

CONCENTRATED SPRAYS
FOR
APPLICATION BY MIST BLOWERS
FOR
CONTROL OF FOREST, SHADE
AND
FRUIT TREE PESTS

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Concentrated Sprays for Application by Mist Blowers for Control of Forest, Shade and Fruit Tree Pests

S. F. Potts¹ and Philip Garman²

During the last decade there has been considerable progress in the design of aerial equipment to apply insecticides in small volumes per unit area. Hundreds of thousands of acres of forests and agricultural crops are now being treated annually with aircraft using in some cases as little as one-half gallon of spray per acre.

Within the last five years ground-operated spraying equipment, notably mist blowers, has been developed for applying insecticides and fungicides in extremely small volumes. Such machines have been found to be more efficient and economical than hydraulic sprayers for the control of certain pests. When insecticides are applied with hydraulic sprayers, it has been found, in the Northeastern States, that from 500 to 700 gallons of spray are required to cover an acre of deciduous woodland. Apple orchards require 200 to 300 gallons per acre during the dormant period and 400 to 600 gallons in the summer. Large shade trees may require from 30 to 50 gallons of spray per tree. With mist blowers, a wooded area may be covered with as little as 1 gallon of spray per acre, or a large shade tree with 1 pint of spray material. Large apple trees may require 1 to 2 gallons per tree. Sprays for use in these blowers may, therefore, be much more concentrated than those applied with hydraulic sprayers.

With the rapid development and manufacture of mist blowers, there is a growing demand for information on the formulation of concentrated sprays for use in them. The purpose of this paper is to report the progress that has been made in formulating concentrated insecticidal and fungicidal sprays suitable for use in machines that apply low volumes of liquid. The formulas given are primarily for the control of forest and shade tree insects and for fruit pests, but they may be used effectively for control of many other similar pests. Although they were developed for use in mist blowers, many of them are suitable for use in aircraft as well.

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GENERAL PROCEDURE FOR PREPARING CONCENTRATED SPRAYS

Concentrated sprays may be prepared as solutions, suspensions, or emulsions. Most of the formulations contain accessory materials such as solvents, emulsifying agents, adhesives, or wetting, spreading or suspending agents.

Some insecticides and fungicides are water-soluble, but others require chemical solvents, such as xylene, benzene, kerosene or fuel oil, or proprietary materials, such as Velsicol or P.D. 544.

Emulsifying agents are compounds that make it possible to suspend and mix one or more liquids in one or more other liquids, such as oil droplets in water. Most of the emulsifiers in use are proprietary materials, such as Triton X-100, Vastol O.T., Tween and Igepal.

Adhesives are compounds that increase the sticking quality of spray droplets or solid particles of the insecticide or fungicide in the spray mixture. Some of the most important adhesives are drying oils, such as fish oil or soybean oil, dissolved casein, and Wyoming bentonite plus powdered skim milk.

Wetting and spreading agents reduce the surface tension of liquids and consequently increase the spreading or coverage of spray deposits on plants. However, they tend to increase the rate at which solid particles settle out in liquids. Some of these agents are Santomerse D, and S, Ultrawet, Aresket, and Daxads Nos. 11 and 14.

Suspending agents help to hold solid particles in suspension in a liquid, thus reducing their settling rate. Daxad No. 27, blood albumin and Wyoming bentonite are examples of suspending agents.

Solutions are prepared by adding the insecticide or fungicide to the solvent. Stirring is usually required to hasten the dissolving process. When two solvents are used as, for example, in a DDT-auxiliary solvent-oil formulation, the pesticide should be dissolved in the auxiliary solvent before the oil is added.

In suspensions of wettable powders the solid particles of insecticide or fungicide are suspended in the liquid. The powdered insecticide or fungicide is added to the liquid rather than the reverse of this procedure. If accessory materials are required, they are added last. Suspensions must be stirred frequently to prevent the solid materials in the spray from settling out. The arsenicals, wettable sulfur and wettable DDT are prepared as suspensions.

Emulsions are prepared by first adding the emulsifier to the solvent, dissolving the insecticide or fungicide in this mixture, and finally adding sufficient water to make the desired quantity of spray material.

As a general rule, when a small volume of one material is to be mixed with a larger volume of another material, the smaller quantity is added to the larger quantity.

