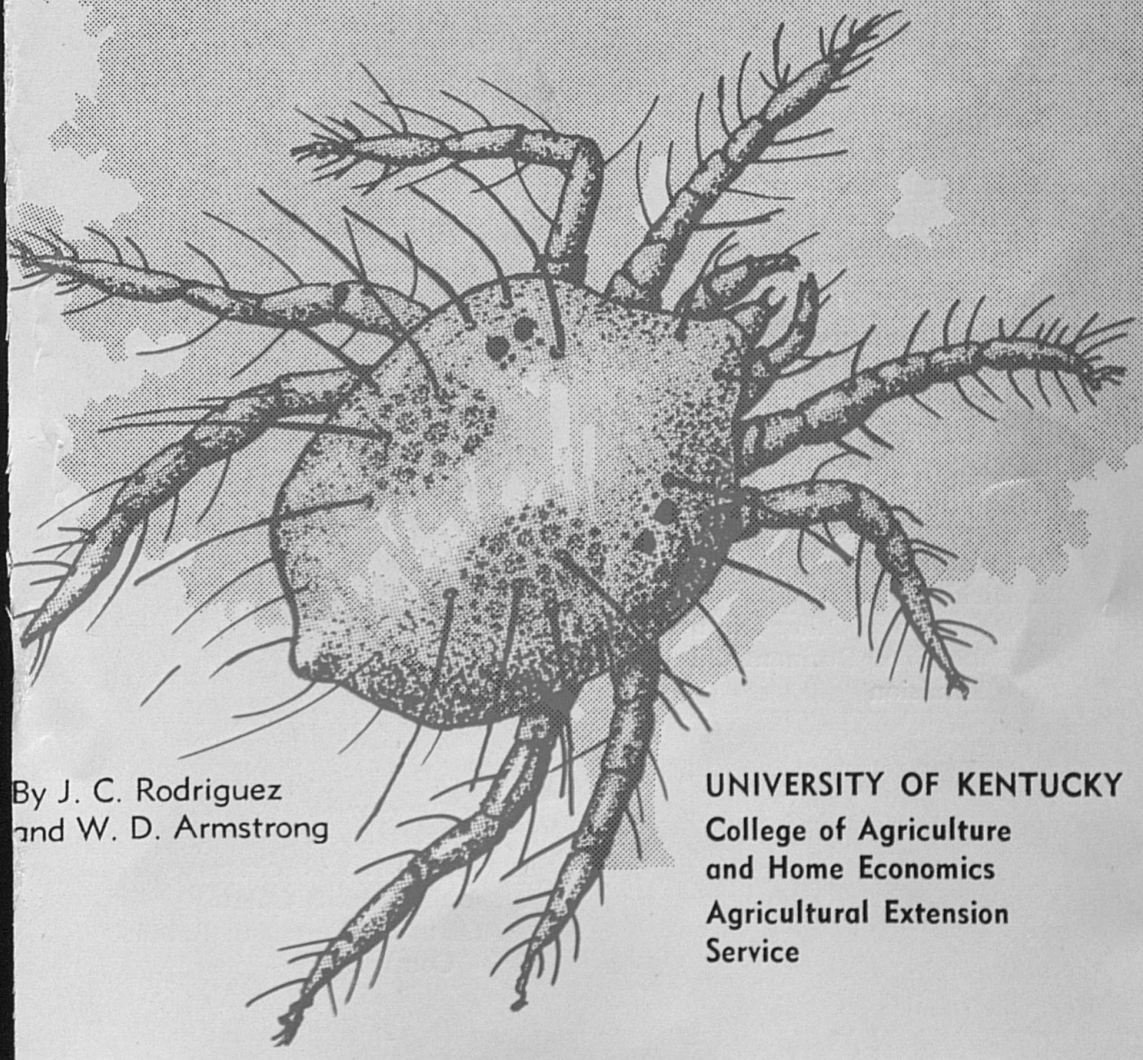
CIRCULAR 544

SPRAY SCHEDULES FOR COMMERCIAL FRUIT PLANTINGS 1957-1958



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PRACTICE ORCHARD SANITATION

Success in producing marketable fruit depends largely on the control of insects and diseases—and the control of insects and diseases depends on adequately spraying or dusting and a careful program of orchard sanitation.

Don't neglect orchard sanitation. The practices in orchard management which help to keep the orchard free from insects are just as important as the proper use of chemicals—perhaps more important. These practices are:

1. Removing trash from orchard
2. Removing rough and loose bark from the trees (do this before May 1 with a solid stream of water, using 500 to 600 pounds pressure and an 8/64-inch disk in the spray gun)
3. Storing orchard crates or used containers in a closed building and keeping picking crates free of worms
4. Screening the packing shed
5. Collecting and removing dropped fruit periodically

Carrying out these practices thoroughly will supplement your spray program and make it more effective.

THE PREPARATION OF YOUR SPRAY PROGRAM

The spray programs recommended in this circular represent the combined experiences and observations of state entomologists, horticulturists, and plant pathologists from Kentucky, Indiana, Illinois, and Ohio, and U.S. Department of Agriculture specialists at the Federal Fruit Laboratory at Vincennes, Indiana. These workers meet annually at Vincennes in a Fruit Pest Conference to discuss research data and growers' experiences, as a means of bringing about improvements in your spray program.

Note:

(a) Certain reference numbers ("Ref. ....") are noted throughout the spray schedules. Take time to study the references. They are found on pages 7 to 14 and 28 to 38.

(b) Spray service work is carried on in the main fruit sections of Kentucky. For help with your problems, consult your spray letters, your county agricultural agent, or the Agricultural Experiment Station, University of Kentucky, Lexington.

(c) If you have only a few trees or wish to use only a minimum schedule, see Kentucky Extension Circular 521, "Sprays for the Home Fruit Garden."

THE MILLER AMENDMENT AND THE FRUIT GROWER

This amendment affects all growers who use pesticide materials in controlling insects and plant diseases (also weeds and rodents). The law establishes procedures for the Food and Drug Administration of the U. S. Department of Health, Education and Welfare to set official limits (tolerances) on how much residue of a material can remain on a crop when it is offered for sale. This law requires that food shipped in interstate commerce be pure and wholesome, and the grower, by virtue of the tolerances established for each material, can with reasonable assurance produce such food products without hazard to the consumer. Growers should be aware of their responsibility and apply only approved materials at approved dosages and directions.

The following list of residue tolerances applies only to the deciduous fruits and strawberries grown in Kentucky. **Growers are urged to follow the directions on the manufacturer's label at all times.**

MATERIAL	TOLERANCE (parts per million)		FINAL SPRAYS BEFORE HARVEST (days)
Aramite	1		14
BHC	5		60
Bordeaux mixture	exempt		....
Captan	20		1
Copper, fixed	exempt		....
DDT	7	Apples	30
		Peaches	42
		Grapes	45
Demeton (Systox)	0.75	Apples	21
Dichlone (Phygon)	0	Not after bloom	....
Dieldrin	0.1	Peaches, Plums	45
	0.25	Apples	35
Ferbam	7		0
Glyodin	5		0
Lead arsenate	7		30
Lindane	10		60
Malathion	8	Apples and Strawberries	3
		Peaches	7
Maneb	7		40
Methoxychlor	14		7
Nicotine	2		10
Ovex	3		....
Parathion	1		10
Ryania	exempt		....
Sulfur	exempt		....
TDE	7		30
Zineb	7		0
Ziram	7		0

Spray Schedules for Commercial Fruit Plantings, 1957-58

By J. G. Rodriguez and W. D. Armstrong

Successful spraying or dusting involves *correct timing, thorough* application, and the use of proper and sufficient materials.

Here are some points to watch in doing a good job of spraying or dusting:

1. Keep trees well pruned so that spray materials can penetrate and so that good circulation of air will hasten drying.
2. Spray thoroughly, paying special attention to the centers and tops of the trees.
3. Use mist sprays; avoid driving a solid stream of spray into foilage or fruit at close range. This is important when applying pre-harvest sprays of lime-sulfur on peaches; use small disks.
4. Don't apply lime-sulfur or bordeaux mixture in slow-drying weather. Never apply lime-sulfur when temperature is 90° F or above.
5. Never use lime-sulfur on Jonathan or Golden Delicious after the pre-pink spray.
6. Don't use an oil spray sooner than 10 days after a sulfur spray. Never use sulfur with oil.
7. Don't carry lime over from year to year—use only fresh spray lime.
8. Never combine ferbam with bordeaux mixture (see Compatibility Chart on page 39); use these materials at least a week apart.
9. Use recommended spray mixtures according to directions. Let someone else experiment.
10. Always use the amount of active ingredient called for in the spray schedules. (Trademarks may differ in formulation.)

SPRAY PROGRAM FOR YOUNG FRUIT TREES NOT YET BEARING

Young trees need to be protected against insect and disease attacks, if they are to grow satisfactorily and reach an early bearing age. They will thus be kept in a vigorous, healthy growing condition. The same is true for mature trees that are not bearing for various reasons, including winter-killing of fruit buds in peaches, as was the case in 1955, and the normal off-year in alternate-bearing apple trees.

A small amount of care in culture, fertilizing, insect and disease and rodent control will insure good health in these non-bearing trees.

All types of young fruit trees need protection against scale insects and this can be provided by the dormant spray listed in the various schedules. All young trees also need protection from grasshopper injury and should be inspected for this purpose through the summer. Young apple trees need scab and cedar rust protection to their leaves and this can be provided by possibly one pre-bloom spray listed in the schedule and a spray at petal fall or first cover period if conditions are severe. Apple blotch cankers should not be allowed to form on young trees. The portions of the schedule pertaining to blotch on bearing trees should be followed to control this disease on young trees. On very young trees it may prove profitable to cut out blotch cankers. Should leafhoppers become serious in midsummer, a spray of nicotine sulfate or DDT should provide control.

