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THREE ARSENICAL INSECTICIDES AND HOW TO
USE THEM

Of the numerous insecticides in which arsenic in some form is the poisonous ingredient, only three are in common use in Arizona at the present time. These are arsenate of lead, Paris green, and London purple. These are successfully used in several different ways, and, it should be said, are frequently used mistakenly against plant lice and other insects that cannot be destroyed by poisons of this class.

Arsenical insecticides are suitable only for use against insects that chew the leaves, the evidence of their attack being exhibited in the form of "ragging" of the leaves, "skeletonizing" of the leaves, or of irregular holes. Beetles in both the larval (grub), and adult stages, grasshoppers in both the nymphal and adult stages, and the larval (caterpillar) stage of butterflies and moths are the principal insects which feed by chewing. Most of the best known sucking insects belong to the bug group, which includes plant lice, scale insects, the squash bug, and the various leaf hoppers. Leaves attacked by such insects may wilt from the effect of the loss of plant juices, or become spotted, due to the extraction of the chlorophyll or green coloring matter, but no holes are made or external parts of the plants eaten. Arsenical or stomach poisons are ineffectual in combating these insects. They require contact insecticides, such as nicotine, whale oil soap, and lime-sulfur solution.

Not all chewing insects can be destroyed by means of arsenical insecticides. Some are borers in wood or in the stems of plants of various kinds, while others live in fruit. As a rule, however, those

chewing insects which attack the leaves or the external parts of the plant can be controlled by the use of this class of stomach poisons.

Arsenate of Lead. This is probably the most extensively used insecticide at the present time. It is sold in both the paste and the powdered form. Practically 50 percent of the paste consists of water, which adds to transportation charges. The powder is more convenient to handle than the paste, and is more easily mixed with water. The powder, therefore, is to be preferred over the paste. The powder is worth from 30 to 35 cents a pound in one pound packages, and from 22 to 24 cents a pound in 100-pound lots. The paste is worth about 25 cents a pound in one pound glass jars, and about 9 or 10 cents a pound in 100-pound steel drums. In spraying for the codling worm one pound of arsenate of lead powder or two pounds of the paste should be used in 50 gallons of water. For beetles, such as the striped or Colorado potato beetle and other chewing insects which are not as easily destroyed as the codling worm, one pound of arsenate of lead powder or two pounds of the paste may be used in 15 to 25 gallons of water. Arsenate of lead adheres to the foliage better than Paris green, and is not as likely to burn the foliage. It costs slightly more than Paris green and does not act as quickly upon the insects.

Paris Green. While arsenate of lead is to be preferred over Paris green for ordinary use on foliage, the latter can be safely used on potato vines against the Colorado or striped potato beetle and the blister beetles. It is also recommended for use in preparing poisoned baits for the destruction of grasshoppers and cut worms. Poisoned bran mash for grasshoppers is made with 1 pound of Paris green, 20 pounds of wheat bran, 2 quarts of molasses, 3 lemons chopped fine, and $3\frac{1}{2}$ gallons of water. For cutworms the lemons may be omitted, or a dry mixture of bran and Paris green, 1 pound of the poison to 10 or 20 pounds of the bran, can be substituted for the wet mixture. When used against grasshoppers the bran mash is spread broadcast, but against cut worms it is distributed in heaps of a teaspoonful each beside each plant or every three or four inches in the row. The dry Paris green mixture should be spread in lines along the rows of plants to be protected. Criddle mixture is another poisoned bait used for the destruction of grasshoppers. This is made with $\frac{1}{2}$ barrel of fresh horse manure, 1 pound Paris green, 1 pound salt, and enough water to make a soft but not sloppy mixture. Details concerning the preparation and use of both the bran mash and the Criddle mixture are given in "Timely Hints for Farmers" No. 104. When Paris green is used as a spray against the potato beetle or other insects, twice as much unslaked lime as Paris green should be added in order to neu-

tralize the water soluble arsenic, for the soluble arsenic is the cause of the burning of the foliage frequently resulting from the use of this insecticide. Paris green is worth from 35 to 40 cents a pound in pound packages. From 5 to 10 ounces should be used in 50 gallons of water according to the requirements of the insect and the susceptibility of the foliage of the plant to arsenical injury. For the Colorado potato beetle the stronger mixture (10 ounces in 50 gallons of water) should always be used.