CONCENTRATED SPRAY FORMULAS

The concentrated spray mixtures that have been tested in the field against insect pests and plant diseases are given in the following tables. From the foregoing discussion these formulas will be readily recognized as solutions, suspensions or emulsions. The active principle is listed first followed by the accessory materials and finally by the water or oil carrier. The quantities of ingredients to make 1 gallon of spray are given, together with their mixing sequence. The user can compute the quantities required for larger volumes.

Proprietary accessory materials are indicated in many of the formulas. This seemed to be necessary where quantities of ingredients are given, but such materials are not recommended to the exclusion of other similar materials.

The formulas are numbered in order to facilitate later reference to a specific formula for control of a specific pest.

Insecticides

ARSENICALS

Formula No.	Ingredients	Quantity for 1 gallon	Mixing Sequence
1	Lead arsenate or Calcium arsenate	1½ lb.	2
	Drying oil	4½ oz. }	3
	White mineral oil	1½ oz. }	1
	Water	7 1/3 pt.	
2	Lead arsenate	3 lb.	3
	Santomerse D	1 oz.	2
	Drying oil	9 oz. }	4
	White mineral oil	3 oz. }	1
	Water	6½ pt.	

The drying oil acts as an adhesive, and the mineral oil prevents the spray droplets from drying out too rapidly. Drying oils include fish oil, cottonseed oil and soybean oil.

By increasing the amount of wetting agent (Santomerse D), it is possible to prepare a more concentrated spray than indicated in Formula 2. As much as 6 pounds of lead arsenate has been incorporated in a gallon of spray mixture. When calcium arsenate is used, 2½ pounds is the maximum that may be mixed in a gallon of spray.

Lead arsenate mixtures are compatible with wettable DDT, wettable sulfur, benzene hexachloride, basic copper sulfate, ferbam¹ and ziram.²

¹ Ferric dimethyl dithiocarbamate.
² Zinc dimethyl dithiocarbamate.

Wettable powders containing DDT or sulfur may also be incorporated in calcium arsenate mixtures.

MINERAL OILS

Formula No.	Ingredients	Quantity for 1 gallon	Mixing Sequence
3	White oil, paraffin-base, 30 to 90 sec. Saybolt	1 gal.	1
4	Miscible white oil, 45 to 65 sec. Saybolt Water	1 qt. 3 qt.	2 1

The straight refined white oils with viscosities ranging from 30 to 90 seconds Saybolt may be used in mist blowers. Miscible white oils diluted to 25 to 40 per cent with water are also suitable for mist blower application. Many insecticides may be dissolved or suspended in these emulsions.

In applying oils with mist blowers, extreme caution should be exercised not to use excessive amounts because of the danger to plants.

TARTAR EMETIC

Formula No.	Ingredients	Quantity for 1 gallon	Mixing Sequence
5	Tartar emetic Sugar Water	8 oz. 1 lb. 7½ pt.	2 3 1

Tartar emetic (potassium antimony tartrate) should be applied within a few hours after it is prepared in order to avoid crystallization at the bottom of the container.

Caution: Tartar emetic is highly toxic to man when taken orally.

Insecticides from Plants

NICOTINE

Formula No.	Ingredients	Quantity for 1 gallon	Mixing Sequence
6	Black Leaf 40 White mineral oil, 40 to 60 sec. Saybolt Emulsifier Water	½ pt. ½ pt. ½ oz. 7 pt.	3 2 1
7	Black Leaf 40 Liquid soap Water	½ pt. 6 oz. 7 1/5 pt.	3 2 1
8	Nicotine alkaloid Kerosene	2 oz. 7 7/8 pt.	2 1
9	Nicotine alkaloid White mineral oil, 40 to 60 sec. Saybolt Emulsifier Water	2 oz. ½ pt. ½ oz. 7 1/3 pt.	3 2 1
10	Black Leaf 155 Santomerse S White mineral oil, 45 to 70 sec. Saybolt Water	2 lb. 1½ oz. 7 oz. 7 pt.	3 2 4 1

Black Leaf 40 is nicotine sulfate and Black Leaf 155 is dual-fixed nicotine. Nicotine alkaloid contains 97 to 99 per cent of nicotine. Nicotine sulfate and nicotine alkaloid are compatible with many insecticides and fungicides.

