
Oregon Agricultural College Experiment Station

The Chemical Composition of Insecti- cides and Fungicides

By

R. H. ROBINSON and C. F. WHITAKER

(1926-1927 Report)



CORVALLIS, OREGON

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INTRODUCTION

Before any spray material can be used successfully for the control of insect pests or fungous diseases it is necessary to know, first, what active constituents are present, and second, what amount or percentage of each active ingredient is present. This is especially important since the appearance on the market of many proprietary mixtures having the same active ingredients but in widely different amounts. For example, there are now for sale in the state more than fifty different brands of nicotine compounds that vary from 0.5 percent to 40.0 percent in the active ingredient, nicotine. Likewise, the different brands of sulfur, copper carbonate, dry bordeaux mixture, or any other commercial spray may vary in composition. There are also worthless materials that contain little if any fungicidal or insecticidal properties.

This publication reports the chemical analyses of various spray materials, collected in carrying out the provisions of the Oregon Economic Poison Law. As an aid in obtaining a better understanding of the spray ingredients, the quality and requirements of each kind are discussed briefly.

THE OREGON ECONOMIC POISON ACT

In order to prevent the sale of fraudulent materials and that the farmers may know more definitely regarding the composition of commercial spray materials, the Economic Poison Act was passed by the state legislature in 1923. The Chemist of the Agricultural Experiment Station has been appointed by the Director to supervise and carry out the provisions of the law. All correspondence pertaining to the law should be addressed to the Chemist, Oregon Agricultural Experiment Station, Corvallis, Oregon.

The term "economic poison," patterned after the California usage, has been adopted to mean all materials that are poisonous to insects, fungi, or weeds regardless of whether they are poisonous to human beings or not.

The Economic Poison law provides "that any substance or mixture of substances intended to be used for preventing, destroying, repelling, or mitigating any and all insects, fungi, or weeds shall be registered at the office of the Director of the Oregon Experiment Station and a permit issued therefrom before the same can be offered for sale."

The law also provides that a plainly printed label must be attached to each original package of economic poison stating the following:

1. Name, brand, or trade-mark.

2. Name and percentage of *each active ingredient*.
3. Total inert ingredients.
4. Name and address of the manufacturer or person responsible for the sale of the material in Oregon.

Consumers should examine labels and report to the Chemist of the Agricultural Experiment Station any omission especially pertaining to the active ingredients.

Dealers, salesmen, or other persons selling or offering for sale any economic poison are requested to ascertain from the Chemist of the Agricultural Experiment Station whether or not the material has been registered by the manufacturer. If not, they must register the different brands on their own guarantee or request the manufacturer to register them before they handle them.

LIST OF REGISTERED MANUFACTURERS

During the past season the following manufacturers have registered their products and have been granted a permit for the calendar year 1927.

Acme White Lead & Color Works.....	Detroit, Michigan
American Smelting and Refining Co.....	San Francisco, California
Associated Oil Co.....	San Francisco, California
American Cyanamid Sales Co.....	Azusa, California
An-Fo Manufacturing Co.....	3129 Elmwood Ave., Oakland, California
Antrol Laboratories.....	Los Angeles, California
Aphicide Spray Mfg. Co.....	Rocky Ford, Colorado
Bayer Co., The.....	New York City
Bear Creek Spray Corp.....	Medford, Oregon
Buhack Producing & Mfg. Co.....	Stockton, California
Braun-Knecht Heimann Co.....	San Francisco, California
California Pest Control Co.....	Burlingame, California
California Sprayer Co.....	6001-11 Pasadena Ave., Los Angeles, California
California Spray-Chemical Co.....	Watsonville, California
California Rex Spray Co.....	Sacramento, California
Carco Spray Co.....	Tacoma, Washington
Chipman Chemical Engineering Co.....	Bound Brook, New Jersey
Colloid Fungicide Products Co.....	504 Federal Reserve Bank Bldg., Omaha, Nebraska
Danforth Chemical Co.....	Leominster, Massachusetts
Devoe and Raynolds.....	14 West Lake St., Chicago, Illinois
Dow Chemical Co., The.....	Midland, Michigan
E. I. duPont de Nemours & Co.....	Wilmington, Delaware
Franklin & Co., J. H.....	Freewater, Oregon
Forsell & Co., M. J.....	Seattle, Washington
Garden Chemical Co., The.....	Park Ave. and 146th St., New York City
General Chemical Co.....	201 Sansome St., San Francisco, California
Germo Manufacturing Co.....	Los Angeles, California
Gideon Stolz Co.....	Salem, Oregon
Glidden Co., The.....	1300 7th St., San Francisco, California
Grasselli Chemical Co., The.....	Cleveland, Ohio
Hammond Paint and Slug Shot Works.....	Beacon, New York
Hardie Mfg. Co., The.....	55 N. Front St., Portland, Oregon
Hemingway Co., The.....	Shellmound and Horton Streets, Oakland, California
Hood River Spray Co.....	Hood River, Oregon
Hooker Electrochemical Co.....	25 Pine St., New York City
Interstate Chemical Co.....	667 Garfield Ave., Jersey City, N. J.
Latimer-Goodwin Chemical Co., The.....	Grand Junction, Colorado
Lee Co., George H.....	Omaha, Nebraska
LeGear Medicine Co., Dr. L. D.....	4161 Beck Ave., St. Louis, Missouri
Lehn and Fink.....	635 Greenwich St., New York City
Leis, Mr. B.....	Beaverton, Oregon
Lilly Co., The Chas. H.....	Seattle, Washington
Lucas Kill-Tone Co.....	Vineland, New Jersey
McClure Chemical Laboratories.....	Emeryville Station, Oakland, California
Miller Products Co.....	Portland, Oregon
Montgomery Ward and Co.....	Portland, Oregon
Mountain Copper Co., The.....	332 Pine St., San Francisco, California
Mt. Hood Soap Co.....	270 Gisan St., Portland, Oregon
Mulford Co., H. K.....	Philadelphia, Pennsylvania
National Chemical Co.....	310 Sansome St., San Francisco, California

