What's Wrong with my Potato Tubers?

Diagnosing tuber abnormalities in western Oregon and Washington

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This bulletin is one of a series on organic potato production developed by "OSPUD." OSPUD is a collaboration among Oregon State University personnel and 11 farmers operating diversified organic vegetable farms. The purpose of OSPUD is to improve potato quality and profitability through a participatory learning process and on-farm, farmer-directed research. The first 2 years of OSPUD were supported by Western SARE Grant SW05-091. For more information on OSPUD, visit ospud.org.

Potato tubers are susceptible to damage from environmental conditions, insect pests, and pathogens. This publication will help you diagnose common abnormalities of potatoes grown in western Oregon and Washington. In this region, potatoes exhibit abnormalities not typically found elsewhere.

For example, tuber flea beetle larvae can cause extensive damage to potato tubers—in extreme cases rendering almost the entire crop unmarketable. This pest is not important in many other production regions, and the damage can be difficult to distinguish from wireworm injury. In addition, potatoes grown on heavier textured soils in our area exhibit moisture-related abnormalities such as elephant hide and enlarged lenticels, both of which can be confused with scab. For these reasons, tuber diagnosis is more difficult for farmers here. If you don't find the abnormality you are observing in your crop in this publication, see "Additional information" (page 10).

Seed type and quality, environmental conditions, and production practices affect the incidence and severity of many tuber abnormalities. Appropriate seed selection and good management practices can improve tuber quality. For information on how to prevent or minimize the occurrence of abnormalities described in this publication, see the "More Information" resources suggested throughout this publication.

How to diagnose tuber problems

When diagnosing abnormalities, it is important to know what a normal, healthy tuber of the same variety looks like. The appearance of normal tubers can vary significantly by variety. Some specialty varieties normally have knobs, flaky or rough skin, or large lenticels.

It is important to determine whether the cause of a problem is living (biotic) or nonliving (physiological). Generally, biotic causes of plant problems develop gradually, progressively spreading to other plants or tubers. These problems exhibit nonuniform patterns both in the field and on the plant foliage or tuber. Examples of biotic problems are tuber flea beetles, wireworms, and late blight. In contrast, physiological causes often develop more rapidly, and symptoms

More information

Characteristics and photos of most common potato varieties grown in the Pacific Northwest are available at http://oregonstate.edu/potatoes/variety.htm#CommonVarieties

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exhibit more uniform patterns. Examples of physiological tuber problems are cracking, hollow heart, and elephant hide.

Diagnosis of plant problems during the season provides some insight into likely causes of tuber damage. For example, tuber flea beetle foliar damage is an indication of possible tuber flea beetle damage in the tubers from that field. If foliage dies from late blight, the tubers in that field are at increased risk for tuber late blight. Foliar damage monitoring, diagnostics, and record-keeping can help you diagnose tuber damage.

Use this publication as a first step in identifying abnormalities. If you cannot make a diagnosis after consulting this publication and the recommended resources, submit a tuber sample to your plant pest diagnostic clinic or local Extension agent for diagnosis. Clinic contact information is available on page 10.

Insects

Flea beetles

Organism: Several species of flea beetles can be found on potato vines, but the tuber flea beetle (*Epitrix tuberis*) is the most common species that damages tubers in the Pacific Northwest (Figure 1). Flea beetle adults are about 1⁄16" long and jump relatively large distances when disturbed. Tuber flea beetles are common pests of potatoes and other Solanaceous crops in western Oregon.

Symptoms: Adults feed on the foliage, giving leaves a characteristic shot-hole appearance (Figure 2). Eggs are laid near plant stems, and larvae feed on tubers. Flea beetle larvae generally cause thin tracks on the surface of tubers and do not burrow deep into the flesh (Figure 3). Damage often is worse at the edge of a field since adults migrate in from field margins. Damage also progresses during the season as larvae grow and feeding intensifies.

More information

Flea beetle identification, life history, monitoring, and management strategies are described in *Flea Beetle Pest Management for Organic Potatoes* (EM 8947-E), a companion publication in this series.