Caution: Nicotine is very poisonous to man and other warm-blooded animals; extreme caution should be taken in handling it.

ROTENONE

Formula No.	Ingredients	Quantity for 1 gallon	Mixing Sequence
11	Derris or cube powder Santomerse S White mineral oil, 45 to 80 sec. Saybolt Water	1 2/5 lb. 2 oz. ½ pt. 7 pt.	3 2 4 1
12A	Emulsifiable rotenone resins Water	1 pt. 7 pt.	2 1
12	Derris or cube powder White mineral oil, 45 to 80 sec. Saybolt Water	1¼ lb. 6 oz. 7 1/6 pt.	2 3 1

Both the derris or cube powder and the rotenone resins should contain 5 per cent of rotenone. Derris and cube powders are compatible with most insecticides and fungicides.

PYRETHRUM

Formula No.	Ingredients	Quantity for 1 gallon	Mixing Sequence
13	Pyrethrum extract	3 oz.	2
	Kerosene	7 pt., 13 oz.	1
14	Pyrethrum extract	3 oz.	3
	Emulsifier	1 oz.	2
	Kerosene	12 oz.	1
	Water	7 pt.	4
15	Pyrethrum extract	1½ oz.	3
	Emulsifier	¾ oz.	2
	Kerosene	½ pt.	1
	Water	7 1/3 pt.	4
16	Pyrethrum powder	1¼ lb.	2
	White mineral oil, 50 to 75 sec. Saybolt	6 oz.	3
	Water	7 pt., 3 oz.	1

The pyrethrum extract should contain 20 per cent of pyrethrins. Good quality powder should contain 0.5 to 1.5 per cent pyrethrins.

Synthetic Organic Compounds

DDT

Formula No.	Ingredients	Quantity for 1 gallon	Mixing Sequence
17	DDT (technical)	6 2/5 oz.	2
	Kerosene	7 7/8 pt.	1
18	DDT (technical)	1 lb.	2
	Xylene	2 pt.	1
	Kerosene or No. 2 fuel oil	5 2/3 pt.	3
19	DDT (technical)	1 lb.	2
	Xylene	2 ¼ pt.	1
	Triton X-100	1½ oz.	3
	Water	5½ pt.	4
20	DDT (50% wettable powder)	2 lb.	2
	Water	7 1/3 pt.	1

There are many solvents for DDT, but xylene causes least injury to plants and is, therefore, safest to use in mist blower applications. Kerosene is less likely to injure plants than is No. 2 fuel oil.

BENZENE HEXACHLORIDE

Formula No.	Ingredients	Quantity for 1 gallon	Mixing Sequence
21	Benzene hexachloride (emulsifiable, 10% gamma)	8 oz.	2
	Water	7½ pt.	1
22	Benzene hexachloride (wetable powder, 10% gamma)	8 oz.	2
	Glycerol	2 oz.	3
	Water	7¾ pt.	1

Benzene hexachloride is available as a liquid containing 10 to 25 per cent of the gamma isomer (the active principle), and as a powder containing 3 to 25 per cent.

Because of the persistent musty odor of technical benzene hexachloride, it is not suitable for use around food products, livestock or residences. An almost odorless preparation made from the essentially pure gamma isomer, known as lindane, is now obtainable and can be used on shade trees, nurseries, and certain crops not intended for human consumption.

CHLORDANE

Formula No.	Ingredients	Quantity for 1 gallon	Mixing Sequence
23	Chlordane	1 pt.	2
	Kerosene or refined white mineral oil	7 pt.	1
24	Chlordane	1 pt.	2
	Triton X-100	1½ oz.	3
	Kerosene	1 pt.	1
25	Water	5 4/5 pt.	4
	Chlordane (50% wettable powder)	2 lb.	2
	Water	7½ pt.	1

Chlordane is completely soluble in oil and can be stirred directly into any oil. Formulations of chlordane are compatible with lead arsenate, nicotine compounds and wettable sulfur.

TOXAPHENE

Formula No.	Ingredients	Quantity for 1 gallon	Mixing Sequence
26	Toxaphene	1 lb.	2
	Kerosene	7½ pt.	1
27	Toxaphene	1 lb.	2
	Kerosene	1 pt.	1
	Triton X-100	1 oz.	3
	Water	6 1/3 pt.	4
28	Toxaphene (50% wettable powder)	2 lb.	2
	Water	7½ pt.	1

Toxaphene is a waxy material. It should stand in the solvent for a few hours to facilitate solution.

