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EC1512 Pests of the Vegetable Garden

O. S. Bare

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April, 1937

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PESTS OF THE VEGETABLE GARDEN

O. S. Bare

Nebraska

COOPERATIVE EXTENSION WORK

IN AGRICULTURE AND HOME ECONOMICS

U. of N. Agr. College and U. S. Dept. of Agr. Cooperating

W. H. Brokaw, Director, Lincoln

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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 must 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. 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.

Rotenone is the most important of the non-poisonous insecticides. It and other active principles are found in the roots of two tropical plants, cube and derris. It appears to act both as a stomach and a contact poison, and is very effective against many insects, but is practically non-poisonous to people. Rotenone is quite slow in action, requiring from 24 to 96 hours to make a fairly complete 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 about three-fourths of 1% rotenone. Several rotenone powders and liquid extracts for making up sprays also are on the market. The manufacturer's directions should be followed in using them. Alkaline carriers or spreaders such as lime and laundry soap should not be used with rotenone sprays or dusts.

2. Contact insecticides

Pyrethrum powders and liquid extracts are very good contact insecticides and they are harmless to persons and animals. They may be used either as dusts or in sprays, and the manufacturer's directions should be followed closely. Some manufacturers 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 air-tight 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.

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 $1\frac{1}{2}$ 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 three-fourths of 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.

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 three-fourths of 1% rotenone gives good results. An ounce of calcium arsenate mixed with 5 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 tablespoonfuls of Paris green into 2 or 3 quarts of dry bran. Then mix a half teacupful of molasses into a quart of water. Pour this slowly into the Paris green-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 children, 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.

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.

In small gardens, plants may be protected 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 a 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 $1\frac{1}{2}$ or 2 teaspoonfuls 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 it seems likely that rotenone dusts of standard strength may prove 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. 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 $1\frac{1}{4}$ pound of flour in a quart of water until it makes a smooth paste. Mix well with 2 gallons of water before using.

Pests 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 $\frac{1}{2}$ ounce of lead arsenate in a gallon of water in which an inch cube of laundry soap has been dissolved.

Rotenone dusts containing one-half or three-fourths of 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 teaspoonfuls 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 three-fourths of 1% rotenone are at least partly effective, and rotenone sprays are quite promising.

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 three-fourths of 1% rotenone dust gives very good control. A 4-4-50 Bordeaux mixture spray gives fair control, especially if $\frac{1}{2}$ 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 hydrated lime is handy and effective. Dust it around the bases of the plants at the rate of $\frac{1}{2}$ 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. This pest is found only in a few counties in western Nebraska. 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 three-fourths of 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 2 parts hydrated lime by weight, or a spray of $\frac{1}{2}$ 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 hydrated lime by weight gives good control. Arsenicals or sodium fluosilicate should not be used on snap beans after the pods have set.

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 aphid. 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 three-fourths of 1% rotenone dust also should give good control.

Pea aphid. This is a pear-shaped green plant louse that may reach a length of $1\frac{1}{6}$ 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 aphid often is found on alfalfa or clover around the garden, and moves from these plants to attack garden peas.

The pea aphid 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.

Recent experiments indicate that rotenone sprays of moderate strength are even more effective than strong nicotine dusts, and 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 about three-fourths of 1% rotenone give fairly 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 4% nicotine dust is fairly effective, but lacks lasting qualities. A dust made by mixing 1 part of sodium fluosilicate with 3 parts of hydrated lime is quite effective, but may burn tender plants.

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 aphid. 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 $1\frac{1}{2}$ teaspoonfuls 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 give fairly 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 teaspoonfuls 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.

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 partly effective. The first spray should be applied when plants are a few days old, and it should be repeated three or four times at intervals of five or six days.

Strong nicotine sulphate sprays probably are the most effective of known control measures. Use 3 or 4 teaspoonfuls 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. It seems likely that rotenone dusts or sprays will prove to be effective if applied as directed for Bordeaux mixture and lead arsenate.

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.

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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 one of our pests 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.

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.

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.

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 about three-fourths of 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.

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

Potato leaf-hopper. This 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 4-4-50 Bordeaux acts as a repellent and reduces injury. Addition of 1 ounce of calcium arsenate to each gallon of spray seems to increase its effectiveness. See "Leaf-hoppers" under "General pests."

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 $1\frac{1}{2}$ teaspoonfuls of nicotine sulphate to a gallon of water in which an inch cube of laundry soap has been dissolved gives good control. A $\frac{3}{4}\%$ nicotine dust also is effective, as is a rotenone dust containing three-fourths of 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 quite difficult as they are resistant to contact insecticides, and it is difficult to get them to eat stomach poisons. The most dependable remedy is a dust of equal parts of sodium fluosilicate and hydrated lime by volume. This should be dusted directly on the beetles. Full results of the dusting will not be apparent for at least two days. Strong Paris green sprays, using 1 ounce of Paris green and 2 ounces of hydrated lime to a gallon of water are quite effective, but are safe for use only on hardy plants such as potatoes. Tender plants are likely to be burned seriously or even killed by such a spray. Spraying with Bordeaux mixture repels blister beetles and often is effective in preventing damage.

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 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 three-fourths of 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 arsenite 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 three-fourths of 1% rotenone are non-poisonous and appear to give fine 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 three-fourths of 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 teaspoonfuls 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 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 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 three-fourths of 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.

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, or rotenone dusts and sprays of standard strength.

Pests of Sweet Corn

Corn earworm. This pest hatches from the eggs of one of our common summer moths or millers. The eggs are laid among the fresh silks of the corn. Control is only partly effective, but is practical and worth while on small plantings. Best control is secured by dusting the silks with a mixture of equal parts of lead arsenate and fine dusting sulphur. The first application should be made when one-fifth of the ears show silks, and the dustings should be repeated every three or four days until the silks are dry. Some experimenters have reported good results with a mixture of 1 part lead arsenate to 4 parts dusting sulphur.

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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