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Department of Entomology
University of Nebraska
Lincoln, Nebr.

Revised
February
1940

Extension
Circular
1512

PESTS OF THE VEGETABLE GARDEN

O. S. Bare

Nebraska
COOPERATIVE EXTENSION WORK
IN AGRICULTURE AND HOME ECONOMICS
U. of N. Agr. College & U. S. Dept. of Agr. Cooperating
W. H. Brokaw, Director, Lincoln

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Extension Circular 1512

PESTS OF THE VEGETABLE GARDEN

by O. S. Bare

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Types of Insects

For purposes of control, insects may be divided into two groups. Insects of one group have biting mouthparts with which they bite off and actually consume parts of the plant. They are controlled most readily by stomach poisons that are swallowed with their food, although other types of insecticides may be effective against them. Insects of the second group have piercing or sucking mouthparts with which they pierce various parts of the plant and suck out the plant juices without actually swallowing the plant tissues. They must be controlled by contact insecticides that kill by coming in contact with the insect.

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Types of Insecticides

1. Stomach poisons

These must be swallowed by the insect. The majority are forms of arsenic, and are poisonous to human beings and farm animals as well as to insects, but several insecticides that are practically non-poisonous to human beings and the higher animals have come into quite common use. Of the arsenicals, lead arsenate, calcium arsenate and Paris green are most commonly used. All are dangerous poisons. Of the three, lead arsenate is used most extensively in garden and orchard spraying and dusting. It adheres well to foliage and seldom burns any but the most tender plants. Paris green is more rapid in action than lead arsenate, but is likely to burn the foliage of most plants. It is used mainly on hardy plants such as potatoes and should always be used with hydrated lime, which reduces the danger of injuring the plants. Calcium arsenate is slightly stronger and quicker in action than lead arsenate, but does not adhere to foliage quite so well, and also is more likely to cause injury by burning.

Sodium fluosilicate is a poisonous insecticide which appears to be more effective than arsenicals against certain insects, and less dangerous to persons and warm blooded animals. It is most commonly used as a dust to control blister beetles. It has a tendency to burn foliage of tender plants, and should not be used in sprays. Barium fluosilicate possesses similar qualities and is used similarly. Cryolite, another insecticide of this group, is often used to replace lead arsenate in dusts and sprays.

Rotenone is the most important of the non-poisonous or "safe" insecticides, and is recommended above all others for general use in the home garden. It is found in two tropical plants, derris and cube, the roots of which are dried and ground and used in making up dusts or sprays for controlling various insects. Rotenone appears to act both as a stomach poison and as a contact poison. Thus it is effective against an unusually large number of insects. However, it is ineffective against a few of the more resistant ones, and seems to be practically non-poisonous to people and common animals. It is quite slow in action, requiring from 24 to 96 hours to make its total kill, but insects usually quit feeding very soon after eating it or coming in contact with it. Several prepared rotenone dusts are on the market. For general purposes, they should contain 3/4% or 1% rotenone. Several powders and liquid extracts for making up rotenone sprays also are on the market. The manufacturer's directions should be followed in mixing and using such sprays. Alkalies weaken or destroy rotenone. Consequently, alkaline carriers or spreaders such as lime and laundry soap should not be used in rotenone dusts or sprays.

Pure cube or derris dusts containing from 4% to 5% of rotenone are now available at some druggists and other dealers in insecticides. They are much stronger than is necessary for controlling most insects and their cost is prohibitive for general use. However, where they are available, they can be used profitably against certain particularly hardy insects such as garden ants and partly grown squash bugs.

2. Contact insecticides

Pyrethrum powders and liquid extracts are very good contact insecticides, and they are harmless to people and common animals. They may be used either as dusts or in sprays, and the manufacturer's directions should be followed closely. Several manufacturers are putting out stabilized pyrethrum dusts that are much

more effective than the plain dusts, and also have much better lasting qualities. These stabilized dusts are put out in several strengths for various types of insects, and give excellent results when used against the types of insects for which different strength dusts are adapted. Some manufacturers also are putting out a combined rotenone and pyrethrum spray that seems to be one of the very best all around insecticides for garden use.