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Niagara Sprayer Co.....	Middleport, New York
Nicotine Production Corporation.....	Clarksville, Tennessee
Nichols Copper Co.....	25 Broad St., New York City
North Coast Soap Co.....	6307 17th Ave. S., Seattle, Washington
Norvell Chemical Corp., The.....	Perth Amboy, New Jersey
Parke Davis and Co.....	2951 Atwater St., Detroit, Michigan
Pest-Go Mfg. Co.....	Portland, Oregon
Pittsburg Plate Glass Co., Corona Chem. Div.....	205 Lake St., Milwaukee, Wisconsin
Portland Gas and Coke Co.....	Portland, Oregon
Portland Seed Co.....	321 E. Alder, Portland, Oregon
Roessler and Hasslacher Chem. Co., The.....	709 Sixth Ave., New York City
Sacramento Chemical Co.....	1816 7th St., Sacramento, California
San Francisco Sulfur Co.....	624 California St., San Francisco, California
San Jose Spray Mfg. Co.....	585 Emery St., San Jose, California
Sherwin-Williams Co., The.....	Cleveland, Ohio
Sun-Ban Laboratories.....	Portland, Oregon
Sutherland Spray Co.....	Sutherland, Oregon
Tobacco By-Products and Chemical Corporation.....	Louisville, Kentucky
U. S. Smelting Refining and Mining Co.....	Salt Lake City, Utah
Valley Fruit Co.....	Walla Walla, Washington
Wheeler, Reynolds and Stauffer.....	624 Calif. St., San Francisco, California

If any brands of economic poison are offered for sale that have not been registered by one of the above manufacturers, the Chemist of the Agricultural Experiment Station should be notified. Such materials should be considered questionable until the manufacturer registers and guarantees them.

Another important purpose of the law is to prevent the sale of those materials that have little or no value as an economic poison. As stated in Section 8 of the law, "the Director of the Experiment Station has power to refuse to register any material that has been shown to have little or no value for the purpose for which it is intended to be used." Thus far registration has been denied five worthless materials and their sale discontinued.

INSPECTION, COLLECTION, AND ANALYSES OF SAMPLES

During the active spraying season representative samples of different brands of insecticides, fungicides, and weed killers are collected and analyzed. Those brands that show a lower percentage of active ingredients than is guaranteed by the manufacturer receive especial attention. The manufacturer is notified to change the guarantee or improve his product. If he fails repeatedly to do so or in any other way violates the provisions of the act, legal action is taken against him. Dealers, moreover, are requested not to handle the product, and publicity is given advising against its use.

During the year 1927 there were more than 300 different brands of economic poisons registered. On account of the large number available it is impossible to secure samples of all brands. Instead, attention is centered on certain classes of materials, especially those spray materials that are subject to chemical changes. Certain manufacturers also are more careful than others and their products may be depended upon as being in accordance with their guarantee. These may necessitate only occasional attention.

New brands and new spray materials are promptly given especial attention. The Agricultural Chemistry department in cooperation with other departments of the Agricultural Experiment Station will be pleased to give available information and advice regarding the composition and the use of this class of sprays.

ANALYTICAL REPORT OF SAMPLES

In the following pages are reported the guaranteed and found composition of economic poisons collected during the past season. Comments are also made relative to the chemical nature and stability of each material.

Lime-sulfur solution. Sulfur, chemically combined with calcium to form calcium polysulfide, is the principal active ingredient in lime-sulfur solution. For all practical purposes its concentration is indicated by the hydrometer test which, for commercial brands, should be at least 30° Baumé.

