage. At least 100 gallons of spray per acre should be used through First Cover, and a minimum of 150 gallons of spray per acre should be used beginning with Second Cover.

Caution: Do not use spray machinery that has previously been used to apply the weed control chemicals, 2,4-D or 2,4,5-T. Leaf distortion, delayed ripening, small berries, and possible death of the vine may occur. If sprayer has been used to apply Karmex-W or Karmex-DW, clean thoroughly, including strainer, before spraying grapes.

Time	Materials per 100 gallons	To control
Just before and as buds start to swell	DDT (50 percent wettable)—2 pounds	Grape flea beetle, climbing cutworm

Grape flea-beetles and climbing cutworms begin to work before and at the time buds start to swell. Check the vineyard daily to determine the presence of these insects and the need for spraying.

DEAD ARM disease is present in a few Michigan vineyards. To reduce *current shoot infection*, identified as dark, elongated spots on the basal areas of new shoot growth, apply captan 2 pounds per 100 gallons when shoot growth is 1 to 2 inches long.

FIRST COVER (When shoots are 4 to 8 inches long)	Ferbam—1½ pounds, <i>or</i> Zineb—1½ pounds	Black rot
	<i>plus</i> DDT (50 percent wettable)—1½ pounds	Berry moth

In vineyards where *black rot* has been a serious problem, apply the first protective spray when the shoots are 2 to 3 inches long, rather than delaying until the shoots have grown 4 to 8 inches in length. Follow with an additional spray 10 days later. The use of ferbam or zineb will not only give excellent control of *black rot*, but will increase yields over the use of copper fungicides. In vineyards *free* of black rot carryover, you can omit this cover.

SECOND COVER (Just as blossoms are opening)	Ferbam—1½ pounds, <i>or</i> Zineb—1½ pounds, <i>or</i> Fixed copper (1½ pounds actual copper) with 6 pounds hydrated lime, <i>or</i> 4-4-100 bordeaux	Black rot
	<i>plus</i> DDT (50 percent wettable) at 1½ pounds when ferbam or zineb is used; increase DDT to 2 pounds when fixed copper or bordeaux is used.	Berry moth, rose chafer

Time	Materials per 100 gallons	To control
THIRD COVER (Immediately after Bloom)	Ferbam—1½ pounds, <i>or</i> Zineb—1½ pounds, <i>or</i> Fixed copper (1½ pound <i>actual</i> copper) with 6 pounds of hydrated lime, <i>or</i> 4-4-100 bordeaux <i>plus</i> The same insecticide as suggested for Second Cover.	Black rot Berry moth, leaf-hopper, rose chafer

The Third Cover is considered the *most critical* for the control of black rot, powdery mildew, and downy mildew. The Concord and Niagara varieties are very susceptible to powdery mildew. The Fredonia, Niagara, and Delaware varieties are highly susceptible to downy mildew. Black rot is generally a problem on all varieties, except Delaware.

Powdery mildew infection may be identified as superficial whitish-grey patches on the upper surface of the leaves, leaf petioles, tendrils, berry stems, and peduncles.

Growers using ferbam or zineb for the control of black rot should substitute fixed copper or bordeaux sprays in place of ferbam or zineb as soon as they observe downy or powdery mildew. Powdery mildew has been appearing on the Concord variety in certain Michigan vineyards.

FOURTH COVER (10 to 14 days after Third Cover)	The same chemicals are suggested as for Third Cover.	Black rot, powdery mildew, downy mildew, berry moth, leafhopper, rose chafer
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For the control of mildews, see note under Third Cover.

Do not use a sticker with DDT or DDD after grapes are the size of buckshot.

FIFTH COVER (Just before the berries begin to touch in clusters)	The same chemicals are suggested as for Third Cover.	Black rot, powdery mildew, downy mildew, berry moth, leafhopper
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For the control of mildews, see note under Third Cover.

Applications to control the third brood of grape berry moth are sometimes necessary from August 7 to 31. Materials that may be used late in the season without creating a residue problem include methoxychlor, parathion, EPN-300 and malathion.

Parathion and EPN-300 are especially hazardous in vineyards. (See page 4). Use chemicals safely.

Consult Table 3, page 50, for information on the number of days between last application and harvest for each material. Base your choice of materials on this information.