Nicotine extracts are among the best of the contact insecticides, and while nicotine is very poisonous it soon evaporates or disintegrates after being exposed to the air for some little time. Nicotine sulphate, which comes under several trade names, is the form most commonly used as an insecticide. In mixing nicotine sprays, follow the manufacturer's directions. A very good general purpose nicotine dust can be made by mixing an ounce of nicotine sulphate with a pound of powdered hydrated lime. Shake it up thoroughly with a few pebbles in a friction top gallon pail. This gives a dust containing 2.4% nicotine. Prepared nicotine dusts also are on the market. For general use they should contain 2% to 3% of nicotine, while 4% is better for very hardy insects. Nicotine dusts and sprays give best results during hot, still weather, and as nicotine is very volatile, all nicotine preparations should be kept in airtight containers to prevent loss of strength.

Soap solutions are effective against many plant lice and some other soft-bodied insects. An inch cube of laundry soap dissolved in a quart of hot water makes a good spray for hardy plants, but must be diluted to half that strength for the more tender ones.

Spraying or dusting - which?

Dusting is steadily gaining favor over spraying as a means of insect control in the home garden. Sprays are cheaper, and are advised where any large area is to be treated, but for the home garden or any other small area, the cheapness of the spray is more than offset by the greater ease and speed of dusting, the lower price of small dusting equipment, and the getting away from the tedious mixing of messy spray materials before control work can be started. In the home garden, prepared dusts can be used, and these can be applied easily and quickly with an inexpensive plunger type hand duster, or in many cases, simply by shaking the dusts through a cheese-cloth or thin muslin sack. Sifter-top boxes also can be used in applying these dusts.

Measures and weights

3 teaspoonsful equal	1 tablespoonful
2 tablespoonsful equal	1 liquid ounce
8 liquid ounces equal	1 cupful
2 cupfuls equal	1 pint

Lead arsenate, calcium arsenate, hydrated lime, and sulphur are nearly equal in weight. A cupful of any one of them weighs approximately 4 ounces. A cupful of Paris green weighs about 8 ounces, and one of white arsenic about 10 ounces.

Controlling Garden Pests

General pests

Aphids or plant lice are small, soft-bodied sucking insects of various colors. Any of the contact insecticides mentioned above will control them.

A nicotine spray made by mixing from 1 to 1½ teaspoonfuls of nicotine into a gallon of water in which an inch cube of laundry soap has been dissolved is a standard remedy. Nicotine dusts containing from 2% to 3% nicotine are effective against most aphids, but a 4% nicotine dust is necessary for a few hardy kinds.

Rotenone dusts containing 3/4% or 1% rotenone are effective against many aphids, and pyrethrum dusts and sprays also are good.

Leaf-hoppers are small, jumping, winged and soft-bodied insects that attack various garden crops. As they are sucking insects, they must be controlled by contact insecticides. Young leaf-hoppers can be killed by nicotine sprays containing 2 teaspoonfuls of nicotine sulphate in a gallon of water in which an inch cube of laundry soap has been dissolved. Young leaf-hoppers and some adults will be killed by a nicotine dust containing 3% to 4% nicotine.

Strong rotenone and pyrethrum dusts and sprays are at least partly effective against leaf-hoppers, and a spray of Bordeaux mixture acts as a repellent although it does not actually kill them. Sulphur dusts, or a spray of 1 pound wettable sulphur in 10 gallons of water will give good control.

Flea beetles are small, jumping, hard-shelled insects, most of which are less than an eighth of an inch long. They vary from black or brown to light colors with various stripes and markings. Their habit of jumping quickly when disturbed gives them their common name of "flea beetles." As they have biting mouthparts, they are controlled best by use of stomach poisons. A rotenone dust containing 3/4% or 1% rotenone is very effective. An ounce of calcium arsenate mixed with 8 ounces of hydrated lime gives fair results if dusted on the plants while they are wet with dew. Bordeaux mixture is repellent to them and serves to reduce damage. Addition of one ounce of calcium arsenate to a gallon of 4-4-50 Bordeaux mixture spray gives good control, but calcium arsenate should not be used on plant parts that are to be eaten without a thorough washing.