Lime-sulfur solution as locally prepared is subject perhaps to greater variation in composition than most sprays. When a poor grade of lime is used or the operator is careless in boiling the solution, the Baumé reading may be low. The orchardist is advised to test the lime-sulfur solution with a Baumé hydrometer and make dilutions for spraying in accordance with Table II of Oregon Experiment Station Bulletin 201. If the test is below the Baumé guaranteed on the label it should be reported immediately to the Agricultural Chemistry department of the Experiment Station. A pint sample also should be sent with the report.

Manufacturers are requested to label all barrels of lime-sulfur solution showing the minimum Baumé reading guaranteed by them. Although the Baumé reading would indicate approximately the strength of the lime-sulfur solution, the polysulfide sulfur and the total sulfur percentages are also given. The results are reported in Table I.

From the results in Table I it is apparent that some brands are below the guarantee. The deficiency, although small, should not be overlooked.

TABLE I. LIME-SULFUR SOLUTION

Name of manufacturer	Address	Guaranteed and found	Density Baumé	Total sulfur		Calcium polysulfide	
				%	%	%	%
Bear Creek Spray Co., Medford, Or.....		Guaranteed	30.0	-----	-----	-----	-----
		Found	29.1	22.9	24.2	-----	-----
B. Leis, Beaverton, Or.....		Guaranteed	30.0	-----	-----	-----	-----
		Found	30.2	24.1	26.7	-----	-----
California Rex Spray Co., Sacramento, Cal.		Guaranteed	32.0	-----	-----	-----	-----
		Found	31.2	25.0	27.9	-----	29.8
Farm Bureau Coop. Exchange, Eugene, Or.		Guaranteed	-----	-----	-----	-----	-----
		Found	29.0	18.7	19.4	-----	-----
Gideon Stolz, Salem, Or.....		Guaranteed	30.0	-----	-----	-----	-----
		Found	29.9	23.2	26.2	-----	-----
Hood River Spray Co., Hood River, Or.		Guaranteed	32.0	-----	-----	-----	-----
		Found	31.0	24.0	27.1	-----	-----
Hood River Spray Co., Hood River, Or.		Guaranteed	30.0	-----	-----	-----	-----
		Found	30.4	24.5	28.2	-----	-----
J. and G. Orchards, Newberg, Or.....		Guaranteed	30.0	-----	-----	-----	-----
		Found	29.1	22.7	24.0	-----	-----
Miller Products Co., Portland, Or.....		Guaranteed	30.0	-----	-----	-----	-----
		Found	32.3	22.1	26.2	-----	-----
Montgomery Ward & Co., Portland, Or.		Guaranteed	30.0	-----	-----	-----	-----
		Found	32.4	24.5	26.2	-----	-----
National Chemical Co., San Francisco, Cal.		Guaranteed	32.0	-----	-----	-----	-----
		Found	33.8	25.0	28.5	-----	-----
Sutherland Spray Plant, Sutherland, Or.....		Guaranteed	30.0	-----	-----	-----	-----
		Found	30.0	26.9	33.2	-----	-----
Valley Fruit Co., Walla Walla, Wash....		Guaranteed	30.0	-----	-----	-----	-----
		Found	30.0	22.4	23.2	-----	-----
		Guaranteed	30.0	-----	-----	-----	-----
		Found	31.9	25.2	31.8	-----	30.9

Dry lime-sulfur. There are several brands of dry lime-sulfur sold in Oregon. Although a powder, this is not a dusting spray but must be dissolved in water before it is applied. The dry lime-sulfur should give as effective results as the liquid lime-sulfur if used in equivalent amounts. This amount should be at the rate of 4.0 pounds of the dry material for each gallon of concentrated lime-sulfur required.

The different brands of the dry lime-sulfur vary somewhat in composition. They should contain a minimum of 65.0 percent of calcium polysulfide, the principal active ingredient, and not more than 12 percent free uncombined sulfur. Even a higher amount of calcium polysulfide is desirable. It is important, therefore, to note the guaranteed statement on the label and to examine the analytical report given in Table II.

Unless dry lime-sulfur is kept in nearly air-tight containers it may partly decompose, whereupon, due to the decreased polysulfide content of the oxidized material, its value as a dormant spray is greatly diminished.

The analysis given in Table II shows that some of the brands are below the guaranteed amount of the main active ingredient, calcium polysulfide. On the other hand, the free sulfur is higher than the guarantee. This combination decreases the value of the material as dormant spray although the excess free sulfur may be beneficial in summer sprays.

