Contents

Distribution
European part of Russia

Diseases of Needles and Leaves

Needle Diseases

Hypodermella Needle Cast of Pine Hosts

Class/Order: Ascomycetes/Phacidiales

Pathogen
Hypodermella sulcigena Tub. (anamorph: *Hendersonia acicola* Munch. et. Tub.)

Host
Species of pine (*Pinus*), including Scots (*Pinus silvestris*) and Siberian (*P. sibirica*)

Diagnosis
In summer, the tips of infected needles turn yellow. A brown band, 2-3 mm wide, separates infected from healthy tissue on the needle. Infected needles remain on the trees most of the growing season. Pycnidia form during the summer. On the dead portion of needles, black pycnidia about 140 µ in diameter form. Gray conidia, 3-celled, oval-cylindrical, 11-15 x 4-5 µ, develop in pycnidia. The sexual stage (ascospores) of the pathogen develops the next spring. Apothecia are convex, black, elongate. Asci are cylindrical, 90-100 µ long. Ascospores are clavate, with a thick, jellied enclosure, 42-60 x 12-16 µ.

Biology
Ascospores infect pine needles in spring. Ascospore maturation and release, and needle infection occurs during spring and summer when the humidity is high. Temperature is not a critical factor for pathogen development. Trees on borders of plantations, along forest edges, and in understory of open forests are particularly susceptible.

Damage
Repeated crown infection causes considerable crown loss that both weakens and reduces the height growth of understory and forest plantation trees less than 5 years old.

Distribution
European part of Russia, Urals, Siberia

Control
- Apply Bordeaux mixture when annual infection is repeated.

Chrysomyxa Rust of Spruce

Class/Order: Basidiomycetes, Uredinales

Pathogen
Chrysomyxa abietis (Wallr.) Unger.

Host
Norway spruce (*Picea abies)*

Diagnosis
Cushion-like bright-orange telia, 2-6 mm long, form along the midribs of the needles. Chains of teliospores mature in the telia. Teliospores are oblong, 1-celled, reddish-orange, 18.8-28 x 10.5-17.8 µ.

Biology
This microcylic rust has only the telio- and basidiospore stages. No alternate host is known or required for infection of spruce needles. Telia are produced on needles in early summer. They overwinter, germinate in the spring, and produce basidia with basidiospores that infect the newly formed needles. Mycelium penetrates epidermis cells, where telia develop. Damaged needles with telia fall during the next year and basidiospores are formed. The disease occurs mostly in overstocked plantations and on

understory trees. Disease development depends primarily on high humidity; the pathogen develops under moderate temperatures. The lower portion of the crown usually is affected but the entire crown can be damaged. The severity of current-year infection indicates the inoculum potential for disease development the following year.

Damage
Causes withering and premature drop of needles on understory and young trees in plantations, occasionally resulting in death.

Distribution
European part of Russia, western Siberia, Far East

Control
Chemical
- Bordeaux mixture can be used in late spring in heavily infected stands or plantations.

Class/Order: Deuteromycetes/Sphaeropsidales

Pathogen
Ceutospora abietina Delacr.

Hosts
Norway spruce *(Picea abies)*

Diagnosis
Initially, single brown spots form on needles; later, they coalesce. Stromata form in the spots and are black-olive, oval-oblong, about 0.6 mm in diameter. Stroma have 3 compartments with a common ostiole. Conidia are cylindrical, with rounded tops; they are colorless, 6 x 2.5 μ, and contain 2 oil drops.

Distribution
European part of Russia

Class/Order: Basidomycetes/Uredinales

Pathogen
Coleosporium pini-pumila Azb.

Host
Mountain pine (*Pinus pumila*)

Diagnosis
Yellow spots appear on the both surfaces of the needle. Later, convex, oblong, orange telia form. Teliospores are 1-celled, 45-152 x 20-37.5 μ.

Distribution
Urals, Siberia, Far East

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Pathogen
Melampsorella symphiti (DC) Bub.

Host
Silver fir *(Abies alba)* (**Fig. 59**) (alternate host: *Symphitum officianale,* and *S.cordatum)*

Diagnosis
Spermagonia and aecia develop on the lower surface of needles. Blister-shaped aecia are covered by the peridium. Uredinia are tiny, orange, and develop on the undersides of leaves of the alternate host, *Symphitum* spp. Telia develop subepidermally on these leaves. Aeciospores are globose, rarely egg-shaped, elliptical, with orange contents, a warty wall, 20-40 x 13-29 μ. Urediniospores are globose,

Figure 59.—Needle rust of fir (*Abies alba*) caused by *Melampsorella symphiti.*

egg-shaped or elliptical, with a colorless, warty wall, 22-35 x 20-28 µ. Teliospores are globose, elliptical or angular, 1-celled, with a pale-yellow colorless wall, 11-18 x 9-15 µ.

Distribution
European part of Russia, Siberia

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Pathogen
Pucciniastrum tiliae Hirat.

Hosts
Silver fir *(Abies alba)* and Siberian fir (*A. sibirica*); the alternate host is lime species *(Tilia)*

Diagnosis
Spermogonia and aecia develop on the underside of needles. Aecia develop deeply in the needle tissue. They are cylindrical, orange-yellow, about 3.5 mm high and 0.2 mm in diameter. Uredinia form on the lower surface of lime leaves. They are orange and covered by the peridium. Telia form on the same surfaces and appear as bright-orange-yellow crusts. Aeciospores are globose or elliptical, orange-yellow, small, with a shallow, warty wall, 19-33.5 x 12-22 µ. Urediniospores are globose or elliptical, yellow, 15-25 x 12.5-15 µ. Teliospores are globose or angular, 2- to 6-celled, with a light-brown wall, 18-38 x 14-27 µ.

Distribution
Siberia, Far East

Leaf Diseases

Powdery Mildew of Siberian Pea Tree

Class/Order: Ascomycetes/Sphaeriales

Pathogen
Microsphaera palczewskii Jacz.

Host
Siberian pea tree (*Caragana arborescens*)

Diagnosis
White, cobwebby mycelium forms on both surfaces of leaves in early June. Mycelium and conidia develop on the foliage and become felty and prominent. In late June, numerous cleistothecia form in the mycelial mat and cover the leaf surface. Infected foliage is a gray to blue at this time. Cleistothecia are dark-brown, nearly black, spherical, 90-120 µ in diameter, with oblong, hexangular cells in the peridium. Cleistothecia have 5-10 appendages that are colorless, without partitions, 80-147 x 5-9 µ, with dichotomous branches on the tips. Four to eight mace-shaped asci form on short pedicles, 47-55 x 8-12 µ. Ascospores are elliptical or egg-shaped, on short pedicles, 14-21 x 8-12 µ.

Biology
Asci form in the cleistothecia in summer and overwinter on fallen infected leaves. Asci mature early the following summer. Mature ascospores infect new leaves in the crown. In 2 weeks, superficial mycelium appears on the leaves; 7-10 days later, conidia form that cause secondary infections of young leaves on the middle and upper crown. In late June, the first cleistothecia are produced on the mycelial mats. By late July, numerous cleistothecia are formed. High humidity is the most important factor in disease development. Development occurs at moderate (18°-20°C), or higher (25°-30°C) temperatures. Environmental factors that delay leaf maturation increase susceptibility to powdery mildew.

Damage
Causes complete loss of aesthetic appearance of trees. Damaged leaves wither and drop prematurely. The plants are weakened and lose resistance to low temperatures.

Distribution
Middle regions of European part of Russia, Siberia, Far East

Control
Observation
- Survey for the disease in early June when the mycelium develops.

Chemical
- Apply colloid sulfur or BAYMEB when the white tender superficial mycelium appears on leaves. Apply 3-4 treatments at intervals of 10-12 days.

Other Powdery Mildews

Class/Order: Ascomycetes, Sphaeriales

Pathogen
Microsphaera divaricata Lev.

Host
Buckthorn *(Frangula alnus)*

Diagnosis
Mycelium forms on the surfaces of leaves, often cobwebby, sometimes in several spots. Cleistothecia occur in groups or individually and have 7-16 appendages, dichotomously branched, 135-330 x 6-9 µ. Asci have short pedicles, 48-60 x 25-40 µ. Asci contain 4-6 ascospores, 18-24 x 9-13.5 µ.

Distribution
European part of Russia

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Pathogen
Uncinula clandestina Schroet.

Hosts
Species of elm (*Ulmus*)

Diagnosis
A cobwebby mycelium forms on both surfaces of leaves. Cleistothecia occur in groups or are dispersed, and have 9-30 appendages. Appendages are simple, colorless, rough or smooth, hooked on the tips, 135-165 x 3-4.5 µ. Asci are spherical or elliptical, on short pedicles, 40-56 x 30-45 µ, and contain 2 or 3 ascospores. Ascospores are elliptical, 25-36 x 11-18 µ.

Distribution
European part of Russia

Orange Leaf Spot of Padus

Class/Order: Ascomycetes/ Sphaeriales

Pathogen
Polystigma ochraceum (Wahl.) Sacc.

Host
Bird cherry (*Padus avium*), Asian cherry (*Padus asiatica*)

Diagnosis
Circular or angular, orange stromata, about 1 cm in diameter, form on leaves in early July (**Fig. 60**). Pycnidia develop in stromata during summer. Maturing conidia are colorless, convex, with a prominent narrow upper portion. The leaf spots darken in autumn and perithecia form. Mature asci are cylindrical, on a long pedicle, about 90-100 x 15 µ. Ascospores are elliptical, colorless, 14 x 5-6 µ.

Biology
Pycnidia containing conidia are formed in stromata during summer. Conidia mate to form the sexual stage. Asci form in autumn and overwinter on fallen leaves. Asci mature early in the growing season of the next year. Ascospore maturation and release, and leaf infection occur over most of the growing season. Infection by ascospores usually takes place in early June in Siberia. The first symptoms of disease develop on leaves in July and the abundance of spots increases in relationship to the extended period of ascospore release. The amount of precipitation in spring and early summer plays an important role in infection. High humidity promotes ascospore maturity and release from the perithecia as well as their germination and penetration of leaf tissue.

Figure 60.—Leaf spot of bird cherry (*Padus avium*) caused by *Polystigma ochraceum*.

