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**GENERAL-PURPOSE SPRAYS FOR HOME
FRUIT PLANTINGS**

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There has long been a need for a general-purpose spray for home fruit plantings but with the older insecticides and fungicides it was impossible to formulate a mixture which would satisfactorily control the major pests and at the same time be reasonably safe on all crops.

For example, Bordeaux mixture and more recently the proprietary low soluble copper compounds were necessary to control black rot of grapes but when used early in the season on apples were likely to severely russet the fruit and to cause heavy leaf-fall. On peaches these copper sprays almost certainly would cause serious injury. Lead arsenate must be used with an arsenical corrective to avoid risk of serious injury to peaches. The most effective safener is zinc-lime mixture which is not safe on apples in the early season scab sprays and under certain conditions has caused injury to grapes. Other of the older insecticides such as nicotine, pyrethrum and rotenone have such short periods of effectiveness as to be of little value against several of the major fruit insects.

With the more recently developed organic fungicides and insecticides, combinations of materials which have a greater range of usefulness in spraying home plantings of fruit are now possible. In preparing mixtures of these materials for general use, it is necessary to take into consideration several important factors. These are:

1. The effectiveness of the materials on the insects and diseases to be controlled.
2. The safety of the combination on plants.
3. Compatability of the materials.
4. Safety to the person applying the spray.
5. Make provisions for the handling of new insect problems arising from the use of the chlorinated hydrocarbons such as DDT.

Two General-Purpose Combination Sprays

From information available in the spring of 1949 two combinations of pesticides which seemed to most nearly meet the require-

ments of a general-purpose spray were tested this year on the fruit crops most commonly grown in Missouri.

Formulation No. 1

Material Used	Lbs. for 100 gals. of dilute spray	
	Proprietary Product	Actual Toxicant
Ferbam* (ferric dimethyldithiocarbamate) - - - - -	1 1/2 lbs.- - - - -	-1.14 lbs.
DDT (technical dichloro-diphenyl-trichloroethane) 50% wettable powder - - - - -	1 1/2 lbs.- - - - -	-0.75 lb.
DDD (technical dichloro-diphenyl-dichloroethane) 50% wettable powder - - - - -	1 1/2 lbs.- - - - -	-0.75 lb.
Microfine sulfur, 95% wettable powder - - - - -	1/2 lb. - - - - -	-0.48 lb.
Lindane (gamma isomer of benzene hexachloride) A commercial product containing 25% of Lindane was used at the rate of - - - - -	1 lb. - - - - -	-0.25 lb.

Formulation No. 2

Material Used	Lbs. for 100 gals. of dilute spray	
	Proprietary Product	Actual Toxicant
Ferbam* (ferric dimethyldithiocarbamate) - - - - -	1 1/2 lbs.- - - - -	-1.14 lbs.
DDD (technical dichloro-diphenyl-dichloroethane) 50% wettable powder - - - - -	1 1/2 lbs.- - - - -	-0.75 lb.
Microfine sulfur, 95% wettable powder - - - - -	1/2 lb. - - - - -	-0.48 lb.
Methoxychlor (technical methoxyphenyl trichloro- ethane) 50% wettable powder - - - - -	1 1/2 lbs.- - - - -	0.75 lb.

* The group name for such commercial products as Fermate, Ferradow and Karbam black based upon ferric dimethyldithiocarbamate.

These two combinations were used in three home fruit plantings or their equivalent.

Experimental Planting No. 1

Horticulture Department's Experimental Home Fruit Planting

Using proprietary products, the two formulations of pesticides were prepared in dry form in advance of the time of application and allowed to remain in a warm room for a time in order to determine whether the safety of the materials to plants was affected by pre-mixing the chemicals at concentrations that ordinarily would be used in compounding.

Four applications were made on the following fruit crops:

Apple	Grape	Gooseberry
Peach	Raspberry	Strawberry
Plum	Blackberry	
Cherry	Currant	

No injury occurred on any of the crops except sulfur injury on grapes. Damage to the foliage was evident but not heavy on Concord and Fredonia and was slight on Herbert and Ontario. In a variety collection vineyard in another planting, two applications of an equivalent amount of sulfur caused more injury than is desirable to the leaves of Concord and Fredonia but only slight injury to Herbert and other varieties containing considerable of the *Vinifera* species. Norton and Cynthinana of the *aestivalis* species were severely injured. Injury in general was so great that sulfur was omitted from all subsequent sprays.

Gooseberries and currants sprayed with these mixtures retained their leaves in a green healthy condition much longer than usual.

Insects and diseases were not serious enough in this planting to obtain reliable information on control.

Experimental Planting No. 2

Pears, apples, peaches, plums, cherries, and grapes were included in this orchard where formulae Number one and Number two were used, starting in the cluster bud stage of apples and continuing through the fourth cover. All crops were sprayed on the same schedule, using the apples, which predominated, as the basis for timing the applications. Due to the appearance of sulfur injury to the grape foliage after the second application, the sulfur was omitted in all later sprays. Two pounds of 50% DDD and two pounds of 50% methoxychlor were used in Formulation Number 2 instead of 1 1/2 pounds.