(Continued on next page)

STRAWBERRY SPRAYING SCHEDULE—1959

(See Table 3, page 50, for Pesticide Residue Information)

To reduce white grub and root weevil injury in strawberry plantings—Just before planting, treat the upper 3 inches of soil with aldrin, chlordane, dieldrin, or heptachlor at the rate of 5 pounds *actual* aldrin, dieldrin, heptachlor or 10 pounds *actual* chlordane per acre. These insecticides may be applied as dusts, sprays, granular formulations or insecticide-fertilizer mixtures. The chemical should be broadcast (sprayed, dusted or drilled) and thoroughly mixed with the soil immediately after the application is made. About 40 percent of the effectiveness may be lost in 5 hours if the chemical is allowed to remain exposed on the surface of the soil. This treatment is effective against white grub and root weevil for about 3 years.

To avoid root aphid injury—When the soil is not treated with chlordane, dip roots and crowns of plants in a solution of nicotine sulfate (40 percent) using one-half pint of nicotine sulfate in 25 gallons of water, just before setting the plants in the field.

Time	Materials per 100 gallons	To control
Fall—(When plants are completely dormant and before applying mulch)	To eradicate— Use a mercury fungicide at strength given on label to control apple scab.	Stem-end fruit rot, leaf blight

Thorough coverage is essential. A rate of 200 gallons of spray per acre should give good control.

When a fall application of mercury is used, a spring application is not necessary.

Varieties susceptible to stem-end rot—Dunlap, Fairland, Jerseybelle, Redcrop, Redglow, Robinson, and Sparkle.

Spring—(As plants begin to break dormancy and new growth is just visible in crown)	Unmulched plantings only—To eradicate— Use a mercury fungicide at strength given on label to control apple scab.	Stem-end fruit rot, leaf blight, leaf spot
FIRST COVER (When new leaves are fully expanded and blossom buds are visible)	Fixed copper—1½ pounds <i>actual</i> copper with hydrated lime—6 pounds, or Captan—2 pounds <i>plus</i> DDD (50 percent wettable)—2 pounds + Dieldrin (50 per cent wettable)—½ pound	Stem-end fruit rot, leaf blight, leaf spot Spittlebug, tarnished plantbug, leafroller

A protective spray using 200 gallons per acre during this early, succulent stage of growth further *reduces primary infection* of leaf diseases as well as stem-end fruit rot on the sepals of the blossom buds. Copper fungicides *applied after this period* may result in stunting and reddening of the leaves, and reddening of the caps of the berries.

SECOND COVER (4 to 5 days after first spittlebug hatch)	Captan—2 pounds <i>plus</i> Parathion (15 percent wettable) 1 pound, or Diazinon (25 percent wettable)—2 pounds	Gray mold, leaf blight Spittlebug, tarnished plant bug, leafroller
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MINIMUM COVERAGE NECESSARY: 200 gallons per acre.

An insecticide is needed in Second Cover only if insects were not adequately controlled in First Cover.

A fungicide included at this time prevents leaf blight and reduces gray mold buildup. Gray mold is generally confined to the fruit. However, in wet seasons, it may attack the blossoms, flower stalks and leaves, turning them brown. The infected parts soon become covered with gray mold spores which may cause extensive fruit infection prior to and during harvest.

Frost control during the bloom period is very important in the control of gray mold. The fungus quickly invades plant tissue which has been damaged by frost increasing the spore load in the field.

THIRD COVER (When berries are one-third grown)	Captan—2 pounds,	Gray mold, leaf diseases
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This application is suggested especially for 2- and 3-year-old bearing fields due to the carryover of disease of the previous seasons.

MINIMUM COVERAGE NECESSARY: 200 gallons per acre

PRE-HARVEST COVER (At least 10 days before harvest)	Captan—2 pounds, or Captan dust (7.5 percent captan) at a rate of 40 pounds per acre.	Gray mold fruit rot, leaf diseases
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To attain effective control of gray mold fruit rot from this period to harvest, it is necessary that the *protective sprays* or *dusts* be applied before predicted rains.

If insects are present in troublesome numbers include Diazinon (25% wettable) in this application.