Damage
Causes premature withering and dropping of leaves, reduced fruit production in the current year, and partial or complete loss of fruit in the next year.

Distribution
Siberia, rarely in European part of Russia

Red Spot of Ussurian Plum

Class/Order: Ascomycetes/Sphaeriales

Pathogen
Polystigma ussuriensis (Natal. et Jacz.) A. Proz.

Host
Ussurian plum (*Prunus ussuriensis*)

Diagnosis
Small, circular spots, 2-8 mm in diameter, develop on infected leaves. They are pale-yellow initially and later bright-orange. Lower surfaces of spots are convex and covered with numerous, dark dots. These dots are the pores at the top of stromata containing pycnidia. As they age, the spots turn brown and on lower surfaces of leaves, nearly black. Pycnidia are 200-300 x 150-210 μ. Conidia are colorless, thread-like, 15 x 1 μ. Asci are narrow, mace-shaped, 85-90 x 10-11. Ascospores are colorless, elliptical, 8-11 x 3-5 μ.

Biology
The pathogen overwinters on fallen leaves in the sexual stage. Ascospores mature in perithecia in late May or early June. Ascospores are disseminated by wind and infect leaves. The first spots appear on leaves in late June and continue to increase; this is related to the long period of pathogen sporulation. Conidia are not involved in foliage infection but mate to form perithecia in autumn. Asci and ascospores do not mature until the next year. The amount of precipitation at the beginning of the growing season influences maturation and release of ascospores and subsequent foliage infection.

Damage
Causes premature foliage damage and reduces fruit yield. Successive infections weaken or kill the tree.

Distribution
Far East, Primorski and Khabarovski regions of Russia

Control
Cultural
- Collect and burn fallen foliage to eliminate the inoculum source of the overwintering pathogen.

Chemical
- Spray three applications of Bordeaux mixture: 1) during the period of foliage expansion; 2) immediately after flowering; and 3) 10-12 days after the second application when humidity is high at the beginning of the growing season.
- Spray with Bordeaux mixture in autumn (before leaf drop) to reduce overwintering inoculum.

Foliage Anthracnoses, Spots, and Blights

Class/Order: Deuteromycetes, Sphaeropsidales

Pathogen
Ascochyta borjomi Bond.

Host
Siberian pea tree (*Caragana arborescens*)

Diagnosis
Leaf spots are round, 4-6 mm in diameter, whiteish, surrounded by brown margins. Pycnidia form on the upper surfaces of spots as small, black dots. Conidia are cylindrical, with rounded ends, straight or curved, usually 1-, or 2-celled, colorless, 8-10.5 x 4.5-5 µ.

Distribution
Southern area of European part of Russia

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Pathogen
Ascochyta crataegi Fckl.

Hosts
Species of hawthorne (*Crataegus*)

Diagnosis
Spots form on the upper surfaces of leaves, often along the margin. They are round or angular, about 6 mm in diameter, brown, with dark borders. Pycnidia form in these spots as brown dots. Conidia are oblong cylindrical, with rounded ends, 2-celled, colorless, 8-12 x 2-3 µ.

Distribution
Southern area of European part of Russia

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Pathogen
Ascochyta elaeagni Sacc.

Hosts
Species of oleaster (*Elaeagnus)*

Diagnosis
Spots usually form near the leaf margins and are irregular, creamy, with a narrow brown border. Pycnidia form on upper surfaces of spots as small black dots. Conidia are spindle-like, 2-celled, light-olive, 8-10 x 3.5-4 µ. Mycelium forms on both surfaces of leaves. It has a cobwebby appearence. Cleistothecia occur in groups or are dispersed, with 9-30 appendages that are simple, colorless, rough or smooth, hooked on the tips, 135-165 x 3-4.5 µ. Asci are spherical or widely elliptical, on a short pedicle, 40-56 x 30-45 µ. Ascospores are elliptical, 25-36 x 11-18 µ.

Distribution
European part of Russia

♦♦♦

Pathogen
Ascochyta piricola Sacc.

Hosts
Species of apple (*Malus)* and pear *(Pyrus*)

Diagnosis
Leaf spots are bright-gray-white. Pycnidia form on upper surfaces of spots as small, black dots. Conidia are oblong, olive, 10 x 2 µ.

Distribution
European part of Russia

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Pathogen
Ascochyta populina Sacc.

Host
White poplar (*Populus alba*)

Diagnosis
Leaf spots are brown and vary in size. Pycnidia form on upper surfaces of spots as small brown dots. Conidia are cylindrical, 2-celled, colorless, 8-10 x 2 µ.

Distribution
Southwestern area of European part of Russia

♦♦♦

Pathogen
Ascochyta ribesia Sacc. et Fautr.

Host
Species of currant *(Ribes)*

Diagnosis
Leaf spots are small, white or pale-brown, with dark borders. Pycnidia form on the upper surfaces of spots as brown dots. Conidia are cylindrical, with rounded ends, 8-12 x 3 m.

Distribution
European part of Russia

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Pathogen
Ascochyta sarmentica Sacc.

Host
Honeysuckle *(Lonicera tatarica)*

Diagnosis
Leaf spots are white with dark borders. Pycnidia form on upper surfaces of spots as dark dots. Conidia are elongate-oval, widened at the top, 2-celled, colorless or smoke-gray, 20-25 x 8 µ.

Distribution
Western area of European part of Russia

♦♦♦

Pathogen
Coniothyrium salicicola Rossi.

Hosts
Species of willow (*Salix*)

Diagnosis
Leaf spots are yellow-brown, sometimes with black borders; in dry conditions they are gray-white. Pycnidia form on upper surfaces of spots as black dots. Conidia are egg-shaped, brown, 5-6.5 x 3-3.5 µ.

Distribution
European part of Russia

Class/Order: Deuteromycetes/Hyphomycetales

Pathogen
Cercospora padi Bub. et Serebr.

Host
Bird cherry (*Padus avium*)

Diagnosis
Leaf spots are small, irregular, sometimes coalesced, white on upper surfaces and brown on the lower, about 0.5-3 mm in diameter. Conidia are spindle-shaped, cylindrical or elongate and wide at the top, slightly curved, 2- or more-celled, pale-olive, 20-70 x 4-6.5 µ.

Distribution
European part of Russia, Western Siberia, Far East

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Pathogen
Coniothecium phyllophilum Desm.

Hosts
Species of hawthorne (*Crataegus*)

Diagnosis
Leaf spots are black and small; they occur on both surfaces of leaves. Conidia are spherical or irregularly spherical, smoke-gray, 4-celled, about 12 µ.

Distribution
European part of Russia

Class/Order: Deuteromycetes/Melanconiales

Pathogen
Cylindrosporium avellanum (B. et Br.) Jbr. et Ach.

Host
Hazel (*Corylus avellana*)

Diagnosis
Leaf spots are numerous, round or angular, brown, sometimes coalesced. Conidia are cylindrical, straight or curved, 2- to 4-celled, colorless, 25-32 x 2-3 µ.

Distribution
European part of Russia

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Pathogen
Cylindrosporium platanoides (Allesch.) Died. (teliomorph: *Mycosphaerella latebrosa* (Ckl.) Schroet.)

Host
Bosnian maple (*Acer platanoides*)

Diagnosis
Leaf spots are small and dark-brown, elongate. Sporodochia are pale, later dark and spherical. Conidia are thread-like or narrow, cylindrical; one end is narrow, straight or slightly curved, 4-celled, colorless, 27-80 x 1.5-3.5 µ.

Distribution
Southern area of European part of Russia

♦♦♦

Pathogen
Cylindrosporium pseudoplatani (Rob. et Desm.) Died. (teliomorph: *Mycosphaerella pseudoplatani* Zer.)

Hosts
Species of maple (*Acer*)

Diagnosis
Leaf spots are dark-brown, on both surfaces of leaves, single or coalesced, about 3 mm in diameter. Sporodochia are small, dark, in clusters. Conidia are cylindrical; one or both ends are narrow, straight or slightly curved, 4-celled, colorless, 22-56 x 2-3.5 µ.

Distribution
European part of Russia

Pathogen
Cylindrosporium propinquum (Bub. et Vleug.) Vassil.

Hosts
Species of willow (*Salix*)

Diagnosis
Leaf spots are irregularly shaped, brown or yellowish, sharply delimited or diffuse. Sporodochia form on the lower surfaces of spots; they are numerous, brown or pale-yellow. There are two types of conidia: microconidia are spindle-shaped, straight or slightly curved, colorless, 10-22 x 2-3.5 μ; macroconidia are spindle-shaped or widened at the top, curved, rarely straight, colorless, 4- to 6-celled, 22-80 x 3.5-7.5 μ.

Distribution
Southeastern area of European part of Russia

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Pathogen
Gloeosporium acericolum Allesch.

Hosts
Species of maple (*Acer*)

Diagnosis
Leaf spots are gray or brown, coalesced. Sporodochia form on the lower surfaces of spots, are inconspicuous, light-yellow, cushion-like, under the epidermal layer. Conidia are cylindrical, colorless, 1-celled, 6-12 x 2-2.5 μ.

Distribution
European part of Russia

♦♦♦

Pathogen
Gloeosporium capreae Allesch.

Hosts
Species of willow (*Salix*)

Diagnosis
Leaf spots are large, gray-brown. Numerous small, black, cushion-like sporodochia form on upper surfaces of spots. Conidia are oblong, straight or curved, colorless, 6-18 x 2-4.5 μ.

Distribution
European part of Russia.

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Pathogen
Gloeosporium perexiguum Sacc.

Hosts
Species of mountain-ash (*Sorbus*)

Diagnosis
Leaf spots are red-brown, small, and eventually drop out of the leaf to form shot holes. Bright-yellow, cushion-like sporodochia form on lower surface of spots. Conidia are elongate, elliptical, 1-celled, colorless, 5-6 x 2-3 μ.

Distribution
European part of Russia

♦♦♦

Pathogen
Pestalotia malorum Elenk. et Ohl.