In addition to scale, young peach trees also need protection against leaf curl and this can be provided by the dormant oil-bordeaux spray listed in the schedule. Peaches also need protection against the peach tree borer. The safest treatment for very young trees is the DDT spray program described in Reference 9 in this circular. If desired, the PDB treatment may be made in September or October.

Young cherry trees will need protection against defoliation by the cherry leaf spot. One early spray and one "post-harvest" spray applied in June should serve this purpose.

Young grape vines need protection against leafhoppers and other leaf-injuring insects and this can be provided by a DDT spray when injury is noticed.

All young fruit trees are subject to winter damage from orchard mice and rabbits. Rabbit injury can usually be easily prevented by wrapping the trunks of the trees in October with old newspaper or by placing a circle of hardware cloth or screen around the tree trunks. Protection against mice is discussed under Reference 45.

To keep young trees growing and healthy, examine them often and provide at once any protective measures that are needed.

REFERENCE NOTES ON INSECTS AND DISEASES

INSECT PESTS

1. Codling Moth

This insect has always been the most important apple insect, since it is largely responsible for wormy fruit. It overwinters as a worm enclosed in a cocoon hidden beneath bark, beneath trash on the ground, or in various crevices in the tree. Many of them also find shelter in picking crates or in various places in the packing shed.

In the spring, the worms transform to brownish pupae and soon emerge as bronze-colored moths. Moth emergence usually starts from 6 to 14 days after petal fall and emergence may be over in 2 weeks or be prolonged 4 to 6 weeks, depending on the weather. Studies at Paducah and Henderson show that egg-laying begins from 12 to 21 days after petal fall and the first worms enter apples 3 to 4 weeks after petal fall. Full-grown, first-generation worms begin leaving fruits about June 1 at Paducah and Henderson, and moths begin emerging during the second or third week in June. Heavy moth flight occurs for about a month.

In general, hatch of second-brood worms can be expected about July 1 in Western Kentucky and July 10-15 in Northern and Eastern Kentucky, or about 10 days after the emergence of first-generation moths, and the first second-brood spray should be timed accordingly. Second-generation worms pupate and give rise to a third brood of worms which attack apples in late August and September and it is this brood that often causes the greatest loss.

The obtaining of good control of the spring-brood worms cannot be over-emphasized, as these give rise to ensuing generations. In some orchards, DDT has been failing to give adequate control of codling moth. Several factors may be involved: Resistance of codling moth to DDT, weather conditions hastening DDT breakdown, or inadequate application. For this reason, the addition of parathion or malathion is suggested. Use 1½ pound of DDT (50%) plus parathion (15%) 1 pound or substitute malathion (25%) 2 pounds for the parathion.

Parathion, used at 1½ pound of the 15 percent material is effective against codling moth and may be used as a combination spray to control codling moth, mites, leaf roller, scales, aphids, and curculio. For mite control a second application should be made within 7 days of the first.

2. Mites

The two kinds of mites common to Kentucky orchards are the two-spotted spider mite and the European red mite. They have become serious pests in recent years; the practice of using DDT in the spray program (apple, peach, grape, strawberry, etc.) has increased the mite infestations, probably because other insects that normally would have preyed on the mites have been eliminated. Both are barely visible to the naked eye, and both feed on the lower leaf surface, causing foliage

to bronze and drop off. The two-spotted spider mite turns from a greenish or brownish mite to a reddish adult to overwinter and it overwinters on tree trunks, grasses, and debris; it cannot be killed with dormant sprays. The European red mite overwinters in the egg stage (reddish eggs); these may be found on twigs and branches. A 3% dormant oil emulsion spray kills the eggs it touches, and a dormant oil spray will generally delay mite trouble a month or so. A mite count of 2 or more per leaf (using a magnifying lens) usually warrants the starting of control sprays.

Malathion, dimite, demeton, aramite and parathion are all effective miticides. It is well to point out that resistance to parathion has been encountered in some orchards. Dimite and aramite are effective only against mites. A systemic material is now available, demeton. (See Ref. 16 in notes for each material.) Regardless of the material used, a thorough spraying is necessary, and particular attention should be given to covering the underside of the foliage. **Except when using demeton,** the second application should always be made about 5-7 days later.

3. Aphids

The rosy apple aphid and the green apple aphid are the most troublesome. The rosy aphid attacks the foliage and fruit clusters; the leaves become curled and the small apples fail to grow. The green apple aphid also causes curling of the leaves and it is particularly injurious to young trees. Both aphids overwinter in the egg stage on the apple tree and can be controlled by the use of dormant oil spray containing a "di-nitro" preparation. Use according to the manufacturer's directions. It is important that dormant "di-nitro" preparations be applied *only* when this tree is dormant. (See Ref. 19.)

If the dormant spray is omitted for some reason, aphids may be controlled in the spring by using BHC, malathion, parathion, or demeton.

4. Scales

The San Jose and Forbes scales are the most common. The overwintering scales give rise to living young ("crawlers") and these, in turn, give rise to two or three more generations.

Trees lightly infested show small grayish specks on the surface of the bark which are disk-shaped and just visible to the eye. Under the lens, these show a raised nipple-shaped spot at the center. Infested trees show a general lack of vigor and thin foliage which may be yellowish. On apples, they may also attack the fruit, causing a red spot around each scale.

Good coverage is essential to good control in the dormant stage as in all other sprays. A spray containing 3% oil emulsion or emulsible oil at the manufacturer's direction will control scale insects and red mite eggs in the dormant stage. Apply when the temperature is above 40° F. DNC may be used for the control of not only scale but aphis and mite eggs. (See Ref. 19.)

Parathion may be used to control scale "crawlers" and if used in the summer spray program, the dormant spray for scale control may be

eliminated. (See Reference 17 on the use of parathion.) Malathion is also recommended.

5. Red-Banded Leaf Roller

This insect has come into prominence since the widespread use of DDT in the spray program. It is thought that lead arsenate does not kill the natural enemies of the leaf whereas DDT does. Lead arsenate will keep this pest in check. The red-banded leaf roller feeds on a number of plants as well as fruit trees. Overwintering as pupae in trash and debris, the moths emerge in early spring and lay eggs on the foliage which hatch into larvae that soon begin webbing or rolling leaves together. They not only feed on the leaves but also on the surface of the fruit. There may be as many as four generations in western Kentucky.

If leaf-roller is prevalent, add 2 pounds of lead arsenate (and 2 pounds of lime) in the pink spray. During the season, TDE or parathion may be used. Use 2 pounds of 50% TDE wettable powder or 1 quart of emulsion per 100 gallons. Use the powder if used with sprays containing sulfur. Parathion is used at the rate of 1 pound of the 15% wettable powder per 100 gallons. (See References 15 and 17.)

6. Apple Flea-Weevil

This pest is becoming of increasing importance in Campbell, Kenton and Boone counties, in northern Kentucky. It has long been a problem in southern Ohio orchards across the river from Kentucky. Sprays of DDT applied in the pre-pink stage are suggested where the pest is a problem. The calyx spray of this material is also effective. One pound of 15% parathion per 100 gallons of water will also control this pest at the time mentioned above. July sprays of DDT or parathion will also help stop the summer adults.

7. Plum Curculio

Curculio is the most troublesome of insects attacking peach and plum fruits and it also frequently injures apples. The adult curculio is a grayish-brown snout beetle about one-fifth of an inch long which overwinters under trash or debris in or near orchards or woods. They resume activity in early spring and fly to fruit trees. Jarring records for Paducah, Henderson, and Lexington show that the first curculios enter peach orchards between the petal fall and shuck-fall stage. They begin laying eggs on peaches between the shuck-split and shuck-fall stage. Eggs hatch into white, legless grubs which make brown, winding tunnels into the small fruit. These fruits usually drop. The grub matures in the dropped fruit and soon enters the soil for pupation. First-generation adults begin emerging in June and continue through July. These beetles fly to fruit where they, in turn, lay eggs. In Kentucky, the second generation curculio often causes heavy losses, since fruits ripen prematurely and drop just before harvest. Second-generation adults emerge from the soil in August. These are the overwintering beetles.

The presence or absence of curculio adults in early spring (or any time) can be determined by jarring the trees in the morning, and this

practice is widely used by peach growers in Kentucky. This is done by placing a canvas underneath the trees and bumping the limbs with a padded pole. The Curculio fall to the canvas sheet and play dead for a short time. The border rows are the first rows that are inhabited.

Dieldrin (½ pound of 50 percent wettable powder) and parathion (1½ pound of the 15 percent material) are very effective against curculio.

In apple orchards curculio may be a problem especially in early varieties; dieldrin or parathion may be applied in the calyx and first cover. (Note compatability chart on page 38.) (See Ref. notes 11, 13, and 17.)

8. Oriental Fruit Moth

This insect was not known in Kentucky until 1928; it has since become a pest of increasing economic importance. This insect overwinters as a worm, like the codling moth, under bark or trash. In spring the moths emerge and lay eggs on twigs and leaves. The hatching worms bore into the tips of twigs, causing the tips to wilt and die back. Later in the season, the worms of later generations (there are four or five in Kentucky), burrow into the peach usually through the stem end and feed inside the fruit. Apples also are attacked, usually in late summer, in years of small peach crops, or soon after nearby blocks of peaches have been "stripped."

Oriental fruit moth is effectively controlled with DDT, and infested peach orchards should include it in the second, third, and fourth cover sprays. DDT should not be used within 42 days of harvest because of the possible danger of harmful residues. Parathion when used in all the sprays indicated in the spray schedule will also control this insect. (See Ref. 17.)

