D-39

Pest Control *on the* Home Front

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Pest Control on the Home Front

By SAM C. McCAMPBELL, Extension Entomologist

Most people can readily identify our common farm and garden plants, quite a few trees, weeds, birds, and animals, but when it comes to an insect they are too often willing just to call it a bug.

When we call to mind that there are more different kinds of insects than there are of all other kinds of plants and animals combined, and we are reminded that of this large group called insects there are many which are beneficial, as well as many pests that seriously damage crops, we can well afford to spend some time learning more about them.

Secretary of Agriculture Claude R. Wickard has stated that "food will win the war and write the peace." When we remember that conservative estimates state that insect pests take a toll of 10 percent of all crops that man grows, the importance of our fight against these pests takes a more serious aspect. We need food to win the war. Perhaps there is little that can be done regarding the loss of food supply from submarines or other war tactics by the common people, but certainly the help of everyone is needed to carry on an intelligent fight against insect pests and help save crops from their attacks.

One of our early scientists states the case against insects briefly and clearly in the following words:

> "It is difficult to understand the long time comparative indifference of the human species to the insect danger—men and nations have always struggled among themselves. But there is a war, not among human beings, but between all humanity and certain forces that are arrayed against it. Man has subdued or turned to his own use nearly all kinds of living creatures. There are still remaining, however, the bacteria and protozoa that cause disease and the enormous forces of injurious insects which attack him from every point and which constitute today his greatest rivals in the control of nature. . . . If human beings are to continue to exist, they must first gain mastery over insects. . . . Insects in this country continually nullify the labor of one million men. Insects are better equipped to occupy the earth than are humans, having been on the earth for fifty million years,* while the human race is but five hundred thousand years old."*

*More recent figures show that insects have been on the earth 100 million years—man 1½ million years.

Wartime Entomology

Insects and man compete for food. Most of our garden and field crops are subject to serious damage by insects if intelligent control measures are not followed. During the coming year thousands of home gardens must be grown to insure an adequate food supply. This is one of the important contributions that every Colorado family should try to make to the war effort.

Boys and girls who have not reached military age can do their part in the coming battle against insect pests. The sharp eye and the alert mind of young folks give them an advantage over adults when it comes to detective work against these small pests that sabotage our home food supply.

The fight against insects must be an intelligent one—a challenge to the alert mind of youth. Observations on the type of feeding, the stages of life cycle and other habits of the pest are necessary.

Many of the poisons used to control insects are important in the manufacture of munitions and other war commodities. Straight shooting and accurate use of the correct insecticide are qualifications required in the home-garden battle against insect pests. The importance of the all-out effort of all of us, especially of our young people, in this war against insect pests cannot be over-emphasized. We must control pests and produce food—we must know the right insecticide to use, shoot straight and make each pound of ammunition count against these pests.

The Allies are engaged in battle with three major Axis powers; on the garden front we, including our boys and girls, must be ready to combat over a dozen major insect pests that have existed on earth at least 75 times longer than man.

The Value of Insect Friends

We have many insect friends. Most fruits must be pollinized by insects. Clover, peas, beans, tomatoes, melons, squash, and many other plants will not set fruit unless visited by insects.

The saliva of the silkworm forms the true silk of commerce. This secretion has a commercial value of over $200,000,000 per year.

The honey bee provides honey to the amount of $30,000,000, and an abundance of beeswax.

Shellac is the secretion from glands on the back of a scale insect.

Another scale insect (cochineal) which lives on the prickly pear, produces a crimson dye used in cosmetics (rouge), cake coloring, coloring beverages.

Certain kinds of insects (blister beetles) are used in medicine.

Insects provide food for many fish, birds, animals, and certain natives of Africa, the Orient, and at one time certain American Indians.

Because of the rapid multiplication, certain flies (Drosophila) are used extensively in the study of heredity.

The maggots of certain flies long ago were found to be very beneficial in healing wounds.