Grasshoppers can be controlled best when less than one-third grown, but even adults can be poisoned successfully. Use a poisoned bran bait made as follows: Stir 2 level tablespoonsful of Paris green or sodium fluosilicate into 3 quarts of dry bran. Then mix a half teacupful of molasses into a quart of water. Pour this slowly into the poison bran mixture, stirring constantly to insure thorough mixing. Scatter this bait very thinly and thoroughly where grasshoppers feed. If thoroughly scattered, there is no danger of poisoning birds, animals or childrem but lumps of this bait are very dangerous. The above formula is enough for a good-sized garden. Repeat the poisoning in about five days if necessary. From sunup to 9:00 A.M. of a bright, warm day is the best time to spread grasshopper bait. For more complete information see Nebr. Extension Circular No. 1507, Grasshopper Control.

Cutworms are the larvae of the gray and brown moths or "millers" that are so numerous around our lights in the summer. They can be controlled in most cases by use of the poisoned bran bait that was recommended above, for grasshoppers. Scatter the bait around the plants in late afternoon or evening, as cutworms feed mainly at night. Repeat in five or six days if necessary. For more complete information see Nebr. Extension Circular No. 1508, Corn and Garden Cutworms.

In small gardens, plants may be protected from cutworms by sinking small cylinders of tin or heavy paper into the soil around them. The cylinders should

extend an inch into the soil and two inches above it. Cleaning up and burning all crop remnants, weeds and trash around the garden in the fall is an excellent control measure.

False chinch bug. This is a small, black or brown-bodied bug with unmarked silvery wings and characteristic "buggy" odor. It attacks corn, beets, radishes, turnips, onions and a great variety of other garden and field crops. It usually moves in from near-by weedy areas, and is worst in hot drouthy weather. It clusters on the upper parts of the plants and sucks out the sap, thus causing withering, curling, and drying of the leaves with resulting severe weakening or death of the plants.

Control measures are not entirely satisfactory but reduce injury enough to be well worth while. A strong nicotine spray, using 1½ or 2 teaspoonsful of nicotine sulphate to a gallon of water in which an inch cube of laundry soap has been dissolved, probably gives best results. The nozzle of the sprayer should be held high above the plants to avoid disturbing the bugs, and then lowered gradually to wet thoroughly the bugs on the plant and on the ground. A 4% nicotine dust also gives fair results, and rotenone dusts of standard strength have proved to be fairly satisfactory.

Red spiders attack many kinds of garden plants. The tiny spiders spin fine webs on the underside of the leaves and feed beneath these webs. They puncture the leaves and suck out the sap, thus causing the leaf to wither, curl and die. Damage is greatest in hot, dry weather. Control is difficult unless it is begun before the infestation has made much progress. Probably the most satisfactory control measure is the use of a dust made of 3 parts fine dusting sulphur and 1 part of fresh hydrated lime, by weight. This should be repeated in ten days. A spray made by mixing 1 pound of wettable sulphur in 10 gallons of water also is very good. However, sulphur may cause damage to cucumbers and other plants of that group.

The Colorado Agricultural College recommends a flour paste spray, made by cooking 1/4 pound of flour in a quart of water until it makes a smooth paste. Mix well with 2 gallons of water before using.

Pest of Cabbage, Cauliflower, Turnips, Radishes, etc.

Common cabbage worm, and cabbage looper. The common velvety green cabbage worms hatch from the eggs of the white cabbage butterflies. The cabbage looper resembles the cabbage worm in size and habits, but is green with four white lines lengthwise of the body. As both of these pests have biting mouthparts, stomach poisons are effective against them. Until the heads are formed, arsenicals may be used safely, but thereafter non-poisonous insecticides must be used.

Dusting with lead arsenate or calcium arsenate at the rate of 1 part of the poison by weight to 8 parts of flour is good. A dust of 1 part Paris green, 5 parts hydrated lime and 10 parts flour is very effective. Good results can be secured by spraying with ½ ounce of lead arsenate in a gallon of water in which an inch cube of laundry soap has been dissolved.

Rotenone dusts containing ½% to 1% rotenone are fully effective, and as they are non-poisonous they are to be preferred over the arsenicals. Destruction

of plant remnants and garden trash by burning after the crop has been gathered in the fall will aid in preventing trouble next year.

