Diseases and insect pests of potatoes
Many insect and disease problems can be prevented by following these precautions:

- Use certified seed. This will prevent the introduction of many diseases.
- Treat the seed pieces before planting. This will protect the plants from several soil diseases.
- Keep weeds down. This will help keep both insects and diseases from developing.

Properly timed vine killing before harvest also prevents the spread of diseases. So does controlling insects, such as aphids and leafhoppers.

In using insecticides and fungicides, it is important to follow the instructions on the label. Some pesticides are highly poisonous and must be used with extreme care for safety. It is also important to follow these instructions carefully to avoid pesticide residues. Read the label and then follow directions concerning dosage level, number of applications, time of application, and minimum interval between application and harvest.

Trade names have been used in certain cases in this bulletin to avoid the use of long and complicated technical chemical names. However, no endorsement of named products is intended nor is criticism of similar products which are not mentioned implied.

Recommendations for potato insect control are issued each year in chart form. Ask your WSU County Extension Agent for a copy of EM 2109, Potato Insect Control Calendar.
Vine Killing

Killing the vines late in the season helps prevent the spread of virus diseases and late blight. It also makes harvesting easier.

Properly timed killing reduces black spot. If the vines are not killed before soil moisture is depleted, the tubers become dehydrated. This makes them susceptible to black spot when bruised.

Mechanical vine killers can be used. However, mechanical killing may leave a green stub with small leaves. This is not desirable for the certified seed grower. Aphids carrying viruses could infect these few leaves and thus spread virus diseases. Late blight could also infect the green stumps.

A combination of mechanical vine killing and chemical sprays is the best way of being sure that the vines are completely killed.

Several chemicals can be used to kill vines. Ammonium sulfate is often used and has value to the next crop as fertilizer. Use 200 pounds per acre in 100 gallons of water. Or use 15 pounds of caustic soda and 6 pounds of arsenic trioxide per acre in 100 gallons of water. This spray should not be applied within seven days of harvest or on exposed tubers. Another satisfactory vine killer is 10 pounds of copper sulfate plus 10 pounds of common salt per acre in 100 gallons of water. One quart of Sinox in 15 gallons of diesel oil per acre may also be used.
Aster Yellows

Aster yellows is caused by a virus that is spread by one kind of leafhopper. The virus spends the winter in several weed hosts.

Symptoms

Vigorous branches sprout from the area where the leaves join the stem. The base of the branch may be enlarged or there may be aerial tubers at the base.

Leaflets on the upper branches are frequently rolled at their bases. They may be pale green or pink or sometimes a very light yellow. Some stems may be discolored internally, especially near the base, and the vines may wilt.

Tubers from plants infected early in the growing season will usually be flabby and produce hair sprouts, before or after planting. If late infection occurs, some tubers may escape and produce normal plants the following year.

Control

Plant certified seed. Get rid of weed hosts such as pigweed (*Amaranthus retroflexus*) and marestail (*Erigeron canadensis*) around edges of fields. Late crop potatoes are usually more heavily infected because the weed hosts are more numerous later in the season.

Control the leafhoppers that spread the disease by using insecticides. Isolate potato plantings from crops, such as clover, where leafhoppers may be numerous.

Discolored leaflets, rolled at base, characterize aster yellows (center).

Vigorous branching at the point where the leaves join the stem is typical.
Black Leg

Black leg is caused by the bacterium, *Erwinia atroseptica*, which overwinters in tubers and soil. The organism occurs naturally in some soils.

Losses from black leg are usually minor with the Russet Burbank variety. They can be serious with some of the red and white varieties.

**Symptoms**

The stems may rot anywhere from the seed piece to several inches above the ground. The decaying spots turn dark green. Later they become black. These spots are slimy and have a foul odor.

Infected plants have curled leaves near the top. They become yellowish after the stem is girdled. Aerial tubers may form on the lower stem above the canker.

Tubers may rot while still in the field or after being placed in storage.

**Control**

Use certified seed. Soak cut seed in a solution of 4 ounces of mercuric chloride in 30 gallons of water for one and one-half hours. Be sure that the seed is warm enough to heal rapidly after it has been cut.

Avoid using too much irrigation water.

