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U. S. DEPARTMENT OF AGRICULTURE.
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CONDENSED INFORMATION
CONCERNING
SOME OF THE MORE IMPORTANT INSECTICIDES.

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The following information relative to kerosene emulsion, resin wash, and arsenical mixtures has been placed in circular form to enable ready and full reply to letters which are constantly being received in reference thereto. It is not intended to be a complete consideration of the question of insecticides, but is drawn up to meet those questions which experience has shown are most often asked by correspondents.

Respectfully,

C. V. RILEY,
Entomologist.

CONDENSED INFORMATION CONCERNING SOME OF THE MORE VALUABLE INSECTICIDES.

KEROSENE EMULSION.

This insecticide acts by contact and is applicable to all non-masticating insects (sucking insects, such as the true bugs and especially plant lice and scale insects) and also to many of the mandibulate insects when the use of arsenites is not advisable. Kerosene emulsion may be made by means of various emulsifying agents, but the most satisfactory substances and those most available to the average farmer and fruit-grower are milk and soapsuds. In each of these cases the amount of emulsifying agent should be one-half the quantity of kerosene.

One of the most satisfactory formulas is as follows:

		Per cent.
Kerosene.....gallons..	2	67
Common soap or whale-oil soap.....pound..	½	} 33
Water.....gallon..	1	

Heat the solution of soap and add it boiling hot to the kerosene. Churn the mixture by means of a force pump and spray nozzle for 5 or 10 minutes. The emulsion, if perfect, forms a cream which thickens upon cooling and should adhere without oiliness to the surface of glass. For use against scale-insects dilute one part of the emulsion with nine parts of cold water. For most other insects dilute one part of the emulsion with fifteen parts of water. For soft insects, like plant lice, the dilution may be carried to from 20 to 25 parts of water.

The milk emulsion is produced by the same methods as the above.

THE RESIN WASHES.

These insecticides act by contact, and also, in the case of scale-insects, by forming an impervious coating which effectually smothers the insects treated. These resin washes vary in efficacy according to the insect treated. Experience has shown that the best formula for the Red Scale (*Aonidia aurantii* Maskell) and its yellow variety (*A. citrinus* Coquillett) is as follows:

Resin.....	pounds..	18
Caustic soda (70 per cent strength)	do....	5
Fish oil.....	pints..	2½
Water to make.....	gallons..	100

The necessary ingredients are placed in a kettle and a sufficient quantity of cold water added to cover them; they are then boiled until dissolved, being occasionally stirred in the meantime, and after the materials are dissolved the boiling should be continued for about an hour, and a considerable degree of heat should be employed so as to keep the preparation in a brisk state of ebullition, cold water being added in small quantities whenever there are indications of the preparation boiling over. Too much cold water, however, should not be added at one time, or the boiling process will be arrested and thereby delayed, but by a little practice the operator will learn how much water to add so as to keep the preparation boiling actively. Stirring the preparation is quite unnecessary during this stage of the work. When boiled sufficiently it will assimilate perfectly with water, and should then be diluted with the proper quantity of cold water, adding it slowly at first and stirring occasionally during the process. The undiluted preparation is pale yellowish in color, but by the addition of water it becomes a very dark brown. Before being sprayed on the trees it should be strained through a fine wire sieve, or through a piece of Swiss muslin, and this is usually accomplished when pouring the liquid into the spraying tank, by means of a strainer placed over the opening through which the preparation is introduced into the tank.

The preparing of this compound will be greatly accelerated if the resin and caustic soda are first pulverized before being placed in the boiler, but this is quite a difficult task to perform. Both of these substances are put up in large cakes for the wholesale trade, the resin being in wooden barrels, each barrel containing a single cake weighing about 375 pounds, while the caustic soda is put up in iron drums containing a single cake each, weighing about 800 pounds. The soda is the most difficult to dissolve, but this could doubtless be obviated by first dissolving it in cold water and then using the solution as required. This insecticide may be applied at any time during the growing season.

A stronger wash is required for the San José scale (*Aspidiotus perniciosus* Comstock), and the following formula gives the best results:

Resin.....	pounds..	30
Caustic soda (70 per cent)	do....	9
Fish oil.....	pints..	4½
Water enough to make.....	gallons..	100

Place all the ingredients in a kettle and cover with water to a depth of 4 or 5 inches; boil briskly for about 2 hours or until the compound can be perfectly dissolved with water. When this stage is reached the kettle should be filled up with water, care being taken not to chill the wash by adding large quantities of cold water at once. It may be thus diluted to about 40 gallons, the additional water being added from time to time as it is used.

This preparation should only be applied during winter or during the dormant period; applied in the growing season it will cause the loss of foliage and fruit.

In the application of both these washes a very fine spray is not essential, as the object is not simply to wet the tree but to thoroughly coat it over with the compound, and this can be best accomplished by the use of a rather coarse spray which can be thrown upon the tree with considerable force.

FOR SUBTERRANEAN INSECTS.

