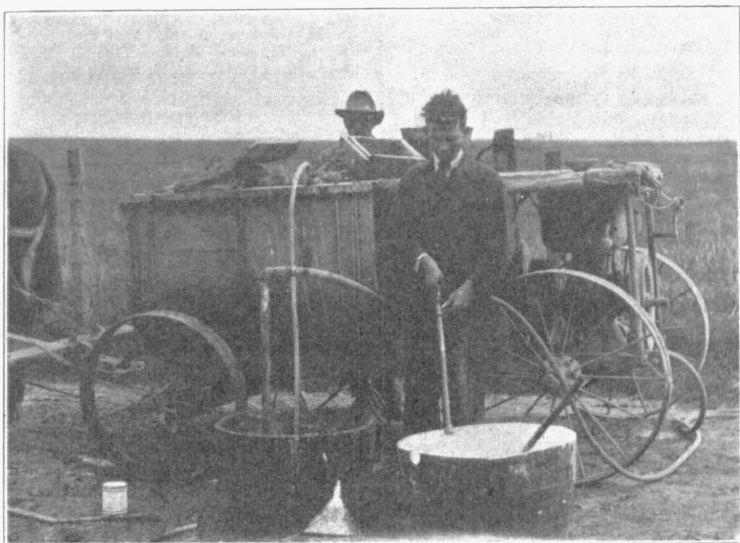


UNIVERSITY OF MISSOURI COLLEGE OF AGRICULTURE
AGRICULTURAL EXPERIMENT STATION
BULLETIN 205

e. 2

A New Method of Making Engine Oil Emulsions



Making use of a suction hose and spray gun to emulsify oil.

COLUMBIA, MISSOURI
AUGUST, 1923

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COLLEGE OF AGRICULTURE
Agricultural Experiment Station

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*In service of U. S. Department of Agriculture.

A New Method of Making Engine Oil Emulsions

A. M. BURROUGHS

It is generally known that oil and water, alone, will not mix. To use an oil spray containing 2 parts of oil to 98 parts of water, an "emulsion" of oil in water is made with the help of a third substance. Potash fish-oil soap is the substance most commonly used to make the oil mix with water. The method of preparing engine oil emulsions for use as sprays is described by Ackerman in the United States Department of Agriculture Circular 263, and by Haseman and Sullivan in Missouri Agricultural Experiment Station Circular 109. The oil, water and soap are heated to boiling and emulsified by pumping. Oil emulsions made as described in these publications are said to be made according to the "government formula". If used with hard water, or with lime-sulphur, such emulsions break down and free oil arises to the surface of the spray mixture. The separation of free oil may be prevented by the addition of bordeaux mixture, copperas-lime mixture, starch, flour, saponin, glue, casein, "Kayso", and other substances.

In the course of experimental work by the department of horticulture of the Missouri Agricultural Experiment Station, at Columbia, it has been found that oil emulsions can be made without the potash fish-oil soap, and without heating. The materials which have been used as stabilizers have been found to act as emulsifiers, just as the soap does.

Inasmuch as the Missouri cold emulsions can be prepared more cheaply and easily than the oil-soap emulsions, they are very promising as a spray for the San Jose scale. The purpose of this circular is to present the results of one year's work with the Missouri cold emulsions, and to give directions for their preparation and use in order that any Missouri grower who so desires may give them a trial.

EFFECT ON INSECTS

Cooperative experiments with the department of entomology* have shown that the cold emulsions give practically the same results against San Jose scale as the oil-soap emulsions. Apparently it is the oil, rather than the soap, which kills the insects. Very encouraging results were obtained when a cold emulsion was used against the grain aphid at the time for the delayed dormant spray on the apple.

NOTE.—The methods used here were suggested by those of Pickering at the Woburn Experimental Fruit Farm in England, and described by him in *The Journal of the Chemical Society*, Vol. 91, page 2001; 1907. A longer article, containing references, detailed data, and an extended discussion was submitted to *The Journal of Economic Entomology* in May, 1923, under the title, "A Simplified Method of Making Lubricating Oil Emulsions," by A. M. Burroughs and W. M. Grube.