Badly infected fields should not be replanted to potatoes for several years.
Black Spot

Bruises due to rough handling are the direct cause of black spot in dehydrated tubers. Cultural conditions may make tubers more susceptible to black spot.

Symptoms
At first the injury is inside the tuber; later it becomes visible on the surface. It is more common at the stem end.

The spots are pinkish 3 to 4 hours after bruising. In 10 hours they become rusty red. After 18 to 36 hours the spots darken to a dense coal black.

The spots are usually in the area that extends from just under the skin to the vascular ring.

Control
Test the soil for potash. A high potash level should be maintained.

Handle potatoes carefully at every stage to avoid bruising. Install rubber padding on all machinery used to handle potatoes.

Keep the soil moist just before harvest. This will prevent loss of water from the undug tubers. Allowing the field to dry down and then irrigating just before digging will reduce black spot if the plant roots are still able to take in moisture.

Maintain high humidity in storage. Tubers that are susceptible to black spot become more resistant if they are warmed to 70°F. and held two days before being handled.

The right tuber in each pair was bruised more severely than the left one.

These tubers, showing some black spot, are from a commercial shipment.
Early Blight

Early blight is caused by a fungus, *Alternaria solani*. It overwinters in old potato vines, other dead plant materials, and in the soil.

**Symptoms**

Any part of the plant above ground can be infected. Dark brown spots usually appear on the oldest, lowest leaves. They enlarge rapidly when it is damp. The spots have a series of slightly raised, target-like rings. Several spots may merge into a large brown area.

A plant may be completely defoliated with brown streaks on the stems. In humid areas all leaves may be severely blighted. In dry areas only lower leaves are affected.

**Control**

Remove diseased weeds belonging to the nightshade family from the edge of the field. Do not replant potatoes in severely infected fields for at least two years.

The disease spreads rapidly in warm, humid weather. Apply sprays or dusts, starting at the early stages of infection. Sprays are more effective. Use 2 pounds of Maneb or Zineb actual per acre in 100 gallons water, or use 40 pounds of 5 per cent Maneb or Zineb dust per acre. Fixed copper at 3 pounds per acre in 100 gallons water or 8-4-100 Bordeaux may also be used.

Sprinkler irrigation favors the development of early blight. Tubers may become infected if wet weather occurs at digging time.
Late Blight

Late blight is caused by a fungus, *Phytophthora infestans*, which overwinters in lesions on seed tubers and on volunteer plants on dumps or in fields.

Symptoms

Watersoaked spots appear on the leaflets. The spots enlarge rapidly and turn brown. When it is humid the fungus produces a white, moldy growth on the underside of the leaf. Elongate brown spots develop on the stems. These spots may become moldy white during wet periods.

Spots on the tubers are small, slightly sunken, and purplish black. The tissue underneath has granular, brick-red blotches. When it is dry, the spots may remain hard and dormant; but when it is wet, a soft, foul-smelling decay soon destroys the tuber.

Control

All diseased tubers should be destroyed, not dumped where they produced diseased volunteers. Before digging an infected field, be sure the vines have been dead and dry for at least two weeks. Spores from vines that are still green will lodge on the tubers and may cause serious rot later.

Start spraying at the first sign of late blight. Continued, frequent sprays are necessary to check the fungus. Severe epidemics can only be controlled by fixed copper sprays. Use 3 pounds per acre in 100 gallons water. Maneb or Zineb continued on page 30

Tubers attacked by late blight have small purplish pits, noticeable in the right tuber. Infected tubers decay rapidly in damp soil or in storage.

Spots on the leaves at first look watersoaked and then turn brown. Note the moldy fungus growth on the lower spot.
Calico

Calico is a virus disease that is spread by aphids. The source is usually alfalfa or clover plants that have alfalfa mosaic.

**Symptoms**

The disease usually appears late in the season. The leaves are normal in size, but distinctly mottled. Parts are bright yellow or cream colored while the rest of the leaf is a normal green.

Tubers from calico plants may be seriously dented and cracked at the stem end. The disease is rarely found in more than trace amounts. Severely infected plants usually produce very few tubers.

**Control**

Do not plant potatoes near an alfalfa field that is severely infected with alfalfa mosaic.