See also *Pacific Northwest Insect Management Handbook*. http://pnwpest.org/pnw/insects

Figure 1. Tuber flea beetle adult.

Figure 2. Flea beetle leaf damage.

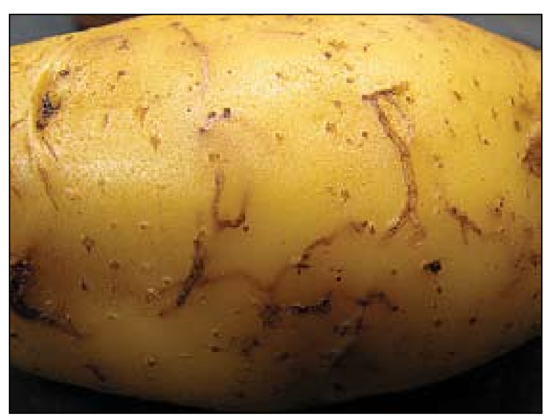

Figure 3. Flea beetle tracks.

Wireworms

Organism: Wireworms are the larval stage of "click" beetles in the family Elateridae. Several species can damage potato tubers in western Oregon. *Limonius* species—i.e., the Pacific Coast wireworm (*L. californicus*) and the sugar beet wireworm (*L. canus*)—are often important in this area. In 2006, invasive European wireworm species (*Agriotes* spp.) were found at several sites in the Portland area. These introduced species have been moving south from British Columbia and may become more important over time.

Adult "click" beetles have a slender, black body about ⅓ to ¾" long (8–20 mm) (Figure 4). Larvae are about 1⁄16" long after hatching and 1½" long or more at maturity (2 mm–4 cm). They are slender and shiny yellow to light brown with a hard cuticle and three pairs of small legs near the head (Figure 5). Larvae live from 2 to 5 years in the soil.

Symptoms: Tuber damage is caused by wireworm larvae. Damaged tubers appear in irregular patterns in the field, depending on the distribution of larvae. Wireworms tunnel into tubers, producing holes about 3 mm in diameter (Figures 6 and 7). The tunnels can be fairly shallow or extend through the entire tuber.

More information

Pacific Northwest Insect Management Handbook. http://pnwpest.org/pnw/insects

Figure 4. Wireworm adult.

Figure 5. Wireworm larvae.

Figure 6. Wireworm holes in tuber.

Figure 7. Wireworm holes, interior view.

Diseases

Early blight

Organism: Early blight is caused by the fungus *Alternaria solani*.

Symptoms

Foliar: Early blight often develops on aging or nitrogen-deficient vines. On leaves and stems, the lesions first appear as small black or brown spots 1 to 2 mm in diameter (Figure 8). As lesions develop, they form concentric black and brown rings ("target spot") with yellow halos. The lesions typically are bordered by leaf veins (Figure 9).

Tuber: Tuber damage is less common than leaf infection, but can develop over time in storage. Tuber lesions begin as sunken brown or black spots that penetrate the flesh of the tuber, developing into dry, brown, corky tissue (Figures 10–12).

More information

Michigan State University Extension Bulletin E-2991. http://www.potatodiseases.org/pdf/early-blight-bulletin.pdf

Figure 8. Early blight—early stage.

Figure 9. Early blight lesions.

Figure 10. Early blight on tuber.

Figure 11. Early blight on tuber.

Figure 12. Early blight on tubers.

Late blight

Organism: Late blight is caused by the funguslike organism *Phytophthora infestans.*

Symptoms

Foliar: Late blight appears on leaves as pale green, water-soaked spots surrounded by a yellowish-green border (Figure 13). Lesions, which are not delimited by leaf veins, become dark brown to purplish-black. During periods of high humidity and leaf wetness (for example, early in the morning), a cottony, white mold usually is visible on the edge of lesions on lower leaf surfaces. Infected stems are brown to black (Figure 14), and entire vines may be killed rapidly under cool, wet conditions.

Tuber: Late blight appears as a copper-brown dry rot in tuber tissue. On the surface, the rot is brown, dry, and sunken. Beneath the skin, decay is granular and copper-brown (Figure 15). Late blight tuber infection frequently is followed by other invasive organisms, especially soft rot bacteria.