TABLE II. DRY LIME-SULFUR

Name of manufacturer	Address	Guaranteed and found	Calcium	Calcium	Free
			polysulfide	thiosulfate	sulfur
			%	%	%
Acme White Lead and Color Works, Detroit, Mich.		Guaranteed	70.0	5.0	10.0
		Found	56.0	7.1	14.5
Devoe and Reynolds Co., New York, N. Y.		Guaranteed	70.0	5.0	8.0
		Found	70.3	13.5	11.2
Hemmingways, Oakland, Cal.		Guaranteed	65.0	5.0	15.0
		Found	63.8	6.8	15.4
The Dow Chemical Co., Midland, Mich.		Guaranteed	70.0	5.0	10.0
		Found	70.1	8.8	8.9
The Sherwin-Williams Co., Oakland, Cal.		Guaranteed	65.0	5.0	15.0
		Found	62.8	7.3	14.4
*Miscellaneous sample		Guaranteed	---	---	---
		Found	53.1	14.1	15.0
Montgomery Ward & Co., Portland, Or.		Guaranteed	70.0	5.0	10.0
		Found	64.0	8.7	12.0

*A composite sample of several brands known to have been carried over from previous season by dealer.

Attention is called to the analysis of the "miscellaneous sample" reported in Table II. This is a composite of several samples all of which had been on the shelves of dealers for a year or more. The low polysulfide sulfur content and the high calcium thiosulfate and free sulfur indicate decomposition. Unless dry lime-sulfur is packed in air-tight containers it should be used soon after it is placed on the market. Otherwise it deteriorates rapidly and its value as a spray is greatly diminished.

Lead arsenate and calcium arsenate. The lead arsenate used in Oregon is mainly the lead hydrogen arsenate form. This form is more toxic than the basic or neutral type and consequently the latter is rarely used in this state. Lead hydrogen arsenate is a standardized product

that does not vary greatly in composition. It can be relied upon generally to be in accordance with the guarantee. The analysis of the different brands as shown in Table III further confirm this statement. Where the manufacturer has guaranteed 98 percent lead arsenate it is assumed that the product will contain a minimum of 30.0 percent arsenic oxide and 63.0 percent lead oxide.

There are a few brands of calcium arsenate offered on the Oregon market. On account of the unstableness of this arsenical it cannot be used safely as an orchard spray and consequently local demand for it is comparatively small. Calcium arsenate can be substituted advantageously for paris green for most purposes, especially in truck garden insect pest control. It costs less than paris green, contains 40 percent of the active ingredient arsenic oxide, and is less water soluble.

TABLE III. LEAD ARSENATE

Name of manufacturer	Address	Guaranteed and found	Arsenic oxide		Lead oxide total
			Total %	Water soluble %	
Acme White Lead and Color Works, Detroit, Mich.		Guaranteed	30.0	1.00	63.0
		Found	31.2	.20	65.7
Chipman Chemical Engr. Co., Bound Brook, N. J.		Guaranteed	30.0	.75	63.0
		Found	32.7	.10	64.2
Corona, Pittsburg Plate Glass Co., Mil- waukee, Wis.		Guaranteed	30.0	.75	63.0
		Found	31.3	.10	64.1
Devoe and Reynolds Co., New York, N. Y.		Guaranteed	30.0	.75	63.0
		Found	32.9	.10	64.1
General Chemical Co., San Francisco, Cal.		Guaranteed	30.0	.75	63.0
		Found	31.6	.10	64.0
Lucas Kil-Tone Co., Vineland, N. J.		Guaranteed	30.0	.75	63.0
		Found	32.1	.20	63.6
Montgomery Ward & Co., Portland, Or.		Guaranteed	30.0	1.00	63.0
		Found	31.5	.20	65.1
National Chemical Co., San Francisco, Cal.		Guaranteed	30.0	.75	63.0
		Found	31.7	.10	63.4
Niagara Sprayer Co., Middleport, N. Y.		Guaranteed	30.0	.75	63.0
		Found	32.2	.20	64.1
The Dow Chemical Co., Midland, Mich.		Guaranteed	30.0	.75	63.0
		Found	31.1	.10	63.9
The Grasselli Chemical Co., Cleveland, Ohio		Guaranteed	30.0	.75	63.0
		Found	31.8	.10	63.8
The Latimer-Goodwin Chemical Co., Grand Junction, Colo.		Guaranteed	30.0	.75	63.0
		Found	30.1	.10	63.6
The Sherwin-Williams Co., Oakland, Cal.		Guaranteed	30.0	.75	63.0
		Found	31.9	.10	64.9

TABLE IV. CALCIUM ARSENATE

Name of manufacturer	Address	Guaranteed and found	Arsenic oxide	
			Total %	Water soluble %
Acme White Lead and Color Works, Detroit, Mich.		Guaranteed	40.0	.75
		Found	44.2	.10
Niagara Sprayer Co., Middleport, N. Y.		Guaranteed	40.0	.75
		Found	41.0	.10
The Dow Chemical Co., Midland, Mich.		Guaranteed	40.0	.75
		Found	41.0	.20

Paris green. Although paris green has been superseded by calcium arsenate and lead arsenate it is still in demand and available on the Oregon market. It finds an important place as the active ingredient of insect baits that cannot be used as a foliage spray. It may contain as much as 3.5 percent water-soluble arsenic oxide, which due to danger of causing foliage burn, limits its use to hardy plants without causing foliage burn.