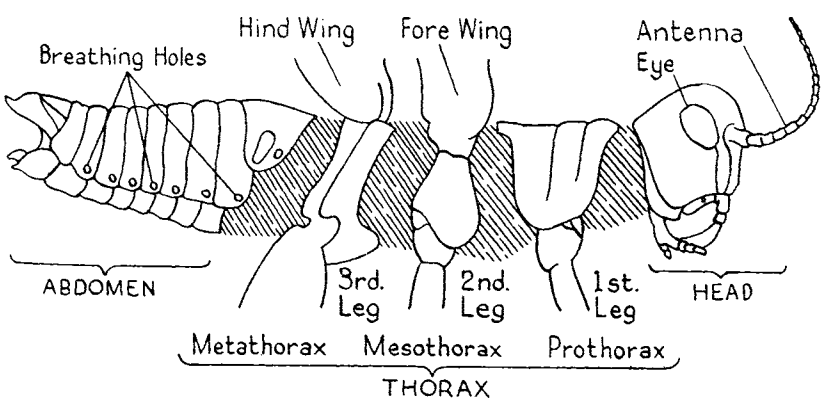
Certain kinds of ladybird beetles, wasps and flies help us to control other insects. The value of these insect friends cannot be over-emphasized, because if it were not for these beneficial insects, all mankind would soon cease to exist.

Since some insects are of great benefit to man, and others threaten man's very existence, let us take a little time to become better acquainted with them.

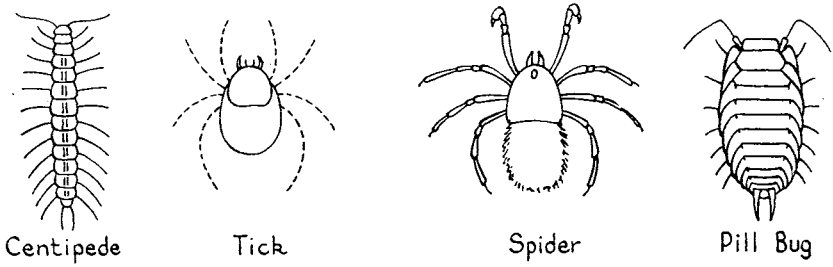
What Is an Insect?

An insect is a small animal that in the adult stage possesses:

1. Six legs.
2. Usually 2 pairs of wings.
3. Three main body divisions termed **head, thorax,** and **abdomen.**
4. A pair of feelers on the head termed **antenna.**
5. Breathes through openings called **spiracles** in the body wall.

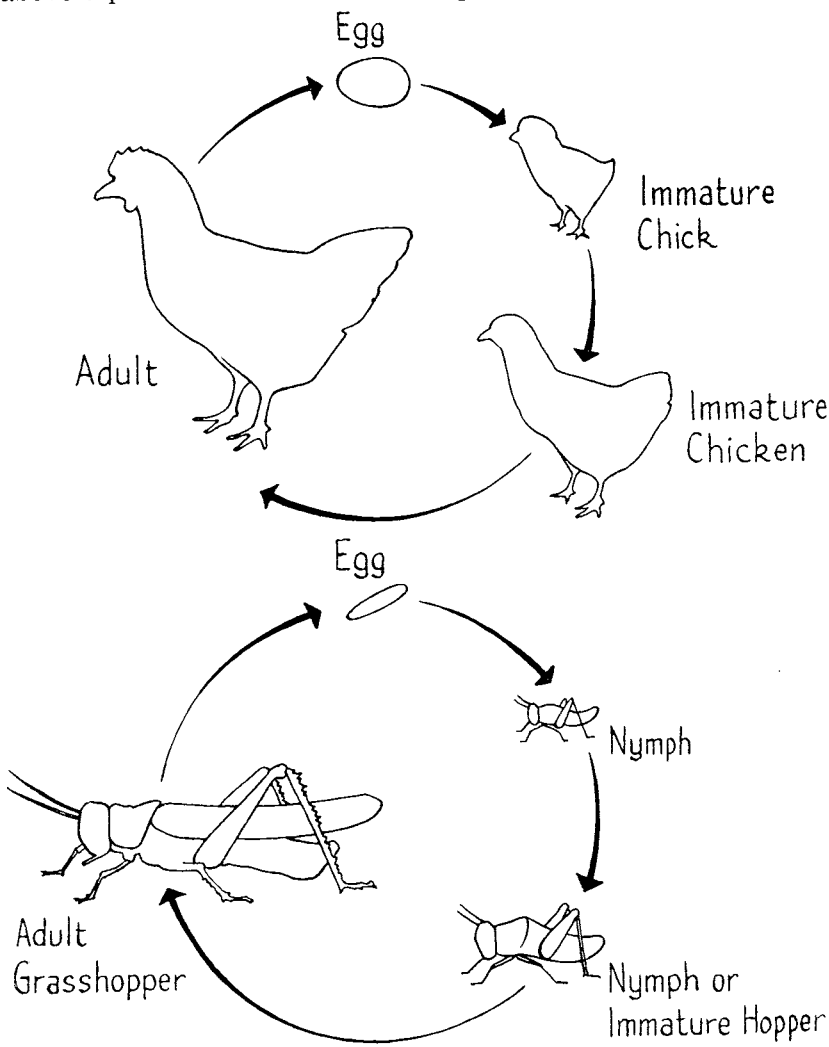


Principal Body Characters of an Insect (Grasshopper)