9. Peach Borers

Among the most important enemies of the peach tree are the peach tree borer and the lesser peach tree borer. The former is the most common and the most destructive, causing heavy losses in Kentucky orchards. These species are closely related and, except for habit, are difficult to distinguish. Borers may be identified by the fact that the *peach tree borer attacks the base of the trunk,* from 2 or 3 inches below the surface to about a foot above the surface, while the *lesser peach tree borer attacks the upper part of the tree trunk,* the crotches, or any wounds in the bark. Jelly-like gum, including sawdust-like frass, exudes from the borings of either borer and this is an indication of infestation. Both borers overwinter as small to medium sized worms in bark crevices or in portions of the trunk in which they feed; they resume burrowing and feeding in early spring. The more advanced of the peach tree borer larvae attain full growth, about 1 inch, by the middle of May. They then spin silken, dirt and gum-covered cocoons on the surface of their burrows or in the soil, and change to the pupal stage. The first moths emerge in late June and continue emerging through September. They are clear-winged, blue and orange moths resembling wasps. The moths of the lesser peach tree

borer may also be mistaken for wasps but they usually emerge somewhat earlier.

Control of both species may be obtained with 3 pounds of 15 percent parathion per 100 gallons of water by spraying the trunk as well as the lower limbs. For control of the peach tree borer, apply July 1, August 1 and September 1. If the lesser peach tree borer is also present, begin the treatments about June 10 or earlier and make at least four applications at 3-week intervals. If a heavy infestation of either exists, spray at 3-week intervals. If only the peach tree borer is present, and the infestation is not too serious, DDT may be used. Use 6 pounds of 50-percent wettable DDT per 100 gallons of water and spray the trunk and crotches. Care should be taken to assure thorough coverage of the trunks; remove all trash, weeds, or grasses from around the tree trunks.

The fall treatment of paradichlorobenzene (PDB) applied at soil level is effective only on the peach tree borer. Apply PDB crystals about October 1, when the soil is dry. Clear trash from the base of the tree trunk, remove gum if present and place a band of crystals around the trunk, taking care to allow at least 2 inches between the band and the trunk. One ounce of PDB is advised for treating trees 6 years of age and older and from ½ to ¾ ounce on trees from 3 to 5 years old (depending upon the size of the tree. One-fourth ounce is the proper dose for 1 and 2 year old trees. Do not use more than 1½ ounce on any tree. Cover the crystals with about 3 inches of fine soil, piling it towards the trunk, and compact the mound with the back of the shovel. Remove the soil after 4 weeks from trees less than 4 years of age; on older trees, the mounds may be removed in the spring. For lesser peach tree borer control, paint the wounds with a mixture of PDB dissolved in crude cottonseed or miscible oil. Warm 2 quarts of oil, dissolve 1 pound of PDB crystals (if miscible oil is used, add water to this mixture to make up to 1 gallon) and apply with a paint brush. Make this treatment during the late fall or warm winter days and apply only to the gummy area. Do not remove the gum.

10. Grasshoppers

Grasshoppers often cause serious injury to trees, particularly young plantings. Chlordane is used at the rate of 2 pounds of the 50% wettable powder per acre or 1 quart of 45% emulsion per acre. Apply as ground spray between rows. Toxaphene, dieldrin and aldrin are also effective materials; use at manufacturers' recommendations.

INSECTICIDES

11. Lead Arsenate

There is less arsenical injury with basic lead arsenate than the standard (acid) lead arsenate on peaches. It is apparently less effective than the standard lead arsenate against the plum curculio, and more applications at greater strength may be needed to obtain comparative control.

12. DDT

This material is probably the safest for codling moth control; it is also effective against Oriental fruit moth. Only wettable powder is recommended for orchard pest control. DDT makes for population rises in mites and leaf roller and for this reason, when it is used to control codling moth and Oriental fruit moth, growers should always be on the alert for outbreaks of mites and leaf roller. For these reasons, it is strongly suggested that DDT not be used in apple orchards where the grower has been getting satisfactory codling moth control with the lead arsenate spray program.

DDT in the apple spray program should be used only up to 30 days of harvest. Sprays closer than 40 days of harvest will likely result in the tolerance being exceeded. Parathion may be used, however, up to within 10 days of harvest. Ryania 5-6 pounds per 100 gallons has been exempted from tolerance limitations and is also recommended for second and third brood codling moth control. On peaches, do not use DDT for oriental fruit moth, 2 pounds of 50 percent wettable powder, closer than 42 days of harvest. For leafhopper control 1 pound of DDT is suggested when not more than 2 applications are made during the last 8 weeks before harvest. Do not use within 3 weeks of harvest. In grapes, do not apply closer than 45 days before harvest.

13. Ryania

This insecticide is of plant origin. Ryania insecticides composed of the ground stems of *Ryania speciosa* have been developed commercially for the control of codling moth and European corn borer. The active materials of Ryania are toxic to insects both as contact insecticides and as stomach poisons. Ryania appears to be even safer to warm-blooded animals than rotenone and has a place in the apple spray schedule in the late cover sprays to avoid dangerous residues of DDT.

14. Malathion

This material is an organic phosphate, but it is much safer to use than parathion and is recommended to those who do not want to use the latter. It is somewhat less effective than parathion on a pound per pound basis, but it is effective against scales, aphids and mites particularly. Wettable powder of 25% malathion is suggested for use in fruit spray schedules, at the rate of 1 to 2 pounds per 100 gallons.

15. TDE

This compound is related to DDT. In the orchard pest control program, the specific use for TDE is for the control of the red-banded leaf roller. There are several formulations but the 50% wettable powder is preferred because there is no question of its compatibility with wettable sulfur.

16. Dimite, Ovex (Ovotran, Coratran), Aramite and Demeton

Dimite is a miticide that is very effective against all species of orchard mites. Use the 25-percent emulsion at 1 pint per 100 gallons of water.

Ovex (Ovotran, Coratran). This material is especially effective for the control of European red mites and is recommended in three early sprays on apples. Added to the pink, bloom, and calyx sprays at ½ pound of the 50 percent wettable powder per 100 gallons, it should eliminate the European red mite problems for the season. Two-spotted mites may be a problem later in the season, however; these may be controlled with aramite, dimite or demeton. This material is not an aphicide.

Aramite is another miticide effective on orchard mites. Use at the rate of 1 to 2 pounds per 100 gallons depending on the infestation and the amount of residual action desired.

Demeton is a systemic material which when sprayed on foliage is absorbed by the foliage and made toxic to such sucking pests as aphids and mites. This material (may be sold under the trade name of Systox) is related to parathion and has to be handled as if it were parathion (see note 17). Demeton is approved for control of mites and aphids on apples, but because it is so long-lasting *only two applications* are approved during the season with the last at least 21 days before harvest. It may be used where green apple aphis and the rosy apple aphis are evident and applications for their control, in the pink and calyx sprays, would also control the European red mite and would perhaps remain effective against an early invasion of two-spotted mites. Use according to directions at the rate of ½ pint per 100 gallons. See Ref. 17 regarding precautions and correct type of respirator.

17. Parathion

This material has been used since 1949. It has been highly satisfactory in respect to insect control. Because it is extremely toxic to warm-blooded animals, its use *cannot be recommended* without qualification. Usage of the material, as outlined in this parathion spray schedule, is suggested only in cases where safer materials have failed to give satisfactory control.

Each package offered for sale carries a detailed list of precautions to be followed; no fruit grower should use or permit the use of parathion unless he knows and enforces all precautions completely. The following are briefly some of the precautions which the user must observe:

Avoid breathing the powder while handling the bags and wash your hands, arms, and face after handling parathion. Care should be taken not to eat or smoke while still contaminated with parathion. Protective clothing, rubber gloves, and a special respirator which is available on the market are essential when using parathion.

Atropine is the emergency antidote for parathion poisoning. Keep on hand a supply of atropine tablets (1/120 grain or 0.5 mg.). A doctor's prescription is required to get them. Never take atropine until AFTER warning symptoms appear. Symptoms of parathion poisoning include headache, blurred vision, weakness, nausea, cramps, diarrhea, and discomfort in the chest. If any symptoms appear while

STANDARD SPRAY SCHEDULE FOR APPLES

The following apple schedule is set up for those who want a definite guide to follow with no decisions to be made as to materials. It is more expensive than the other schedules, but should give control of serious attacks of insects and diseases and give good fruit finish. IMPORTANT - READ FOOTNOTE.

Nol.	Application	Materials (100 gallons)	To Control	Remarks
1	Dormant - apply before growth start in the spring when temperature is above 40° F.	Oil emulsion or Miscible oil, carrying 3% oil See Ref. 2, 4, 16, 19, 20	Scales Red mite (eggs) Aphids	Always apply dormant oil spray if DDT is to be used. Dinitro materials can be added to this spray for mite and rosy aphis egg kill.
	Optional - except on Red Delicious Green-tip, apply when buds burst.	Captan - 2 lb	Apple scab Powdery Mildew *	Important on Red Delicious Use mildew program (see note) if disease was present the previous year.
2	Pre-Pink - apply when first leaves are unfolding from around the blossom buds.	Captan - 2 lb	Apple scab	Control of scab during rainy weather depends on frequent spraying from green-tip to bloom stages. Re-spray every 3 - 6 days. Start rust control sprays.
3	Pink Spray - apply when buds separate but before blooms open.	Captan - 2 lb Ferbam - 1/2 lb Ovex - 1/2 lb See Fireblight note. Ref. 2, 3, 6, 16, 21, 24, 42	Apple scab Cedar rust Quince rust Mites	For Control of apple flea weevil in Northern Kentucky, add DDT (50%), 2 lb.
4	Bloom Spray - apply when one-third of blossoms are open.	Ovex - 1/2 lb Ref. 16	Apple scab Blossom blight Rusts Mites	A long in-bloom period may require 2 sprays. Important for rust control.
5	Calyx Spray - apply when most petals have fallen. Complete before any calyx lobes close.	Captan - 2 lb Ferbam - 1/2 lb Ovex - 1/2 lb Lead arsenate - 3 lb Ref. 1, 5, 6, 8,11, 22, 23	Apple scab Apple blotch Cedar rust Sooty blotch Codling moth Curculio Leaf roller Mites	Repeat spray to upper third of trees of scab - susceptible varieties or if serious codling moth problem exists. Spray the same day if possible. Use malathion, 2 lb, if mites are present.