PRIOR TO HARVEST (3 days or less before harvest)	Captan—2 pounds, or Captan dust (7.5 percent captan) at the rate of 40 pounds per acre.	Gray mold fruit rot, leaf diseases
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This application is suggested because rainy periods conducive to development of gray mold fruit rot generally occur during harvest.

Consult Table 3, page 50, for information on the number of days between last application and harvest for each material. Base your choice of materials on this information.

AFTER-HARVEST (Immediately after harvest)	Parathion—(15 percent wettable) 2 pounds	Root weevil, leaf roller
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The need for an After-Harvest application is determined by observation. If leaf roller is the only pest present, DDD or TDE (50 percent wettable) can be used at 2 pounds per 100 gallons in place of parathion.

BRAMBLE SPRAYING SCHEDULE—1959

RED RASPBERRIES, BLACK RASPBERRIES, DEWBERRIES AND BLACKBERRIES

(See Table 3, page 50, for Pesticide Residue Information)

Time	Materials per 100 gallons	To control
DELAYED DORMANT (When leaves are exposed one-half to three-fourths inch)	Lime-sulfur—10 gallons	Anthracnose
<i>or</i>	<i>OR</i>	
(When a few leaves have unfolded from the buds)	Lime-sulfur—5 gallons	Anthracnose

Caution: If unable to apply the first-mentioned eradicated spray for anthracnose when the leaves are exposed one-half to three-fourths of an inch, a lime-sulfur spray at 5 gallons per 100 when a few leaves have unfolded from buds will give effective control.

There is a greater risk of lime-sulfur burn, however, by spraying at this later time.

PRE-BLOSSOM (When blossom buds are visible on fruiting canes or when new canes are 6-8 inches tall)	Captan—2 pounds DDD or TDE (50 percent wettable)— 3 pounds <i>plus</i>	Anthracnose Leafroller, sawfly, fruit worm
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A fungicide application at this time aids greatly in reducing anthracnose infection on the tender flower parts and young canes. Time protective sprays on raspberries with plant development and *before* predicted rains.

To control *spur blight* (a disease common in northern areas) on red raspberries, use a 3-3-100 bordeaux at this time in place of captan. Follow with a second bordeaux spray 10 to 14 days later.

In plantings where leafrollers are not a problem, you can use lead arsenate at the rate of 3 pounds per 100 gallons in place of DDD or TDE.

FIRST COVER (Right after Petal Fall)	Captan—2 pounds <i>plus</i> Malathion (25 percent wettable)—2 pounds	Anthracnose Aphids, leafrollers
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A fungicide at this time helps protect the developing fruits, spurs and new canes against anthracnose. The insecticide helps reduce aphids which are responsible for the spread of leaf curl, mosaic, and streak virus diseases in bramble plantings.

PRE-HARVEST (10 to 15 days before harvest)	Malathion (25 percent wettable)—2 pounds	Aphids, leafrollers
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The need of this application is determined by observation. Leafrollers, aphids and predators (lady beetle larvae) that feed on aphids are often troublesome at harvest time. The control of aphids reduces the predators. If leafrollers are a serious problem, include 1½ pounds of DDD or TDE per 100 gallons. Do not use DDD within 14 days of harvest.

Consult Table 3, page 50, for information on the number of days between last application and harvest for each material. Base your choice of materials on this information.

Time	Materials per 100 gallons	To control
POST-HARVEST (5 to 10 days after harvest)	Parathion (15 percent wettable)—1½ pounds	Aphids, mites

The need for this application is determined by observation of pests. *Do not* use parathion on brambles at any other time.

Sprays at this time to control anthracnose are of no value.

CURRENT AND GOOSEBERRY SPRAYING SCHEDULE—1959

(See Table 3, page 50, for Pesticide Residue Information)

Time	Materials per 100 gallons	To control
DORMANT (For both currants and gooseberries)	DN-289—1 quart, or Elgetol 318—1 quart	Aphids
GREEN TIP (For gooseberries only)	Eradicative application Lime-sulfur—5 gallons THOROUGH COVERAGE IS ESSENTIAL FOR GOOD CONTROL OF POWDERY MILDEW	Powdery mildew
FIRST COVER (As soon as the fruit has set) (For gooseberries only)	Eradicative and protective Lime sulfur—2½ gallons <i>plus</i> Parathion (15 percent wettable)—1½ pounds, or Malathion (25 percent wettable)—2 pounds	Powdery mildew Currantworm, aphids
SECOND COVER (2 to 3 weeks after bloom) (For both currants and gooseberries)	Ferbam—2 pounds <i>plus</i> Malathion (25 percent wettable)—2 pounds	Leaf spot Currantworm, aphids

The timing of this spray varies with the individual planting. However, for best disease control, spray when leaf spot is *first* noticed. Generally it is observed first on the lower leaves of the bushes.