Near Relatives of Insects

There are a number of close relatives to insects, but the above 5 points will enable one to separate them from insects be-

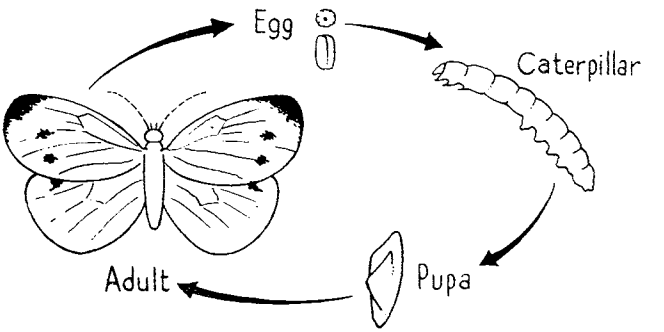


cause none of these forms such as spiders, ticks, pill bugs, centipedes, or millipedes, has all the characteristics given for insects. For instance, a spider possesses 8 legs, insects only 6.

One point should be made clear—immature insects do not possess all of the five characters listed for the adult. The green worm with the velvet-like skin that feeds on cabbages does not resemble the white butterfly into which it eventually develops. Considerable study and close observation will be required to obtain a good working knowledge of insects and their control, but these efforts will pay big dividends because as long as we grow crops and gardens, that long will it be necessary to control the insect pests that try to destroy them.

How Insects Grow

Insects go through a definite cycle in their development. Some insects hatch out of the egg into a form which resembles that of the adult. This group goes through a cycle as simple as that of many farm animals. The chicken and grasshopper may be used for examples.



Development of Cabbage Butterfly

Aphids or plant lice, scale insects, squash, and boxelder bugs, crickets, and locusts all have life cycles as simple as that of the grasshopper.

The second type of life cycle of insects involves four stages —egg, larvae, pupa, and adult. The white cabbage butterfly, or any other butterfly may be used to illustrate the stages of development through which this group goes.

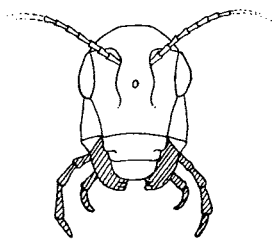
Butterflies, moths, bees, wasps, and flies all go through the four stages of development illustrated.

Time is taken to explain the stages of development of the different groups of insects because this type of information is basic to a working knowledge, whether the problem is one of control or propagation.

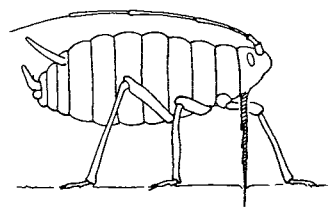
How Insects Feed

Insects may be divided into two general groups according to the way they obtain their food.

1. Those that have jaws and bite away portions of the host. Examples are the grasshoppers, caterpillars, and beetles.
2. Those that obtain their food by inserting their beaks and sucking the juices of the plant or animal. Plant lice or aphids and mosquitoes are good examples.



Grasshopper Has Chewing Mouth Parts



Aphid Has Sucking Mouth Parts.

The importance of how an insect feeds is realized when we think how useless it would be to put lead arsenate, paris green, or some such poison on the leaf of a plant to kill plant lice. The insect would insert its beak right through the poison and drink the plant's sap without getting any of the poison. On the other hand, if a leaf were poisoned with paris green or lead arsenate, a beetle or caterpillar eating bites from the leaf would become poisoned.

The Insecticide Situation

The recommendations for pest control given here are made to meet the present insecticide situation. Little emphasis is given to the use of pyrethrum and rotenone because when the present supply is exhausted, substitutes may be necessary. However, present supplies of these insecticides now held on dealers' shelves should be used during the current season since they lose toxicity when they are held over a period of years.