Cabbage and turnip aphids are very small whitish green plant lice that attack nearly all plants of this group. They feed by sucking sap from the under side of the leaves. The leaves curl, forming protective covers for the aphids, and later wither and die.

Both of these aphids are quite resistant to sprays and dusts. A nicotine spray, using 2 teaspoonsful of nicotine sulphate to a gallon of water in which an inch cube of laundry soap has been dissolved gives fair results, but must hit the under side of the leaves. A 3% nicotine dust gives good control except in cases of advanced infestations. In such cases a 4% nicotine dust is required. Rotenone dusts containing 3/4% or 1% rotenone are at least partly effective.

Flea beetles. Several species of small, quick-jumping, flea-like beetles attack cabbage, turnips, radishes, and so on. Some are so small and lively that they are difficult to see. They injure the plants by feeding on the leaves and riddling them with holes.

A 3/4% or 1% rotenone dust gives very good control. A 4-4-50 Bordeaux mixture spray gives fair control, especially if ½ ounce of calcium arsenate is added to each gallon.

Cabbage maggot. This pest attacks cabbage, cauliflower, turnips, radishes, etc. The parent is a small fly which lays eggs on or around the base of the plants. The maggots hatch and begin feeding on the roots. The plants are killed or badly weakened.

Calomel is best suited to control of this pest in the home garden. A calomel-lime dust, made by mixing 1 ounce of calomel with 24 ounces of cornstarch or hydrated lime is handy and effective. Dust it around the bases of the plants at the rate of ½ pound per square rod of cabbage patch, or at a corresponding rate on turnips and radishes. Apply as soon as plants are set out or come through the ground, and repeat three times at intervals of a week or ten days.

Pests of Beans and Peas

Mexican bean beetle. In Nebraska this pest is found only in a few western counties. It is the only injurious ladybird beetle that is found in the state. Both larvae and adults feed mainly on beans, but may attack some other legumes. The adult is a rather large yellowish or orange ladybird having eight black marks on each wing cover. The larva is orange-yellow with many spines. The larvae feed only on the under side of the leaves.

A 3/4% or 1% rotenone dust gives excellent control, and as it is non-poisonous it can be used at all times. A dust of 1 part calcium arsenate to 8 parts hydrated lime by weight, or a spray of ½ ounce calcium arsenate in 2 gallons of water gives fair control, but may damage the plants. When the adults first appear in the spring, dusting lightly with a mixture of 1 part sodium fluosilicate to 4 parts of flour by weight gives good control. Arsenicals or sodium fluosilicate should not be used on snap beans after the pods have set.

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Cleaning up and burning all crop remnants and trash around the garden in the fall is a good preventive of trouble, as the beetles winter largely in such material.

Bean aphis. This is a small, dark brown, or nearly black, plant louse that attacks beans and a few other plants. They are likely to gather in large numbers on the terminal growth of the plant. Nicotine sprays or dusts of standard strength are fully effective. A 3/4% or 1% rotenone dust also gives good control.

Pea aphis. This is a pear-shaped green plant louse that may reach a length of 1/6 inch. It attacks several kinds of legumes, but is most serious on peas. The plants turn yellow, wither and die. If the plants are weakened but not killed, both the quantity and quality of the crop is reduced. This aphis often is found on alfalfa or clover around the garden, and moves from these plants to attack garden peas. Thus, getting rid of alfalfa and clover around the garden is a help in fighting this pest.

The pea aphis is difficult to control, as it is more than ordinarily resistant to contact sprays and dusts. Strong nicotine dusts have been considered to give the best control. On light or moderate infestations, a 3% nicotine dust is effective, but where infestation is heavy a 4% nicotine dust is recommended. It should be applied on warm, still days.

Rotenone sprays of moderate strength are about as effective as strong nicotine dusts, and strong rotenone dusts also give fair control.

Pests of Cucumbers, Melons, Squashes and Related Crops

Cucumber beetles. The striped cucumber beetle is probably the most important pest of these crops in Nebraska. It winters in trash and may attack the plants as soon as they appear in the spring. The adult beetles not only feed on the plants, but also lay eggs in the soil about the base of the plants. When these hatch the tiny white larvae bore into and destroy the roots. This beetle also is a carrier of a serious plant disease known as cucumber wilt. The green and black-spotted cucumber beetle often attacks cucumbers and related plants, but is less important. Its habits are similar to those of the striped cucumber beetle, and control measures are the same for both.