TABLE V. PARIS GREEN

Name of manufacturer	Address	Guaranteed and found	Arsenous oxide	Copper oxide	
			Total	Water soluble	total
			%	%	%
Acme White Lead and Color Works, Detroit, Mich.		Guaranteed	50.0	....	....
		Found	57.5	1.0	24.6
Montgomery Ward & Co., Portland, Or.		Guaranteed	50.0	3.5	....
		Found	56.5	1.6	24.7
The Sherwin-Williams Co., Oakland, Cal.		Guaranteed	50.0	3.5	....
		Found	56.8	1.2	24.6

Nicotine compounds and dusts. Especial care should be exercised in the purchase and subsequent handling of certain nicotine combinations. The dealer, also, who retails nicotine sprays should thoroughly understand the different combinations. This is important because some lose their nicotine content very rapidly, while others may be kept indefinitely without loss of the active ingredient.

Nicotine sulfate in liquid form is very stable and may be kept indefinitely without deterioration. The highest grade form is a solution of nearly 50 percent nicotine sulfate in water containing 40 percent nicotine. It is sold on the Oregon market as "Black Leaf 40," Hall's 40 percent nicotine, N. P. C. Nicotine, and Ortho nicotine sulfate.

Nicotine dusts may or may not be stable compounds. The stability of the combination depends upon the carrier used to hold the nicotine. The importance of nicotine dusts warrants detailed explanation.

In the preparation of nicotine dusts the use of some carrier or filler is necessary to hold the alkaloid which is the active ingredient and distribute it uniformly as a powder. Thatcher and Streeter of the New York Agricultural Experiment Station classify the carriers in three divisions:

First, "absorbent" carriers, which tend to prevent volatilization of the nicotine. This class of materials may be represented by talc, kaolin, and kieselguhr.

Second, "inert" carriers, which have no other effect than to distribute the nicotine so as to expose a larger surface for evaporation. This class may be represented by gypsum, sulfur, and slate dust.

Third, "active" carriers, which increase the volatility of the nicotine sulfate by changing it to a more volatile form. This class may be represented by hydrated lime, calcium carbonate (limestone), and magnesium carbonate.

Immediately after nicotine sulfate is mixed with one or more of the several carriers or fillers the probability of loss may be summarized as follows:

(1) With hydrated lime or calcium carbonate (limestone) significant losses will occur rapidly. Air-tight containers prevent this loss to a very

limited extent only. Notable losses under these conditions have been observed, due perhaps, to chemical changes. In paper bags half or more of the nicotine may be lost in thirty days. In cartons practically all the nicotine would be lost in six months.

(2) When any of the absorbent or inert carriers are used together with either hydrated lime or calcium carbonate similar losses may be expected as noted under (1).

(3) With kaolin, talc, kieselguhr, sulfur, or similar carriers, no appreciable losses may be anticipated.

(4) Tobacco leaf or waste pulverized dust will not lose its nicotine unless hydrated lime is mixed with it.

From the above it is apparent that unless the carrier is known, any commercial nicotine dust should be used as soon as possible after it has been prepared. Dust held over from the previous season should be discarded unless it is known that only "absorbent" or "inert" carrier was used in the mixture. It is not advisable to purchase nicotine dusts taken from broken packages.

Nicotine dusts may be home-prepared satisfactorily. Directions for the preparation of these dusts may be obtained by writing to the Chemistry department of the Experiment Station.

During the past season samples of the various nicotine compounds were collected. Only new stock samples were analyzed although several brands of old stock were inspected. No doubt the old stock would be deficient in nicotine and the dealers were advised accordingly. The persons or firms having last year's goods were advised to handle only what could be disposed of during the active spraying season.

Tables VI and VII contain the results of analyses. It will be observed that most of the brands came up to the guaranteed composition. One sample collected from an old stock lot showed only a part of the guaranteed nicotine content. This indicates loss of nicotine on storage of the previous year's stock. The importance, therefore, of using new stock is obvious.

TABLE VI. NICOTINE COMPOUNDS

Brand	Name of manufacturer	Address	Guaranteed and found	Nicotine
An Fo Nicotine.....	An-Fo Manufacturing Co.,	Oakland, Cal.	Guaranteed	% 1.0 also soap 12.5%, and oil 1.5%
Tobacco Soap	Lilly Company, The	Chas. H. Seattle, Wash.	Found	1.1 soap 16.3%
Nicotine Sulfate	Montgomery Ward & Company,	Portland, Or.	Guaranteed	2.0 also soap 6.0%
N. P. C.			Found	2.1 soap 6.3%
Nicotine Sulfate	Nicotine Production Corporation,	Clarksville, Tenn.	Guaranteed	40.0
"Black Leaf 40".....	Tobacco By-Products & Chem. Corp.,	Louisville, Ky.	Found	40.8
"Nico-Fume" powder....	Tobacco By-Products & Chem. Corp.,	Louisville, Ky.	Guaranteed	40.0
"Nico-Fume" paper.....	Tobacco By-Products & Chem. Corp.,	Louisville, Ky.	Found	40.2
			Guaranteed	12.5
			Found	12.8
			Guaranteed	20.0
			Found	21.1