Recent experiments have shown the practical value of the resin compounds against the Grape Phylloxera; and they will also be applicable to the Apple Root-louse and other underground insects. The cheapest and at the same time one of the most satisfactory compounds experimented with is the following:

Caustic soda (77 per cent.).....	pounds..	5
Resin.....	do....	40
Water to make.....	gallons..	50

Dissolve the soda over fire with 4 gallons of water; add the resin, and after it is dissolved and while boiling add water, slowly, to make 50 gallons of compound. For use dilute to 500 gallons. Excavate basins about the vines 6 inches deep and about 2 feet in diameter, and apply to each vine 5 gallons. The results will be more satisfactory if the treatment is made early in the spring so that the rain of the season will assist in disseminating the wash about the roots.

The kerosene emulsion made according to the formula given above is also applicable to certain underground insects in cases where it will not prove too expensive, as, for instance, the grape phylloxera or where white grubs are infesting a valuable lawn. It may then be used in the proportion of 1 part of the emulsion to 15 gallons of water, applied liberally to the soil, and afterwards washed down at frequent intervals with large quantities of water for several days. This can be done only where there is plenty of water at hand, but will be found of great value in special cases.

In other cases bisulphide of carbon may be used for specific and local underground forms. Nests of ants, for instance, may be destroyed by pouring an ounce of this substance into several holes, covering them with a wet blanket for 10 minutes and afterwards exploding the vapor at the mouth of the holes with a torch. Against Onion, Cabbage, and Radish maggots this substance may also be used by punching a hole with a sharp stick at the base of the plant and pouring in a teaspoonful of the liquid, covering afterwards with earth.

THE ARSENITES: LONDON PURPLE, PARIS GREEN, AND WHITE ARSENIC.

These poisons are of the greatest service against all mandibulate insects, as larvæ and beetles, and they furnish the most satisfactory means of controlling most leaf-feeders, and the best wholesale remedy

against the Codling Moth. Caution must be used in applying them on account of the liability of burning or scalding the foliage.

The poisons should be thoroughly mixed with water at the rate of from 1 pound to 100—250 gallons water, and applied with a force pump or hand spray nozzle. In preparing the wash it will be best to first mix the poison with a small quantity of water, making a thick batter, and then dilute the latter and add to the reservoir or spray tank, mixing the whole thoroughly. When freshly mixed, either London purple or Paris green may be applied to Apple, Plum, and other fruit trees, except the Peach, at the rate of 1 pound to 150—200 gallons, the latter amount being recommended for the Plum, which is somewhat more susceptible to scalding than the Apple. White arsenic does little if any injury at the rate of 1 pound to 50 gallons of water. As shown by Mr. Gillette, however, when allowed to remain for some time (2 weeks or more) in water, the white arsenic acts with wonderful energy, scalding when used at the rate of 1 pound to 100 gallons from 10 to 90 per cent. of the foliage; the action of the other arsenites remains practically the same, with, perhaps, a slight increase in the case of London purple.

With the Peach these poisons, when applied alone, even at the rate of 1 pound to 300 or more gallons of water, are injurious in their action, causing the loss of much of the foliage.

By the addition of a little lime to the mixture, London purple and Paris green may be safely applied, at the rate of 1 pound to 125 to 150 gallons of water, to the Peach or the tenderest foliage, or in much greater strength to strong foliage, such as that of the Apple or most shade trees.

Whenever, therefore, the application is made to tender foliage or when the treating with a strong mixture is desirable, lime water, milky but not heavy enough to close the nozzle, should be added at the rate of about 2 gallons to 100 gallons of the poison.

Pure arsenic, however, should never be used with lime, as the latter greatly increases its action.

With the Apple, in spraying for the Codling Moth, at least two applications should be made—the first on the falling of the blossoms, the apples being about the size of peas, and the second a week or 10 days later; but the poison should never be applied after the fruit turns down on the stem, on account of the danger of the poison collecting and remaining permanently in the stem cavity.

For the Plum Curculio on the Plum, Cherry, Peach, etc., two or three applications should be made during the latter part of May and the first half of June; in the case of most leaf-feeders, spray on the first indication of their presence.

CAUTION NECESSARY IN THE USE OF THESE INSECTICIDES.

The relative susceptibility of Apple, Plum, and Peach has just been indicated under the head of arsenical poisons, and these remarks apply

equally well to the use of the kerosene emulsions. In the case of other plants thorough experiments are still necessary, and all insecticides should be first used in comparatively high dilution. In general it may be said that tender, young foliage is more susceptible and must be carefully treated. Thin-leaved, pilose plants are more readily injured, while thick-leaved glabrous species are least affected. Annual plants, such as cabbages and other garden vegetables, are more susceptible than perennials, but in the case of root crops, such as beets, turnips, radishes, and potatoes, there is not the same need of caution as to damage to foliage. Damage to foliage is not shown at once, and in case of rain following an application another application should not be made for several days. Fruit trees should not be sprayed with arsenical poison before the blossoms fall, on account of the danger of poisoning honey bees.

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