In alfalfa fields that have been plowed up and planted to potatoes, volunteer alfalfa plants should be destroyed. Those carrying alfalfa mosaic may be the source of calico.

Alfalfa fields intended for potatoes the following year should be sprayed with 2 pounds of 2,4-D amine per acre two weeks before fall plowing. This treatment will kill alfalfa effectively at any time of the year, but spring applications may cause injury to the subsequent potato crop.

In seed fields which are to be certified, remove all calico plants—including the seed piece.
Leaf Roll

Leaf roll, a virus disease, is spread by several species of aphids. It survives the winter in tubers in cull piles, in volunteer plants, and in seed potatoes.

Symptoms

Plants grown from diseased seed show chronic leaf roll symptoms, easily seen when the plants are about 12 inches high. Leaflets are thick, stiff, and leathery. The end leaflet may turn over and grow with the under side up. The entire plant is greenish yellow rather than normal green. Rolling of the leaves starts at the bottom of the plant.

Plants infected during the growing season show current season leaf roll symptoms—only the upper leaves may be rolled. With current season leaf roll, some varieties, such as Russet Burbank, also have net necrosis. The tuber flesh has a dark brown or black netting, particularly in the vascular ring area at the stem end.

Control

Use certified seed. It may not be absolutely free of leaf roll, but it will be much more so than uncertified seed. Plants with chronic leaf roll should be rogued and destroyed—including the seed piece—early in the season. Eliminate volunteers in fields, nearby areas, and cull piles. Effective control of aphids is necessary to prevent the spread of leaf roll.

Net necrosis (left and center) often accompanies current season leaf roll.

Rolling occurs on all leaves of a plant (left) with chronic leaf roll.
**Powdery Mildew**

Powdery mildew is caused by a fungus, *Erysiphe cichoracearum*, which overwinters on weeds or debris in the field. It is found on many kinds of plants.

The disease is more severe on red-skinned varieties than on russet potatoes.

**Symptoms**

Brown to dark brown short streaks or stipled patches on the stem above ground are the first sign. These patches increase in size and number until they cover the whole stem and even the leaf stalks. The brown stipling may be present for some time before white, mealy spots of mold appear on the underside of the leaves and on the stem. Eventually the whole plant is covered with white mold.

Severe defoliation occurs, starting with the lower leaves, and only the tip of the plant remains green.

Late in the season the mold may become gray with tiny black specks scattered through it.

**Control**

Dust with sulfur at 30 pounds per acre when the first symptoms of the disease appear. Additional applications may be necessary at a later date. Do not apply if temperatures are above 90° F. If dusting is delayed until the mildew is well established on the plants, it will not control the disease.

White mold on the stem and leaves is an advanced symptom of powdery mildew.

Mildewed leaves (left) become somewhat distorted and misshapen.
Mosaics

Mosaics are virus diseases that are spread by several species of aphids. The virus survives the winter in the seed tubers. Mosaic is common on White Rose and red varieties, but seldom seen on Netted Gems.

Symptoms

The leaves show varying patterns of color. Some are deep green, others various shades of light green to yellow.

In mild mosaic, leaves may be nearly normal in size and shape.

In the rugose type of mosaic, the leaves are cupped and ruffled to an extreme degree. Rugose plants tend to be brittle rather than tough and leathery.

Most rugose plants are stunted and produce few tubers. The tubers are poorly shaped and somewhat smaller than normal.

Control

The use of certified seed will reduce the amount of mosaic to a minimum at the beginning of the season. Eliminate all volunteer plants in and around a field and in any nearby home gardens.

Take out mosaic plants, including the seed piece, as soon as the disease is detected. Be careful not to scatter any aphids that may be on the plants.

Control of aphids is necessary to prevent the spread of mosaic in the field.
Nematodes

Microscopic round worms of the genus *Meloidogyne*, known as root knot nematodes, penetrate the roots and tubers of potatoes. They also attack many other plants and can remain dormant in the soil for long periods.

**Symptoms**

Nematodes burrow into the tubers. Although usually found just under the surface, they can penetrate to the center. The surface of the tuber is covered with small pimple-like bumps from $\frac{1}{4}$ to $\frac{1}{8}$ inch in diameter.

In cross sections of infested tubers, the nematodes appear as tiny yellow to brown specks about the size of a pinhead, or smaller. Potato roots, when infected, show small knots.