The spray schedule at the No. 2 orchard was as follows:

Cluster bud	April 13	2nd cover	May 30
Calyx	May 5	3rd cover	June 13
1st cover	May 16	4th cover	July 8

The following table gives the results of codling moth and plum curculio control.

RESULTS OF CODLING MOTH AND PLUM CURCULIO CONTROL

Kind of Fruit	No. of fruits in Sample	Date	Formula No. 1		Formula No. 2	
			Percent damaged Fruits		Percent damaged Fruits	
			Curculio	Codling Moth	Curculio	Codling Moth
Peach	75	5/20	20%		9.3%	
Plum	75	5/20	17%		9.3%	
Cherry	100	5/20	12%		1.0%	
Apple	100	5/20	1%	0	1.0%	0
Apple	250	9/6	10%	2.8%	5.0%	3.2%

The apples in this planting were free from scab in both plots. There was some russet on the Golden Delicious where Formula No. 2 was used but not severe enough to be objectionable on fruit for home use. Injury was less where Formula No. 1 was used. There was no appreciable injury to other varieties. The only case of foliage injury, except slight sulfur injury on grapes, was on gooseberries following the first application of Formula No. 2. The injury appeared as a severe yellowing of the leaves.

Experimental Planting No. 3

This planting was chosen because there were apples with plums adjoining that had not been sprayed the previous season. As a result codling moth and plum curculio were abundant. The orchard had a number of varieties present such as Yellow Transparent, Jonathan, Rome Beauty, Golden Delicious, Winesap, Stayman, Maiden Blush and York. It was possible to observe the effect of the sprays on a number of varieties.

Two row plots were used and as many trees sprayed with each formulation as a 200 gallon tank would cover. Two pounds of 50% methoxychlor were used instead of 1 1/2 pounds as listed in Formulation No. 2.

This planting was sprayed on the same schedule as Planting No. 2 using the same materials except that liquid lime sulfur alone was used in the cluster bud application. The 1/2 pound of microfine sulfur was continued through the 5th spray and omitted in the 6th.

The following table gives the results on Planting No. 3:

RESULTS OF PLANTING NO. 3

Kind of Fruit	No. of fruits in Sample	Date	Formula No. 1		Formula No. 2	
			Percent damaged Fruits		Percent damaged Fruits	
			Curculio	Codling Moth	Curculio	Codling Moth
Transparent Apples	500	6/21	7.0%	0	1.2%	.2%
Red June Apples	300	6/21	6.6%	0	.4%	0
Plums	50	6/21	62.0%	-	2.0%	-
Plums	Check	6/21	100.0%	-	-	-
Jonathan Apples	500	9/28	-	3.6%	-	2.2%
Golden Delicious	500	9/28	-	-	-	2.0%

By way of comparison the lead arsenate plot of Golden Delicious had 9.3% of the apples injured by codling moth.

There was more russet on Golden Delicious with Formula No. 2 than with Formula No. 1. Neither of the two formulations seemed to

increase russeting on varieties other than Golden Delicious.

All spray formulations were made by adding each material to the spray tank at the time of application.

Modifications in Original General-Purpose Sprays

Sulfur was included in the original general-purpose sprays to add to the fungicidal effectiveness of the mixtures and to control red spider (two-spotted mite). Preliminary tests in 1948 indicated one-half pound of sulfur to be safe on Concord and related varieties of grapes but such was not the case this year. Although damage to the foliage was not great in all cases it was severe enough in others to make undesirable the inclusion of sulfur in combination sprays to be used on varieties of American grapes. Where there are no grapes to be sprayed, or if you prefer to spray them separately, include sulfur at the rate of 1/2 lb. microfine wettable powder. Its addition is desirable for the other crops listed. To spray grapes separately use Ferbam at 2 lbs. to 100 gals. (1/2 cup to 5 gals.) with DDT at 2 lbs. to 100 gals. (7 tablespoons to 5 gals.).

Methoxychlor has been found to be appreciably more effective against plum curculio than Lindane. Since curculio is a major pest on peach and plums, important on cherries and increases in severity on apples where DDT is used it has been deemed advisable to increase the dosage rate of methoxychlor to two pounds to 100 gallons.

With these changes, the two general-purpose sprays now suggested are as follows:

Formula No. 1

For 100 gals. of dilute spray.

Ferbam - - - - -	1 1/2 lbs. (Actual Toxicant 1.14 lbs.)
DDT (50% wettable powder) - - -	1 1/2 lbs. (Actual Toxicant 0.75 lb.)
DDD (50% wettable powder) - - -	1 1/2 lbs. (Actual Toxicant 0.75 lb.)
Lindane (25% wettable powder)*	1 lb. (Actual Toxicant 0.25 lb.)