*Powdery mildew is a new disease. For control use wettable sulfur 4 lb and half-strenght of either Captan, ferbam, glyodin of mercurials in green tip and sprays 2 and 3; then use wettable sulfur 6 lb in sprays 4 and 5. Ref. 28.

SPRAY SCHEDULE FOR APPLES (cont.)

No.	Application	Materials (100 gallons)	To Control	Remarks
6	1st Cover Spray - apply 10 days after No. 5	Same as No. 5 but omit Ovex	Same as No. 5	Examine for apple blotch Important for curculio, blotch, scab and rust.
7	2nd Cover Spray - apply 10 days after No. 6	Captan - 2 lb DDT, 50% - 1 1/2 lb * Parathion, 15% - 1/2 lb (See important note below on the commercial mixture containing DDT and parathion.) See Ref. 12, 27, 37, 40	Same as No. 5 Also: Bitter rot and Leaf hoppers	Captan as a summer spray has given good disease control generally and has improved fruit finish, especially Golden Delicious and Jonathan - and reduced fruit cracking. Cease DDT sprays 30 days before harvest.
8	3rd Cover Spray - apply 10 days after No. 7	Same as No. 7	Same as No. 7	Examine fruit for leaf-roller injury. If present, add TDE (2 lb 50% powder or 1 qt of emulsion per 100 gal) to this spray. See Ref. 5, 15
9	4th Cover Spray - apply 12 - 14 days after No. 8	Same as No. 7 plus Aramite - 1 1/2 lb See Ref. 9, 16 and remarks.	Same as No. 7	Mites are frequently numerous by this time. Examine foliage with hand lens for mites. See Ref. 16
10	5th Cover Spray - apply 14 days after No. 9	Same as No. 7	Same as No. 7	Same as No. 9. In many orchards, mites are now one of the major problems.
11	6th Cover Spray - apply about 2 weeks after No. 10. Consult spray service reports. (Usually late June or early July.)	Captan - 1 lb DDT, 50% - 1 1/2 lb * Parathion 15% - 1/2 lb	Same as No. 7 (Start on 2nd brood codling moth.)	Same as No. 9; also examine for leaf-rollers. See Ref. 12, 17.
12	7th Cover Spray - apply 2-3 weeks after No. 11	Same as No. 11	Same as No. 7	Same as No. 11 See Ref. 12

Additional sprays to check codling moth, leaf roller, or mite populations may be necessary after spray No. 12. Check with spray service, and be on the alert for evidence.

* A commercial package mixture of these materials is avialable (Black Leaf 253). Its use is suggested at the rate of 2 1/2 lb per 100 gallons. Where the parathion is not used with the DDT 1 1/2 lb plus malathion (25% W.P.) 1-2 lb is also suggested as a substitute for DDT and parathion -- expecially for use on Golden Delicious. Ryania, 5-6 lb per 100 gallons is also recommended for second and third brood codling moth control, increase the DDT to 2 lb, but do not use DDT within 30 days of harvest.

Scab Control Note:

Where desirable other materials may be used for scab control, apply them at the times indicated in above schedule. Some suggested materials: liquid lime-sulfur, 2 gal in green-tip and pre-pink; and wettable sulfur 4 lb plus 1/2 lb of ferbam in the pink, bloom and calyx sprays. Also Mercurials or Glyodin and mixtures are satisfactory. See Reference Notes 39, 40, 41.

Fireblight Note: Streptomycin shows promise of control and is worth trying, following manufacturer's directions. Sprays should be applied when blossoms start to open and every 5-7 days during bloom period. Agrimycin and Agristrep are commercial preparations of this material.

LEAD ARSENATE APPLE SPRAY SCHEDULE FOR LIGHT CODLING MOTH INFESTATION

No.	Application	Materials (100 gallons)	To Control	Remarks
1-5	Dormant to First Cover	**Same as Standard Apple Spray Schedule**		
6	1st Cover Spray - Apply 10 days after calyx spray No. 5	Lead arsenate - 3 lb Wettable sulfur - 6 lb Ferbam 1/2 lb See Ref. 1, 5, 7, 11, 21, 22, 27, 34, 35, 36, 40	Apple scab Bitter rot Codling moth Curculio Leaf roller Apple blotch	Important for control of curculio, blotch, scab, and cedar rust.
7	2nd Cover Spray - Apply 10 days after No. 6	Lead arsenate - 4 lb Wettable sulfur - 6 lb Lime - 2 lb	Same as No. 6	On varieties susceptible to blotch, use either 4-6-100 bordeaux or 2 lb ferbam per 100 gallons.
8	3rd Cover Spray - Apply 2 weeks after No. 7	Lead arsenate - 4 lb or Ferbam - 2 lb or Captan - 2 lb See Ref. in No. 7	Same as No. 6	Examine fruit for leaf-roller. See Ref. No. 5. Captan for Bitter Rot.
9	4th Cover Spray - Apply about July 10 in eastern Kentucky. Consult spray service reports.	Same as No. 8	Same as No. 6 (Start on 2nd brood codling moth)	Examine foliage for mites. See Ref. 2
10	5th Cover Spray - Apply about 2 weeks after No. 9	Same as No. 8	Same as No. 6	May be omitted if bitter rot did not cause losses last year.
11	6th Cover Spray - Apply about 2 weeks after No. 10	Same as No. 8	Same as No. 6	Same as No. 10

PEAR SPRAY SCHEDULE

No.	Application	Materials (100 gallons)	To Control	Remarks
1	Dormant - Apply before buds swell.	Oil emulsion - 3 gal See Ref. 2, 4, 19	Scale Red mite (eggs)	Important if either one of these pests is serious.
2	Cluster Bud - Apply when blossom bud separates in cluster before bloom.	Ferbam - 1 1/2 lb See Ref. 21, 32	Scab Leaf Spot	Omit if neither is a factor.
3	Bloom - Apply when 1/2 to 3/4 of blossoms are open.	Bordeaux 2-6-100 See Ref. 25, 42	Fire blight	Important to control the blossom blight stage of fire blight.
4	Calyx - Apply when petals are off.	Lead arsenate - 3 lb Lime - 3 lb Microfine sulfur - 8 lb See remarks and Ref. 1, 7, 11, 21, 32	Scab Leaf spot Codling moth Curculio Slug	Coverage of clusters important. Ferbam, 1 1/2 lb may be substituted for sulfur in this and following sprays. If so, omit lime.
5	1st Cover - Apply 10 to 14 days after No. 4	Same as No. 4	Same as No. 4	Good coverage of both fruit and foliage important.
6	2nd Cover - Apply 14 days after No. 5	Same as No. 4	Same as No. 4	Omit if codling moth is not a problem.
7	3rd Cover - Apply about July 1 or see Spray Service Reports.	Same as No. 4	Same as No. 4	Important to control second-brood codling moth.

PEACH SPRAY SCHEDULE

Growers who do not wish to use parathion - see footnote
(DO NOT use Dieldrin for second brood curculio)

No.	Application	Materials (100 gallons)	To Control	Remarks
1	Dormant - apply in spring before buds swell.	Bordeaux 4-3-100 or Ferbam 2 lb	Leaf curl	Dormant oil not needed to control scale with this schedule. See Ref. 4
2	Pre-Bloom - apply when fruit buds show pink.	Wettable sulfur - 4 lb Phygon - 1/4 lb	Brown rot Blossom blight	Important where brown rot has been a problem.
3	Bloom - apply early to full bloom.	Wettable sulfur - 4 lb Phygon - 1/4 lb Dieldrin, 50% 1/2 lb	Brown rot Blossom blight "Catfacing" bugs	Important to prevent brown rot. Repeat sulfur and phygon sprays at 4-day intervals where blight or brown rot has been a problem. See Ref. 18
4	Petal-Fall - apply when petals are off.	Same as No. 3 but omit phygon	Same as No. 3 Also - Curculio	
5	Shuck-Split - apply when shucks begin to split.	Wettable sulfur - 6 lb Dieldrin, 50% - 1/2 lb	Brown rot Scab "Catfacing" bugs Curculio	Check trees for mites. See footnote. Peach scab infections start about 3 weeks after full bloom and continue through 2nd cover. If heavy rains occur, respray with wettable sulfur the following day.
6	1st Cover - apply when 3/4 of shucks are off (Shuck-fall).	Same as No. 5	Same as No. 5	
7	2nd Cover - apply 10 days after No. 6.	Wettable sulfur - 6 lb Parathion, 15% - 2 lb	Brown rot Scab "Catfacing" bugs Curculio Scales Leaf roller Oriental Fruit moth Mites	Parathion is extremely toxic to persons making application. Those using it should closely follow all printed precautions on the label. See mite note below. See Ref. 17

PEACH SPRAY SCHEDULE (Cont.)

No.	Application	Materials (100 gallons)	To Control	Remarks
8	3rd Cover - apply 10 days after No. 7	Same as No. 7	Same as No. 5	
9	4th Cover - apply 10 days after No. 8	Captan 50% - 2 lb Parathion 15% - 2 lb	Same as No. 5	Important to control second brood curculio.
10	5th Cover - month before harvest spray	Same as No. 7	Curculio Brown rot	Use 3/64 size discs to apply; a finely divided mist is needed.
11	6th Cover - apply 2 weeks before harvest	Captan, 50% - 2 lb See Ref. 36	Same as No. 10	See Ref. 40
12	7th Cover - apply 1 week before harvest	Same as No. 11		This spray should be repeated just before harvest if season is rainy and brown rot appears. Use 1 lb captan in this case.