Hosts
Species of apple (*Malus*)

Diagnosis
Leaf spots are gray-brown, roundish, 3-7 mm in diameter, and coalesced. Sporodochia form on the upper surfaces of spots, are black, cushion-like, and inconspicuous. Conidia are spindle-like, 4-celled, with 3-4 appendages, dark-olive, 17 x 6.5 µ.

Distribution
European part of Russia

Class/Order: Deuteromycetes/Sphaeropsidales

Pathogen
Hendersonia piricolea Sacc.

Hosts
Species of pear (*Pyrus*)

Diagnosis
Leaf spots are white-gray on the upper surfaces of leaves. Pycnidia occur as black dots. Conidia are egg-shaped, 3- to 4-celled, brown, 10x5 µ.

Distribution
European part of Russia

♦♦♦

Pathogen
Phleospora oxyacanthae (Kze. et Schum.) Wallr. (teliomorph: *Mycosphaerella oxyacanthae* Jaap.)

Hosts
Species of hawthorne (*Crataegus*)

Diagnosis
Spots are round, form on the both surfaces of leaves, are brown on the upper surface and gray on the lower. Perithecium form on the upper surfaces of spots, and are buried in leaf tissue. Perithecia form under the stroma. Asci are wide at the top, 90-110 x 10 m. Ascospores are cylindrical, sickle-like, with a wide top, yellow-brown, 6- or 7-celled, with oil drops, 66-78 x 4-5 µ.

Distribution
Siberia

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Pathogen
Phoma betulae Jacz.

Hosts
Species of birch (*Betula*)

Diagnosis
Leaf spots are small, brown, scattered over entire leaf surface. Pycnidia are black and inconspicuous. Perithecia form on upper surfaces of spots buried in leaf tissue. Conidia are elliptical, colorless, 1-celled, 12-14 x 2 µ.

Distribution
European part of Russia, Siberia

♦♦♦

Pathogen
Phyllosticta aceris Sacc.

Host
English field maple (*Acer campestre*)

Diagnosis
Leaf spots are small, light-brown, later whitish with a dark border. Scattered pycnidia form on the spots as black dots. Conidia are oblong, pointed, colorless, 5-7 x 2.5-3 μ.

Distribution
European part of Russia, Siberia

♦♦♦

Pathogen
Phyllosticta aucupariae Thum.

Hosts
Species of mountain-ash (*Sorbus*)

Diagnosis
Leaf spots are gray, with wide, dark-brown borders. Pycnidia form on upper surfaces of spots, scattered or in groups, inconspicous, black. Conidia are elliptical, colorless, 1-celled, 5-8 x 3 μ.

Distribution
European part of Russia, Siberia

♦♦♦

Pathogen
Phyllosticta associata Bub.

Host
Pedunculate oak (*Querqus robur*)

Diagnosis
Leaf spots form on both surfaces of leaves; they are brown and coalesced. Scattered, black pycnidia form on the lower surfaces of spots. Conidia are short and cylindrical, with rounded ends, colorless, 2-4 x 1 μ.

Distribution
Southwestern area of European part of Russia

♦♦♦

Pathogen
Phyllosticta bellunensis Mart.

Hosts
Species of elm (*Ulmus)*

Diagnosis
Leaf spots are large, round, and brown. Pycnidia are small and inconspicous. Conidia are cylindrical, 1-celled, colorless, 2.5-3 x 0.75-1 μ.

Distribution
European part of Russia, Urals, Siberia

♦♦♦

Pathogen
Phyllosticta borschzowii Thum.

Host
Siberian pea tree (*Caragana arborescens*)

Diagnosis
Leaf spots form on the lower surface of leaves; they are gray- or light-brown. Pycnidia form on the lower surface of spots, rarely both sides. Conidia are ellyptical, colorless, 3 x 1.5 μ.

Distribution
European part of Russia

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Pathogen
Phyllosticta cathartici Sacc.

Host
European buckthorn (*Rhamnus cathartica)*

Diagnosis
Leaf spots are round, light-brown, with a dark border. Pycnidia form on the upper surface of spots; they are black, spherical, and flat. Conidia are oval spindle-shaped, 1-celled, colorless, 10 x 4 µ.

Distribution
European part of Russia

♦♦♦

Pathogen
Phyllosticta corylaria Sacc.

Host
Hazel (*Corylus avellana*)

Diagnosis
Leaf spots are scattered on both surfaces of leaves; they are large, irregularly shaped, yellow-brown, with a brown border. Pycnidia form on the upper surfaces of spots; they are scattered, inconspicuous, spherical, and black. Conidia are oval, 1-celled, light-olive, 4-4.5 x 2 µ.

Distribution
European part of Russia

♦♦♦

Pathogen
Phyllosticta globulosa Thum.

Host
Pedunculate oak (*Quercus robur*)

Diagnosis
Leaf spots form on the upper surfaces of leaves, are irregularly shaped, and gray-white. Pycnidia are scattered, spherical, and black. Initially, they are buried in leaf tissue but later erupt. Conidia are spherical, widely egg-shaped, 1-celled, colorless, with 1-2 oil drops, 6 x 9 µ.

Distribution
Southwestern area of European part of Russia

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Pathogen
Phyllosticta lacerans Pass.

Hosts
Species of elm (*Ulmus*)

Diagnosis
Leaf spots are round, 0.4-0.6 mm in diameter, gray, and eventually drop out, leaving holes in leaves. Black pycnidia form on the upper surface of spots. Initially, they are buried in leaf tissue but later erupt. Conidia are egg-shaped, 1-celled, colorless, 4-7.5 x 2.5-3 µ.

Distribution
European part of Russia, Urals

♦♦♦

Pathogen
Phyllosticta monogyna Allesch.

Hosts
Species of hawthorne (*Crataegus*)

Diagnosis
Leaf spots vary in size, are round and rusty-brown. Pycnidia form on lower surface of spots, are scattered, spherical, and black. Initially, they are buried in leaf tissue but later erupt. Conidia are oval-elongate, 1-celled, colorless, 3-8 x 2.5-3 µ.

Distribution
Southwestern area of European part of Russia

♦♦♦

Pathogen
Phyllosticta michailowskoensis Elenk.

Hosts
Species of hawthorne (*Crataegus*)

Diagnosis
Leaf spots form on the upper surface of leaves, are round or angular, light-brown, with a dark border. Pycnidia form on the upper surface of spots, are scattered or in groups, spherical, and black. Initially, they are buried in leaf tissue but later erupt. Conidia are egg-shaped or cylindrical, with rounded ends, 1-celled, sometimes with 1-2 oil drops, 4-6 x 2.5-3 µ.

Distribution
European part of Russia, Urals, Siberia

♦♦♦

Pathogen
Phyllosticta populi-nigrae Allesch.

Hosts
Species of poplar (*Populus*)

Diagnosis
Spots are round and initially gray-brown, later white to gray, with a dark border. Pycnidia form on the upper surface of spots, are inconspicuous and spherical; they are initially buried in leaf tissue but later erupt. Conidia are elongate, oval, 1-celled, colorless, 15 x 2.5-3.5 µ.

Distribution
Urals, Siberia

♦♦♦

Pathogen
Phyllosticta quercina Thum.

Host
Pedunculate oak (*Quercus robur*)

Diagnosis
Leaf spots are round, red-brown, with diffuse margins. Pycnidia form in the center of the upper surface of spots, are black and spherical. Conidia are egg-shaped or oval, 1-celled, grayish, 3.5-5 x 2.5 µ.

Distribution
European part of Russia

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Pathogen
Phyllosticta tambowiensis Bub. et Serebr.

Hosts
Species of maple (*Acer*)

Diagnosis.
Leaf spots are round or oval, about 10 mm in diameter, initially gray and later brown. Pycnidia form on the lower surface of spots. They are black, spherical, numerous, and aggregated. Conidia are cylindrical, 1-celled, colorless, 4-7.5 x 1 μ.

Distribution
European part of Russia

♦♦♦

Pathogen
Phyllosticta ulmaria Pass.

Hosts
Species of elm (*Ulmus*)

Diagnosis
Leaf spots are round, white, with a dark-brown border. Pycnidia are black, spherical, and scattered. Conidia are oval, 1-celled, colorless, 3.5-4 x 2.5 to 3 μ.

Distribution
European part of Russia, Urals

♦♦♦

Pathogen
Phyllosticta ulmi H.C. Greene

Hosts
Species of elm (*Ulmus*)

Diagnosis
Leaf spots form on both surfaces of leaves, are round, gray, scattered, sometimes coalesced. Pycnidia form on both surfaces of spots, are spherical, black, and scattered. Conidia are egg-shaped, 1-celled, colorless, with 1-2 oil drops, 10 x 5 μ.

Distribution
European part of Russia, Urals

♦♦♦

Pathogen
Septoria acerella Sacc. (syn. *S. acerina* Sacc.)

Hosts
Species of maple (*Acer*)

Diagnosis
Spots are white, round or angular, small, and form on upper surfaces of leaves. Pycnidia are black, spherical, and rare. Conidia are cylindrical, curved, 1-celled or without a clear partition, colorless, 20-22 x 2 μ.

Distribution
European part of Russia

♦♦♦

Pathogen
Septoria candida (Fckl.) Sacc.

Host
White poplar (*Populus alba*)

Diagnosis
Spots are round, white, and form on the upper surface of leaves. Pycnidia are spherical, brown, and dispersed. Conidia are cylindrical, curved, 4-celled, colorless, 28-30 x 2.5 μ.

Distribution
European part of Russia

♦♦♦

Pathogen
Septoria crataegicola Bond. et Tranz.

Host
Hawthorne (*Crataegus oxyacantha*)

Diagnosis
Spots form on both surfaces of leaves and are scattered. Initially, they are yellow-green, later chestnut-brown and gray in the center. Black, spherical pycnidia form on the upper surface of spots. Conidia are wide, cylindrical or spindle-shaped, curved, 2- to 6-celled, colorless or light olive, 45-80 x 3.5-4 μ.

Distribution
European part of Russia

♦♦♦

Pathogen
Septoria ebuli Desm. et Rob.

Hosts
Species of elderberry (*Sambucus*)

Diagnosis
Spots form on both surfaces of leaves, initially pale-yellow but later red, with a brown border. Pycnidia form on the upper surface of spots; they are brown and later black. Conidia are thread-like, slightly curved, 2-celled, colorless, 30-50 x 1-1.5 μ.