*Mr. W. M. Grube, a graduate student, has been largely responsible for the development of the Kayso emulsions, and has done a large part of the entomological work mentioned.

EFFECT ON THE TREES

No visible injury on the apple, peach or cherry trees was observed when the cold emulsions were applied during the dormant period. Concentrations up to 10% showed no injury. Of course, it will be several years before it can be said definitely that any dormant oil spray is without some cumulative injurious effect on fruit trees.

When a 2% oil emulsion was applied on apple foliage, there was little burning up to the cluster bud stage. After that, however, rather severe leaf burning occurred in some cases, both with the cold emulsions and the oil-soap emulsions. Where three applications were made in succession, severe dropping of fruit occurred. It may be said that the oil-soap emulsions and cold emulsions are dangerous if applied to apple trees after the time for the cluster bud spray.

One season's results indicate that oil emulsions cannot be applied safely to the foliage of the stone fruits at any time.

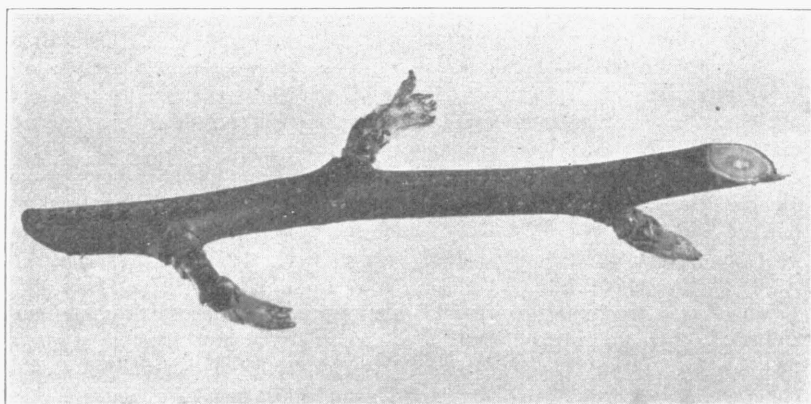


Fig. 2.—Delayed dormant stage on apples when aphids are readily killed by a 2 or 3% oil emulsion spray.

EASE OF APPLICATION

A new spray may give good results under experimental conditions but be impractical under field conditions. However, the Missouri cold emulsions have been applied successfully to over 300 bearing apple trees and can be handled and applied by any grower without difficulty. The fact that the oil does not separate out when used with hard water or water contaminated with lime or lime-sulphur makes the cold emulsions especially easy to handle.

FORMULAS

Four formulas which have proved successful at the Experiment Station are given below. Good emulsions could undoubtedly be made using different proportions or different combinations of materials. We have found Formula 3, with Kayso as the emulsifying agent, to be one of the easiest to prepare and handle. When this formula is used the cost of materials for 100 gallons of

spray is 38 cents as compared with 34 to 35 cents for Formulas 1 and 2. It is believed, however, that the Kayso emulsion is enough better to warrant the extra cost.

Formula I

Engine Oil -----	2 gal.
Water -----	1 gal.
Copper Sulphate (Bluestone) $\frac{1}{4}$ lb.	
or	
Iron Sulphate (copperas) ----	$\frac{1}{4}$ lb.
Burned Lime -----	$\frac{1}{4}$ lb.

Formula II

Engine Oil -----	2 gal.
Water -----	2 gal.
Copper Sulphate -----	$\frac{1}{2}$ lb.
or	
Iron Sulphate -----	$\frac{1}{2}$ lb.
Burned Lime -----	$\frac{1}{2}$ lb.

Formula III

Engine Oil -----	2 gal.
Water -----	1 gal.
Kayso -----	4 oz.

Formula IV

Engine Oil -----	2 gal.
Water -----	1 gal.
Saponin -----	4 oz.