Cucumber beetles are difficult to control, as the adults do not eat poison readily, and the larvae feed only underground. To be effective, control measures must be begun before the beetles have laid eggs around the bases of the plants and this often occurs when the plants are only a few days old. Rotenone dusts containing 3/4% or 1% rotenone give good results and are gaining rapidly in popularity. All dusts must be applied around the bases of the plants as well as on the leaves. Dusting should begin soon after the plants come through the ground, and should be repeated about once a week until the middle or latter part of July.

A calcium arsenate-gypsum dust has been used extensively in the past and is still popular in many places. To make it, mix an ounce of calcium arsenate with a pound of powdered burnt gypsum or land plaster. A strong nicotine dust is fairly effective, but lacks lasting qualities. A dust made by mixing 1 part of sodium fluosilicate with 3 parts of flour is quite effective, but may burn tender plants. Stabilized pyrethrum dusts of medium to strong strength give excellent control.

Clean up and burn all vines and crop refuse as soon as the crop has been gathered. Raking and burning all crop remnants, weeds and trash around the garden in the fall is an important control measure.

Melon aphis. This is a small plant louse that feeds by sucking sap from the under surface of the leaves, thus causing them to curl, wilt, and die. Even if the plants are not killed, both the quantity and quality of the fruit will be reduced. They usually start by building up a heavy population on a few hills, and spread from them over the entire patch.

Control measures should be started as soon as the first aphids appear on the first plant. A 3% nicotine dust is the most effective remedy. It should be applied on a hot, still, and dry day, and must get under the leaves. Covering the plants with a muslin sheet or piece of canvas, and shooting the dust underneath it gives splendid results. A nicotine spray, made by mixing 1½ teaspoonsful of nicotine sulphate into a gallon of water in which an inch cube of laundry soap has been dissolved, gives fair control if the spray reaches the underside of the leaves. Rotenone dusts and sprays also give good control, although slower in action than nicotine.

Squash bugs. These large, brownish-black bugs and their red to white and gray nymphs are among the worst pests of squashes, pumpkins, and related plants. Adults winter in trash and move to the young plants in the spring. They lay their yellowish or bronze eggs in groups, usually in the leaf axils. Both the adults and the young bugs or nymphs feed by sucking the sap from the plant leaves and stems.

Control is difficult as the adults and older nymphs are very resistant to contact insecticides. In spring, while the plants are small, the overwintered adults may be trapped very successfully by scattering pieces of shingle or light boards around the garden, and particularly around the young squash or pumpkin plants. The bugs gather under these during cool nights, and may be collected and destroyed by dropping them into a can containing a little kerosene. This is important in reducing later infestation. Hand-picking adult bugs from the vines is effective before they become numerous, and hand-picking and crushing the egg clusters is effective on small patches or gardens. Young bugs, up to half grown, may be killed by spraying with nicotine sulphate at the rate of 2 to 3 teaspoonsful of nicotine sulphate to a gallon of water in which an inch cube of laundry soap has been dissolved. A 4% nicotine dust is fairly effective if applied on a still, hot day. Strong rotenone dusts are effective against the young bugs, but are of little use after they are half grown. Very strong stabilized pyrethrum dusts give excellent control of the nymphs and are fairly effective against the adults.

Squash vine borer. This borer is the larva of a daylight flying moth that lays its eggs on the squash plants. The larvae work inside the stems and soon kill or badly weaken the plant. Control is difficult, as any insecticide must reach the tiny larva before it bores into the stem. Spraying the plants with 4-4-50 Bordeaux mixture, with a half ounce of lead arsenate added to each gallon of spray, is fairly effective. The first spray should be applied about July 1, and it should be repeated three of four times at intervals of five or six days.

Strong nicotine sulphate sprays are among the most effective of known control measures. Use 3 or 4 teaspoonsful of nicotine sulphate to a gallon of

water in which an inch cube of laundry soap has been dissolved. The first spray should be applied about July 1, and should be repeated three times at seven-day intervals. Recent experiments indicate that a 1% rotenone dust, applied as directed for the Bordeaux-lead arsenate spray, is probably most effective of all control measures.