Distribution
European part of Russia

♦♦♦

Pathogen
Septoria frangulae Guep.

Host
Buckthorn *(Rhamnus frangula)*

Diagnosis
Spots are yellow-brown with light borders and form on the upper surface of leaves. Pycnidia are black, spherical, and raised or flat. Conidia are cylindrical, 1-celled, colorless, 18-25 x 2 μ.

Distribution
European part of Russia, Urals

♦♦♦

Pathogen
Septoria pallens Sacc.

Hosts
Species of plum and cherry (*Prunus*)

Diagnosis
Leaf spots are pale-yellow, later brown. Black, spherical pycnidia form on the upper surface of spots. Conidia are thread-like, straight or curved, 1-celled, colorless or greenish, 8-18 x 0.5-1 μ.

Distribution
European part of Russia

Pathogen
Septoria tiliae Westend.

Hosts
Species of lime (*Tilia*)

Diagnosis
Leaf spots are brown, often with a lighter center, scattered, sometimes coalesced. Pycnidia form on both surfaces of spots. Conidia are cylindrical, straight or curved, 3- to 5-celled, colorless, 20-40 x 2-3 µ.

Distribution
European part of Russia, Urals, Siberia

♦♦♦

Pathogen
Septoria tremulae Pass.

Host
European aspen (*Populus tremula*)

Diagnosis
Brown spots form on both surfaces of leaves, sometimes coalesced. Black pycnidia form on the lower surface of spots, buried in leaf tissue. Conidia are thread-like, twisted, 1-celled, colorless, 20-25 x 1.5 µ.

Distribution
European part of Russia, Urals

Class/Order: Deuteromycetes/Hyphomycetales

Pathogen
Polystigmina rubra (Desm.) Sacc. (teliomorph: *Polistigma rubra* Sacc.)

Hosts
Species of cherry and plum (*Prunus*)

Diagnosis
Bright-red, shiny, convex, stromata form on the lower surface of leaves. Initially, pycnidia develop inside stromata. Conidia are colorless, hooked, 25-30 x 1-1.5 µ. Perithecia later form near pycnidia. Asci are wide on top and elongate. Ascospores are oval, 1-celled, colorless, 11-13 x 4.5 µ.

Distribution
European part of Russia

♦♦♦

Pathogen
Ramularia sorbi Karak.

Hosts
Species of mountain-ash (*Sorbus*)

Diagnosis
Leaf spots are red-brown, with diffuse margins, and coalesced. There are two types of conidia: peach-like, colorless or greenish, 2-celled, 21-24 x 4-8 µ; cylindrical, colorless or greenish, 2- to 4-celled, 20-40 x 4-6 µ.

Distribution
European part of Russia

♦♦♦

Pathogen
Ramularia tiliae Lobik.

Hosts
Species of lime (*Tilia*)

Diagnosis
Leaf spots are gray-brown, 0.7-1.2 mm in diameter. Conidiophores form on the lower surface of leaves as small, gray, fur-like spots. Conidia are cylindrical, pointed, colorless, 2- to 4-celled, 23-36 x 2.2-3.8 µ.

Distribution
European part of Russia

Class/Order: Ascomycetes/Phacidiales

Pathogen
Rhytisma symmetricum Joh. Mull.

Hosts
Species of willow (*Salix*)

Diagnosis
Black, shiny stromata, about 5 mm in diameter, form on both surfaces of leaves. Asci are wide on top, 135-162 x 12-9 µ. Ascospores are thread-like, wide at one end and pointed at the other, colorless, 108 x 2.5 µ.

Distribution
European part of Russia

♦♦♦

Pathogen
Rhytisma xylostei Naum.

Hosts
Species of honeysuckle (*Lonicera*)

Diagnosis
Black, shiny stromata, 5-12 mm in diameter, are formed between leaf veins. Asci are wide at one end, 69-82 x 8-11 µ. Ascospores are 1-celled, colorless, elongate, wide at one end, 50-55 x 2.8 µ.

Distribution
Siberia

Leaf Rusts

Class/Order: Basidiomycetes/Uredinales

Pathogen
Melampsora larici-caprearum Kleb.

Hosts
Willow (*Salix caprea)* and species of larch (*Larix*)

Diagnosis
Spermagonia and aecia develop on the needles of larch. Uredinia form on the lower surface of leaves of willow (the alternate host). They are light-orange, powdery, cushion-like. Telia form on the upper surface of willow leaves. They are initially yellow, later dark-brown, 1-1.5 mm long, and coalesce to cover the entire leaf surface. Urediniospores are oval, sherical or angular, with a warty wall, 14-21 x 13-15 µ. Teliospores are prismatic, with a light-brown enclosure, 30-45 x 7-14 µ.

Distribution
European part of Russia, Siberia, Far East

Pathogen
Melampsora larici-populina Kleb.

Hosts
Poplar (*Populus nigra)* and species of larch *(Larix)*

Diagnosis
Spermagonia and aecia develop on larch needles. Uredinia develop on both surfaces of poplar leaves. They are orange, powdery, cushion-like. Telia form on the upper and rarely on the lower surface of leaves, are light-brown, later turning dark-brown and becoming crust-like. Urediniospores are elongate, with a thorny, warty wall, 30-40 x 13-17 µ. Teliospores are prismatic, with a round top and a thin, light-brown wall, 40-70 x 10 µ.

Distribution
European part of Russia, Siberia, Far East

♦♦♦

Pathogen
Melampsora larici-tremulae Kleb.

Hosts
Species of poplar (*Populus tremula, P. alba*) and larch *(Larix)*

Diagnosis
Spermagonia and aecia develop on larch needles. Uredinia form on the lower surface of poplar leaves. They are orange and powdery. Telia develop on the lower surface of poplar leaves. They are small, dark-brown, single or clustered. Urediniospores are oval, oblong, elliptical, sometimes globose, with a thorny wall, 15-22 x 10-15 µ. Teliospores are prismatic, with round ends, 40-50 x 7-12 µ.

Distribution
Siberia, Caucasus Mountains

♦♦♦

Pathogen
Pucciniastrum coryli Kom.

Host
Hazel (*Corylus avellana*)

Diagnosis
This is an autoecious rust. Orange pustules of uredinia form on the upper surface of leaves. Telia form on the lower surface, are crust-like, small, initially yellow but later yellow-brown. Urediniospores are egg-like, elliptical, globose, orange, 17.5-25 x 12.5-17.5 µ. Teliospores are single or in groups, 2- to 8-celled, oblong, with a light-brown wall, 18-30 x 12-5 µ.

Distribution
Far East

♦♦♦

Pathogen
Puccinia coronifera Kleb.

Host
European buckthorn *(Rhamnus cathartica),* species of oats *(Avena),* and fescue grass *(Fustuca)*

Diagnosis
Globose spermogonia develop beneath the epidermis on the upper surface of leaves of *Rhamus.* Cup-like aecia develop on the lower surface and on leaf petioles. Damaged leaves and shoots are deformed. Uredinia and telia develop on leaves of *Avena* and *Festuca* species. Aeciospores are globose or angular-globose, with orange contents and a colorless, warty wall, 16-24 x 12-18 µ.

Distribution
European part of Russia, Urals, Siberia

Class/Order: Ascomycetes-Taphrinales

Pathogen
Taphrina autumnalis Palm.

Hosts
Species of birch (*Betula*)

Diagnosis
Red spots form on both surfaces of leaves. Asci are cylindrical, 44-80 x 14-30 µ. Ascospores are globose, colorless, 3-4 µ.

Distribution
European part of Russia

♦♦♦

Pathogen
Taphrina betulae Johans.

Hosts
Species of birch (*Betula*)

Diagnosis
Leaf spots are round, swollen, white to yellow. A layer of asci develop on the upper surface of spots; they are cylindrical with round tops, 40 x 8-12 µ. Ascospores are globose or elliptical, 3-5 µ.

Distribution
European part of Russia, Urals, Siberia

♦♦♦

Pathogen
Taphrina betulina Rostr.

Hosts
Species of birch (*Betula*)

Diagnosis
Infected leaves are curled with a layer of asci on the lower surface. Brooms of numerous, shortened shoots develop from sprouting, latent buds. Asci are cylindrical, 45-55 x 15 µ. Ascospores are globose, colorless, 3-5 µ.

Distribution
European part of Russia

♦♦♦

Pathogen
Taphrina crataegi Sad.

Hosts
Species of hawthorne (*Crataegus*)

Diagnosis
Red, swollen spots with a white, waxy surface form on the lower surface of leaves, rarely on calix lobes. Asci are cylindrical, with round tops, 25-35 x 8 µ. Ascospores are globose, colorless, 4-6 µ.

Distribution
European part of Russia

♦♦♦

Pathogen
Taphrina turgida Sad.

Hosts
Species of birch (*Betula*)

Diagnosis
Infected leaves are curled with a gray, waxy layer of asci on the lower surface of leaves. Brooms of numerous, shortened shoots with dwarfed leaves develop. Asci are cylindrical, with blunt, usually concave tops, 45-50 x 15 µ. Ascospores are globose, 4 µ.

Diseases of Roots, Stems, and Branches

Diseases in Tree Nurseries and Young Forests

"Infectious Damping" of Coniferous Seedlings

Class/Order: Ascomycetes/Helotiales and Basidiomycetes/Aphyllophorales

Pathogens
Sclerotinia graminearum Elen. and *Typhula graminearum* Tul.

Hosts
Scots pine (*Pinus silvestris*), Norway spruce (*Picea abies*), and species in the following genera: *Phleum* L. *Poa* L., *Festuca* L., *Agropyron*, *Alopecurus* L., *Dactylis* L., *Bromus* L., *Lolium* L., *Myosotis* L., *Sellaria* L., *Cerastium* L., *Potentilla* L., and *Achillea* L.