Parathion cannot be applied safely to currants or gooseberries later than 30 days before harvest.

If leaf spot is present at harvest time, spray immediately after harvest with the fungicide suggested for Second Cover.

Consult Table 3, page 50, for information on the number of days between last application and harvest for each material. Base your choice of materials on this information.

BLUEBERRY SPRAYING SCHEDULE—1959

(See Table 3, page 50, for Pesticide Residue Information)

Time	Materials per 100 gallons	To control
DORMANT (When buds are swelling)	Eradicative measures: Premerge—1½ quarts; <i>or</i> Rake and cultivate planting floor to cover the mummified berries; <i>or</i> Aero calcium cyanamid (57 percent) special grade, at a rate of 150-200 pounds per acre.	Mummy berry

Apply the premerge spray or aero calcium cyanamid dust to the entire ground area of the planting, and especially to the crowns of the plant.

IMPORTANT—If plants have broken dormancy and green tips are showing, *do not* use aero calcium cyanamid dust.

FIRST COVER (Immediately after bloom or as soon as curculio is active)	Methoxychlor (50 percent wettable) 3 pounds.	Curculio
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When using dust, apply 30 pounds of 5 percent methoxychlor dust per acre.

SECOND COVER (10 days after First Cover)	The same chemicals are suggested as for First Cover.	Curculio, fruit worm
THIRD COVER (10 days after Second Cover)	The same chemicals are suggested as for First Cover.	Fruit worm
FOURTH COVER (When fruit fly appears)	Rotenone dust (2½ percent) or malathion dust (4 percent) used at the rate of 25 pounds per acre.	Fruit fly

The time to make this application will be announced by your county agricultural agent. *Do not harvest berries* within 1 day after a malathion treatment.

When the lecanium scale is abundant, make two applications of malathion (25 percent wettable) at 2 pounds per 100 gallons, or a malathion dust (4 percent) at the rate of 35 pounds per acre. Make the first application when 75 percent of the eggs have hatched; follow by a second application 7 days later. The need for a third application will depend on the presence of crawlers 14 days after the first treatment.

Consult Table 3, page 50, for information on the number of days between last application and harvest for each material. Base your choice of materials on this formation.

RESIDUE TOLERANCES OF PESTICIDES ON FRUITS

According to regulations established under "The Miller Bill," certain small amounts (tolerances) of pesticides may legally remain on harvested fruits. You, as a grower, are responsible for producing legally marketable fruit.

By following three rules, you can be reasonably sure your harvested fruit will be "within the limits of the law":

Rule 1. Do not increase dosage rates above those listed in Table 3.

Rule 2. Do not use materials on crops not listed in Table 3.

Rule 3. Do not use materials closer to harvest than is indicated in Table 3.

Information on materials used in the dormant, pre-bloom, and post-harvest periods has been omitted. Ordinarily, materials used at these times do not present a residue problem on harvested fruits.

The information in Table 3 is up-to-date as of January 1, 1959. Minor changes may occur during the growing season. County agricultural agents will be notified when these occur.

Pesticides suggested for use in this table are grouped into the following chemical classes: Unrelated Materials, Chlorinated Hydrocarbons, Organic Phosphates, and Carbamate Compounds.

Where residues of two or more chemicals in the same chemical class are present on a fruit, a "chemical class" tolerance becomes effective. For example, the combined amount of DDT and DDD on harvested apples cannot legally exceed 7 parts per million (ppm) by weight. (See Table 3.)

Neither can combined amounts of materials in the same class exceed 100 percent of tolerances for component materials. For instance, if apples have a residue of 6 ppm of malathion (75 percent of its tolerance), only 0.25 ppm of parathion (25 percent of its tolerance) is allowed.