**Control**

Take every precaution to avoid soil contamination. Nematodes may be spread by irrigation water, by soil that clings to tools or animals, and by infected tubers or plant roots.

Do not plant potatoes in infested fields. After a long rotation of a grass, corn, or cereal crops, it may be possible to produce potatoes for one year.

Chemical treatment of the soil will control nematodes, or possibly exterminate them, but it is expensive in relation to the value of the crop. Either Telone (1-3 dichloropropene) at 120 to 202 pounds

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Rhizoctonia

Rhizoctonia is caused by a fungus, *Rhizoctonia solani*, found naturally in most soils and often present on seed potatoes.

Symptoms

On mature tubers rhizoctonia appears as small, black specks, known as "the dirt that can’t be washed off." Young stems are often infected before they appear above ground. The cankers are cinnamon brown, or darker. Stems may be girdled, killing the plant tops. Or plant tops may turn dark green and be slightly stunted. Leaf curl, similar to leaf roll virus infection, may occur. Plants infected late in the season often have aerial tubers or many small tubers at the ground line. The disease is most destructive early in the season when soils are cold and damp.

Control

Be sure green manure crops have rotted before planting potatoes. When planting in cold soil, cover seed with only 2 or 3 inches of soil, or harrow down the planter ridges just before the plants emerge. Where the organism is plentiful, plant after the soil has warmed.

Damage can be reduced by using larger seed pieces, not irrigating too early, and not planting potatoes after potatoes. Dip seed pieces in a solution of 1 pound of Semesan Bel in 7½ gallons water, then drain and dry before planting. Do not feed treated potatoes to livestock.
Ring Rot

Ring rot is caused by the bacterium, Corynebacterium sepedonium, which overwinters in the tubers.

Symptoms

The disease may or may not show in the vines. Infected leaves are slightly rolled, mottled, and yellowish or pale green. The yellowed areas may turn brown and die. Some stalks merely wilt and dry up. The tubers of diseased plants may be cracked on the outer surface, or may show no external symptoms. In cross section, the vascular ring just under the skin is yellowish or whitish and soft. If an infected tuber is squeezed, a yellowish mass will ooze up in a ring. Secondary rots may completely destroy the tuber, either in the soil or in storage.

Control

Use disease-free seed. Seed potatoes should be stored in disinfected bins. Sacks, tools, and other equipment that come into contact with diseased tubers should be disinfected. Quaternary ammonium type compounds, such as Roccal, have been highly effective. Other disinfectants which may be used are 1 to 2 pounds copper sulfate in 10 gallons water; 1 pint formaldehyde in 15 gallons water; or 3 teaspoons Lysol in 1 gallon water. Ring rot is often spread by the cutting knife. Disinfect it with mercuric chloride solution (1-1000) or boiling water.
Common Potato Scab

Common potato scab is caused by a fungus, *Streptomyces scabies*, which exists in the soil and occurs in nearly every potato-growing region. It also attacks sugar beets, garden beets, carrots, turnips, and several species of weeds. In the Columbia Basin, scab seems to be more severe on newly cultivated soils than on soils where potatoes have grown for many years. Usually the scab organism is favored by neutral or alkaline soils.

**Symptoms**

The fungus attacks the tubers. Their surface is covered with slightly raised corky spots. Occasionally sunken scabby areas or pits develop. The spots are seldom deep, but usually penetrate the skin. The spots may be few or many, covering the entire surface.

**Control**

A combination of control measures is most effective in reducing scab. No variety is immune, but varieties such as Early Gem and Russet Burbank are relatively resistant. Others with moderate to slight resistance are Ontario, Menominee, Russet Sebago, Cherokee, and Norland.

A long rotation using crops such as rye, alfalfa, and soybeans will reduce scab. When potatoes follow corn or small grains, use more nitrogen. Avoid hot, dry soils by maintaining good soil moisture. Several fumigants have given control, but they are costly.
Seed Decay

Seed piece decay may be caused by any of a number of soil fungi and bacteria.

Rot can be a problem in warm, dry soils; but in Washington, seed decay usually occurs in untreated seed pieces that are planted in cold soil.