Dieldrin and Parathion Note: Excessive dieldrin residues may result on peaches if dieldrin is used within 45 days of harvest; hence do not use for control of second brood plum curculio. Growers not wishing to use parathion may substitute malathion 25 %, 2 lb for parathion on sprays 9 and 10. If oriental fruit moth is serious, add DDT to the spray 9. See Ref. 12.

Mite Note: Important! Dieldrin is excellent for control of curculio and "cat-facing" insects and is suggested because it is safer to use than is parathion. However, orchard mites have in many cases increased alarmingly following the use of dieldrin sprays. Hence, peach growers using dieldrin should be on the alert for mite damage to their trees and be prepared to apply mite control sprays, if parathion or malathion fail to control them.

Peach Tree Borer Control: Apply sprays to the tree trunks on July 1, August 1, and September 1. Use 6 lb of 50% DDT per 100 gallons. For lesser peach tree borer control, see Ref. 9.

LEAD ARSENATE PEACH SPRAY SCHEDULE
(for light curculio infestations - see footnote on DDT)

No.	Application	Materials (100 gallons)	To Control	Remarks
1	Dormant - Apply in spring before buds swell.	Bordeaux 4-3-100 Dormant oil - 3 gal See Ref. 2, 4, 19, 29, 34	Leaf curl Scale Red mite (eggs)	Do not omit dormant oil when DDT is used.
2	Pre-Bloom - Apply when fruit buds show pink.	Wettable sulfur - 4 lb Phygon - 1/4 lb See Ref. 36, 38	Brown rot blossom blight	Important where brown rot has been a problem.
3	Bloom - Apply early to full bloom.	Wettable sulfur - 4 lb Phygon - 1/4 lb DDT 50% - 2 lb See Ref. 12	Brown rot blossom blight "Catfacing" bugs	Important to control brown rot at this time. Repeat sulfur and phygon sprays at 4-day intervals where blossom blight or brown rot has been a problem.
4	Petal-Fall - Apply when petals are off.	Same as No. 3 but omit Phygon	Same as No. 3 Also: Oriental fruit moth	Important to control brown rot.
5	Shuck-Split - Apply when shucks begin to split.	Wettable sulfur - 6 lb DDT 50% - 2 lb See Remarks	Same as No. 3	If jarring shows curculio are abundant, add lead arsenate, lime, and zinc sulfate as given in No. 5. See Ref. 7
6	1st Cover - Apply when 3/4 of shucks are off. (Shuck-fall)	Wettable sulfur - 6 lb Lime - 6 lb Lead arsenate - 2 lb Zinc sulfate - 4 lb See Ref. 7, 11, 27	Brown rot Curculio	Continue to jar for curculio.

LEAD ARSENATE PEACH SPRAY SCHEDULE (cont.)

No.	Application	Materials (100 gallons)	To Control	Remarks
7	2nd Cover - Apply 10 days after No. 6	Wettable sulfur - 6 lb Lime - 6 lb Lead arsenate - 2 lb Zinc sulfate - 4 lb See Ref. 30	Brown rot Scab Curculio	Watch for Oriental fruit moth; if already there, add 2 lb 50% DDT.
8	3rd Cover - Apply 14 days later, or time with Spray Service Reports.	Wettable sulfur - 6 lb Malathion, 2 lb	Same as No. 7 Also: Oriental fruit moth Mites	See Ref. 2, 16
	FOR PEACH TREE BORER CONTROL SEE REF. 8			
9	4th Cover - Month Before Harvest spray.	Same as No. 8	Same as No. 8	
10	5th Cover - Apply 2 weeks before harvest.	Wettable sulfur - 6 lb See Ref. 29	Brown rot	
11	6th Cover - Apply 1 week before harvest.	Same as No. 10	Brown rot	This spray should be repeated if season is rainy and brown rot appears.

NOTE on wettable sulfur: Captan, 50% - 2 lb may be substituted for wettable sulfur from No. 2 on, to improve fruit finish and color.

No.	Application	Materials (100 gallons)	To Control	Remarks
1	Dormant - Apply in spring before buds swell.	Oil emulsion - 3 gal See Remarks and Ref. 2, 4, 19, 32	Red mite (eggs) Scales	Add 8-8-100 bordeaux if black knot is found.
2	Bloom - Apply in early bloom.	Wettable Sulfur - 8 lb	Brown Rot Blossom blight	
3	Petal-Fall - Apply when petals are off.	Wettable Sulfur - 8 lb Dieldrin, 50% - 1/2 lb See Remark and Ref. 7, 18, 36	Leaf spot Curculio	Jar trees to determine presence of curculio.
4	Shuck-Fall - Apply when shucks begin to split.	Same as No. 2	Leaf spot Brown rot Curculio	
5	1st Cover - Apply 10 days after shuck-fall.	Same as No. 3	Same as No. 3	See Remark No. 3
6	2nd Cover - Apply 14 days after No. 4	Insecticides Wettable Sulfur - 6 lb See Ref. 16	Brown rot Curculio Mites	Examine foliage for mites. See Ref. 16. On Japanese and hybrid varieties use 6 lb wettable sulfur, 3 lb lead arsenate, and 6 lb lime.
7	3rd Cover - Apply 3 weeks before harvest.	Wettable sulfur - 6 lb	Same as No. 5	More frequent applications may be necessary to control brown rot if season is rainy.
8	Pre-Harvest - Apply 1 week before harvest	Same as No. 6	Same as No. 5	

CHERRY SPRAY SCHEDULE

No.	Application	Materials (100 gallons)	To Control	Remarks
1	Dormant - Apply in spring before buds swell.	Oil emulsion - 3 gal See Ref. 4, 20	Scale	Use Di-nitro compound at manufacturers' recommendation to control black cherry aphis. See Ref. 18.
2	1st Cover - Apply after shucks are off.	Ferbam - 1 1/2 lb Spreader-sticker - 2 oz Lead arsenate - 2 lb See Ref. 6, 11, 32, 35, 38, 43	Leaf spot Brown rot Slug Curculio	In some seasons, an earlier application may be advisable for leaf spot.
3	2nd Cover - Apply 2 to 3 weeks after No. 2.	Same as No. 2	Same as No. 2	If aphis is prevalent, add 1 lb of 15% parathion to spray. See Ref. 16.
4	After-Harvest - Apply after harvest as soon as fruit is picked.	Ferbam - 1 1/2 lb or Bordeaux 2-4-100 plus Summer oil - 1 qt	Leaf spot	Apply to protect foliage.

Note: Bordeaux (2-4-100) may be substituted for ferbam as a fungicide in the above schedule.
For leaf-spot control: A new material, Actidione, at 1 part per million in sprays Nos. 2, 3, and 4 is reported to give superior leaf-spot control in neighboring states.

GRAPE SPRAY SCHEDULE

No.	Application	Materials (100 gallons)	To Control	Remarks
1	Dormant - Apply before growth starts in spring.	Oil emulsion - 2 gal or Liquid lime-sulfur - 12 gal See Ref. 4, 19, 36	Scale	May be omitted if scale is not prevalent.
2	Delayed Dormant - Apply when new growth is about 1 inch long.	Bordeaux 4-6-100 DDT 50% - 2 lb or Ferbam - 2 lb DDT 50% - 2 lb Spreader-sticker - 2 oz See Ref. 12, 34, 37, 43	Black rot Mildew Flea-beetle	Apply 150-200 gallons per acre. Important for black rot control. See Ref. 2
3	Cluster-Breaking - Apply when shoots are 4 to 8 inches long.	Same as No. 2	Black rot	Very important for black rot control.
4	Pre-Bloom - Apply when first blossoms are opening.	Bordeaux 4-6-100 Summer oil - 2 qt or Ferbam - 2 lb Spreader-sticker - 2 oz See Ref. 12, 34, 37, 43	Same as No. 3	
5	Post-Blossom - Apply when bloom is nearly complete.	Same as No. 4 plus DDT 50% - 2 lb	Same as No. 3 Berry moth Leafhopper	Berry moth eggs beginning to hatch. Apply 200-250 gallons per acre.
6	Pea-Size - Apply just before berries touch, when size of peas.	Same as No. 5 plus Parathion 15% - 1 lb	Same as No. 5	Parathion will kill berry moth worms already in the berry

Note: Lead arsenate, 2 lb per 100 gallons, may be substituted for DDT all through this schedule. (See Ref. 2). If so, nicotine or DDT may be needed during the summer for leafhopper control.

Captan at 2 lb per 100 gallons seems to be satisfactory as a substitute for ferbam where desired.

Beware of 2,4-D since grapes are extremely sensitive to this material!

RASPBERRY SPRAY SCHEDULE

No.	Application	Materials (100 gallons)	To Control	Remarks
1	Delayed-Dormant - Apply in spring when leaflets are just unfolding.	Liquid lime-sulfur - 12 gal or Dry-lime sulfur - 20 lb See Ref. 4, 35	Anthracnose Scale	
2	Pre-Bloom - Apply at 10-day intervals from time new shoots are 4-5 inches high until well after bloom.	Ferbam - 1 1/2 lb See Remark and Ref. 11, 37	Same as No. 1	Add lead arsenate, 2 lb when plants are in full leaf.
3	Post-Bloom - Apply 7 days after full foliage.	Ferbam 1 1/2 lb Lead arsenate 2 lb	Same as No. 1 Saw flies	May be omitted if not a problem. Examine foliage with lens for mites. See Ref. 2, 16
4	Post-Harvest - Apply 2 sprays at 2 to 3 week intervals, as soon as old canes are removed.	Ferbam - 1 1/2 lb.	Leaf spot Anthracnose Mites	To maintain plant vigor.