Where pyrethrum or rotenone are mentioned in control recommendations, we have qualified with "if permitted" to indicate

their use only when not in conflict with War Production Board orders, which may change to meet changing situations.

Many of the recommendations given here are for substitutions to meet shortages which may arise. Where or when there is an adequate supply of pyrethrum or rotenone, we suggest that Extension Circular D-6 "Vegetable Crop Pests" be obtained and those recommendations followed.

Dust Carriers

To apply arsenate of lead, calcium arsenate, and many other poisons in a dust form evenly and economically, usually some material is added as a diluent or carrier. Several materials are mentioned here and at least one of them should be readily available. Hydrated lime, flour, talc, diatomaceous earth, and dusting sulfur are some of the more common carriers. Hydrated lime may stunt the growth of some plants; flour is just a little heavy for most dust guns; talc is ideal if available; sulfur is most desirable of all where there is no danger of burning foliage.

Insecticides

The ammunition used in the battle against pests is usually referred to as an insecticide. Insecticides may be applied as liquid sprays, or as dry or dust sprays. Sometimes poisonous gases are used to control insects, but for common garden crop pests, liquid sprays or dusts are usually used.

We have discussed how insects feed—some chewing or eating the entire leaf, others piercing the leaf surface and obtaining juices from within. Now we must understand the kinds of insecticides necessary for the control of each.

First it must be remembered that any insecticide must be used in sufficient quantity to kill the insect yet not in such quantity that the plant may be injured. Just as the powder must be carefully measured for loading the various types of shells for use in guns against the Axis, in the same way we must carefully measure the insecticide to be used in the bug spray or dust. Then, too, just as various types of explosives are used in human warfare, different kinds of insecticides are required for pests that vary greatly in their habits and structures.

In times of peace a very simple list of insecticides would be sufficient for controlling the common garden pests, but now that shortages exist it will be necessary to become familiar with the various insecticides that may be available so that substitutions may be made when necessary.

Stomach Poisons

The term "stomach poison" is used in referring to those insecticides that kill the insect when they are eaten. They are recommended for insects that have the chewing or biting type of mouth parts. These materials may be used either as liquid sprays or as dusts, depending upon circumstances.

The most common stomach poisons are: Lead arsenate, calcium arsenate, zinc arsenite, paris green, cryolite, and fluosilicates. All of these materials are poisonous to humans when they are eaten, and for this reason care should be taken not to use them in large quantities on fruits or vegetables approaching market size unless they are to be washed to remove the poisonous residue. This would apply to such fruits as apples, pears, cherries, and berries, and to such vegetables as lettuce, cabbage, cauliflower, and green beans. Naturally when such fruits or vegetables are used for the home food supply, they will be washed carefully before eating. This may be sufficient to remove any poisonous residue they may carry.

A brief discussion of the stomach poisons mentioned follows:

Lead Arsenate (Arsenate of lead)—Used principally to control fruit pests such as codling moth but may be used to control many of the chewing pests of the garden such as cabbage worms, fleabeetles and webworms. May be used as a liquid spray or as a dust.

The usual liquid spray formula is: Lead arsenate—1 tablespoon; water—1 gallon.

In preparing a liquid spray first form a paste by stirring the tablespoon of lead arsenate into half a cup of water and then add to this paste the gallon of water. Stir until thoroughly mixed. This same procedure should be followed in mixing a liquid spray from any dry insecticides.

The usual dust formula is: Lead arsenate—1 pound; carrier—5 pounds.

To prepare a dust mixture, place the dust carrier and insecticide in a tight container such as an old milk can. Add a few rocks and roll the can about slowly until the insecticide and lime are evenly mixed.

Calcium Arsenate—This insecticide is used principally as a dust in the home garden. It should be mixed in the same manner and same proportions as given for arsenate of lead. Calcium arsenate is recommended for the control of cabbage worms, flea-

beetles, and certain other chewing pests. It may be used as a liquid spray, 1 tablespoonful to 1 gallon of water. However, it does not stick to the foliage as well as lead arsenate.

Zinc Arsenite—This material is usually used as a liquid spray—1 tablespoonful to 1 gallon of water. It is best for the control of bean beetles, fleabeetles, blister beetles, and the Colorado potato bug. It may be mixed with liquid, lime-sulfur, psyllid spray, and for cabbage worms where other materials are not available.