TETRAETHYL PYROPHOSPHATE AND PARATHION

Formula No.	Ingredients	Quantity for 1 gallon	Mixing Sequence
29	Tetraethyl pyrophosphate (40% emulsifiable)	6 oz.	2
	Water	7 2/3 pt.	1
30	Parathion (25% wettable powder)	4 oz.	2
	Water	7¾ pt.	1

Both tetraethyl pyrophosphate and parathion lose their toxicity rapidly when exposed to air; they should be kept in air-tight glass containers. They are also corrosive to metal spray tanks and containers; such equipment should be flushed out after use.

Caution: Tetraethyl pyrophosphate and parathion are very toxic to man and other warm-blooded animals. These materials are dangerous when inhaled or taken orally and may also be absorbed through the skin. Anyone handling these materials should wear goggles, a gas mask and rubber gloves.

DINITRO COMPOUNDS

Formula No.	Ingredients	Quantity for 1 gallon	Mixing Sequence
31	DN (40 to 50% dinitro- <i>o</i> -cyclohexylphenol)	3 pt.	2
	Glycerol	6 oz.	3
	Water	4 5/8 pt.	1
32	DN-111 (dicyclohexylamine salt of DN)	4 lb.	2
	Glycerol	12 oz.	3
	Water	6 pt.	1

DN-III should not be used where there is danger of the spray drifting onto buildings.

Fungicides

SULFUR

Formula No.	Ingredients	Quantity for 1 gallon	Mixing Sequence
33	Wettable sulfur	3 lb.	2
	White mineral oil, 50 to 80 sec. Saybolt	9 cz.	3
	Water	6¾ pt.	1
34	Lime-sulfur concentrate	7½ pt.	1
	Glycerol	½ pt.	2
35	Dry lime-sulfur	2½ lb.	2
	Glycerol	5 oz.	3
	Water	7 pt.	1

Concentrated spray formulations of wettable sulfur are compatible with lead arsenate, pyrethrum powder and extract, and wettable powders of DDT, benzene hexachloride, and chlordane. Sulfur seems to prolong the residual effectiveness of DDT. The addition of glycerol to lime-sulfur reduces the volatility of finely atomized spray, and causes some spreading of spray deposit.

Organic Fungicides

FERBAM—Ferric dimethyl dithiocarbamate

ZIRAM—Zinc dimethyl dithiocarbamate

PURATIZED—Phenyl mercuric triethanol ammonium lactate

PHYGON—2, 3-Dichloro-1, 4-naphthoquinone

DITHANE—Disodium ethylene bisdithiocarbamate

Formula No.	Ingredients	Quantity for 1 gallon	Mixing Sequence
36	Ferbam	2 lb.	3
	Daxad No. 14	2/3 oz.	2
	White mineral oil, 50 to 90 sec. Saybolt	½ pt.	4
	Water	6¾ pt.	1
37	Ziram	1½ lb.	2
	White mineral oil, 50 to 90 sec. Saybolt	4 oz.	3
	Water	7½ pt.	1
38	Puratized (active ingredient 5%)	8 oz.	2
	Water	7½ pt.	1
39	Phygon	8 oz.	2
	Glycerol	4 oz.	3
	Water	7 2/3 pt.	1
40	Dithane	1 pt.	2
	Glycerol	4 oz.	3
	Water	6¾ pt.	1

Combinations of Insecticides and Fungicides

A number of concentrated sprays containing both insecticides and fungicides have been prepared and tested in mist blowers.

Formula No.	Ingredients	Quantity for 1 gallon	Mixing Sequence
41	Derris (5% rotenone)	¾ lb.	3
	Wettable sulfur	2½ lb.	2
	Glycerol	10 oz.	4
	Water	6½ pt.	1
42	Wettable sulfur	2½ lb.	2
	Lead arsenate	1¼ lb.	3
	Black Leaf 40	½ pt.	4
	Water	6¼ pt.	1
43	Basic copper sulfate (34 to 53% copper)	1½ lb.	2
	Lead or calcium arsenate	1½ lb.	3
	White mineral oil, 50 to 80 sec. Saybolt	10 oz.	4
	Water	6½ pt.	1
44 (Bordeaux mixture)	Copper sulfate	¾ lb.	1
	Fine hydrated lime	¾ lb.	
	White mineral oil, 50 to 80 sec. Saybolt	7 oz.	
	Water	7 pt.	