HOW TO MAKE STOCK EMULSIONS

Emulsions with copperas and lime are made the same way as those with bordeaux mixture. Merely substitute copperas for bluestone in the directions given below. First, make a stock solution containing 1 pound of bluestone to

every gallon of water. Place 25 pounds of bluestone in a burlap sack, and suspend over night in a barrel containing 25 gallons of water. The bluestone requires 12 to 20 hours to dissolve. In another container, such as one-half of a lime-sulphur barrel, place 25 pounds of burned lime and slake it. Then add cold water to make 25 gallons.

If it is desired to use 200 gallons of 2% oil spray emulsified according to Formula 1, put 4 gallons of oil in a half barrel or other container, then add $\frac{1}{2}$ gallon of the copper sulphate solution and one gallon of water. Stir up the lime and add $\frac{1}{2}$ gallon of the milk of lime. Mix the oil and water, etc., by pumping the mixture back on itself, using a coarse spray. After a minute's pumping, reduce the opening in the nozzle until a fine spray is obtained and pump the emulsion into another container. Then pump it back again. The emulsion would probably be satisfactory with one pumping, but it is generally best to

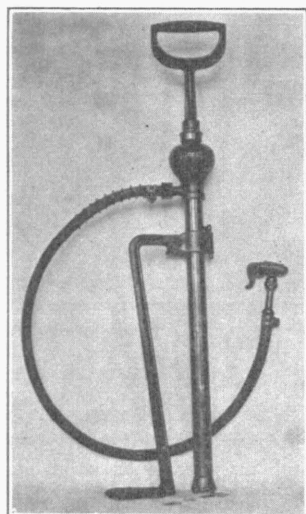


Fig. 3.—Bucket pump used in emulsifying lubricating oils.

give it two. The finer the spray, the better is the emulsion obtained. To make the emulsion by means of a power sprayer put the suction hose and a hose from the return line into the half-barrel containing the mixture and pump it back and forth a time or two. It is essential that the pumping be done immediately after mixing the various materials. *Only freshly made bordeaux or iron sulphate-and-lime mixture will act as a good emulsifying agent.*

To make an equal amount of emulsion by means of Kayso, take 8 ounces of Kayso, make into a paste by slowly adding water and stirring until 2 gallons of water have been added. Then add this to 4 gallons of oil, mix, and pump as before. No haste is necessary here. To make an emulsion according to Formula 4, substitute 8 ounces of saponin powder, or the extract from $\frac{1}{2}$ pound of soap bark, for the Kayso.

The stock emulsions made according to Formulas 1, 3 and 4, as described above, contain $66\frac{2}{3}\%$ oil. To make a 2% oil spray use 3 gallons of stock emulsion to 97 gallons of water. If Formula 2 is used, the stock emulsion will contain 50% oil, and 4 gallons will be required to 96 gallons of water in order to make a 2% oil spray.



Fig. 4.—Demonstrating the making of Missouri cold emulsions, Horticultural Day, August 30, 1923.

These stock emulsions are ready for use with any kind of water or with lime-sulphur. They may also be put into tanks or barrels which have contained lime-sulphur, bordeaux or oil. A large enough quantity of stock emulsion to last a day or two may be made by means of the power sprayer. The Kayso emulsions will keep a long time. Oil sometimes separates out of the other emulsions after a few days, but can be re-emulsified by pumping again. All oil emulsions and miscible oils stored in quantity should be thoroughly stirred before measuring out for use.

SUMMARY

There is strong evidence that a 2% oil will control San Jose scale. The same may be said for the control of aphids at the delayed dormant period.

The engine oil sprays are many times cheaper than any other sprays now

on the market. The fact that the farmer can make the emulsions easily and cheaply should keep the price of the spray down to the minimum.

The cold emulsions are cheaper and easier to prepare than the oil-soap emulsions, and have the added advantage that they do not break down in hard water or water contaminated with lime or lime-sulphur. This removes one of the dangers involved when the oil sprays are used by inexperienced men.