Symptoms

The seed pieces develop a slimy soft rot and completely decay in a short time. In drier soils they may show a dry, fibrous rot.

Control

Seed held at 50 to 60°F for several days before cutting sprouts more readily than that cut and planted without a warmup period. The enzymes that change starch to sugar around the eyes become active only when potatoes have been out of cold storage for a while.

Treat the cut seed pieces with 5 per cent Captan dust at the rate of 1 to 1 1/2 pounds of dust per 100 pounds of cut potatoes or use 2 to 3 pounds of 5 per cent Captan in 100 gallons water as a dip.

Treat the seed pieces immediately after cutting and then plant them promptly.

If planting must be delayed, keep the treated seed pieces in open crates before sacking them. The seed pieces may be held several days without difficulty if they are kept in burlap bags arranged to give air circulation.
Silver Scurf

Silver scurf is caused by a fungus, *Spondylocladium atrovirens*, which overwinters on tubers or in the soil. It is not severe on the Russet Burbank variety, but is important on red varieties.

**Symptoms**

Light brown spots of varying sizes appear on the young tubers. Lesions may appear as watery blisters. The stem end of the tuber is affected first. Occasionally spots may cover the entire surface.

Later the skin becomes slightly loosened, giving the tubers a silvery appearance. With red varieties there is a serious loss of color, affecting market appearance. The condition is most severe at full maturity of the tubers.

In dry soil or when stored in a dry atmosphere, tubers dry out and become wrinkled from loss of moisture. In warm humid storage, the disease continues to develop.

**Control**

Treat the seed pieces with hot formaldehyde for four minutes. Use 1 pint commercial formaldehyde in 30 gallons water at 125°F. Avoid inhaling fumes. Select certified seed which is free of this fungus. Do not replant potatoes where the disease is severe.

Harvest affected red varieties before full maturity and do not leave unharvested potatoes in dry soil. Market infected tubers as soon as possible after harvesting.
Soft Rot

Soft rot is caused by several species of bacteria and fungi, including *Phytophthora erythroseptica*, normally found in damp soils.

Symptoms

There are several types of soft rot. One type is called leak. It is caused by a fungus and attacks tubers grown in wet soil. Infection starts in enlarged lenticels on the stem or in wounds. The center of the tuber decays first, leaving a shell. This rot, caused by *Phytophthora erythroseptica*, is sometimes called pink rot, since some rotting tubers develop a pinkish cast.

Some water rots resemble frost injury. The tuber tissue near the stem may be dark brown or black. The tuber has a watersoaked appearance at first, but soon breaks down into a slimy, foul-smelling, mushy mass.

Bacterial soft rot is similar to the others. It may take place in storage, but infection usually occurs in the field. Entire bins stored under unusually moist conditions may break down, causing growers to believe that the rot spreads in stored potatoes.

Control

Do not over-irrigate or otherwise allow tubers to become too wet in the soil. After digging, avoid excessive drying or exposure to wind. Keep the tubers dry and cool during loading operations. 

Storage promptly at fairly low temperatures continued on page 30
Verticillium Wilt

The wilt is caused by a fungus, *Verticillium albo-atrum*, which is native to most soils and can live on dead plant material. The fungus increases in soils where tomatoes, peppers and eggplants have been grown.

**Symptoms**

Potato vines may wilt or merely mature earlier than normal. The vines may be stunted, lose their green color, and die. The woody part of the stems may turn a dark reddish brown. In the Columbia Basin, most varieties merely turn yellow and die early.

Tubers often have a brownish discoloration in the vascular area just under the surface at the stem end. Infected tubers seldom rot.

Not all of the tubers or vines in an infected hill will show symptoms of the disease.

**Control**

Do not use potatoes from an infected field for seed. Good control of the organism can be obtained by dipping the seed pieces in a solution of 1 pound of Semesan Bel in \( \frac{7}{2} \) gallons water. Drain and dry the seed pieces.

Do not plant potatoes following diseased potatoes, tomatoes, or eggplants. Soil fumigation is a possible control, but expensive. The most practical method is a long rotation, including alfalfa or clover. With mild soil infestations, planting late or planting late varieties may provide adequate control.
Aphids

Several different kinds of aphids attack potatoes. The two most important are the green peach aphid and the potato aphid. These transmit viruses that cause leaf roll, mosaic, and certain less common diseases.