Paris Green—This material will burn the foliage of tender plants such as beans. It is a poor sticker to the leaf surface. It is recommended that when used as a liquid spray hydrated lime be added. The usual formulae is 1 and ½ teaspoonful of paris green, and 1 tablespoonful of hydrated lime mixed with 1 gallon of water. It will control potato bugs, fleabeetles, cabbage worms and webworms. Paris green is an excellent dust for the control of cabbage worms and is mixed at the rate of 1 pound to 10 pounds of carrier. Paris green is also used in grasshopper and cutworm bait but to conserve arsenicals, sodium fluosilicate is recommended as a substitute.

Cryolite—Cryolite is one of the more promising fluorine materials that have been found effective for the control of bean beetles, fleabeetles and tomato fruitworms. It may be mixed with liquid lime-sulfur spray for the control of the potato fleabeetle if zinc arsenite, which is recommended for this purpose, should not be available. As a liquid spray, use 1 tablespoon of cryolite in 1 gallon of water. For tomato fruitworm, use a dust made by mixing 4 pounds of cryolite with 6 pounds of talc or some other inert carrier. Another effective treatment for tomato fruitworm consists of a dry bait that is broadcast by hand over the tomato plants. This mixture consists of ½ pound of cryolite mixed with 12 pounds of cornmeal. Cryolite is poisonous and the same precautions should be used to avoid poisonous residue as for arsenicals.

Sodium Fluosilicate—Sodium fluosilicate is effective as a liquid spray or a dust for the control of many chewing insects. However, during the present shortage of arsenicals its principal use will be in grasshopper and cutworm baits. Grasshopper or cutworm-bait mixture consists of 25 pounds of coarse-flaked wheat bran mixed with 1 pound of sodium fluosilicate and sufficient water to moisten.

Contact Insecticides

Contact insecticides are used against insects that have the sucking type of mouth parts and take their food by piercing the

leaf surface and sucking the juices from within. It is necessary to hit the insect with the contact spray or dust since death comes only to those that are wet or dusted with the material. "Hit the insect" is the rule with the contact poisons while with stomach poisons "coat or cover the plant" is the rule.

Contact insecticides may be used to control some chewing insects, but seldom if ever can we kill a sucking insect with a stomach poison.

The most common contact insecticides are nicotine sulfate, sulfur, rotenone, pyrethrum, soaps, and specially prepared oils.

Unlike the stomach poisons, contact poisons mentioned here leave very little poison residue after they have been exposed to the atmosphere for 24 to 36 hours.

Nicotine Sulfate—The common nicotine sulfate contains 40 percent nicotine. Most of the available supply is sold under the trade name of Black Leaf 40. It may be used as a liquid spray for the control of aphids or plant lice, leafhoppers, and many other sucking insects. Small chewing insects such as young cabbage worms are killed when hit with strong nicotine spray. The usual liquid spray is made by adding 1 teaspoonful of Black Leaf 40 to 1 gallon of water in which an inch cube of laundry soap or a tablespoonful of soap flakes has been dissolved. Always be sure to add soap since it greatly increases the effectiveness of the spray.

Nicotine sulfate may also be used as a dust, and is especially recommended for aphids and other pests that cause leaves to curl in such a manner as to make it difficult to hit the insect with a liquid spray. Cabbage and cucumber aphids are pests that are easier to control with the dust. Nicotine sulfate may be used in solutions or dust mixtures containing stomach poisons such as arsenate of lead, thus forming a spray mixture effective for the control of both chewing and sucking insects.

Directions for mixing the dust are printed on or included with the package of Black Leaf 40.

Sulfur—There are two common forms of sulfur used as insecticides: Dusting sulfur and wettable sulfur.

Dusting Sulfur—This is a specially prepared form of sulfur suitable for use in dust guns. It is used to control tomato and potato psyllids, red spider, and certain plant diseases such as mildew. Stock sulfur or the common sulfur used as a fertilizer is too coarse for insecticidal purposes. Be sure and buy **dusting sulfur** for dusting. It is usually used without diluting.

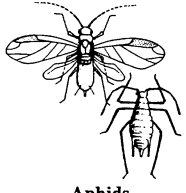
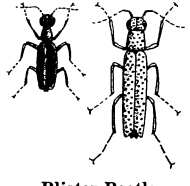
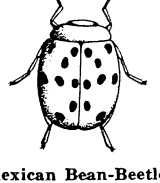
Wettable sulfur is a specially prepared product that mixes readily with water. Ordinary dusting sulfur or stock sulfur is not suitable for liquid spraying since it does not mix readily with water. Wettable sulfur is recommended for the control of potato and tomato psyllid, red spider, and certain plant diseases such as mildew. It is usually used at the rate of 1 ounce mixed in 5 quarts of water.