DOSAGES OF CONCENTRATED SPRAYS

The dosages of concentrated spray to be applied with mist blowers will vary with the insecticide or fungicide used and the pest to be controlled. The amount of active ingredient will be the same as when dilute sprays are used. The amounts of other ingredients and the volume of concentrate can then be calculated from the formulas given in this circular.

To calculate the rate of coverage in acres per hour, multiply the rate of travel of the mist blower in miles per hour by the width of the swath in feet by 5,280 (feet per mile) and divide the product by 43,560 (square feet per acre). To calculate the number of gallons that will be delivered per acre, multiply the number of nozzles by the number of gallons delivered per nozzle per hour, and divide the product by the acreage that will be covered per hour.

The following table gives the amounts of concentrated DDT spray required to control various insect defoliators.

¹The copper sulfate is completely dissolved in about one-fourth of the water while the lime is thoroughly stirred into one-fourth to one-third of the water. The two mixtures are then poured into the remaining water with vigorous agitation. The oil is added last. To avoid clogging, coarse screens, and nozzles with large orifices should be used.

Dosages of 12 per cent DDT solution (Formula No. 17) or emulsion (Formula No. 18) required per tree (50 to 70 feet in height) and/or per acre for control of various defoliators

Insect	Pints per 50-foot tree	Gallons per acre
Gypsy moth, <i>Porthetria dispar</i> (L.)	½	1
Brown-tail moth, <i>Nygmia phaeorrhoea</i> (Donov.)	....	1
White-marked tussock moth, <i>Hemerocampa leucostigma</i> (A. & S.)	1	1
Eastern tent caterpillar, <i>Malacosoma americanum</i> (F.)	1	1
Forest tent caterpillar, <i>Malacosoma disstria</i> Hbn.	2/3	1
Elm leaf beetle, <i>Galerucella xanthomelaena</i> (Schr.)	2	....
Cankerworms, <i>Paleacrita vernata</i> (Peck)	1	1
<i>Alsophila pometaria</i> (Harr.)		
Japanese beetle, <i>Popillia japonica</i> Newm.	2	2
Fall webworm, <i>Hyphantria cunea</i> (Drury)	½	½
May beetles, various species of Phyllophaga	1	1
Green-striped mapleworm, <i>Anisota rubicunda</i> (F.)	1	2
Orange-striped oak worm, <i>Anisota senatoria</i> A. & S.	1	2
Saw flies on pines, <i>Neodiprion lecontei</i> (Fitch)	....	1
<i>Neodiprion sertifer</i> (Geoff)		
<i>Diprion frutetorum</i> (Fabr.)		
Lace bugs on oak and sycamore, <i>Corythucha</i> spp.	1	1
Mourning-cloak butterfly, <i>Nymphalis antiopa</i> (L.)	1	1
Imported willow leaf beetle, <i>Plagiodesa versicolora</i> (Laich.)	1	....
Hemlock looper, <i>Lambdina fiscellaria</i> (Guen.)	....	1
Spruce budworm, <i>Archips fumiferana</i> (Clem.)	....	1

FORMULAS SUGGESTED FOR CONTROL OF VARIOUS PESTS Forest and Shade Tree Insects

Insect	Formula No.
SUMMER TREATMENT	
European pine shoot moth, <i>Rhyacionia buoliana</i> (Schiff)	11
Larch casebearer, <i>Coleophora laricella</i> (Hbn.)	35
Birch leaf miner, <i>Fenusa pusilla</i> (Klug)	6, 7, 8, 9
Saratoga spittlebug, <i>Aphrophora saratogensis</i> (Fitch)	17, 18, 19, 12
Bagworm, <i>Thyridopteryx ephemeraeformis</i> (Haw.)	2
Green birch aphid, <i>Euceraphis betulae</i> L.	6, 7, 8, 9, 29, 30
Leafhoppers, <i>Empoasca fabae</i> (Harr.)	17, 19
Thrips on hedges	17, 19, 5
Red mites, <i>Paratetranychus pilosus</i> (C. & F.)	4, 29, 30
<i>Paratetranychus bicolor</i> Banks	17, 18, 19
<i>Paratetranychus ununguis</i> (Jac.)	17, 18
Black flies, <i>Simulium meridionale</i> Riley	17, 18, 19
(out of doors)	
Mosquitoes, various species	17, 18
House flies, <i>Musca domestica</i> L. (out of doors)	17, 18, 19