STRAWBERRY DUST OR SPRAY SCHEDULE

(for Bearing Fields)

No.	Application	Materials	To Control	Remarks
1	Early Bloom - apply when plants begin to bloom.	Parathion - 1%* or Malathion 5% and DDT 5% (Either of above) plus Captan 7 1/2% See Ref. 13, 17, 40	"Catfacing" bugs Bud weevil Millipedes Mites Spittle bugs Crown borer Aphids Leaf-roller Leaf spot Harvest rots	Apply dusts at 40 lb per acre. Wettable powder may be used instead of dusts. Use 2 lb 15% parathion or use a mixture of 2 lb 50% DDT plus 4 lb 25% malathion per 100 gal. To either spray add 5 lb 50% captan. Agitate well during spraying. Apply 100 gal per acre.
2	General Bloom - about one-half bloom.	Same as No. 1	Same as No. 1	Same as No. 1
3	Petal-fall - apply after petals are off.	Captan only Same as No. 1	Leaf spot Gray mold, and other Harvest rots	Penetration of mulch important. Increase gallonage per acre, if possible.
4	Pre-Harvest - 1 week before harvest starts.	Captan only	Same as No. 3	
5	Summer Treatment - apply post harvest treatments during summer, if needed.	Same as No. 1, but omit captan See Ref. 2, 17	Crown borer adults Leaf beetle Leaf roller Mites	Examine for mites and leaf roller. See Ref. 17

*1% parathion will also help keep plantings virus-free when used through the season at 2-week intervals. See Ref. 17.

Note Regarding New Plantings: Protect new plantings from crown borers and other pests by making 4 to 5 applications of the dusts mentioned above at monthly intervals. If the field was treated with a soil insecticide prior to planting, crown borer and other soil-infesting insects would be controlled. Foliage applications in the new planting are needed only for control of aphids, mites, leaf-roller, strawberry weevil, and other lesser foliage pests.

spraying with parathion, quit spraying, take two atropine tablets at once, and go to a doctor.

Parathion can be used in the control of curculio, Oriental fruit moth, codling moth, leaf roller, mites, aphids, and scale "crawlers." At the rate used in the spray schedule, 1½ pounds per 100 gallons of water, it will control all of these insects. As a supplement for DDT, in codling moth control, parathion 15 percent wettable powder is suggested at ½ to 1 pound (plus DDT 1½ lb.) or as a total substitute at 1½ pounds. It may be used within 10 days of harvest. In the peach spray schedule, it is suggested for second-brood curculio control instead of dieldrin (see Ref. 18). For peach tree borer control use at 3 pounds per 100 gallons of water, applied as specified in Ref. 8.

Parathion russets Golden Delicious (also McIntosh and its relatives) when it is used in early season sprays; less russetting occurs when used late.

The following respirators give adequate protection against dusts and mists of parathion, demeton, EPN, TEPP, aldrin, dieldrin, chlordane, and nicotine, and can be obtained from the firms noted:

1. American Optical Company Respirator No. 5561 equipped with filter cartridge combination R-561. American Optical Co., Southbridge, Mass.
2. Mine Safety Appliances Co., Farm Spray Respirator No. CR-72183 equipped with cartridge No. CR-49293 and filter No. 73488. Mine Safety Appliances Co. 201 N. Braddock Ave., Pittsburg, Pa.
3. Willson Products, Inc. Agitox Respirator equipped with cartridge, No. 11A and filter No. R490, Willson Products, Inc., Reading, Pa.

18. Dieldrin

This is a toxic material that has long-lasting residual properties At the present time it is recommended only for control of first-brood plum curculio on apples, peaches, and plums; use at ½ pound of the 50% wettable powder per 100 gallons. Its use in this manner in the spray schedule will provide better plum curculio and "catfacing" insect control than other known materials; moreover dieldrin is one-fifth as toxic to the operator as parathion when used at the recommended dosage. Dieldrin is not recommended for second-brood plum curculio control. (WARNING—experience has shown that dieldrin encourages mite infestations.) Its use on apples is particularly recommended in orchards located close to sources of plum curculio infestations and to those orchards which have a past history of curculio infestations.

19. DN-289 and Other Dinitros

DN-289 is a non-oil dormant liquid that may be used on apples during the dormant stage. It is effective against aphid eggs, scales, and only somewhat effective against European red mite eggs. Use only before growth starts, on apples, at the rate of 2 quarts per 100 gallons of water. For control of black cherry aphis on cherries, use 1 quart per 100 gallons of water. Do not use on peaches.

Dormant oil, 3 gallons (actual), plus DNC, 1 pound (actual) may be used, instead of DN-289. This is effective against all scale, insects, aphid eggs, and European red mite eggs. Use before the buds are open.

20. Cold-Mixed Dormant Oil Emulsion

The most commonly used emulsifier combines bordeaux (fungicide) with oil. To prepare a 200-gallon tank, pour about 25 gallons of water in the tank, with agitator running, and add 2 pounds of powdered copper sulfate and 2 pounds of lime.

After the copper sulfate has dissolved and the materials are well mixed, add 6 gallons of oil (it should be of the following specifications: specific gravity at 20° C., 0.89 to 0.93; volatility at 110° C., not over 10% viscosity at 110° F.—Saybolt—90 to 120 seconds): this makes a 3% oil mixture. For a 2% mixture, add 4 gallons instead of 6. Run the mixture through the pump a short time. Then fill with water. It should be used soon after mixing: injury will result if mixture is allowed to stand overnight and then used.

APPLE DISEASES

21. Apple Scab

This is the worst apple disease in Kentucky; it causes damage to both the leaves and the fruits and is evidenced by black spots on each. Serious infestations will defoliate trees and ruin all fruits.

Apple scab spores develop in the spring on the old apple leaves which have fallen to the ground. Spores are discharged during times when soaking rains occur, usually about the bud-bursting period in the spring. Consequently, the most important scab control sprays are usually needed between the green tip bud stage and before blooming. Apple blossoms are also very susceptible to scab infections and sprays are often needed during a long blooming season when rains occur *during* that time.

Apple scab development is usually so active and apple foliage and buds are developing so rapidly during the pre-bloom period that scab sprays should be applied at not more than seven-day intervals during that period when rains occur.

Wettable sulfurs, ferbam, or dusting sulfurs have given good scab control where conditions were such that *frequent applications could be given regardless of rainy spells.* However, where sprays have to be delayed because of wet ground and unfavorable conditions, lime-sulfur or one of the mercurials is often needed to "burn out" scab infections that have started. Local experiences are usually the best indication of the type of material needed.

Early applications, well applied, will usually control the primary scab infections before or during blossoming. If this is done, little or no scab trouble is usually experienced later, although apple growers should be on the alert for the start of secondary scab spots later in the season if rainy conditions prevail.

If primary scab infections are not prevented or stopped by early applications, it is often impossible or very difficult to stop secondary infections during wet seasons. Consequently, it is generally considered

that the early (pre-bloom) sprays are the most important in controlling scab. It has been found with the Delicious variety, which is very subject to scab, and with possibly some others, that scab sprays should start in the green tip stage. With most other varieties, less susceptible to scab, sprays can start in the pre-pink stage. Usually considered very subject to scab are Delicious, Rome, Winesap, Stayman, McIntosh, Golden Delicious (leaves), and Cortland. Less subject to scab, or to some extent slightly resistant, are Yellow Transparent, Lodi, Polly Eades, Grimes, and Jonathan.

In any case, the number of sprays and the frequency of application should be governed by the amount of rain during the pre-bloom and bloom period. The more rain, the more frequently the sprays are needed.

22. Apple Blotch

This disease causes cankers on small twigs and limbs and cobwebby (radiating) spots on fruits. It is usually seen only on Duchess, Ben Davis, Maiden Blush, Cortland, Rome Beauty, and occasionally on Yellow Transparent. The fungus lives overwinter in the twig and limb cankers and the spores are spread from these cankers about 2 weeks after petal fall and continue to be given off for 6 to 8 weeks. Sprays starting at petal fall and continuing through the second or third cover period are needed to prevent fruit spotting.

Ferbam has proved to be outstanding in the control of apple blotch and is the suggested control material. Weak bordeaux mixture is also fairly effective against blotch and can be used where satisfactory or where ferbam is not available.

23. Sooty Blotch

This apple disease gives the surface of the fruit a sooty, stained appearance which reduces its grade and attractiveness but does not injure the flesh of the fruit. In general any weak summer fungicides added to the sprays from petal fall through the second or third cover will control the disease. Most all apple varieties are affected by the disease when summer fungicides are omitted from the sprays.

24. Cedar Rust and Quince Rust

These two diseases are closely related and overwinter on red cedar trees; the spores are blown to the apples during rainy weather, starting about the pink bud stage and continuing through the petal fall or first cover period. In turn, spores are blown from apples during late summer back to the cedar trees where infections are formed that carry the diseases through the winter. Cedar trees up to 3 miles distant are dangerous to susceptible apple varieties such as Rome, York, Jonathan, Wealthy, Cortland, Grimes, Delicious, Stayman, and several others.

Cedar rust causes raised spots on fruits and reddish yellow spots on leaves. Quince rust causes a serious wrinkled, withered, distorted condition and an internal browning of affected fruit and many of the infected apples drop soon after the petal fall stage. Quince rust causes no leaf spotting.

Ferbam is the first satisfactory material available for the control of these two diseases. When applied at 1 pound per 100 gallons in the pink, full bloom, calyx, first cover and possibly second cover sprays, it has materially reduced the losses. Or ½ pound of ferbam combined with 3 pounds of wettable sulfur per 100 gallons during the above times has served satisfactorily. These materials will also serve to control apple scab during these periods.

Where possible, it is a good practice to remove cedar trees in the vicinity of apple orchards.