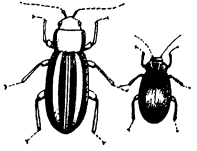
Strong soap-and-water solutions are effective in killing certain aphids but there may be danger of burning the plants. For this reason it is suggested that Black Leaf 40 be used in conjunction with soap as recommended under nicotine sulfate.

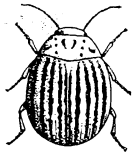
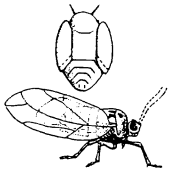
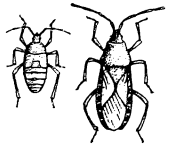
Pyrethrum and Rotenone—These materials are usually considered as non-poisonous to humans as far as leaving dangerous residues on the plants is concerned. They have been used successfully to control many chewing and sucking garden pests. However, the war situation has greatly decreased the supply of these materials available for garden-pest control, and when the present stock on dealers' shelves is exhausted, it may be necessary to use other insecticides as substitutes.

Dusting Versus Liquid Spraying

Nearly all of the common garden pests can be controlled by either of these methods. Liquid sprays have the advantage of sticking to the plant better. However, dusts are easier to apply and can be blown into curled leaves that are hard to wet with liquid sprays. Recommendations given here are made to fit whichever type of equipment may be available.

INSECT PEST	PLANTS ATTACKED	DIFFERENT DUST CONTROLS	DIFFERENT SPRAY CONTROLS	REMARKS—SIZE OF INSECTS
 **Aphids**	Cabbage Cucumbers Potatoes Melons Peas and nearly all other garden plants	Thoroughly mix 2 tablespoons of 40 percent nicotine sulfate with 1 pound of hydrated lime; apply with dust gun when the air is still.	1 teaspoon of 40 percent nicotine sulfate—1 tablespoon of soap flakes dissolved in 1 gallon of water—apply when there is no wind and temperature is 70° or above.	Be sure and hit every aphid with dust or spray. Dust or spray when aphids first appear and before they become abundant and cause leaves to curl. Aphids vary in size from 1/6 to 1/10 of an inch in length.
 **Blister Beetle**	Tomatoes Potatoes and many other plants	Pyrethrum dust of .2 percent pyrethrin content if permitted; 1 part of cryolite or fluosilicate mixed with 5 parts of carrier.	1 tablespoon of zinc arsenite dissolved in 1 gallon of water. Cryolite or fluosilicate may be substituted for zinc arsenite.	Watch for beetles and be prepared to spray or dust as soon as they appear—an entire garden may be destroyed in a single day. Size ½ to 1½ inches in length, vary in color. Several different species.
 **Mexican Bean-Beetle**	All kinds of beans	If permitted, pyrethrum or rotenone dust; 1 part of cryolite mixed with 5 parts of carrier—zinc arsenite or calcium arsenate may be used as a substitute for cryolite.	1 tablespoon of zinc arsenite or cryolite to 1 gallon of water. Calcium arsenate or basic copper arsenate may be used as a substitute for cryolite or zinc arsenite.	Watch for adult bean-beetles to appear during the 2nd week in June. Apply spray or dust so as to cover both lower and upper surfaces of leaves. **Do not** use lead arsenate or paris green. Size—about ¼ in. long.
 **Cabbage Worm**	Cabbage Cauliflower Broccoli	If permitted, pyrethrum dust; 1 part calcium arsenate to 5 parts of hydrated lime or 1 part paris green to 10 parts carrier—lead arsenate or cryolite third choice.	1 tablespoon lead arsenate to 1 gallon of water or 1½ teaspoons of paris green to 1 gallon of water. If aphids are present, add nicotine sulfate to spray mixture.	Start dusting or spraying when worms first appear. Dusts usually are to be preferred because they stick better—size ¾ to 1½ inches.