Aphids also suck the sap and cause the leaves to curl, become yellow, and die. In heavy infestations, the leaves become covered with a sweet, sticky honeydew. Control of aphids is very important in preventing the spread of leaf roll, a cause of net necrosis in Russet Burbank potato tubers.

Description

The adult potato aphid is about 1/6 inch long. It is usually leaf green, but occasionally it is pink. The green peach aphid is smaller and yellowish green. Most aphids are wingless. Some winged forms can nearly always be found during the growing season, but the largest number appear in mid-summer and late summer.

During the potato growing season all aphids are females and each one is capable of producing from 50 to 100 living young. In eastern Washington the green peach aphid usually spends the winter in the egg stage on peach trees, but in mild winters some may survive as adults on weeds.

Winged aphids start migrating to potatoes the first week in May in eastern Washington and populations increase slowly on potatoes in May and the first half of June. Starting about June 15 to June 25, aphids increase rapidly on early potatoes and some fly to younger plants. In late July, there is usually a heavy migration of winged aphids to late crop potatoes. These winged forms produce large populations of the wingless form of aphid. Following this high population, there usually is a sudden decline in aphid numbers in mid-August or late August.

Most of the spread of leaf roll occurs from June 15 to August 1. During this period control of aphids is very necessary. A number of generations occur each year.

Control

For application by aircraft use 1 pound Thiodan (either 1/2 gallon of 2 pounds per gallon emulsifiable concentrate in 8 gallons water or 33 pounds of 3 per cent dust) per acre.

For application by ground equipment use 1 pound actual Thiodan in 20 to 40 gallons water or a 3 per cent dust at 33 pounds per acre.

Endrin at the rate of 9 ounces actual material per acre or parathion at 12 ounces actual material per acre will also provide control when applied as a spray or dust by ground equipment. Parathion should not be applied within five days of harvest.

Insecticide applications should start about June 15 and continue at 10- to 12-day intervals to about August 1 or until hot weather stops aphid reproduction.
Colorado Potato Beetles

Colorado potato beetles are one of the most destructive pests of potatoes in eastern Washington. They also feed on nightshade, tomatoes, and eggplants. A heavy population can quickly defoliate potato plants. They also spread several diseases, such as brown rot, spindle tuber, and ring rot.

Description

Adult Colorado potato beetles are hard shelled, oval, about $\frac{3}{8}$ inch long, and $\frac{1}{4}$ inch wide. They have black and yellow stripes running lengthwise on their wing covers.

The orange-yellow eggs are laid in masses of 10 to 30, or more, on the underside of the leaves. The eggs hatch in four to nine days. The larvae or slugs are dark red when young, but become orange as they grow larger. They have two rows of black spots along each side of their bodies. The larvae or slugs become full grown 10 to 21 days after hatching. They then burrow into the soil and change to the pupa or resting stage.

After 5 to 10 days the adult beetles crawl out of the ground and after feeding for a few days, lay eggs for another brood of larvae. There are usually two generations of this insect in eastern Washington.
Flea Beetles

Several kinds of flea beetles feed on potatoes. The two which are common in this area are the tuber flea beetle and the western potato flea beetle. Only the tuber flea beetle is likely to cause commercial damage to potatoes in Washington. At present, this insect is not known as a pest in Grant, Adams, or Franklin counties.

The beetles feed on both sides of potato leaves, often making many small holes. The larvae feed on the small roots or tubers. Damage to the tubers may be in the form of roughened trails on the surface or tiny brown tunnels extending as far as 3/4 inch into the tuber.

Description

The adult flea beetle is about 1/16 inch long and shiny black. The larvae are slender, white, and about 1/4 inch long.

This insect spends the winter in the soil as an adult and leaves the soil in May and June. After feeding a few days, the female beetle re-enters the soil near the base of the plant to lay her eggs. The eggs hatch in five to eight days into slender, white larvae which feed on the roots and tubers. The larvae feed for two to three weeks and then enter the pupal stage, which lasts 10 to 14 days. Then young beetles leave the soil to begin a second genera-

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Iris Whitefly

Tremendous populations of iris whiteflies can develop on potatoes in eastern Washington during the summer and fall.