Diagnosis
The first symptoms of infection occur immediately after snowmelt. Needles of infected seedlings are covered by a gray-white cobwebby mycelium that disappears after several days. Affected dead needles are red-brown but later turn gray. The tops of infected seedlings die and fall off. Sclerotia form on the stems near the buds, sometimes inside the stem. Sclerotia drop to the ground when seedlings are disturbed. Sclerotia of *S. graminearum* are dark-brown, almost black, often irregularely shaped, about 6 mm in long. They produce yellow-gray, stalked, saucer-like apothecia, about 7 mm in diameter. Asci are cylindrical, 175-225 x 10-13 µ. Ascospores are colorless, oval, 14-21 x 6.5-9 µ. Sclerotia of *T. graminearum* are dark-brown, almost black, spherical, about 2 mm in diameter. They produce clavate fruiting bodies about 17 mm long; basidia with basidiospores develop on them.

Biology
Infection of conifer seedlings is from spores produced by germinating fruiting bodies from the fallen sclerotia, ascospores of *S. graminearum*, or basidiospores of *T. graminearum*. Warm and wet weather in autumn promotes germination of *S. graminearum* sclerotia. High humidity also is important for germination of *T. graminearum* sclerotia. Sclerotia can survive 1-2 years. For both fungi, spore discharge and seedling infection continue through the growing season until temperatures are constantly below 0°C. Disease development occurs in winter under the snow layer. Mycelium develops inside needles until mid-March when growth on the needle surface begins. Healthy seedlings are infected by aerial mycelium during this time. Damaged needles remain alive and green until snowmelt and then die and turn gray-green. Warm winters with numerous thaws and deep snow cover along with long springs with slow snowmelts favor disease development, i.e., small cavities are formed around seedlings under the snow cover. Herbaceous hosts are sources of inoculum for infection of conifer seedlings.

Damage
Growth is reduced and tops dieback in affected seedlings, which become deformed. Heavy infection may kill seedlings. Infection in nurseries fluctuates yearly and ranges from 10-80 percent; mortality ranges from 10-40 percent.

Distribution
European part of Russia, Middle Urals, Western Siberia, Far East

Control
Prevention
- Establish nurseries on level, well-drained soil; avoid low, wet areas.

Figure 61.—Lesion on three-year-old pine (*Pinus sylvestris*) branch caused by *Sclerophoma pithia.*

Cultural
- Do not repeat sowing of pine and spruce seeds in the same nursery beds for at least 2 years.
- Control weeds in and near nurseries to reduce inoculum sources.
- Survey seedlings just after snowmelt and remove and destroy infected seedlings within a week after snowmelt.

Chemical
- No fungicides are registered for control of snow molds of conifer seedlings.

Sclerophoma Disease of Pine Shoots

Class/Order: Deuteromycetes/Sphaeropsidales

Pathogen
Sclerophoma pithia v. Hohn

Host
Scots pine *(Pinus sylvestris)*

Diagnosis
Isolated, brown, necrotic lesions, elongate and about 1 to 1.5 cm long, form on shoots (**Fig 61**). Affected shoots become bright rusty-brown, often curved. Later, lesions turn gray and numerous pycnidia form on the surface of necrotic areas. Longitudinal lines of pycnidia form in bark cracks.

Pycnidia are spherical, black, about 460 µ in diameter. Conidia are egg-shaped, colorless, 1-celled, 6-7 x 2-2.5 µ. Needles of diseased shoots turn brown and dark bands about 2 mm wide form on the boundary with the healthy part of needles. In autumn, pycnidia form on dead ends of needles. Infected shoots are covered by picnidia, turn black, and drop in autumn.

Biology
In spring, shoots are infected by conidia from pycnidia on previously damaged shoots. Infection severity depends on seedling age. The number of diseased plants decreases significantly as plantation age increases. In plantations more than 6 years old, only shoots of upper nodes are infected. Environmental conditions also play a role in disease development. High levels of sunlight and low humidity promote moisture deficits in seedlings and stimulate rapid and vigorous fungal development. Cool, moist weather can cause outbreaks to collapse. Attacks by the pine tip moth (*Rhuacionia petrova*) promote infection of shoots by *Sclerophoma*.

Damage
Affects seedlings in nurseries and in plantations less than 12 years old. Causes seedling death in nurseries and reduces the number of seedlings for standard planting material. Infection in plantations less than 5 years old results in deformed crowns and, with repeated epiphytotics, seedling death and plantation decline.

Distribution
European part of Russia

Control
Observation
- Survey nurseries and pine plantations in the beginning of summer during drought years.

Cultural
- Remove and burn infected seedlings in the nurseries.
- Maintain row spacing in young pine plantations to allow for ploughing infected shoots into the soil.

Pine Shoot Rust

Class/Order: Basidiomycetes/Uredinales

Pathogen
Melampsora pinitorqua Rostr.

Hosts
Species of pines (*Pinus*), including Scots (*Pinus sylvestris),* Siberian *(P. sibirica),* and white *(P. strobus);* the alternate host is poplar *(Populus)*

Diagnosis
Aecia form from May to June on current-year shoots or on needles (**Fig. 62**). They develop beneath epidermis as oblong, orange swellings. Mature aeciospores burst through the epidermis as a bright-yellow, powdery mass. Aeciospores are 1-celled, oval or globose, 15-22 x 11-17 µ. The infected shoots lose turgor and bend. Small pitching wounds remain on the shoot's surface after aeciospore release. Numerous dormant (latent) buds can grow from below injured shoots and one can replace the dead leader, creating a false whorl.

Biology
The spermogonial and aecial stages develop on *Pinus* species. Uredinial and basidial stages develop on *Populus tremula* and other *Populus* species. In June, aeciospores disperse and infect leaves of *Populus* species. In summer, uredinia with urediniospores develop and spores are dispersed by wind to reinfect poplar; this continues until August. In late summer (August to early September), telia form in place of uredinia. Telia are brown or black and crust-like. Teliospores are brown, irregularly prismatical, 20-35 x 7-11 µ. Teliospores overwinter in fallen leaves. In spring, they produce basidia with basidiospores, which forms a golden layer on fallen poplar leaves. Basidiospores disperse in May and infect pine. Wet and warm springs favor the maturity and dispersion of basidiospores, and the infection of pine. The degree of injury also depends on growing conditions and seed origin (provenance). Optimal growing conditions increase pine resistance. The disease can be severe where *P.tremula* and *P.alba* grow near pine seedlings or plantations.

Figure 62.—Current-year shoots of pine (*Pinus sylvestris*) infected with *Melampsora pinitorqua.*

Damage
Damages pine seedlings and plantations less than 20 years old but rarely affects pine understory. Infected seedlings weaken and some die. Young seedlings (1-2 years old) are deformed by the bending or dieback of the terminal shoot. Heavy infection reduces the number of standard seedlings for planting by 40 percent. Infection of older seedlings distorts current-year shoots, including the main terminal (**Fig. 63**). Lateral shoots replace the leader and the main stem is deformed. Dieback of infected branches does not occur even with heavy infection. However, infection significantly reduces height growth. Upper crown injury in seed plantations reduces seed production.

Distribution
European part of Russia, Urals, Siberia, Far East

Control
Observation
- Survey pine nurseries and plantations in May-June for the presence of aecia on shoots and needles.

Cultural
- Locate new pine nurseries at least 250 m from *P. tremula* and *P. alba* plantations.
- Gather and burn fallen poplar leaves.
- Eliminate poplar sprouting near pine nurseries and plantations less than 10 years old.

Chemical
- Apply Bordeaux mixture (1%), Zineb (1%), or poliram combi 3 times beginning in mid-May, followed by 2 additional applications 6-7 days apart.

Chrysomyxa Rust of Spruce Shoots and Needles

Class/Order: Basidiomycetes/Uredinales

Pathogen
Chrysomyxa woroninii Tranz.

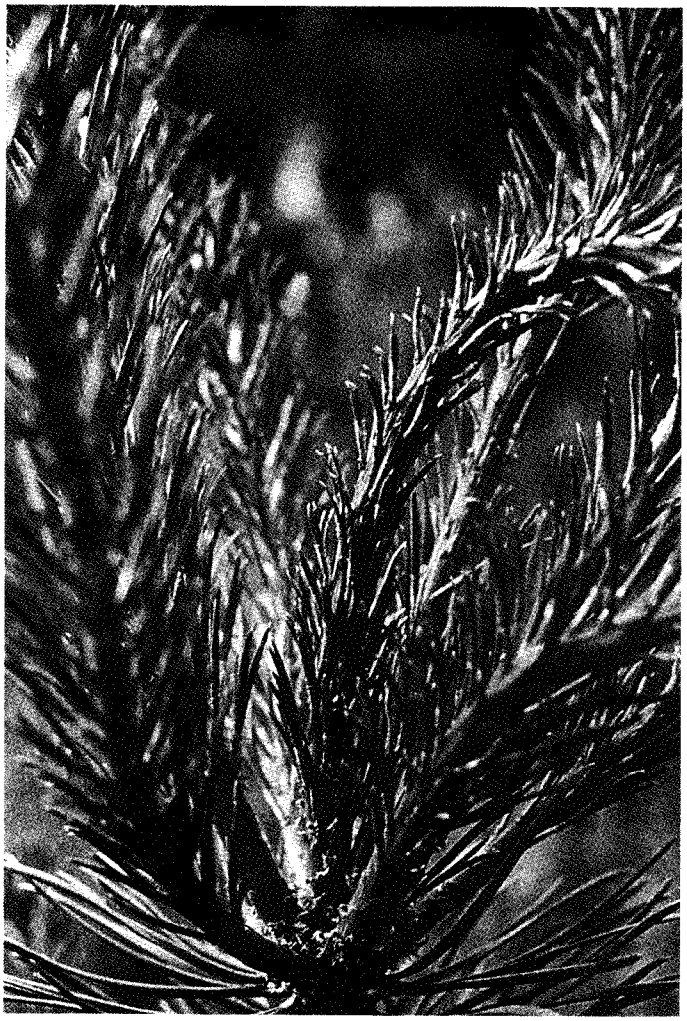

Figure 63.—Distortion of a current-year pine shoot (*Pinus sylvestris*) caused by *Melampsora pinitorqua*.