INSECT PEST	PLANTS ATTACKED	DIFFERENT DUST CONTROLS	DIFFERENT SPRAY CONTROLS	REMARKS—SIZE OF INSECTS
 **Corn Earworm Tomato Fruitworm**	Corn and Tomatoes	Dust corn silks with calcium arsenate 1 part, dusting sulfur 3 parts, 3 days after silks appear.	Not practical.	For control on tomatoes scatter bait over plants, made by mixing 1 pound of cryolite with 25 pounds of cornmeal as soon as worms appear.
 **Cucumber Beetle**	Cucumbers Melons Squash Pumpkins	Pyrethrum-copper dust if permitted; 1 pound of calcium arsenate or cryolite mixed with 5 pounds of carrier.	Dust more practical but arsenate-of-lead or calcium-arsenate standard spray may be used in emergency.	Dust just as soon as plants come through ground. Second application may be necessary. Dust mixture is improved by adding 6 percent by weight of yellow cuprocide; $\frac{1}{4}$ inch long.
 **Cutworm**	Practically all garden plants	Dust not practical—zinc arsenite or sodium fluosilicate may be substituted for paris green in bait formula.	Before setting out cabbage or tomato plants, wrap paper collars about stems so as to extend from roots to first leaves.	Scatter poisoned-bran bait over garden at sundown just before garden plants come up. Prepare bait by mixing $\frac{1}{4}$ pound paris green with $\frac{1}{2}$ pint molasses, then add 2 quarts water. Sprinkle solution over 5 pounds of coarse bran and mix until crumbly. Size—1 to 2 inches long.
 **Fleabeetle**	Radishes Potatoes Turnips and practically all garden crops	Pyrethrum or rotenone dusts if permitted. Use cryolite, calcium arsenate, fluosilicate, lead arsenate, or paris green mixed 1 part to 5 parts of carrier.	Use zinc arsenite, cryolite, lead arsenate, or calcium arsenate at standard spray strength.	Dip tops of cabbage and tomatoes in a lead-arsenate solution before setting out. Watch radishes, turnips, beets, and other small vegetables, and dust when injury starts. Several different species occur, varying in color. Size: 1/10 in. long.
 **Grasshopper**	Practically all garden plants	Dust not practical. In most counties Federal grasshopper bait ready-mixed is available through county agent's office.	4 tablespoons zinc arsenite to 1 gallon water may be sprayed on weeds but poisoned-bran bait is much better.	Use poisoned-bran bait recommended for cutworms, but for grasshoppers scatter bait at sunup. Size: 1 to 2$\frac{1}{2}$ in.

INSECT PEST	PLANTS ATTACKED	DIFFERENT DUST CONTROLS	DIFFERENT SPRAY CONTROLS	REMARKS—SIZE OF INSECTS
 **Colorado Potato-Beetle**	Irish Potatoes	Dust with any stomach poison available at rate of 1 part mixed with 5 parts of carrier.	Spray with 1 tablespoon of zinc arsenite in 1 gallon of water. Other stomach poisons may be used.	Dust or spray as soon as striped beetles appear. Size—about 3/8 in. long.
 **Psyllid (nymph)** **Psyllid (adult)**	Irish Potatoes and Tomatoes	Dust with straight dusting sulfur.	Spray with wettable sulfur 2 tablespoons in 1 gallon of water.	Usually 3 sprays necessary—be sure to get sulfur on under sides of leaves—first application when plants are 4 to 6 in. tall; 2nd—10 days to 2 weeks later. Size—1/20 to 1/10 in. long.
 **Red Spider**	Most small fruits and vegetables	Dust with mixture of 1 part dusting sulfur to 1 part of carrier.	Spray with wettable sulfur 1 tablespoon in 1 gallon of water.	Watch for minute mites on under sides of leaves; be sure to hit them with dust or spray as soon as injury shows. Almost too small to see—1/40 to 1/60 inch long.
 **Squash Bug**	Squash, sometimes Pumpkins and Melons	Pyrethrum dust, .2 percent pyrethrin content if permitted. Young bugs may be killed with strong nicotine dusts.	Small bugs may be killed with double-strength 40 percent nicotine soap spray. Hand-pick bugs and eggs from plants.	Place small boards on ground. Collect and destroy bugs each morning. The bugs crawl under the boards at night. Size—½ to ¾ inch long.
 **Tomato Hornworm**	Tomatoes	When worms are small they may be controlled with dusts recommended for fleabeetles.	When worms are small they may be controlled with sprays recommended for potato bugs.	When worms are large, hand-pick and destroy. They are nearly 3 inches in length when full grown.