Borers in the vine may be removed by slitting the stem lengthwise with a sharp knife, or where the borer can be located, a pin may be thrust through the stem, killing the borer with slight injury to the plant. Cover the injured part of the stem with moist soil. Gather and burn all plant remnants as soon as the crop is gathered, and plow the patch deeply in late fall or very early in the spring.

Pests of Tomatoes

Tomato fruitworm. This is the same pest that is known as the corn earworm when it attacks corn. Most of its damage to tomatoes comes fairly late in the season, and it is a pest whose control is difficult and seldom entirely satisfactory.

A spray made by mixing a half ounce of lead arsenate and an ounce of hydrated lime into a gallon of water is at least partly effective and can be used as needed until the fruit is half grown. A dust of 1 part calcium arsenate, 4 parts hydrated lime and 4 parts flour, by weight, gives fairly good results. It may be applied several times at twelve-day intervals but arsenicals should not be used on tomatoes after the fruit is half grown. After that time, a mixture of 1 part fresh pyrethrum powder to 3 parts of flour by weight may be used as needed, and is non-poisonous. Rotenone dusts and sprays seem to be quite variable in results against this pest. A stabilized pyrethrum dust of medium strength should give good control.

Tomato hornworm. This big green and brown worm often reaches a length of two to three inches. It takes its name from a sharp horn-like projection near the end of the body. One or two of these hornworms can completely defoliate a large tomato plant in a day or two. A lead arsenate spray or a calcium arsenate-lime flour dust as directed for the tomato fruitworm gives fairly good control, but on small gardens, hand-picking is sufficient.

Psyllid. This small jumping plant louse and its young feed by sucking sap from the plant, and also inject a poison that stunts and deforms both the plant and fruit. It can be controlled by dusting with fine dusting sulphur. The first dusting should be given when the first psyllids are noticed on the plants, usually about June 10 to 15, and should be repeated twice at intervals of 10 days or 2 weeks. A combination sulphur-rotenone dust is especially good, and a spray of 1 pound of wettable sulphur in 10 gallons of water also is effective. Most of the damage by this insect occurs in the western quarter of the state.

Flea beetles. Several kinds of flea beetles may attack and riddle the foliage of the tomato plant. Spraying with 4-4-50 Bordeaux with the addition of a half ounce of calcium arsenate to each gallon of spray is effective. Rotenone dusts also give good control, and have the advantage of being practically non-poisonous.

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Pests of Potatoes

Colorado potato beetle. This is our most common pest of potatoes. The heavy-bodied, thirteen-striped beetles, as well as the reddish, black-spotted larvae, feed on the foliage of potatoes and some related plants, and sometimes strip entire fields. The adults winter in trash, and move to the crops in the spring. The yellow to dark orange eggs are laid in groups on the underside of the leaves.

Control is not difficult. On small patches good control can be secured by picking and destroying the overwintered adults and the clusters of eggs. Rotenone dusts give excellent control. A dust of 1 part lead arsenate or calcium arsenate by weight with 8 parts of flour is effective. A Paris green dust of 1 part Paris green, 5 parts hydrated lime and 10 parts of flour, all by weight, is both effective and quick in action. A spray of 1 ounce of lead arsenate or calcium arsenate to a gallon of water is good, and excellent control can be secured by use of a spray of 1 ounce Paris green, 1/4 pound hydrated lime and 3 gallons of water.

In the fall, burn the dead vines and trash in or around the garden.

Potato flea beetle. These quick-jumping, flea-like beetles often riddle the foliage, while the tiny larvae bore into and do much damage to the potato tubers. Rotenone dusts containing 3/4% or 1% rotenone give good control if applied about once a week. A dust of 1 ounce calcium arsenate to 8 ounces of hydrated lime also is fairly effective. Spraying with 4-4-50 Bordeaux mixture, with 1 ounce of calcium arsenate added to each gallon of spray, is a tried and fairly effective remedy. On large acreages growers use 2 pounds of zinc arsenite in 40 gallons of water or prepared lime-sulphur spray and find it quite effective.