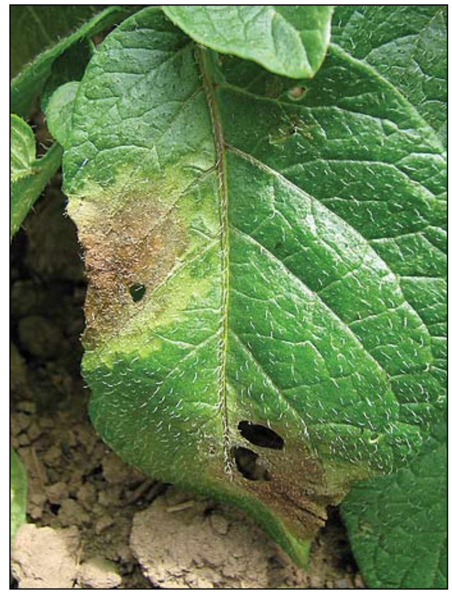

Figure 13. Late blight lesions on leaf.

More information

Late Blight Management for Organic Potatoes, a companion publication in this series (forthcoming), will provide information on late blight biology, monitoring, and organic management.

See also *Managing Late Blight on Irrigated Potatoes in the Pacific Northwest* (PNW 555) http://info.ag.uidaho.edu/pdf/PNW/PNW0555.pdf

Figure 14. Late blight lesions on leaf and stem.

Figure 15. Late blight on tubers.

Fusarium dry rot

Organism: Dry rot is caused by several Fusarium species, including *F. sambucinum, F. solani,* and *F. avenaceum*.

Symptoms: Dry rot pathogens typically gain entry to tubers when tubers are damaged during harvest or storage. Infections start as small, brown discolorations at a bruise or other wound. Fusarium dry rot is easily identified in storage by the dry, crumbly decay of the tuber and the presence of reddish, white, yellow, or tan fungal mycelium (Figures 16 and 17). Dry rot may be associated with wet *Erwinia* (soft rot) bacterial infections.

Figure 16. Fusarium.

Figure 17. Fusarium.

More information

See also *Fusarium Dry Rot.* Michigan State University Extension bulletin E-2992. http://www.potatodiseases.org/pdf/fusarium-dry-rot-bulletin.pdf

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Black scurf

Organism: Black scurf is caused by the fungus *Rhizoctonia solani.*

Symptoms

Tuber: Black scurf appears as brown or black, durable, raised masses on the surface of the tuber (Figure 18). These masses are the resting structures of the pathogen, called "sclerotia." The sclerotia may look like small clumps of soil, but, unlike soil, they are very difficult to remove. Rhizoctonia often is described as "the dirt that won't wash off."

Foliar: This pathogen causes another disease, Rhizoctonia stem canker, which affects potato sprouts as they begin to grow from the seed piece through the soil. For diagnostics and management of this disease, refer to the MSU publication listed below.

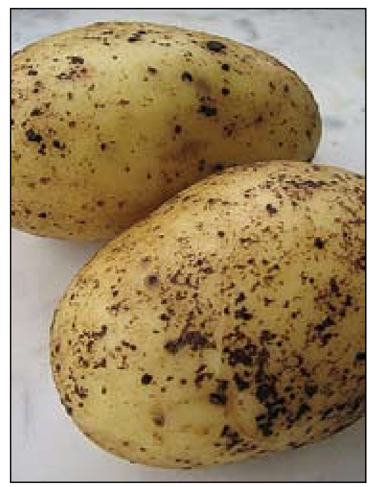

Figure 18. Black scurf.

More information

Rhizoctonia Stem Canker and Black Scurf of Potato. Michigan State University Extension bulletin E-2994. http://www.potatodiseases.org/pdf/rhizoctonia-bulletin.pdf

Silver scurf

Organism: Silver scurf is caused by *Helminthosporium solani*.

Symptoms: When infection occurs in the field, silver scurf appears as silvery irregular lesions, or as a silvery "sheen" on smooth-skinned potatoes (Figure 19). The silvery appearance is more visible on wet tubers. Silver scurf also can spread and infect tubers in storage; storage lesions typically are smaller and individual (Figure 20).