Materials of different chemical classes are considered separately; therefore, an apple can have a legal residue of 14 ppm methoxychlor, 8 ppm malathion, 7 ppm lead arsenate, and 7 ppm ferbam.

TABLE 3—RESIDUE TOLERANCES OF PESTICIDES ON FRUITS—(Continued)

Material	Tolerance (parts per million by weight)	Maximum dosage rate per 100 gallons of spray	Days between final spray and harvest	Crops	Remarks
<i>Unrelated Materials</i>					
Lead arsenate.....	7	3 lb.	30	Apples, cherries, peaches, pears, plums	Fruit sprayed with lead arsenate may need washing to be within tolerance. Processors who remove residues may accept cherries that have been sprayed with lead arsenate up to 14 days before harvest.
Nicotine sulfate (40%).....	2	1 pt.	3	Apples, brambles, currants, goose- berries, cherries, grapes, plums, peaches, strawberries	
Rotenone (4% W.P.).....			0	Any fruit as needed	Rotenone and Ryania are exempt from the requirement of a toler- ance.
Ryania (50% W.P.).....			0	Apples	
Sevin (50% W.P.).....	10	2 lb.	7	Apples, pears	Sevin had an experimental label for use on apples and pears in 1958. Complete clearance for its use had not been granted as of Jan. 1, 1959.
<i>Chlorinated Hydrocarbons</i>					
Aramite (15% W.P.).....	0	Note:—Aramite data are being reviewed. The tolerance for Aramite was changed from one part per million to zero in December 1958. Unless subsequent rulings permit more liberal usage, <i>do not use Aramite on bearing trees or small fruits after bloom</i> , if there is ANY danger of residue on the harvested fruit.			
Chlorobenzilate (25% W.P.)...	5	1½ lb.	14	Apples	Do not use a sticker or spreader with DDD or DDT on grapes after the fruit is the size of buck- shot.
Chlorobenzilate (25% W.P.)...	5	1½ lb.	7	Pears	
DDD or TDE (50% W.P.)....	7	2 lb.	30	Apples, cherries, pears, plums, peaches	
DDD or TDE (50% W.P.)....	7	2 lb.	40	Grapes	
DDD or TDE (50% W.P.)....	7	2 lb.	5	Strawberries	
DDD or TDE (50% W.P.)....	7	2 lb.	14	Brambles, blueberries	

DDT (50% W.P.).....	7	2 lb.	30	Apples, cherries, pears, plums, peaches	If more than five applications of DDT are made on apples, reduce the dosage below 2 pounds and/or increase the interval between final spray and harvest.
DDT (50% W.P.).....	7	2 lb.	40	Grapes	
Dieldrin (50% W.P.).....	.25	$\frac{1}{2}$ lb.	30	Cherries	Do not make more than one application of Kelthane on apples within 30 days of harvest.
Dieldrin (50% W.P.).....	.1	$\frac{1}{2}$ lb.	14	Grapes	
Dieldrin (50% W.P.).....	.25	$\frac{1}{2}$ lb.	35	Apples, pears	
Dieldrin (50% W.P.).....	.1	$\frac{1}{2}$ lb.	45	Peaches, plums	
Kelthane (25% W.P.).....	5	2 lb.	7	Apples, pears, cherries, plums grapes	
Kelthane (25% W.P.).....	10	2 lb.	14	Peaches	
Kelthane (25% W.P.).....	5	2 lb.	2	Strawberries, brambles	
Methoxychlor (50% W.P.).....	14	3 lb.	7	Apples, cherries, pears, plums	
Methoxychlor (50% W.P.).....	14	3 lb.	14	Blueberries, brambles, grapes, strawberries, currants, gooseberries	
Methoxychlor (50% W.P.).....	14	3 lb.	21	Peaches	
Ovex (50% W.P.).....	3	$\frac{1}{2}$ lb.	30	Apples, pears, peaches, plums	
<i>Organic Phosphates</i>					Do not use more than three applications of Demeton on apples or pears.
Demeton or Systox (26% Em.)..	.75	$\frac{3}{4}$ pt.	21	Apples, pears, strawberries	
Demeton or Systox (26% Em.)..	1.25	$\frac{3}{4}$ pt.	21	Grapes	Do not make more than 8 applications of Guthion per season.
Diazinon (25% W.P.).....	.75	2 lb.	5	Strawberries	
Diazinon (25% W.P.).....	.75	2 lb.	10	Cherries, plums	
Diazinon (25% W.P.).....	.75	2 lb.	14	Apples, pears	
Diazinon (25% W.P.).....	.75	2 lb.	20	Peaches	
EPN-300 (25% W.P.).....	3	1 lb.	21	Apples, cherries, plums, peaches, pears, grapes	
Guthion (25% W.P.).....	2	$1\frac{1}{4}$ lb.	15	Apples, pears	
Guthion (25% W.P.).....	2	$1\frac{1}{4}$ lb.	21	Peaches	
Malathion (25% W.P.).....	8	2 lb.	3	Apples, currants, gooseberries, cherries, grapes, pears, plums, strawberries	
Malathion (25% W.P.).....	8	2 lb.	7	Peaches	
Malathion (25% W.P.).....	8	2 lb.	1	Blueberries, brambles	
Parathion (15% W.P.).....	1	2 lb.	14	Apples, cherries, pears, plums, strawberries, peaches, grapes	
Parathion (15% W.P.).....	1	2 lb.	30	Currants, gooseberries	
Phosdrin (20% Em.).....	.5	$1\frac{1}{2}$ pt.	1	Apples, pears	
Phosdrin (20% Em.).....	1.	$1\frac{1}{2}$ pt.	1	Peaches, strawberries, plums	