Hosts
Species of spruce (*Picea*) and *Ledum*

Diagnosis
Aecia form on current-year needles in spring, are elongate, sometimes the entire needle length, about 0.5 mm wide. Aeciospores are elliptical, 27-52 x 19-32 μ. Infected needles are short, covered by aecia, and resemble bright-yellow or orange brushes (**Fig. 64**) within an otherwise green crown. The telia stage of the pathogen develops on *Ledum* species and causes the formation of witches'-brooms.

Biology
This pathogen is heteroecious but not macrocyclic. Spermagonial and aecial stages develop on spruce. The telial stage develops on *Ledum* species. The fungus overwinters on *Ledum* as teliospores. In spring, basidiospores infect opening buds and expanding spruce needles; spermogonia and aecia form on them. Maturing aeciospores are windblown and infect the alternate host *Ledum*. Infection can be severe in good growing conditions as well as during wet springs and dry summers.

Damage
Affects seedlings in the understory, rarely occurring in overstory crowns. Causes dieback of shoots, malformed trees, and reduced vitality and height growth. Damage can occur on up to 40 percent of the shoots on 35-40 percent of the trees.

Distribution
Kolsky Peninsula, Karelia, and Lake Baikal, Siberia, Far East

Figure 64.—Current year shoot of spruce (*Picea abies*) infected by *Chrysomyxa woroninii.*

Control
Cultural
- Remove diseased plants in nurseries.

Diseases of Forest Stands

Dieback and Canker Diseases

Black Cytospora Canker of Poplar

Class/Order: Deuteromycetes, Sphaeropsidales

Pathogen
Cytospora foetida Vl. et Rr.

Hosts
Species of poplar (*Populus*), including white (*P. alba*), Carolina (*P. canadensis)*, black (*P. nigra*), and Bolle's (*P. bolleana)*

Diagnosis
The fungus affects interior bark and outer sapwood. Both are colonized by mycelium and turn dark-brown. The exterior color of bark may not change. Diatrypoid stromata form inside bark and extend along trunks and branches. Stromata can be several cm to 1.5 m long. In the final stage of disease

development, stromata can encircle stems and branches. The stroma is dark-brown, almost black, powdery, 1-4 cm thick. Multichamber pycnidia, 1-4 mm in diameter, form beneath the periderm on infected stems and branches with smooth bark. Pycnidia chambers are irregularly spherical or oval, 100-300 μ in diameter, in one or more layers. A solid layer of conidiophores forms on the chamber wall. Each conidiophore is nearly colorless, but in mass conidiophores are light-orange; they measure 24-29 x 0.5-1 μ. Conidia are colorless, alantoid, 5-7 x 1.5-2 μ. They exude from pycnidia as blood-red drops and ribbons. A characteristic symptom of the disease is the fishy odor of infected bark. Some infected trees die annually branch by branch while others die rapidly. The crown is sparsely foliated with small leaves that suddenly turn chlorotic and drop. Severely affected trees may not produce foliage in spring, or foliage withers 1-2 weeks after expansion.

Biology
The fungus sporulates in late May to early June and again in late August through September. Infection occurs at the same times in moist conditions. Spores are spread by rain, insects, on plant material, rarely by air. In stool-bed plantations, infection occurs on trees left after shoot cutting. In tree plantations and natural stands, infection occurs through mechanical and insect injury, cracks on the base of branches, and severely weakened branches. After penetration, the pathogen secrets toxins, kills inner bark and sapwood tissues, forms cankers, and causes dieback. External symptoms can be absent in the first year after infection. The sexual stage of the fungus, (*Valsa* sp.), rarely develops.

Damage
Trees of a range of ages are affected, but most damage occurs in poplar stands that are 21-60 years old. The fungus forms distinct cankers, causing dieback. In young stands, sprouts form in response to dieback but also can dieback over a 2- to 4-year period. In older stands, dieback occurs gradually, causing partial loss of upper crown and epicormic sprouting. Damage is severe in stands affected by unfavorable environmental factors, e.g., drought, winter damage, nutrient imbalances, and insect injury.

Distribution
Southeastern area of European part of Russia

Control
Observation
- Survey poplar plantations in spring after full leaf expansion and again in late summer and early autumn.

Cultural
- Establish plantations in areas with appropriate soil and climate conditions for vigorous growth of poplar.
- Use healthy, canker-free plant material to establish nursery beds and plantations.
- Minimize mechanical injury during nursery and plantation maintenance.
- Conduct shoot cutting for vegetative propagation in early spring before sap ascent.
- Use resistant poplar clones to establish nursery beds and plantations.

Chemical
- Use fungicides (ENT987, DITHANE Z-78) to treat cuttings before planting.
- Spray copper fungicide in late summer to prevent autumn infection.

Biatorella Canker

Class/Order: Ascomycetes, Lecanorales

Pathogen
Biatorella difformis (Fries.) Rehm. (anamorph: *Biatoridina pinastri* Golov. et Stzedr.)

Host
Scots pine (*Pinus sylvestris)*

Diagnosis
Cankers form on branches and stems and often occur at the juncture of the main stem and limb (**Fig. 65**). Twenty or more cankers can occur on a single understory tree. Young cankers are orbicular or oval and encircled by pitch-covered callus. Old cankers are open, deep, with sharp edges and covered

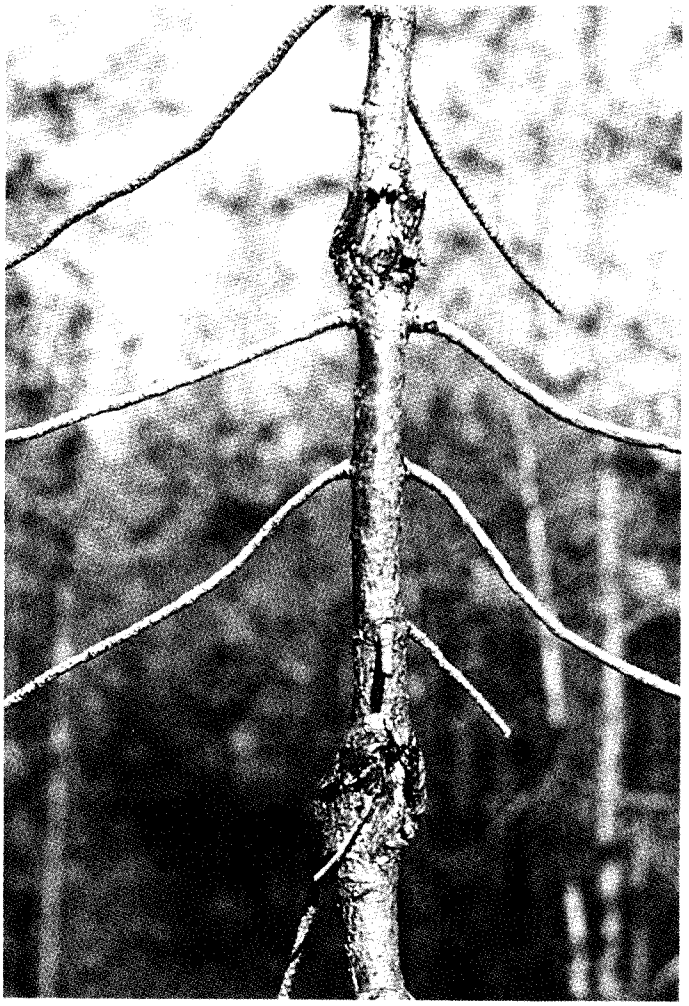

Figure 65.—Young pine tree (*Pinus sylvestris*) affected by the fungus *Biatorella difformis*. Note the "target" canker on the trunk.

with pitch. Cankers form yearly concentric rings of dead wood. In mature and overmature forests, cankers develop for several decades. The surface of old cankers, often black, is caused by the nonparasitic fungus *Auerobasidium pullulans* (de Bary) G.Arnaud. The imperfect stage of the canker fungus forms on the surface of wood and appears as a circle of black pycnidia, about 2.5-3 mm, resting on a brown matrix of mycelium. Bottle-like conidiophores about 6 to 8 μ long form in the pycnidia. Conidia are oval, colorless or light-olive but dark-olive in mass, 1.8-3 μ. Conidia are extruded as a dark, slimy mass. Black, waxy apothecia form very rarely. They are 500-800 μ in diameter and form in the same brown matrix as pycnidia.

Biology

Infection and spread from tree to tree occurs by conidia produced in early summer. A second sporulation occurs in autumn when temperatures are lower; most infections occur at this time. Conidia penetrate tree tissues through natural openings but primarily through mechanical injuries, including borer damage. Insects that are important in development of this disease are *Eveteria resinella* L., *Hylobius abictis* L., and species of *Pissodes*. Mycelium spreads from damaged to living tree tissue, affecting the phloem, cambium, and eventually sapwood, where mycelium spreads up and around the stem at a rate of 1-2 cm per year. The disease mostly affects weak and suppressed trees growing off-site. High moisture and low light are predisposing factors in the understory, where infected trees range from 20-80 percent. In plantations growing in full sunlight, infection is 2 percent.

Damage

Trees that are 10-80 years old are damaged. Understory trees and forest plantations are affected more than natural mature forests. Infection reduces radial growth in both understory trees and forest plantations. Severe infection on understory trees increases branch breakage by snow, but few trees

are killed. Mature trees in natural forests are rarely damaged but cankers on the stem base will reduce the volume of commercial wood. The disease is most severe on trees growing off-site.

Distribution
European part of Russia, East and West Siberia

Control
- Conduct improvement and sanitation cuts.
- Remove and destroy severely damaged trees.
- Control insects that promote infection by the canker fungus.

Pitch Blister Rust Canker

Class/Order: Basidiomycetes, Uredinales

Pathogen
Cronartium flaccidum Wint. and *Peridermium pini* (Willd.) Let. et Kleb.

Hosts
Species of pines (*Pinus*), including Scots (*P. sylvestris*), Swiss mountain (*P. montana*), and Austrian (*P. nigra*)

Diagnosis
Both pathogens cause the same symptoms. Cankers form on stems and develop over years to decades, and can occur along the entire length of the stem **(Fig. 66).** Bark on infected areas sloughs and resin flows out from infected tissues and congeals as gray-yellow spots. Cankers can be 2.5 m long. Affected stems are deformed by eccentric growth near the cankers. Aecia are produced on young cankers on stems and branches. They erupt through the bark as orange blisters, 3-7 mm high and 3-4 mm wide, and release aeciospores. Yellowish, highly visible cracks in the bark remain after spore release on branches and stems with thin smooth bark **(Fig. 67)**.