The potato leaves become glazed and sticky with honeydew produced by the larvae of this insect. Yields are reduced by the feeding of whiteflies.

Description

The adults are about 1/16 inch long and white except for small parts of their bodies and two faint spots on the outer wings which are gray.

The adults pass the winter on the underside of hardy plants, particularly near buildings and other protected areas. They are active on warm sunny days during the winter and begin migrating from various plants to potatoes in May or June. Damage to late planted potatoes occurs in August and September. The iris whitefly may have as many as five generations a year.

Control

Iris whitefly adults are easily killed with DDT, parathion, endrin, or Thiodan as used for control of other potato insects. The immature forms are fairly resistant to insecticides, possibly because they are coated with wax. Satisfactory control requires early and repeated applications directed against the adults before they can lay many of their eggs.

FLEA BEETLES

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Flea beetles. There are several generations a year in eastern and western Washington.

Control

Apply aldrin or dieldrin either as spray or dust to the soil surface before planting. Work into the soil immediately to a depth of 6 inches. Use 5 pounds actual aldrin or 1 1/2 to 2 pounds actual dieldrin per acre. Success in controlling the flea beetle depends largely on the thoroughness with which the insecticide is mixed with the soil. One soil application of aldrin has been effective for one to two years. Dieldrin has been effective for three to four years. Potatoes grown in soils treated with these materials should not be fed to dairy animals.

If soil insecticides are not applied, four to five applications of a 5 per cent DDT dust or a 2 per cent endrin dust at 25 to 30 pounds per acre will provide control. Make the first foliage application when the potatoes just break ground and repeat applications at 10-day intervals.
Leafhoppers

The intermountain potato leafhopper is the most common leafhopper attacking potatoes in Washington. The six-spotted leafhopper, while rarely abundant, can be a serious problem since it spreads the aster yellows, or purple top, virus to potatoes. The intermountain potato leafhopper causes a yellowing of the lower leaves. The beet leafhopper occasionally transmits the beet curly top virus to potatoes.

Description

Adult leafhoppers are pale green or mottled brown, somewhat wedge-shaped, and about \( \frac{1}{8} \) inch long. They are very active, jumping or flying when disturbed. The adult females deposit slender white eggs within the stems and larger veins of various plants. Adults and nymphs suck the sap from potato leaves and stems.

Some leafhoppers spend the winter as adults under leaves, weeds, and trash. Others overwinter in the egg stage. They appear in April and May to feed on various weeds and cultivated plants and later migrate to potatoes.

Control

Thiodan, endrin, or parathion as applied for aphid control will control leafhoppers. A 5 per cent DDT dust at the rate of 30 to 35 pounds per acre will also control leafhoppers. Several applications may be required during the season.
Spider Mites

Spider mites can cause serious damage to potatoes. A heavy population of two-spotted spider mites causes the foliage to turn brown and in severe cases stops further growth of the tubers. Fields near alfalfa, corn, or bean plantings are most likely to become infested. Spider mites are small and difficult to see without the aid of a lens.

Description

Two-spotted spider mites are greenish to flesh colored, with a dark spot on each side near the middle of their bodies. They spend the winter as adults under dead vegetation, weeds, and other debris. Overwintering adults become active in the spring and begin feeding on a wide range of plants. Tiny, spherical, transparent eggs are laid, usually on the underside of leaves. Dry, hot weather favors rapid development of these mites. They produce a moderate amount of webbing on the plants. Several generations occur each year.

Control

For aircraft application use 1 pound actual Trithion or Kelthane in 8 gallons of spray per acre. For dust applications use 33 pounds of 3 per cent Trithion or Kelthane dust per acre. Control measures should be applied before mites become too numerous. A dust containing 2 per cent parathion plus 50 per cent sulfur at 25 pounds

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Wireworms

Several kinds of wireworms cause damage to potatoes.

The Pacific Coast wireworm and the sugar beet wireworm can be serious pests on potatoes grown under irrigation.

The Great Basin or dry-land wireworm can also injure potatoes on newly irrigated land for a period of two or three years after it comes under irrigation.

Wireworms are the young or larval form of click beetles. They are easily recognized by their wire-like, yellow to orange bodies and by their habit of feeding on the underground parts of plants.