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TABLE VII. NICOTINE DUSTS

Brand	Name of manufacturer	Address	Guaranteed and found	Nicotine	Sulfur	Arsenic oxide
				%	%	%
Bug Death Alpha.....	Danforth Chemical Co.,	Leominster, Mass.	Guaranteed	.05	20.0	also zinc oxide 15% and lead oxide 1.0%
			Found	trace	18.2	also zinc oxide 16.5% and lead oxide 4.8%
N. S. P. Dust.....	Hood River Spray Co.,	Hood River, Or.....	Guaranteed	.....	.....	.....
			Found	1.89	64.0	.....
Tobacco Dust	Montgomery Ward and	Co., Portland, Or.....	Guaranteed	1.50	.....	.....
			Found	1.32	.....	.....
All-in-one	Niagara Sprayer Co., San	Francisco, Cal.	Guaranteed	1.25	65.0	3.0
			Found	1.49	65.5	3.2
Niagara No. 5.....	Niagara Sprayer Co., San	Francisco, Cal.	Guaranteed	1.75	58.0	.....
			Found	1.36	51.3	.....
Niagara No. 6.....	Niagara Sprayer Co., San	Francisco, Cal.	Guaranteed	2.00	.....	.....
			Found	2.28	.....	.....
Niagara No. 10.....	Niagara Sprayer Co., San	Francisco, Cal.	Guaranteed	3.25	.....	.....
			Found	3.93	.....	.....
Niagara No. A-1.....	Niagara Sprayer Co., San	Francisco, Cal.	Guaranteed	2.70	.....	.....
			Found	2.68	.....	.....
Nico-Fume Powder....	Tobacco By-Products &	Chemical Corp.	Guaranteed	12.5	.....	.....
			Found	12.8	.....	.....

Miscellaneous dusts. In this classification are placed the powdered sulfurs, sulfur-lead arsenate, sulfur-hydrated lime, bordeaux-lead arsenate, and almost any other combination.

It is important to examine the label of these dusts in order to know how much of the active ingredients the dust is guaranteed to contain. Some of them may consist mainly of cheap, inert filler combined with enough of the active poison to permit its sale legally as an insecticide or fungicide. Table VIII contains the analyses of a limited number of these samples, all of which are high grade.

TABLE VIII. MISCELLANEOUS DUSTS

Brand	Name of manufacturer	Address	Guaranteed and found	Active ingredients
Bug Death.....	Danforth Chemical Co.,	Leominster, Mass.	Guaranteed	47.8% zinc oxide, 5.0% lead oxide
			Found	48.8% zinc oxide 17.7% lead oxide
Grape Dust.....	Hammond's Paint & Slug Shot	Works, Beacon, N. Y.....	Guaranteed	2.5% copper sulfate .64% sulfur
			Found	2.7% copper sulfate 67% sulfur
Sulfo	Miller Products Co.,	Portland, Or.....	Guaranteed	90.0% sulfur
			Found	85.5% sulfur
Dormant Dust..	Niagara Sprayer Co., San	Francisco, Cal.	Guaranteed	40.0% sodium polysulfide
			Found	22.3% sodium polysulfide
Niagara 85-15....	Niagara Sprayer Co.,	Middleport, N. Y.	Guaranteed	14.7% lead arsenate
			Found	16.2% lead arsenate

Dry bordeaux mixture. The different brands of commercial bordeaux mixture are subject to considerable variation in the active ingredient copper. Nearly as important, however, is the physical condition of the material. Field experiments have shown that unless the powder is superfine it will not adhere sufficiently long to give control comparative with the home-prepared bordeaux mixture. Until a generally higher grade commercial product is available the consumer is advised to use home-prepared bordeaux mixture or add casein spreader to the commercial bordeaux to increase adherence.

Table IX shows that most of the dry bordeaux mixtures are in accord with the manufacturer's guarantee for the amount of the active ingredient copper.