Insect	Formula No.
DORMANT TREATMENT	
Cankerworms, <i>Paleacrita vernata</i> (Peck)	17, 18, 19
<i>Alsophila pometaria</i> (Harr.)	17, 18, 19
Pine needle scale, <i>Phenacaspis pinifoliae</i> (Fitch)	4
Oystershell scale, <i>Lepidosaphes ulmi</i> (L.)	3
Aphids, various species	3, 4, 6, 7, 8, 9, 29
Red mites, <i>Paratetranychus pilosus</i> (C. & F.)	3, 21, 29, 30
<i>Paratetranychus bicolor</i> Banks	3, 21, 29, 30
<i>Paratetranychus ununguis</i> (Jac.)	3, 21, 29, 30

Fruit Tree Pests

The volume of spray required for treating fruit trees is larger than for shade trees.

The following formulas are intended only as a guide for use in mist blowers. Some of them have not been tested extensively and should be used with considerable caution.

Formula No.	Ingredients	Quantity for 1 gallon	Mixing Sequence
DORMANT TREATMENT			
45	Paraffin-base mineral oil, 60 to 100 sec. Saybolt	1 gal.	1
46	Miscible oil (97%) Water	2¼ pt. 5¾ pt.	2 1
47	Oil emulsion (83% oil) Water	2½ pt. 5½ pt.	2 1
48	Nicotine sulfate Water	2 oz. 1 gal.	2 1
49	DN (Elgetol or Krenite) Water	5 oz. 2¾ pt.	2 1
50	Wettable DN powder Water	3 oz. 1 gal.	2 1
SUMMER TREATMENT			
51	White refined oil emulsion, 83% paraffin base oil, 50 to 100 sec. Saybolt Water	4/5 pt. 7 1/5 pt.	2 1
52	DN-111 (wettable powder) Water	3/5 oz. 1 gal.	2 1

Formula No.	Ingredients	Quantity for 1 gallon	Mixing Sequence
SUMMER TREATMENT (Continued)			
53	Tetraethyl pyrophosphate (40%) Water	2 oz. 1 gal.	2 1
54	Parathion (15% wettable powder) Water	2 oz. 1 gal.	2 1
55	Lead arsenate Wettable sulfur Daxad No. 14 Water	½ lb. 1½ lb. ½ oz. 7½ pt.	3 4 2 1
56	Lead arsenate Wettable sulfur Vegetable oil Daxad No. 14 Water	¾ lb. 1½ lb. 4 oz. ½ oz. 7 1/3 pt.	3 4 5 2 1
57	Lead arsenate Ferbam Daxad No. 14 Skim milk powder White mineral oil Water	1½ lb. 6 oz. ¼ oz. 1½ oz. 12 oz. 6 2/3 pt.	4 3 2 5 6 1
58	Lime-sulfur concentrate Water	2 pt. 6 pt.	2 1
59	Puratized (5% active ingredient) Water	4 oz. 7¾ pt.	2 1
60	Dry lime-sulfur Water	4 oz. 1 gal.	2 1
61	DDT (50% wettable powder) Water	2½ to 5 oz. 1 gal.	2 1
62	DDT (50% wettable powder) Wettable sulfur Water	2½ to 5 oz. 1½ lb. 7 3/5 pt.	3 2 1
63	Derris or cube (5% rotenone) Daxad No. 14 White mineral oil, 50 to 100 sec. Saybolt Water	1 lb. ¼ oz. 4 oz. 7½ pt.	3 2 4 1
64	Chlordane (50% wettable powder) Water	4 oz. 1 gal.	2 1
65	Wettable sulfur Basic lead arsenate Water	2 lb. 12 oz. 6¾ pt.	2 3 1

Dosages of Formula 45 range from 3 ounces per tree for small apple trees to 1/5 gallon for the largest apple trees. Formula 45 may be combined with Formulas 48 and 49 for control of aphids.