More information: *Silver Scurf Management in Potatoes*. PNW 596. http://extension.oregonstate.edu/catalog/pdf/pnw/pnw596.pdf

Figure 19. Silver scurf.

Figure 20. Silver scurf lesions from infection during storage.

Common scab

Organism: Scab is caused by *Streptomyces scabies,* a funguslike bacterium.

Symptoms: Scab appears on tubers as corky-appearing surface lesions (Figure 21), raised lesions (Figure 22), or pitted lesions (not shown; see the MSU publication listed below). Sometimes scab lesions are difficult to distinguish from russeting and elephant hide.

More information

Michigan State University Extension bulletin E-2990. http://www.potatodiseases.org/pdf/common-potato-scab-bulletin.pdf

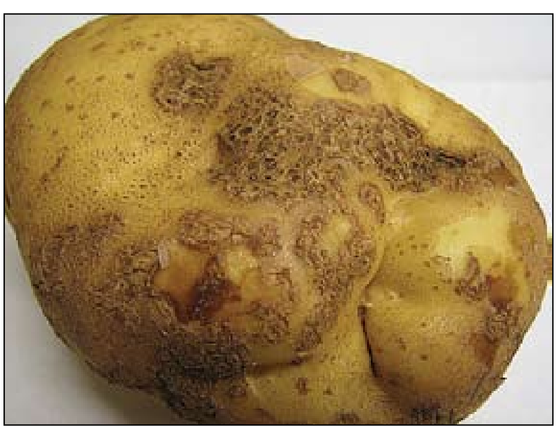

Figure 21. Surface scab lesions on yellow variety.

Figure 22. Raised scab lesions on red variety.

Physiological Disorders

Growth cracks and secondary growth

Tuber cracking (Figure 23) occurs when the potato splits while still growing. These cracks generally start at the bud or apical end of the potato and extend lengthwise. Unlike cracks from mechanical injury, growth cracks typically are well-healed with intact skins. Secondary growth (Figure 24) refers to knobs that grow from lateral buds.

Cause: Both of these physiological problems are related to fluctuations in soil moisture and rapid, uneven uptake of water. Dry periods or periods of high temperature followed by rain can also cause growth malformations.

Maintaining proper soil moisture during the season can reduce the incidence of growth problems. This is especially important during the bulking stage, when plants are large and tubers are expanding rapidly.

More information

http://www.panhandle.unl.edu/potato/html/cracking.htm

http://www.panhandle.unl.edu/potato/html/deformations.htm

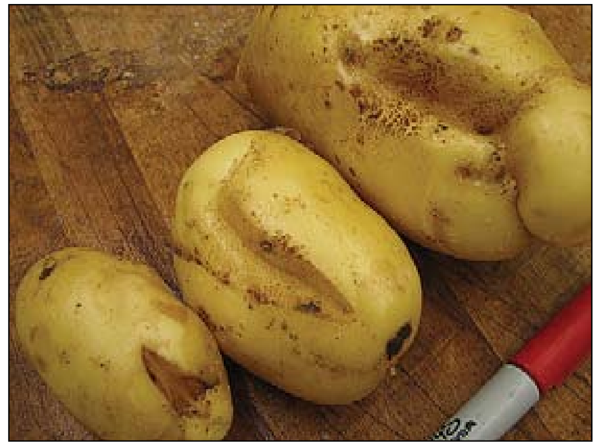

Figure 23. Growth cracks with elephant hide.

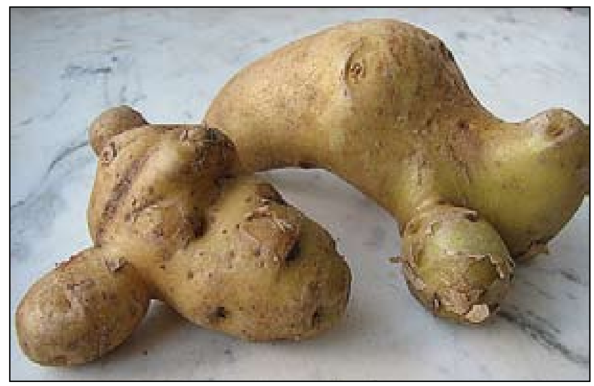

Figure. 24. Secondary growth.