TABLE IX. DRY BORDEAUX MIXTURES

Name of manufacturer	Address	Guaranteed and found	Copper
Acme White Lead and Color Works, Detroit, Mich.....		Guaranteed	12.75
		Found	12.25
California Rex Spray Company, Sacramento, Cal.....		Guaranteed	12.75
		Found	12.05
Chipman Chemical Engineering Co., Bound Brook, N. J.....		Guaranteed	12.5
		Found	12.5
Devoe and Reynolds, New York, N. Y.....		Guaranteed	18.00
		Found	11.15
*Hood River Spray Company, Hood River, Or.....		Guaranteed	24.0
		Found	24.6
Lucas Kil-Tone Company, Vineland, N. J.....		Guaranteed	22.0
		Found	21.8
*Miller Products Company, Portland, Or.....		Guaranteed	24.0
		Found	25.2
Montgomery Ward and Company, Portland, Or.....		Guaranteed	14.0
		Found	12.5
Shewin-Williams Company, The, Oakland, Cal.....		Guaranteed	12.75
		Found	12.65

*These brands are "two powder" bordeaux. One package contains partly dehydrated copper sulfate and the other hydrated lime. The copper is reported as found in one package.

Copper carbonate. Copper carbonate has been found very effective and less injurious than the older types of fungicides for bunt control in wheat. Similar to bordeaux mixture, the fineness of the dust particles is an important consideration. Most of the commercial brands have been improved to the extent that all particles pass through a 200-mesh sieve. This degree of fineness has been found satisfactory for effective adherence to the wheat seeds. Table X contains the analyses of samples of copper carbonate inspected during the past season.

TABLE X. COPPER CARBONATE

Name of manufacturer	Address	Guaranteed and Found	Copper
Braun-Knecht Heimann Company, San Francisco, Cal.....		Guaranteed	50.0
		Found	52.1
Corona, Pittsburg Plate Glass Co., Milwaukee, Wis.....		Guaranteed	18.0
		Found	19.4
Miller Products Company, Portland, Or.....		Guaranteed	53.0
		Found	55.5
Mountain Copper Co., The, San Francisco, Cal.....		Guaranteed	54.0
		Found	54.1
Nichols Copper Company, New York, N. Y.....		Guaranteed	53.0
		Found	54.0

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Copper and arsenic preparations and compounds. These preparations are usually mixtures of lead arsenate and dry bordeaux mixture. Table XI reports the relative amounts of copper and arsenic calculated as arsenic oxide, present in the mixtures.

TABLE XI. COPPER AND ARSENIC PREPARATIONS AND COMPOUNDS

Brand	Name of manufacturer	Address	Guaranteed and found	Arsenic oxide Copper	
				%	%
2-Way Spray	Acme White Lead & Color Works, Detroit, Mich.		Guaranteed Found	4.35 4.70	11.0 11.6
Garden Guard	Acme White Lead & Color Works, Detroit, Mich.		Guaranteed Found	2.25 2.6	.5 also 1.6 also 4.0% sulfur 4.5% sulfur
Nu Rex O.	California Rex Spray Co., Sacramento, Cal.		Guaranteed Found	5.55 6.62	12.7 11.5
D-20 Mixture	Niagara Sprayer Co., Middleport, N. Y.		Guaranteed Found	5.3 8.3	7.8 6.6
S. W. Pestroy	Sherwin-Williams Co., Oakland, Cal.		Guaranteed Found	4.3 4.1	11.0 11.3

Mercuric fungicides. Recently several organic mercury compounds have been developed that have proved effective as fungicides and insecticides. Their cost is an objection at present, but this difficulty may be overcome as cheaper methods of manufacture are developed.

Among these compounds may be listed semesan, seed-o-san, chlorophol, germisan, and uspulun. Two of these are listed in Table XIV.

Formaldehyde. Formaldehyde is another commonly used fungicide. Recently it has been found efficacious in the control of certain decay-producing organisms of fruit. As a result there will be an increased demand for this fungicide during the next fruit harvest season.

All formaldehyde containers should be carefully labeled showing a minimum of 37.0 percent by weight. Consumers should demand this guarantee before accepting any shipments of formaldehyde. Table XIII shows the grade of products inspected during the past season.

TABLE XII. OIL EMULSIONS

Name of manufacturer	Address	Guaranteed and found	Oil
California Pest Control Co., Burlingame, Cal.		Guaranteed Found	80.0 80.6
California Spray Chemical Co., Watsonville, Cal.		Guaranteed Found	75.0 76.5
California Spray Chemical Co., Watsonville, Cal.		Guaranteed Found	83.0 84.2
California Spray Chemical Co., Watsonville, Cal.		Guaranteed Found	83.0 82.3
Carco Spray Co., Tacoma, Wash.		Guaranteed Found	86.6 86.6
Hood River Spray Co., Hood River, Or.		Guaranteed Found	84.0 90.7
Hood River Spray Co., Hood River, Or.		Guaranteed Found	75.0 73.8
San Jose Spray Mfg. Co., San Jose, Cal.		Guaranteed Found	80.0 84.8

Oil sprays. Miscible oils and various oil emulsions are manufactured from kerosene and the heavier mineral oils. It is necessary that a good quality emulsion be produced in order that the oil may be dispersed uniformly throughout the diluted spray. If the oil separates out injury to the tree may ensue.