Nevertheless, the new sprays should not be adopted too quickly in regions where they have not been tried out. There is still the possibility that some cumulative injury may result, though it seems improbable. In former times the application of kerosene emulsions gave no immediate harmful results, yet the spray was abandoned because of the injury resulting from their continued application. However, the safety with which the miscible oils have been used year after year gives us confidence that the low concentrations of engine oil used in controlling scale will do no harm.

It has not been shown as yet that lubricating oil emulsion can be safely applied to apple foliage, although it is probable that no serious injury would result to apple trees up to the time the blossoms appear. From the evidence at hand, we are of the opinion that in the future the engine oil emulsions may be the standard spray for scale on deciduous fruit trees. It may be possible to delay the San Jose scale spray until the time for the pink or cluster bud spray when we may be able to use bordeaux-oil-arsenate of lead and thus control all sucking and biting insects and fungus diseases present at that time.

Abstract.—A New Method of Making Engine Oil Emulsions, A. M. Burroughs (Missouri Agr. Exp. Sta. Bul. 205 [1923], pp. 3-8, figs. 4.)—A method is described whereby paraffin oils of the type used in spraying can be emulsified without heating, and without the use of potash fish-oil soap. Substances which have served to stabilize oil-soap emulsions in the presence of hard water have been used as emulsifying agents. These are: freshly made bordeaux mixture, freshly made copperas-lime mixture, calcium caseinate ("Kayso"), saponin and others. The cold emulsions have proven to be as efficient as the oil-soap emulsions against the San Jose Scale and the grain aphid. No injury to apple trees has resulted from one year's use in the dormant, delayed dormant, and cluster bud stages. The cold emulsions are somewhat cheaper and easier to prepare than the oil-soap emulsions, and very much cheaper than lime-sulphur and the miscible oils. They break down more easily in storage than the manufactured oil-soap emulsions, but can be re-emulsified by pumping through a spray nozzle. The cold emulsions have the advantage that they do not break down in the presence of hard water or water contaminated with lime or lime-sulphur, as do the soap emulsions.

**METHOD OF MAKING THE HOME MADE OIL-SOAP EMULSION
ACCORDING TO THE GOVERNMENT FORMULA**

The method of making the oil-soap emulsion which has been used successfully in Arkansas is described in Missouri Agricultural Experiment Station Circular 109, by L. Haseman and K. C. Sullivan. Some of the brands of oil which have been used successfully are Diamond Paraffin, Red Engine Oil, Nabob, and 180 Red Neutral. Potash fish-oil soap is the only soap that has proven a success. The oils can be obtained from local oil stations. The soap is sold by chemical and fertilizer companies. Emulsions made according to the government formula can be obtained at a reasonable price from various spray manufacturing companies.

Making the Stock Emulsion.—To make a stock emulsion containing 66 $\frac{2}{3}$ per cent oil, the following formula is used:

Paraffin oil—2 gallons.

Potash-fish oil soap—2 pounds (about 1 qt.)

Soft water—enough to make a total of 3 gallons (about 3 qts.)

The three substances are mixed in a vessel and heated to boiling. While still hot the mixture is pumped twice through a nozzle with a fine opening. A bucket pump similar to the one illustrated above will give good results. If properly made this stock emulsion should last for some time, but freezing will cause it to break down.

Dilution.—It has been found that a spray containing 2 per cent of oil will control San Jose scale without apparent injury to apple trees in the dormant stage. To get a 2 per cent oil spray, use 3 gallons of the stock emulsion to 97 gallons of water.

If hard water is used, or if the tank is contaminated with traces of lime-sulphur or bordeaux mixture, a freshly made $\frac{1}{4}$ — $\frac{1}{4}$ —50 bordeaux mixture will prevent the breaking down of the emulsion and consequent rising of free oil to the surface. If soft water and a clean tank are used this precaution is unnecessary.