* Other preparations according to Lindane content.

Formula No. 2

For 100 gals. of dilute spray

Ferbam - - - - -	1 1/2 lbs. (Actual Toxicant 1.14 lbs.)
DDD (50% wettable powder) - - -	1 1/2 lbs. (Actual Toxicant 0.75 lb.)
Methoxychlor (50% wettable powder) - - -	2 lbs. (Actual Toxicant 1.00 lb.)

The No. 2 formula is not very effective against aphids but more effective in controlling curculio. Since curculio is much more important in Missouri than aphids the No. 2 formula is preferred for our conditions.

* Add Ferbam at the rate of 2 lbs. in 100 gallons or 1/2 cupful in 5 gallons to control both scale and leaf curl on peaches.

Neither of these formulae are adequate as dormant sprays for the control of scale insects, nor do they provide for the control of mites (red spider and European red mite) which may become a problem as a result of the use of these general-purpose sprays. Special sprays will be needed for the control of these pests.

Purpose of the Materials

Ferbam was chosen as the fungicide since previous work has shown it to be the most effective material that is safe on all fruit crops commonly grown in this section. It has been found to be more effective against cedar rust on apples than any other fungicide except some closely related compounds which are not as safe on fruits in general. It is highly effective against black rot of grapes, apple blotch and raspberry anthracnose and will adequately control apple scab, cherry leafspot and brown rot of cherries, peaches, and plums most years in home fruit plantings. Ferbam is not very effective against downy mildew of grapes but this disease is seldom of economic importance in Missouri.

DDT is primarily for the control of codling moth and leaf hoppers on apples; and, berry moth, leaf hoppers, and leaf folder on grapes. Since the use of DDT favors build-up of the red-banded leaf roller, DDD is included for the control of this insect. Lindane is for the control of curculio but is also effective against aphids. Methoxychlor serves to take the place of DDT and Lindane except for the control of aphids.

Suggested Spray Programs

Special Sprays. Dormant sprays should be applied to apples, pears, peaches*, plums, cherries, and currants for the control of scale and in some cases European red mites. Use a miscible dormant oil at the rate of 3 gallons in 100 gallons of spray or 2 1/2 cups in 5 gallons.

Apply in early spring just before growth starts and at a time when the spray will dry before freezing.

Mite Spray. Mites may become numerous enough during July and August to require control measures.

For mite control use DN 111 at 1 1/4 pounds per 100 gallons (3 1/2 tablespoons in 5 gallons) on Arathane at 1 pound per 100 gallons (6 tablespoons in 5 gallons).

General-Purpose Sprays. Suggestions for the use of the general-purpose sprays on the various fruit crops are as follows (For Formula No. 1 as outlined on page 6, use 5 1/2 lbs. to 100 gals. of water or a strong 1/4 lb. to 5 gals.; for Formula No. 2, use 5 lbs. to 100 gals. or 1/4 lb. to 5 gals.).

When to Apply

Apples. When most of the blossom buds show pink. When most of the petals have fallen. About every two weeks until the last of June or early July. This usually will be a total of six sprays. Do not spray summer varieties within three weeks of harvest time.

Pears. When most of the petals have fallen. Two or three more sprays at about two-week intervals.

Peaches and Plums. When the petals have fallen. Apply three more sprays at about 12 to 14 day intervals. To more effectively control brown rot on the fruit use wettable sulfur beginning about one month before ripening time. Apply sulfur at 7 to 14-day intervals up to picking time. With wet weather at this time follow the shorter interval (7 or 8 days between sprays). Use microfine wettable sulfur at the rate of 2 lbs. in 50 gals. (1 level cupful in 5 gals.) or at the rate given on the package.

Note: Do not use the general-purpose spray within one month of picking time.

Cherries. When the petals have fallen. One or two more sprays at 10 to 14-day intervals depending upon the development of the fruit. Do not apply these sprays after the fruit has started to color. Apply one and preferably two sprays after the fruit has been harvested.

Grapes. Start spraying when most of the new shoots are 1/2 to 1 inch long and continue spraying at 12 to 14-day intervals until two or three weeks after bloom but if possible avoid spraying when in full bloom.

Raspberries, Dewberries, Boysenberries, Gooseberries, and Currants. Start spraying when the first leaves begin unfolding and continue at 10 to 14-day intervals until blooming begins. Do not apply these sprays after the fruit has started to develop.

By varying a few days the time for applying some of the sprays on certain crops it is possible to spray many of the fruits at the same time. Such adjustments will have to be made by each grower to fit the season and the kinds and varieties of fruits being grown.

These combination sprays have not been tested extensively enough to determine their degree of safety under widely varying weather conditions and on the many different kinds and varieties of fruits that may be found in home plantings. They are being suggested because of the many requests that have been received for a general-purpose spray. Present information indicates that they are generally safe and effective but if at any time noticeable injury appears, discontinue the spray on the affected variety or varieties.