25. Fire Blight

This destructive bacterial disease attacks both pears and apples. Young vigorous trees usually suffer the greatest damage but mature trees are attacked also. On susceptible varieties, the disease attacks and kills numerous blossom clusters as well as many tender vegetative twigs. The dead blossoms, leaves, and twigs turn black and remain on the tree through most of the growing season. The trouble is commonly seen in pears. The more susceptible apple varieties are Yellow Transparent, Jonathan, Grimes, Polly Eades, Wealthy, and some others. A spray of ½-1-100 bordeaux applied when about ⅓ of the blossoms are open has proved helpful in retarding this disease. A second spray might be advisable during a prolonged bloom period in plantings where losses have been heavy.

Growers with a severe fireblight problem may want to consider the limited use of streptomycin sulfate. (For more information see Ref. 42.)

26. Black Rot

The fungus that causes black rot on fruit also causes "frogeye" spots on leaves and cankers on limbs. The fruit rot first appears as firm brown spots around injuries, often near the calyx end, which later enlarge and become dark in color. Small black pustules appear on the surface of the rotted areas and the tissue remains firm. Leaf spots appear as concentric reddish-brown rings around grayish centers and are usually abundant below dead twigs and branches. Cankers are at first reddish-brown, slightly sunken areas containing black pustules. These slowly enlarge, becoming dark colored and they may eventually girdle limbs. Woody tissue which has been injured by fire blight is often infected by the black rot fungus. The fungus overwinters in the cankers. Pear and quince are also affected by this fungus.

Anything which reduces the amount of injury to the fruit, leaves, and limbs, such as good insect control, reduces the amount of black rot. Sanitation, complete removal of all dead wood, and removing drops are helpful in the control of black rot. A spray of 12-12-100 bordeaux in 3% oil in the dormant spray has shown promise as an effective means of reducing the amount of black rot, blotch, sooty blotch and other so-called summer diseases.

27. Bitter Rot

This disease usually appears on fruit during humid hot periods in the summer and fall, as brown, rotten spots which have a flat sur-

face. Spread from these spots by insects such as flies and by splashing rains is rapid. After bitter rot spots show up, it is often impossible to stop the spread of the trouble, for it has a long incubation period from the time the infestion takes place to the time the spots are visible. It is therefore very important to start bitter rot sprays early in orchards and blocks that have had a bad bitter rot history.

Growers should watch for the first appearance of bitter rot, and immediately hand-pick and destroy all spotted fruit, search out and remove the overwintering places, and spray the affected trees and neighboring trees. The overwintering places (old fruit stems, mummied fruits, cankers, and dead wood) will usually be found directly above the first rotted fruits. Bitter rot often starts on one certain tree each year. All of that tree's fruit is often lost with the disease spreading to other trees. The removal of such trees has often solved the bitter rot problem.

Growers who had loss from bitter rot last year should start applying captan 50%, 2 lb per 100 gallons, in second-cover, followed by other captan applications at 2-week intervals thereafter until 4 sprays have been applied. In commercial orchards where the full schedule of first-brood cover sprays is followed, frequent use of fungicides as called for in the cover sprays should control bitter rot.

28. Powdery Mildew—A New Apple Disease in Kentucky.

Powdery mildew has long been a serious problem in apple growing in some orchards in both the northeast and northwest sections of the United States. In 1956, for the first time, the disease showed up in apple orchards in several parts of Kentucky. The first symptom of powdery mildew is a cobweb-like, whitish covering on leaves and bark at the the ends of the new twigs. The disease injures the foliage, the set of fruit and later on causes damage to the fruit.

In sections where the disease has developed, it has been kept under control by the use of sulfur sprays (both liquid lime sulfur and/or wettable sulfurs) in early season and wettable sulfur on through the calyx and first cover sprays.

In order to control mildew and to avoid sulfur damage in hot weather, it is considered safe to combine half strength wettable (3 lb per 100 gallons) with half strength of one of the following: captan, glyodin, ferbam or a mercurial. Where use of liquid lime-sulfur is planned against mildew, it should be used in only one or two sprays before the pink stage of development. A material known as Karathane has also shown promise in control of powdery mildew as a summer spray, but it is still in the experimental stage as far as Kentucky is concerned.

PEACH DISEASES

29. Brown Rot

This disease causes severe damage to fruits of the peach, plum, and cherry and occasionally damages apples. In general, the disease lives over winter in mummied fruits that remain on the trees or which have fallen to the ground beneath the trees. At blossom time spores

develop from these old mummied fruits causing a blossom infection known as brown rot blossom blight. These blighted blossoms are killed, and the disease invades the tissue at their base, often causing drops of gummy wax to form. With each wetting by rain, spores are given off from this waxy infection. As the season progresses, the number of spores increases and the fruits become easier to infect as they approach maturity.

In recent years, more importance has been given to starting brown rot control in the pink bud and blossom stage rather than in the period just ahead of harvest, as was formerly done. Research work in Illinois in 1949 and 1950 has indicated that Phygon or a mixture of Phygon and wettable sulfur applied at the blossom stage was superior to other materials tested in reducing blossom blight on peaches. Research and commercial experience in Kentucky, Indiana, and some other states has also indicated that liquid lime-sulfur (1½ gallons per 100) will reduce the blossom blight stage of brown rot, In the schedule a spray of lime-sulfur is suggested in the pink bud stage followed by a blossom spray of the wettable sulfur-phygon mixture, for orchards where brown rot is serious. Sulfur in the other sprays through the season is thought to reduce the number of brown rot spores. Sprays of wettable sulfur or a combination of 3 quarts lime-sulfur and 3 pounds of wettable sulfur per 100 gallons 10 days to 2 weeks ahead of harvest and again 7 days and less before harvest are considered valuable in reducing fruit rotting at harvest and during transit.

The removal and destruction of all brown rotted fruits from the orchard, thus eliminating the overwintering mummies, is considered a very important step in controlling this disease.

30. Peach Leaf Curl

This disease affects peach leaves early in the season causing them to be swollen, distorted, and leathery and to fall from the trees. Leaf curl can be easily controlled by a fungicidal spray of either lime-sulfur, ferbam, or bordeaux mixture during the dormant season, before buds swell. Where a dormant oil spray is applied for scale control, ferbam or bordeaux mixture is often added to this for leaf curl control.

31. Peach Scab

This disease, also often referred to as "freckles," is a common peach trouble in Kentucky. The fungus causes dark greenish to black, freckle-like spots on the fruit; these are frequently numerous enough to blacken one side of the fruit completely. A few scab spots are not injurious but heavy infection may result in cracking and rotting. Infection takes place during wet periods when the fruit is about ½ inch in diameter. The disease has a long incubation period, and scab spots are not visible until about 8 weeks after infection. The disease is easily controlled by thorough applications of sulfur dust or wettable sulfur sprays applied when the fruit is about half an inch in diameter. Applications at the time of the shuck fall and 10 day period (first and second cover) will usually cover this period. Where sulfur is applied

in every application as an aid in brown rot control, peach scab is automatically controlled.

32. Bacterial Spot or Bacterium Pruni

Arsenical burning of peach leaves caused by lead arsenate sprays has often been confused with bacterium pruni leaf spot. Zinc sulfate and lime have been added to arsenical sprays to help reduce arsenical injury and this has been interpreted as controlling bacterium pruni.

Vigorous, well nourished trees with healthy foliage are more resistant to attacks of this disease. Mist-type sprays using small nozzles reduce the danger of spray injury often called "pruni shot."

A spray of copper sulfate (bluestone) using 4 pounds per 100 gallons followed by a lime spray (4 pounds/100) as soon as the copper spray dries has been effective when applied in the fall when the leaves are dropping. The lime spray must be applied as soon as the copper spray is dry in order to avoid injury.

OTHER DISEASES

33. Cherry Leaf Spot

This is the chief limiting factor to cherry production in Kentucky. The fungus overwinters in old leaves on the ground and the first infections appear on the new foliage early in the summer. Some of the affected leaves turn yellow and drop, and sometimes the tree may be practically defoliated. This results in a weakened condition of the tree, failure to form fruit buds and susceptibility to winter injury. The fruit on weakened trees suffers in size, color, and quality. Sprays of either ferbam, liquid lime-sulfur or bordeaux mixture as indicated in the schedule are control aids. The post-harvest sprays are the most important and virtually essential to long life. In dooryard plantings, raking and burning all leaves as they drop in late summer and fall, destroy the rewintering stage and keeps the disease under control.

34. Grape Black Rot

This is the most serious disease of grapes in Kentucky. It is carried over from year to year usually on the base of year old canes and is spread to the young shoots and leaves when growth starts in the spring. Infections on new canes a few inches long appear to carry the fungus over to the following year. These should be prevented by an early spray. Infection of the fruit stems, even before bloom, may result in loose clusters. The first conspicuous appearance of rot is on the half-grown grapes, as small, black or brownish spots that enlarge rapidly. Finally the berry becomes shriveled and mummified. Since infection takes place several weeks before it can be observed on the fruit, sprays must be applied early to be effective. Dry weather during the spring, when the spores are ordinarily spread, may prevent infection and this explains why there is little damage some years. Recently, ferbam or captan sprays have been found to give good black rot control without the leaf stunting and injury often caused by bordeaux mixture sprays. Hence, many growers are now using a ferbam or captan spray schedule on their grapes. It should be pointed out that

these materials are not effective against grape mildew but this disease is usually of little importance in Kentucky. Should mildew appear, one spray of bordeaux mixture (4-6-100) or fixed copper should control it.

FUNGICIDES

35. Bordeaux Mixture

This is an old standard fungicide made in the spray tank by the combination of copper sulfate (blue stone) and hydrated lime and water. Strengths of bordeaux mixture in general use are 1-2-100 and 4-6-100. In these formulas the first number indicates the pounds of copper sulfate, the second number the pounds of lime and the third number the gallons of water. Only fresh spray lime should be used in preparing bordeaux mixture. Bordeaux mixture can be prepared in the spray tank by the following method. Fill tank 1/8 to 1/4 full of water, start engine and agitator and slowly add the desired amount of *powdered* copper sulfate. This will dissolve quickly. Then slowly add the desired amount of lime water as the tank is filled. Other materials as needed can then be added and the spray applied. Bordeaux is a safener for lead arsenate.