Material	Tolerance (parts per million by weight)	Maximum dosage rate per 100 gallons of spray	Days between final spray and harvest	Crops	Remarks
<i>Organic Phosphates—Con.</i>					
Phosdrin (20% Em.).....	0	1 pt.	5	Grapes	Do not apply Trithion at intervals closer than 30 days.
TEPP (40% Em.).....	0	1 pt.	3	Any fruit as needed	
Trithion (25% W.P.).....	.8	1 lb.	30	Applies, pears, cherries, plums, peaches, grapes	
Trithion (25% W.P.).....	.8	2 lb.	3	Strawberries	

FUNGICIDES

<i>Unrelated Compounds</i>					
Actidione.....	0	2 p.p.m.	4	Cherries	Copper is exempt from the require- ment of a tolerance.
Captan.....	10	2 lb.	0	Apples, pears	
Captan.....	10	2 lb.	0	Strawberries, brambles	
Captan.....	10	2 lb.	0	Cherries	
Captan.....	10	2 lb.	0	Plums, prunes	
Coppers.....			0	Any fruits as needed	
Dichlone (Phygon XL).....	3	½ lb.	1	Apples	Mercuries and streptomycin should not be used later than petal fall Sulfur is exempt from the require- ment of a tolerance
Dichlone (Phygon XL).....	3	½ lb.	7	Peaches	
Dichlone (Phygon XL).....	0	½ lb.	90	Cherries, plums, prunes	
Glyodin.....	5	1 qt.	0	Apples	
Glyodin.....	5	1½ pt.	7	Cherries	
Karathane.....	0	½ lb.	14	Apples	
Mercuries.....	0		See Note	Apples	
Streptomycin.....	0	100 p.p.m.	See Note	Apples	
Sulfur.....			0	Any fruit as needed	

<i>Carbamate Compounds</i>					
Ferbam.....	7	1½ lb.	7	Apples, cherries, pears	
Ferbam.....	7	1½ lb.	35	Plums, prunes	
Ferbam.....	7	2 lb.	0	Currants, gooseberries	
Ferbam.....	7	1½ lb.	60	Grapes	Ferbam may not be used on grapes later than 14 days after berries touch in cluster
Thiram (Thylate).....	7	2 lb.	7	Apples	
Thiram (Thylate).....	7	2 lb.	7	Strawberries	Thylate had an experimental label for use on strawberries in 1958. Complete clearance for its use had not been granted as of Jan. 1, 1959.
Zineb.....	7	2 lb.	7	Grapes, strawberries	
Ziram.....	7	2 lb.	7	Strawberries	

Note:—These dosage rates refer to maximum allowable amounts for dilute spraying and are not necessarily suggested amounts. Refer to fruit spraying schedules and package labels for suggested amounts on specific crops.

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