Hollow heart

Hollow heart (Figure 25, with growth cracks) is a discolored lens- or star-shaped cavity found in the center of an otherwise healthy tuber.

Cause: Hollow heart is associated with rapid tuber growth after cool temperatures and moisture stress (too much or too little water). Large tubers usually, but not always, are more susceptible than small tubers.

More information

http://www.panhandle.unl.edu/potato/html/hollow_heart.htm

Figure 25. Hollow heart.

Elephant hide

A rough, irregular surface of the tuber skin is referred to as elephant or alligator hide (Figure 26). The disorder is shallow and appears scaly or crackled.

Cause: The primary cause of this condition is unknown, but contributing factors may include high temperature, variety, high soil organic matter content, and excessive soil moisture and fertilization. Some researchers speculate that elephant hide is caused by uneven growth of the tuber.

Figure 26. Elephant hide.

Enlarged lenticels

Lenticels are openings (ruptured stomates from tuber skin expansion) on the potato that allow for air exchange. They can become enlarged when exposed to waterlogged soils or prolonged wet conditions. Enlarged lenticels look like small, white bumps on the surface of the tuber (Figure 27).

Cause: Oxygen availability drops in saturated soils or when tuber surfaces remain wet for extended periods of time in storage; in response, lenticels open and become enlarged. This disorder is not merely superficial, as it increases susceptibility to the entry of disease organisms, especially soft rot.

More information

http://www.panhandle.unl.edu/potato/html/swollen_lenicels.htm

Figure 27. Enlarged lenticels.

Greening

A green hue on the tuber surface is referred to as "greening" and indicates the accumulation of chlorophyll (Figure 28).

Cause: Potato tuber exposure to light in the field causes the formation of a green pigmentation on the potato. This occurs when sunlight directly contacts tubers growing at or near the soil surface or reaches tubers through cracks in the soil surface. Greening typically affects a limited part of the tuber. The same effect can be caused by extended exposure to low light levels in storage or on store shelves. In this case, the result typically is a lighter, more diffuse coloration on the entire tuber.

Figure 28. Greening.

More Information

University of California-Davis IPM Online Statewide Integrated Pest Management Program. http://www.ipm.ucdavis.edu/PMG/selectnewpest.potatoes.html

Potato Information Exchange. Oregon State University's comprehensive website on potato production. http://oregonstate.edu/potatoes/

J.C. Stark and S.L Love. 2006. *Potato Production Systems*. University of Idaho. 420 pages and 350 color photos. Excellent book covering all aspects of potato production from seed quality to storage. Order from Educational Communications, University of Idaho, P.O. Box 442240, Moscow, ID 83844-2240; *phone* 208-885-7982; *fax* 208-885-4648; *e-mail* calspubs@uidaho.edu

"Spinning tuber" online tuber disease videos (black scurf, black dot, and silver scurf). http://vegetablemdonline.ppath.cornell.edu/PhotoPages/Spin/Pot_spin.html

Oregon State University Online Guide to Plant Disease Control. http://plant-disease.ippc.orst.edu/index.cfm

Pacific Northwest Insect Management Handbook. http://pnwpest.org/pnw/insects

Western Oregon and Washington plant diagnostic clinics

OSU Plant Diagnostic Clinic
Melodie Putnam, director
Department of Botany and Plant Pathology
1089 Cordley Hall
Corvallis, OR 97331
Phone: 541-737-5520
Fax: 541-737-3573
Web: http://www.science.oregonstate.edu/bpp/Plant_Clinic/index.htm
E-mail: putnamm@science.oregonstate.edu
Fees required

WSU-Puyallup Plant Diagnostic Clinic
Jenny Glass, director
7612 Pioneer Way East
Puyallup, WA 98371-4998
Phone: 253-445-4582
Web: http://www.puyallup.wsu.edu/plantclinic/
Fees required

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