Clean culture and the burning of all dead vines and trash in or about the garden in the fall are said to reduce future infestations.

Psyllid. Both the brown adults and the greenish nymphs of this small, jumping plant louse feed by sucking the sap from the plant. They also inject a poison that stunts and deforms the plant, and prevents development of normal tubers. Psyllids usually appear on the potato plants about June 15 or July 1. That can be controlled by sulphur sprays or dusts, when the plants are 6 to 8 inches high, and repeated once or twice at intervals of about 2 weeks. Liquid lime-sulphur, 1 part to 40 parts of water, is the standard spray. Dry lime-sulphur or wettable sulphur, 1 pound to 10 gallons of water is good, and dusting with fine dusting sulphur gives fair control. Prolonged hot, dry weather usually checks psyllid infestations.

Potato leaf-hopper. This small, green, jumping insect sucks sap from the plants and thus weakens them. It also is blamed for the condition known as "tip burn" in potato plants.

Spraying with a 4-4-50, or stronger, Bordeaux misture is quite effective in reducing injury, and the addition of 1 ounce of calcium arsenate to each gallon of spray seems to increase its effectiveness. A spray of 1 part liquid lime sulphur to 40 parts of water, or dusting frequently with fine dusting sulphur reduces injury to a marked degree. Strong nicotine, rotenone, and pyrethrum dusts and sprays are at least partly effective.

Potato aphids. These plant lice suck sap from the leaves and terminal shoots of the plants, thus causing withering and curling, and a weakening of the plants. A nicotine sulphate spray of 1½ teaspoonsful of nicotine sulphate to a gallon of water in which an inch cube of laundry soap has been dissolved gives good control. A 3% nicotine dust also is effective, as is a rotenone dust containing 3/4% or 1% rotenone.

Blister beetles. These slender-bodied, cylindrical, slim-necked beetles do most damage to potatoes although they may attack almost any kind of garden crops, alfalfa, shrubbery and trees. They are likely to appear suddenly in large numbers and may strip a potato patch or garden before their presence is discovered. The most common ones are gray, but black, brown, striped, and spotted ones often appear. Feeding habits of all seem to be quite similar.

Control is difficult as blister beetles are very resistant to contact insecticides, and they do not eat stomach poisons readily. Probably the most dependable remedy for garden use is a dust of equal parts by volume of sodium fluosilicate and flour. This should be dusted directly on the beetles. Full results of the dusting will not be apparent for at least 2 days. On hardy plants such as potatoes, undiluted sodium fluosilicate may be used. Some excellent results also have been secured by use of a dust composed of 1 part of barium fluosilicate and 3 parts of flour.

Strong Paris green sprays, using 1 ounce of Paris green and twice that much hydrated lime to a gallon of water, are effective, but are safe for use only on hardy plants such as potatoes. Tender plants will be seriously damaged by such a spray. Spraying with Bordeaux mixture repels blister beetles, and its effectiveness is increased by adding 1 ounce of calcium arsenate to each gallon of spray.

Pests of Beets

Beet leaf-hopper. This active, little leaf-hopper sucks sap from the beet leaves, and also spreads the disease known as "curly top" of sugar beets. Its control is difficult. Early planting and clean cultivation is helpful. Spraying with Bordeaux mixture repels the leaf-hoppers and tends to lessen the damage. See "Leaf-hoppers" under "General pests."

Beet flea beetle. This active, little, jumping beetle often does severe damage by attacking and riddling the foliage of beets. It can be controlled quite satisfactorily by use of a rotenone dust containing about 3/4% or 1% rotenone. The dust should be applied about once a week while the beetles are present.

Spraying with Bordeaux mixture tends to repel the beetles, and its effectiveness is increased by adding 1 ounce of calcium arsenate to each gallon of spray. A dust of 1 ounce calcium arsenate in 8 ounces of hydrated lime is fairly effective. Clean culture, and burning of crop remnants in the fall are helpful.

Beet webworm. This small, striped and spotted, yellowish-green caterpillar comes from the eggs of a small, brownish-gray moth. The caterpillars usually hatch and develop in weed patches, particularly of Russian thistle, common pigweed and lamb's quarter. From these they travel in armies, and may completely strip beet fields and gardens.