"*London Purple*. This insecticide is used comparatively little for spraying purposes, owing to the variable composition and tendency to cause burning of the foliage. In Arizona it is used in large quantities against the large red ants, known as the "harvester ants." There are several varieties of these which are especially destructive in southern Arizona. They are best known as alfalfa pests, owing to the conspicuous areas bare of vegetation which mark their presence. These bare areas not infrequently comprise from five to ten percent of the total acreage. London purple appears to be especially suited for poisoning these ants, owing to its fine state of pulverization. About a tablespoonful is spread around the entrance to each nest. The powder is carried into the nests on the legs of the ants and the food supply is thereby poisoned. In some cases where there are several entrances to the nest more than a tablespoonful can be used to advantage, and, after a colony has been weakened by the first application, a smaller amount will be sufficient. The poison should be renewed every ten days until no more live ants appear. London purple is worth from 25 to 30 cents a pound in pound lots. Owing to the variability of its action on ants, sample lots of a fourth or a half pound should be tested out before large quantities are purchased. Whenever arsenical poison is needed for spraying plants and London purple is the only kind available, it should be used at the rate of five to ten ounces to 50 gallons of water. Unslaked lime should be used as recommended in the case of Paris green to neutralize the water soluble arsenic.

Spraying with Arsenical Poisons. In preparing any arsenical spray the required amount of the poison should be mixed thoroughly with a small quantity of water before being added to the full quantity. This is more especially necessary in preparing arsenate of lead spray from the paste. While being applied the spray must be kept well agitated to prevent settling of the poison. It is not necessary to hit the insects with the spray, the sole object being to distribute it evenly in fine drops over the surface of the leaves. The addition of laundry soap or whale oil soap at the rate of one ounce to eight gallons of spray will allow a more even distribution of the liquid on smooth leaved plants,

such as cabbage, and in addition the soap will delay the settling of the poison. Except in the case of the first two applications against the codling moth high pressure is not ordinarily required for spraying with arsenical insecticides, the only advantage in high pressure being in the more rapid discharge of the spray, which allows more rapid work. A drenching spray with arsenical or other stomach poisons is a disadvantage, since much of the spray collects in large drops on the tips of the leaves and falls to the ground and is wasted. If the insects are feeding on the under surfaces of the leaves and are not eating all the way through, the application should be made from below. This can be done by means of an "angle ell" or "elbow joint" used on the end of the extension rod, or the nozzle itself may be of the type which directs the spray at right angles to the rod, such as the "side cyclone" nozzle.

Almost any style of spray pump may be employed for applying arsenical insecticides. The three common garden sprayers are known as the "bucket pump," "compressed air sprayer," and the "knapsack sprayer." These should always be equipped with three feet of rubber hose and a three-foot extension rod. The extension rod should preferably be made of aluminum or brass. A stop-cock at the end of the extension rod is necessary in the case of the compressed air sprayer, and desirable in the case of the knapsack sprayer. A barrel pump, one of the larger hand pumps, or a power sprayer is needed for extensive work, such as spraying an orchard. These should have a cut-off at the pump, from 20 to 35 feet of rubber hose, an angle or elbow joint, and a nozzle. The length of the rod and hose is dependent on the nature of the work. For ordinary orchard work 30 feet of hose and a 10-foot extension make a suitable combination.

The following are among the best known manufacturers of spray pumps and accessories:

The Bean Spray Pump Company, San Jose, California.
The Brant Manufacturing Co., Minneapolis, Minn.
The Deming Company, Salem, Ohio.
The Friend Manufacturing Company, Gasport, New York.
The Gould Manufacturing Company, Seneca Falls, New York.
The Hardie Manufacturing Company, Portland, Oregon.
F. E. Myers & Brother, Ashland, Ohio.

A. W. MORRILL.