Biology
The fungus *C. flaccidum* is heteroecious and macrocyclic. Aecia with aeciospores form in June on stems and branches of pine. Aeciospores infect leaves of herbaceous plants such as *Vincetoxicum officinale* (syn. *Cynanchum vincetoxicum*), *Pedicularis palustris, Impatiens* species, and *Verbena* species. Uredinia and telia develop on these plants. Telia form in autumn and are columnar, 1-2 mm high. Vertical chains of teliospores form; they are elleptical, yellow-brown, 25-60 x 9-16 µ. Teliospores overwinter, germinate in spring, and produce basidia with basidiospores that infect pine.

The fungus *P. pini* develops only on pine in the aecial stage. Mature aeciospores reinfect the pine. Infection occurs through young succulent shoots. The mycelium penetrates and destroys wood cells and resin ducts. Two to three years after infection, cambium cells are killed and wood production ceases. About the same time, aecia form on the cankers. Affected young shoots usually die along with pathogen mycelium in 1-2 years. If the mycelium penetrates the stem before the branch dies, it develops a perennial canker. Disease development is favored by wet conditions; pure pine forests are damaged more than mixed stands. Both pathogens are enhanced by sunlight and most injury occurs on trees in partially stocked stands and those at the forest edge, along roads, and clear areas.

Damage
Damages young understory, plantation, and mature trees. Affected understory plantation trees are weakened and can wither in a short time. Also weakens mature trees and reduces terminal growth, causing partial and later total crown dieback. Cankers deform the stem and reduces the volume of commercial wood. Affected trees often are attacked by bark beetles, e.g., *Ips acuminatus, Tomicus piniperda, T. minor, Pityogenes quadridens*, and *P. irkutensis*. Beetle attack accelerates dieback and mortality.

Distribution
European part of Russia, Urals, Siberia

Control
Observation
- Survey for the disease in May-June during aecial development.

Figure 66.—Pitch blister rust of pine (*Pinus sylvestris*) caused by *Cronartium flaccidum* and *Peridermium pini*. The affected pine has a canker on upper portion of the trunk.

- Determine tree condition and canker distribution (location) on the stem, e.g., low, middle, or upper portion of crown.
- Determine the degree of canker development around the stem circumference: less than 1/2, more than 1/2 but less than 3/4, more than 3/4 to complete.
- Record species and abundance of bark beetles on affected trees.

Cultural
- Conduct a 2-stage sanitation cutting at intervals of 3-5 years. Remove heavily weakened, suppressed, and dead trees with below-crown cankers and evidence of attack by bark beetles; cut stag-headed trees in the second stage.
- Create mixed-pine stands and forest plantations with high initial planting density.

Endoxylina Canker of Ash

Class/Order: Ascomycetes, Diaporthales

Pathogen
Endoxylina stellulata Rom. (syn. *Valsaria stellulata* Rom.) (anamorph: *Libertella fraxini* Ogan.)

Host
European ash (*Fraxinus excelsior* L.)

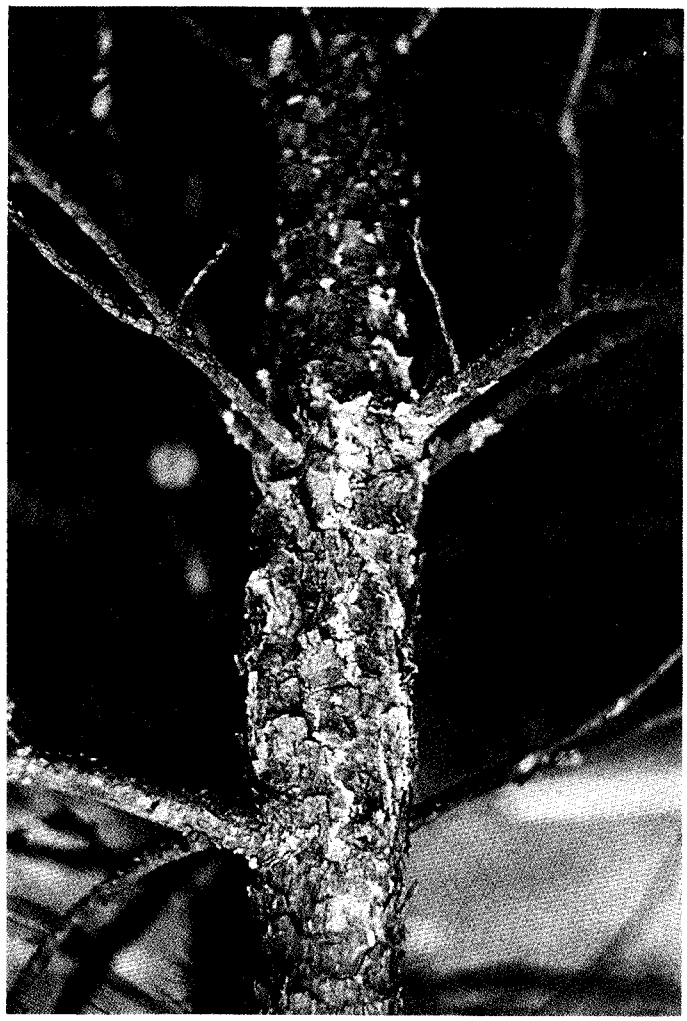

Figure 67.—Aecia of *Peridermium pini* breaking through the bark surface on the stem of a young pine (*Pinus sylvestris*) tree.

Diagnosis

Usually 1-2 perennial cankers form on the stem, primarily below the crown. They are elongate-oval, target-like, with clear annual concentric ridges of wood, up to 0.7 m long. Dark, almost black stromata develop under dead bark. The wood of the canker is exposed annually after dead bark and stromata slough. Injured wood in the canker is characteristically dark because of the remains of stromata. The surface of canker wood is covered by numerous, thin, transverse splits. Perithecia are buried in the stroma but necks form a solid layer of black, dotted hillocks. Perithecia are black, bottle-shaped, single, with a thickened pore on top, 375-800 x 150-360 µ. Asci are clavate, on long stalks, 135-150 x 10-12 µ. Ascospores are 2-celled, olive-brown, allantoid, 14-20 x 4-6 µ. The characteristic symptom of the disease is the marbled or yellow appearance of decayed heartwood and sapwood. It spreads upward and downward from the initial canker.

Biology

Infection occurs through cracks on dry, low branches on the lower portion of the trunk. Mycelium develops in bark, cambium, and heartwood over several years. In the second year after wood tissues die, perithecia form. Mycelium grows into the base of the stem; multiple stems can be infected. The disease usually persists for 7-17 years, but it can develop quickly and kills trees in 5-7 years. More weakened than healthy trees are affected. Most canker damage occurs in understocked stands, on dry slopes, where soils are high in alkalinity.

Damage

Cankers form on the stem below the crown and are relatively fast growing. The result is weakening and gradual dieback and decline of the tree. The pathogen often penetrates tissues at the base of the

stem, causing dieback of sprouts. Sapwood and heartwood decay reduces resistance to wind, promoting breakage. Coppice stands are less resistant to the disease; damage in these stands ranges from 40-60 percent.

Distribution
Steppe zone of southeastern area of European part of Russia.

Control
Cultural
- Conduct sanitation cuttings to remove dying and dead trees within disease centers.
- Remove or uproot stumps after sanitation cutting to prevent sprout infection.

Cankers and Diebacks

Class/Order: Deuteromycetes/Sphaeropsidales

Pathogen
Camarosporium ribicolum Sacc.

Host
Golden currant *(Ribes aureum)*

Diagnosis
Necrotic lesions develop on the bark. Pycnidia are dispersed or coalesced in groups in necrotic areas. They are black, spherical, similar to stromata. Conidia are oblong-globose or egg-shaped, brown, with 3-4 transverse and 1-2 longitudinal walls, 12-16 x 6-8 µ.

Distribution
European part of Russia

♦♦♦

Pathogen
Coniothyrium inisitivum Sacc.

Hosts
Bird cherry (*Padus avium),* barberry *(Berberis vulgaris),* and lilac *(Syringa vulgaris)*

Diagnosis
Dark, necrotic lesions form on the bark. Pycnidia develop in the necrotic areas in clusters. They are black and spherical. Initially, they are buried in leaf tissue but later erupt and release conidia. Conidia are elongate-egg-shaped, 1-celled, brown, 4.5 x 2.5 x 4 µ.

Distribution
European part of Russia

♦♦♦

Pathogen
Cytospora tumida Lib.

Host
Pedunculate oak *(Quercus robur)*

Diagnosis
Necrotic lesions form on the bark; later, black stromata develop that are cushion-like, black, round or angular. Initially, they are buried in leaf tissue but later erupt. Conidia are alantoid, colorless, 6 x 1.5 µ.

Distribution
European part of Russia

♦♦♦

Pathogen
Diplodia amphisphaerioides Pass.

Host
Pedunculate oak *(Quercus robur)*

Diagnosis
Black, sphaerical or flat-spherical pycnidia form on the bark of dead, dry branches. Initially, they are buried in tissue but later erupt. Conidia are ellipsoidal, brown, 2-celled, 17.5 x 7.5 µ.

Distribution
European part of Russia

♦♦♦

Pathogen
Microdiplodia ascochytula (Sacc.) Allesch. (syn. *Diplodia ascochytula* Sacc.)

Hosts
Species of honeysuckle *(Lonicera)*

Diagnosis
Brown necrotic lesions form on dead areas of bark. Brown pycnidia in groups form on the dead bark and are initially buried in tissue but later erupt. Conidia are spindle-like with blunt ends, 2-celled, olive-brown, 8-12 x 2.5-3 µ.

Distribution
European part of Russia

♦♦♦

Pathogen
Diplodia juniperi Westend.

Host
Red cedar *(Juniperus virginiana)*

Diagnosis
Bark on branches dies. Black, spherical, single, scattered pycnidia form in the cracks of dead bark. Conidia are oblong-egg-shaped, 2-celled, brown or dark-brown, 18-20 x 8-10 µ.