These webworms are easily controlled by use of stomach poisons. A spray of 1 ounce calcium arsenate and 1 ounce of hydrated lime in a gallon of water is fully effective. However, it should not be used on foliage that is to be eaten. Rotenone dusts containing 3/4% or 1% rotenone are non-poisonous and give good control.

Pests of Onions

Onion maggot. This small, white maggot which comes from the egg of a small fly burrows into the roots of the young plants and destroys or greatly weakens them. The fly lays its eggs at the base of the plant and the maggots hatch there.

The onion maggot may be controlled by the use of a dust made of 1 ounce of calomel thoroughly mixed with 24 ounces of hydrated lime. This should be dusted along the rows, using a half pound per square rod of onion patch. The first application should be made as soon as the plants are well through the ground, and it should be repeated three times at intervals of a week. All cull onions and crop remnants should be gathered and burned as soon as the crop is harvested.

Onion thrips. These are yellowish or brown, lice-like insects not over 1/25 of an inch in length. They hide in the crotches and leaf sheaths of the plant and feed on the leaves at night or on dark days. Their injury causes the onion tops to turn white and become crisp and dry.

Control is only partly successful. Thorough dusting with a rotenone dust containing 3/4% or 1% rotenone gives fair results. Such dusting should be repeated at intervals of a week while thrips are troublesome. Heavy applications of a 3% nicotine dust are fairly satisfactory. Generous spraying with nicotine sulphate at the rate of 1½ teaspoonsful of the nicotine sulphate to a gallon of water in which an inch cube of laundry soap has been dissolved is another fairly satisfactory control measure.

Pests of Lettuce, Spinach and Similar Crops

Arsenicals and other poisonous sprays and dusts should never be used on such crops as lettuce, spinach, chard, and celery, as the greater part of the vegetative growth is to be used for food, and thus there is considerable danger of poisonous residues being eaten. Nicotine dusts, pyrethrum powders and sprays, and rotenone preparations are recommended for such plants. Combination rotenone-pyrethrum sprays or dusts also are excellent, and probably are superior to either one used alone.

Aphids. Various kinds of aphids or plant lice commonly attack one or more of these crops. They feed by sucking the sap from leaves and stems of the plants, and thus must be controlled by contact sprays or dusts. A 3% nicotine dust gives good control, and most of them can be controlled quite readily by rotenone or pyrethrum dusts or sprays of standard strength.

Flea beetles. Spinach, in particular, is likely to suffer from attacks of quick-jumping, black and orange flea beetles and their larvae. Rotenone dusts containing 3/4% or 1% rotenone are recommended for their control, and it seems probable that a 3% nicotine-lime dust would kill the larvae and repel the adults.

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Loopers. Yellowish-green, smooth-bodied caterpillars that crawl with a looping motion often attack several of these crops. They can be controlled by use of 3% nicotine-lime dusts, and rotenone or pyrethrum dusts and sprays of standard strength.

Pests of Sweet Corn

Corn earworn. This pest hatches from the eggs of one of our common cutworm moths or millers. The eggs are laid among the fresh silks of the corn. Control is only partly effective, but is practical and worthwhile on small plantings.

Fair control may be secured by dusting the silks with a mixture of 1 part of lead arsenate and 3 parts of fine dusting sulphur by weight. The first dusting should be given when one-fifth of the ears show silks, and other dustings should be made on new silks every 3 or 4 days until all silks have been dusted.

Injecting from 10 to 20 drops of heavy, refined, white mineral oil among the silks just inside the husk tips will probably reduce infestation by 75% if the treatment is given at the correct time. The oil should be applied just as soon as the silk begins to wilt and turn brown. If applied before wilting begins, pollination will be prevented and the ear will not fill properly. A small oil can with a long, fine spout may be used to apply the oil.

Clipping off the silk and about an inch of the husk tips as soon as the silk begins to turn brown will reduce infestation considerably, but is not as effective as use of mineral oil.

APPLY TO THE COUNTY AGENT OF YOUR COUNTY FOR ANY FURTHER INFORMATION THAT YOU MAY REQUIRE CONCERNING THE SECURING OR USE OF ANY INSECTICIDE MATERIAL MENTIONED IN THIS CIRCULAR.

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