Two types of emulsions are now available: one in which the oil is emulsified with soap and cresylic acid or soap alone and the other, a non-soap emulsion, in which the oil is dispersed by means of a protein material such as casein or some other emulsifying agent. The latter may be termed a quick breaking type emulsion. More trouble may be experienced with this type and care should be taken to see that the oil does not separate out in the spray tank.

In preparing the emulsions various other ingredients are sometimes added depending upon the formula of the manufacturer. The oil content, however, is the main active ingredient. The percentage of oil found in several commercial brands is given in Table XII.

TABLE XIII. FORMALDEHYDE

Name of manufacturer	Address	Guaranteed and found	Formaldehyde
Braun-Knecht-Heimann Co., San Francisco, Cal.....		Guaranteed	% 37.0
		Found	37.1
Roessler and Hasslacher Chemical Co., New York, N. Y.....		Guaranteed	37.0
		Found	37.7

Several brands of soap are offered on the market primarily as spray soaps. These are guaranteed to be either whale-oil or fish-oil products. There are also the "hard" and "soft" whale-oil soaps. The soft soaps are the potash soaps, while the hard types are soda soaps. It is well to examine the label and purchase the soap on the guaranteed actual weight of the dry soap.

Miscellaneous spray materials. The guaranteed and found amounts of the active ingredients of various miscellaneous materials are given in Table XIV. The purposes for which they are intended are self-evident from the active ingredients present. Most of the analyses are above the manufacturer's guarantee.

TABLE XIV. MISCELLANEOUS SPRAY MATERIALS

Brand	Name of manufacturer	Address	Guaranteed and found	Active ingredients
London Purple	Acme White Lead and Color Works, Detroit, Mich.		Guaranteed Found 40.0%	arsenic oxide
Snarol	Antrol Laboratories, Los Angeles, Cal.		Guaranteed 3.5% Found 5.1%	calcium arsenate; .05% sodium arsenite calcium arsenate
Paradichlorobenzene	Braun-Knecht Heimann, San Francisco, Cal.....		Guaranteed 99.0% Found 98.8%	paradichlorobenzene paradichlorobenzene
Buhack Insect Powder	Buhack Producing & Mfg. Company, Stockton, Cal.		Guaranteed 6.0% Found 4.5%	oil of pyrethrum oil of pyrethrum

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Paradichloro- benzeneCalifornia Spray Chemical Com- pany, Watsonville, Cal.	Guaranteed Found	99.0% 99.2%	paradichloro- benzene paradichloro- benzene
Weed Killer .....Chipman Chemical Engineering Company, Bound Brook, N. J.	Guaranteed Found	45.0% 44.1%	salts salts
Semesan .....E. I. du Pont de Nemours and Company, Wilmington, Del....	Guaranteed Found	35.0% 36.1%	hydroxymer- curichloro- phenol hydroxymer- curichloro- phenol
Semesan Bel. ....E. I. du Pont de Nemours and Company, Wilmington, Del....	Guaranteed Found	10.0% 11.5%	hydroxymer- curichloro- phenol hydroxymer- curichloro- phenol
Go-West .....M. J. Forsell & Company, Se- attle, Wash.	Guaranteed Found	5.0% 5.4%	calcium arsenate calcium arsenate
Melrosine .....Garden Chemical Company, New York, N. Y.	Guaranteed Found	Soap and volatile oils Passed	
Earwig Bait .....Hardy Mfg. Company, Portland, Or.	Guaranteed Found	4.3% 4.8%	Sodium fluoride Sodium fluoride
Weed Killer .....Hood River Spray Co., Hood River, Or.	Guaranteed Found	30.0%	arsenous oxide
Tree Paint .....Hood River Spray Co., Hood River, Or.	Guaranteed Found	1.0% .7%	copper copper
Whale oil soap.....Miller Products Co., Portland, Or.	Guaranteed Found	60.0% 57.9%	anhydrous soap anhydrous soap
Naptholene .....Miller Products Co., Portland, Or.	Guaranteed Found	85.0% 89.0%	naphthalene naphthalene
Sodium Fluoride.Montgomery Ward & Co., Port- land, Or.	Guaranteed Found	65.0% 98.6%	Sodium fluoride Sodium fluoride
Felbro Whale Oil Soap .....Mt. Hood Soap Company, Port- land, Or.	Guaranteed Found	58.5% 76.1%	anhydrous soap anhydrous soap
Copper Sulfate .....Nichols Copper Co., New York, N. Y.	Guaranteed Found Guaranteed Found	25.2% 24.9% 70.0% 68.8%	Copper sulfate Copper sulfate Active salts Active salts
Pest-Go .....Pest-Go, Inc., Portland, Or.	Guaranteed Found	32.1% 30.4%	soap soap
ClenselSun-Ban Laboratories, Portland, Or.	Guaranteed Found	43.0% 44.5%	sodium arsenite sodium arsenite
Weed KillerU. S. Smelting Refining and Mining Co., Salt Lake City, Utah			

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