Dosages of Formula 51 range from 3 fluid ounces per tree for small apple trees to 3 pints per tree for the largest apple trees.

Cautions: Do not over-spray. If possible spray the entire tree at one time. Do not use more than 6 or 7 gallons of total oil per acre.

Tetraethyl pyrophosphate and parathion are very toxic to man and animals. The following precautions should be observed:

1. Do not breathe dust, vapors, or spray mist.
2. Wear a proper respirator (airplane pilots should wear full face mask).
3. Bathe promptly with soap and water after application of sprays and dusts.
4. Wear waterproof or protective clothing, rubber gloves, and hat. Wash clothing daily with soap and hot water before re-use.
5. Keep on hand an emergency supply of atropine sulfate tablets. Consult doctor immediately if parathion or TEP poisoning is suspected.

Persons handling parathion should carry an emergency antidotal supply of atropine. For severe parathion poisoning take two tablets at once; additional doses hourly as directed by a physician. Avoid further exposure until permitted. *Remember*, from the outset of severe symptoms until death may be only a few hours. ACT PROMPTLY.

Do not apply more than 10 ounces of tetraethyl pyrophosphate or 6 ounces of parathion per acre. This maximum limitation would amount to 1/3 to 1/5 ounce per large tree.

The formula numbers of sprays suggested for the control of a number of fruit pests are given below.

Fruit	Pest	Formula No.
DORMANT TREATMENT		
Apple	European red mite, <i>Paratetranychus pilosus</i> (C. & F.)	45, 46, 47
	San Jose scale, <i>Aspidiotus perniciosus</i> Comst.	45, 46, 47
	Rosy apple aphid, <i>Anuraphis rosceus</i> Baker	49, 50
	Eye-spotted bud moth, <i>Spilonota ocellana</i> (D. & S.)	49, 50
Peach	Peach leaf curl, <i>Exoascus deformans</i> (Berk.) F.	49, 50, 58
	San Jose scale, <i>Aspidiotus perniciosus</i> Comst.	45, 46, 47
Pear	Pear psylla, <i>Psyllia pyricola</i> (Foerst.)	45, 46, 47, 48

Fruit	Pest	Formula No.
SUMMER TREATMENT		
Apple	European red mite, <i>Paratetranychus pilosus</i> (C. & F.)	51, 52
	White apple leafhopper, <i>Typhlocyba pomaria</i> McA.	61, 62
	Apple aphid, <i>Aphis pomi</i> Deg.	53, 54
	Rosy apple aphid, <i>Anuraphis rosceus</i> Baker	53, 54
	Plum curculio, <i>Conotrachelus nenuphar</i> (Hbst.)	57, 64
	Apple maggot, <i>Rhagoletis pomonella</i> (Walsh)	55, 56
	Codling moth, <i>Carpocapsa pomonella</i> (L.)	62
Peach	Apple scale	55, 58
	Plum curculio, <i>Conotrachelus nenuphar</i> (Hbst.)	64, 65, 54
	Oriental fruit moth, <i>Grapholitha molesta</i> (Busck)	62, 63
	Peach tree borer, <i>Sanninoidea exitiosa</i> (Say) (apply to lower trunk)	61, 62
Pear	Japanese beetle, <i>Popillia japonica</i> Newm.	61, 62
	Plum curculio, <i>Conotrachelus nenuphar</i> (Hbst.)	55, 57, 54
Grape	Pear psylla, <i>Psyllia pyricola</i> (Foerst.)	51, 54
	Japanese beetle, <i>Popillia japonica</i> Newm.	61, 62
	Grape berry moth, <i>Polychrosis vitcana</i> (Clem.)	57, 61, 62
	Black rot, <i>Guignardia Bidwellii</i> (Ellis) (V. & R.)	57

In treating fruit trees near vegetable gardens use great care to keep the spray from drifting onto leafy vegetables. Also, take care to prevent sprays containing lime-sulfur, lead arsenate, sulfur, and dinitro compounds from drifting onto buildings, as these sprays may discolor the paint.

Carefully flush out tanks and spray lines of sprayers between changes of formulation.

To avoid foliage injury, apply only the formulas given.

For proper timing, consult the spray calendar of State Experiment Stations or Extension Service.