Because of the damage to the finish on Golden Delicious apples, frequent summer foliage damage and special damage when applied to mite injured foliage, the summer use of bordeaux mixture has sharply declined generally in mid-western states.

36. Wettable Sulfurs—Liquid and Dry Lime-Sulfur

These are available under a number of trade names. These very finely ground sulfurs are mixed with a wetting agent so they can be readily mixed with water. These sulfurs are helpful in preventing infections of apple scab, peach scab, and brown rot on peaches, plums, and cherries.

The wettable sulfurs are milder and cause less foliage injury than liquid lime-sulfur and are correspondingly less effective in apple scab control. When wettable sulfurs, sulfur paste or dusting sulfurs are used in apple scab control, it is necessary to make earlier and more frequent or timely applications than when liquid lime-sulfur is used. This is because the milder sulfurs can only prevent scab infections while liquid lime-sulfur is caustic enough to "burn out" small scab infections after they have started.

Because of their mildness, wettable sulfurs are used for in-bloom sprays on apples for scab control and on peaches for brown rot blossom blight control. Also, since lime-sulfur is more caustic to apple foliage as the season becomes warmer, its use in Kentucky is now chiefly confined to pre-bloom sprays on apples while wettable sulfurs and other materials are favored for use in the petal fall and later sprays.

A combination of wettable sulfur and ferbam is helpful in preventing cedar apple rust and quince rust on apples and when mixed with Phygon, wettable sulfur is more effective in reducing the blossom blight stage of brown rot on peaches.

Liquid Lime-Sulfur: Because liquid lime sulfur is disagreeable to use, difficult to store and handle, often difficult to obtain, and is caustic to foliage, its use is becoming less general. Some growers who can still obtain lime sulfur and who have found it satisfactory in some special spray are continuing its use.

Dry Lime-Sulfur: Where available and where a fungicide is needed that has many of the properties of liquid lime sulfur, dry lime sulfur is useful.

37. Ferbam

Ferbam is now the one accepted name for the following several trade names applied to the same material, *Fermate, Karbam,* and *Ferradow*. The use of the name "ferbam" was decided upon nationally to reduce the confusion.

Ferbam is of special interest because of its ability to control cedar apple rust and quince rust, apple blotch, grape black rot, cherry leaf spot and as an aid in apple scab and bitter rot control. In apple scab control, ferbam has given results similar to wettable sulfur and has to be used frequently during rainy periods.

Ferbam is a safener for lead arsenate and hence can be used alone with this material. Ferbam can also be combined with wettable sulfur and summer oil, but should not be used with bordeaux mixture or lime.

38. Phygon

One-fourth (¼) pound of Phygon mixed with 4 pounds of wettable sulfur has shown some ability to reduce brown rot blossom blight as well as brown rot at harvest season. Its suggested use in the Kentucky spray program is limited to this mixture. Such a Phygon-sulfur mixture is available from commercial sources; on the other hand, if it is more convenient, the wettable sulfur and the Phygon could be bought separately and combined in the spray tank in the proper amounts. Phygon is irritating to the skin of some people. It should therefore be used with caution and in accordance with the manufacturer's instructions.

39. Mercurials

"Puratized Agricultural Spray," "Puratized Apple Spray" and "Tag 331" are three relatively new materials that have given especially good scab control in Illinois, Indiana, and Kentucky. Since these materials contain mercury, manufacturer's directions specify use only early in the season. All of these materials are effective in "burning out" scab infections and do not cause spray injury under conditions of slow drying and high humidity as does liquid lime-sulfur. They do not afford protection for more than a short period of time. They are also very effective when used at half strength when mixed with half strength captan or half strength glyodin.

40. Captan

Captan has been particularly effective in controlling bitter rot of apples in Kentucky. It is also effective for the control of apple scab.

It is compatible with most insecticides and fungicides except oil and hydrated lime or other highly alkaline materials. It has been particularly valuable in providing fruit with good finish on Golden Delicious and other varieties which are very susceptible to russetting.

It is recommended also for peaches and strawberries. On peaches, used in the latter sprays, it noticeably improves finish and gives excellent control of brown rot. On strawberries, apply either the 50% wettable powder or 7½% dust at a rate of 3-4 pounds of actual captan per acre per application. These applications should be about 30, 20, and 10 days ahead of harvest.

41. Glyodin

Glyodin is the name for the active ingredient of the commercial preparation "Crag Fruit Fungicide" or "Crag 341". It is used at the rate of 1 quart to 100 gallons in the delayed dormant through petal fall sprays for apple scab. If used in the cover sprays, the concentration should be reduced to 1½ pints in 100 gallons. It and mercurials are frequently used together at half strength each. See reference 39. Where cedar rust is a problem, ½ pound of ferbam should be added.

42. Antibiotics

Much work has been done in some states with antibiotics for fireblight control and some growers have tried streptomycin sulfate with good results. It should be used at 50 to 100 parts per million. Apply first in the pink stage at 5- to 7-day intervals during blooming. This drug is available under the trade names "Agrimycin," "Agristrep," and "Phytomycin." Until more data is available, do not use it in combination with other materials. Follow directions on label carefully.

43. Spreaders and Stickers

Small amounts of additional materials are often helpful in spreading and sticking spray materials to the fruits and foliage. Use according to directions for an excess may cause an excess run off. DuPont spreader-sticker is very satisfactory; use at 2 oz per 100 gallons. Summer oil, at the strength of one or two quarts per 100 gallons is helpful in spreading and sticking bordeaux mixture sprays. With grapes and raspberries, one-fourth pound of soybean flour per 100 gallons is effective in spreading and sticking ferbam. For liquid lime-sulfur sprays, 3 ounces of Santomerse-S per 100 gallons is helpful as a spreader.

44. Compatability Chart

See next page.

45. Orchard Mouse and Rabbit Control

Meadow mice and pine mice often cause serious damage to the base and roots of fruit trees. It is always wise to examine the floor of the orchard in the fall for mice runways on the surface and tunnels (pine mouse) under the surface.

Mouse Control: Two types of poisoned bait are commonly used to bait orchards for mouse control. Both materials, (1) zinc phosphide powder and (2) strychnine-treated oats are available through the U. S. Fish and Wildlife Service, North Carolina State College, Raleigh, N. C. One teaspoon of the zinc phosphide powder is sprinkled over one quart of chopped apples or carrots. The bait pieces are placed singly (using an ice pick or sharp stick) in the runways, under mulch or in tunnels, also under 18-inch square pieces of roofing paper placed over the runways near trees. The strychnine-treated oats are used as they are received and are placed about as are the zinc phosphide-fruit baits. Bait the whole orchard. Re-examine and re-bait the orchard every 6 weeks during the winter if evidence of mice or mouse damage continues. Grass and weeds should be removed from the base of all trees each fall for a 2-foot distance around each tree, as an added precaution in orchard mouse control.

Rabbit Control: Rabbits frequently cause serious damage to young fruit trees and nursery stock during winter. A sleeve of galvanized hardware cloth (wire, 4 meshes per inch) extending from the ground well up to the crotch will keep the rabbits off. Also, wrapping the trunks with newspaper or wrapping paper will prevent rabbit damage and also protect against certain wood-boring insects.

Certain washes and preparations are also available that discourage rabbit damage.

COMPATIBILITY CHART FOR ORCHARD

INSECTICIDES AND FUNGICIDES

Aramite	BHC	Bordeaux Mixture	Captan	Chlordane	DDT, Dieldrin, Methoxychlor	Dimite	Glyodin (Crag 341)	DN 289	Dormant Oil	EPN 300	Ferbam	Hydrated Lime	Lead arsenate	Lime sulfur	Organic mercuries	Parathion, Malathion, Demeton	Phygon XL	Sulfur	Summer oil	TDE	TEPP	Zineb
x																						
-	.																					
.	x	-																				
x	x	.	x																			
x	x	.	x	x																		
o	x	x	x	x	x																	
x	.	x	-	.	x	x																
o	o	o	o	o	o	o	o															
o	o	x	o	o	o	o	o	-														
o	x	.	x	x	x	x	x	o	o													
x	x	-	x	x	x	x	x	o	o	x												
-	.	x	-	.	.	x	x	-	x	.	-											
x	x	x	x	x	x	x	.	o	o	x	x	x										
-	.	-	-	.	.	x	o	o	-	-	-	x	x									
o	x	-	x	x	x	o	x	o	o	-	x	-	x	-								
x	x	.	x	x	x	x	x	o	o	x	x	.	x	-	x							
x	x	-	o	x	x	x	x	o	o	x	o	-	x	-	o	x						
x	x	x	x	x	x	x	x	o	-	x	x	x	x	x	x	x	x					
x	x	.	-	-	x	x	-	o	o	o	x	x	x	-	-	o	-	-				
x	x	.	x	x	x	x	x	o	o	x	x	.	x	.	x	x	x	x	x			
x	x	-	x	-	x	x	x	o	o	x	x	-	x	-	.	o	x	x	o	x		
.	x	-	.	x	x	x	x	-	-	x	x	-	x	-	x	x	-	x	-	x	x	

Key to symbols

x Materials can be used together.

- Materials cannot be used together.

. Materials are physically compatible, but the residual effectiveness of either or both would be reduced.

o There is no need to use materials together, or they should not be used together because of increased toxicity to the operator.

How to use this chart

This chart is made on the same principle as a mileage chart. For example, if you want to know whether captan and hydrated lime can be used together, read down the column headed "captan" until you get to the row labeled "hydrated lime." The minus sign (–) where the two meet indicates that the materials are not compatible and should not be used together.

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