They can cause injury at planting time by feeding on potato seed pieces, thus retarding or preventing plant development.

Wireworms chew deep pits or holes in the developing tubers which lower the grade and often make them unmarketable.

Description

Adult wireworms are slender beetles 1/4 to 1/2 inch long. They range in color from reddish brown to black.

In the spring the adults emerge from the soil to mate and the female then returns to deposit her eggs several inches deep in damp soil.

Most of the eggs hatch in three or four weeks and the young larvae or wireworms work their way through the soil in search of food.

Wireworm larvae are yellow to orange and about 3/4 inch long.

Wireworms leave deep holes in tubers, often making them unmarketable.
Lygus Bugs

Several kinds of lygus bugs feed on potato plants. They develop on alfalfa, clover, other legumes, and weeds.

Large numbers are apt to fly to potato fields when the crops are cut or when weeds become dry.

The bugs feed on the tender new leaves and small stems of potatoes, causing them to wilt and die.

**Description**

Lygus bugs are about 3/16 inch long and may be pale gray-green, yellowish, or dark brown marked with yellow, black, and sometimes brown. The nymphs are pale yellow or green.

The winter is passed in the adult stage on vegetation. The adults become active in March and April and deposit their eggs in the stems of growing plants, such as alfalfa or clover. The nymphs begin to appear in April and become abundant in June. There are from three to five generations a year.

**Control**

A 10 per cent DDT dust at the rate of 25 to 30 pounds per acre will usually give control of lygus bugs.

Endrin or Thiodan as used for aphids will also give control.

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**WIREWORMS**

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Most of these wireworms take three years to complete their life cycle.

**Control**

Apply 20 pounds of 50 per cent DDT powder or its equivalent per acre as a spray or dust in the fall or at least six to eight weeks before planting.

Broadcast the material and thoroughly mix it with the top 6 to 9 inches of soil.

Aldrin used at 5 pounds of actual material per acre or dieldrin at 2 pounds actual material per acre, applied in the same manner as DDT, will also give control.

Repeat the treatment every three to seven years, or when worms average two per square foot of soil. Potatoes grown in soils treated with any of these materials should not be fed to dairy animals.

The Great Basin or dry-land wireworm, a native in the bunch grass and dry farming areas of eastern Washington may be easily controlled by one broadcast treatment of insecticide.

Using aldrin and similar insecticides in row or band treatments, with or without fertilizers, has not controlled the Pacific Coast wireworm and is not recommended for controlling wireworms in Washington.
LATE BLIGHT

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will check less severe infestations. Use 2 pounds actual Maneb or Zineb per acre in 100 gallons water or use 40 pounds of 5 per cent Maneb or Zineb dust per acre. Spraying is usually better than dusting.

NEMATODES

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actual per acre or DD (dichloro-propene-dichloropropane mixture) at 160 to 250 pounds actual per acre can be used as preplanting treatments. Telone must be applied at least two to three weeks before planting. All odor must have left the soil before planting. The time interval for DD is one week for each 100 pounds applied per acre. If heavy rains occur after the DD application, a longer delay before planting is necessary.

SOFTWARE

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with moderate humidity. Grade out all tubers showing any indication of soft rot before storage. Do not store potatoes from fields showing a considerable amount of soft rot. Practice careful handling to avoid injuries which may serve as points of entry for the soft rot organism.

COLORADO POTATO BEETLES

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Washington. The adults of the last generation spend the winter in the ground, emerging in the spring to lay eggs about the time the earliest potatoes are up.

Control
Dust the foliage thoroughly with 5 per cent DDT at the rate of 25 to 30 pounds per acre or with 3 per cent Thiodan at 33 pounds per acre. For liquid application by aircraft use 2 quarts of Thiodan or DDT (2 pounds per gallon emulsifiable concentrate) in 8 to 10 gallons water per acre. For spray application with ground equipment use Thiodan or DDT at the above concentrations or ½ pound of actual dieldrin in 20 to 40 gallons of water per acre.

SPIDER MITES

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per acre applied with ground equipment or by aircraft will usually give control of spider mites for two or three weeks. This dust mixture is especially useful when both mites and powdery mildew are present. Do not apply para-thion within three days of harvest.

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