Distribution
Southwestern areas of European part of Russia

♦♦♦

Pathogen
Diplodina tatarica Allesch.

Host
Honeysuckle (*Lonicera tatarica)*

Diagnosis
Bark dies on affected branches. Numerous, black, spherically-flat, dispersed pycnidia form in bark cracks. Conidia are spindle-like, 2-celled, with a small septum, colorless, 8-12 x 2.5-3 µ.

Distribution
European part of Russia

♦♦♦

Pathogen
Dothiorella robiniae Prill. et Delacr.

Host
Black locust *(Robinia pseudoacacia)*

Diagnosis
Black, erumpent stromata form in the bark of dead, dry branches. Pycnidia, oblong or irregularly shaped, develop in the stroma. Conidia are egg-shaped or elliptical, 1-celled, colorless, with 2-3 oil drops, 10.5-12 x 3.5-4 μ.

Distribution
European part of Russia

♦♦♦

Pathogen
Fucicoccum obtusulum Grove

Hosts
Species of maple (*Acer*)

Diagnosis
Stromata form within the bark of dead branches. They are dark-gray, with yellow centers, flat-conical, dispersed. Conidia are spindle-like with blunt ends, straight, 1-celled, colorless, 12-14 x 2-2.5 μ.

Distribution
European part of Russia

♦♦♦

Pathogen
Hendersonia pseudoacaciae Ell. et Barth.

Host
Black locust *(Robinia pseudoacacia)*

Diagnosis
Black, dispersed pycnidia form in the bark of dead branches. Conidia are oblong-oval, 4- to 8-celled, brown, 15-24 x 6-10 μ.

Distribution
European part of Russia

♦♦♦

Pathogen
Phoma aceris-negundinis Arcang.

Host
Species of maple (*Acer*)

Diagnosis
The affected bark surface is rough and light-yellow. Pycnidia form under the epidermis; they are slightly raised, black, and spherical. Conidia are oval, colorless, with 2 drops of oil, 8-3 μ.

Distribution
European part of Russia

♦♦♦

Pathogen
Rhabdospora passerinii Sacc.

Hosts
Species of maple (*Acer*), primarily boxelder *(A. negunda).*

Diagnosis
Affected branches and sprouts dieback. Brown-black pycnidia form in the cracks in dead bark in longitudinal lines. Conidia are cylindrical, straight, slightly narrowed on the ends, 4-celled, 30-32 x 2.5 μ.

Distribution
European part of Russia

Class/Order: Ascomycetes/Helotiales

Pathogen
Lachnellula angustispora Raitv.

Hosts
Species of fir *(Abies)* and larch (*Larix*)

Diagnosis
Apothecia form on the bark of dead branches. They have a short stalk, white outside surface, bright-orange center, 0.3-3 mm in diameter. Asci are clavate, 101-106 x 9.7-10.2 µ. Ascospores are ellipsoid to spindle-shaped, asymmetrical, colorless, 1-celled, 12.8-14.2 x 5-5.2 µ.

Distribution
Middle Urals, Siberia

♦♦♦

Pathogen
Lachnellula flavovirens (Bres.) Dennis

Hosts
Species of spruce *(Picea)*, fir *(Abies)*, and larch (*Larix*)

Diagnosis
Apothecia form on the bark of dead branches. They have a short stalk, brown, hairy outside surface, bright-orange center, 1-3 mm in diameter. Asci are clavate, 55-65 x 6.2-6.6 µ. Ascospores are ellipsoid to spindle-shaped, asymmetrical, colorless, 1-celled, 7-7.5 x 3.5-3.8 µ.

Distribution
Urals, Siberia, Far East

♦♦♦

Pathogen
Lachnellula fuckelii (Bres. in Rehm.) Dharne.

Hosts
Species of spruce *(Picea)* and pine (*Pinus*)

Diagnosis
Apothecia form on the bark of dead branches. They have a short stalk, snowy-white outside surface, bright-orange center, 0.3 to 3 mm in diameter. Asci are clavate, 113-118 x 9.3-10.5 µ. Ascospores are ellipsoid to spindle-shaped, asymmetrical, 1-celled, colorless, 12.8-13.2 x 6-6.4 µ.

Distribution
Middle Urals, Far East

♦♦♦

Pathogen
Lachnellula kamtschatica Raitv.

Hosts
Mountain pine *(Pinus pumila)*

Diagnosis
Apothecia form on the bark of dead branches. They have a short stalk, snowy-white outside surface, and a bright-orange center. Ascospores are widely ellipsoid, 1-celled, colorless, 6-7 x 4-5 µ.

Distribution
Far East

♦♦♦

Pathogen
Lachnellula minuscula Raitv.

Host
Species of fir (*Abies*)

Diagnosis
Apothecia on short stalks form on the bark of dead branches. The outside surface is covered with hairs; the inside disk is bright-orange, 1-2 mm in diameter. Asci are clavate, 44-56 x 4.4-5 μ. Ascospores are ellipsoid to spindle-shaped, 1-celled, colorless, 5.1-5.7 x 1.8-2.3 μ.

Distribution
Siberia, Far East

♦♦♦

Pathogen
Lachnellula pseudofarinacea (Cronan.) Dennis

Host
Species of pine (*Pinus*)

Diagnosis
Apothecia form on the bark of dead branches. The outside surface is covered with snowy-white, dense hairs; the inside disk is bright-orange, 1-1.5 mm in diameter. Asci are clavate, 100-115 x 9-10.5 mm. Ascospores are thread-like, without a septum, colorless, 73-97 x 1.5-2 μ.

Distribution
Northern area of European part of Russia, Siberia

Class/Order: Deuteromycetes/Melanconiales

Pathogen
Didymosporium profusum Fr.

Host
Species of maple *(Acer)*

Diagnosis
Cushion-like, conical structures form in cracks on dead bark. Conidia are oblong or egg-shaped, 2-celled, a smoky color, 10-12 x 8-9 μ.

♦♦♦

Pathogen
Melanconium desmazierii (Berk. et Br.) Sacc.

Hosts
Species of lime (*Tilia*)

Diagnosis
Black, depressed, cushion-like stromata, slightly erumpent, form under the epidermis of dead branches and stems. Conidia are short, spindle-like, with blunt ends, smoky-blue, 1-celled, with 2 oil drops, 30-35 x 6-10 μ.

Distribution
European part of Russia

♦♦♦

Pathogen
Melanconium czerniaiewi Poteb.

Hosts
Species of oak (*Quercus*)

Diagnosis
Bark dies on young branches. Black, conical stromata, 1-2 mm in diameter, form under the bark. Conidia are oval, ellipsoid or pear-like, dark-brown, 1-celled, 18-24 x 11-14 µ.

Distribution
Southwestern area of European part of Russia

♦♦♦

Pathogen
Septogloeum hartigianum Sacc.

Hosts
Species of maple (*Acer*)

Diagnosis
Affected branches and sprouts dieback and turn brown. Sporodochia form in longitudinal bark cracks. They are cushion-like, oblong, brown, 1-3 mm in diameter. Conidia are oblong-oval, 3-celled, colorless, 4-15 x 2-4 µ.

Distribution
European part of Russia

♦♦♦

Pathogen
Septomyxa negundinis Allesch.

Hosts
Species of maple (*Acer*)

Diagnosis
White-yellow or gray necrotic lesions with dark borders form on affected branches. Numerous, aggregated sporodochia form on dead bark. Initially, they are buried in tissue but later erupt. They are cushion-like, red- or dark-brown. Conidia are fusiform, pointed, rarely oval, initially 1-celled, and later 2-celled, colorless, 10-20 x 3-4.5 µ.

Distribution
European part of Russia

♦♦♦

Pathogen
Stilbospora angustata Pers. (teliomorph: *Pseudovalsa berkeleyi* Sacc.)

Hosts
Species of hornbeam *(Carpinus)* and beech *(Fagus)*

Diagnosis
Black, cushion-like, convex, often coalesced sporodochia form under the epidermis of affected bark. Conidia are cylindrical, elongate, 4-celled, olive, often with a sticky jelly cover, 35-50 x 10-14 µ.

Distribution
European part of Russia

Class/Order: Ascomycetes/Sphaeriales

Pathogen
Leucostoma diatrype Fr.

Hosts
Species of alder (*Alnus*)

Diagnosis
Black, conical, dispersed stromata with white or gray-white disks form in the bark of dying and dead branches. Each stroma contains 3-7 perithecia. Asci are clavate, 80-100 x 8-16 µ. Ascospores are cylindrical, colorless, 16-18 x 3-6 µ.

Distribution
European part of Russia

♦♦♦

Pathogen
Nitschkia cupularis (Pers.) Winter (anamorph: *Phoma fuckeli* Sacc.)

Hosts
Species of elm (*Ulmus*)

Diagnosis
Affected branches, especially sprouts, die. Perithecia form in clusters in dead bark. They are black, round but more often elongate, 0.5-3 mm in diameter, and resemble small hillocks erupting the epidermis. Asci are elongate, clavate, 40-60 x 7-8 µ. Ascospores are short, cylindrical, slightly curved, colorless, with oil drops, 9-10 x 2-3 µ.

Distribution
European part of Russia

♦♦♦

Pathogen
Nummularia succenturiata (Tode) Nitschke

Hosts
Species of elm *(Ulmus)*

Diagnosis
Affected trees die. Stromata form within dead bark as black, flat disks, 3-5 mm in diameter. Perithecia form on the surface of the stromata. Asci are elongate, clavate, 120-150 x 9 µ. Ascospores are ovoid or fusiform, straight or slightly curved, brown, 16-18 x 5-7 µ.

Distribution
European part of Russia

Class/Order: Ascomycetes/Dothideales

Pathogen
Cucurbitaria rhamni (Nees.) Fckl. (anamorph: *Diplodia rhamni* Gaap.

Host
Species of buckthorn *(Frangula alnus, Rhamnus cathartica)*

Diagnosis
Initially, pycnidia form on dead branches. They are single or clustered, black, and spherical. Initially, they are buried in bark tissue but later erupt. Black pseudothecia form in bark cracks. They are spherical, cup-like, concave, black, often in long rows. Conidia are oblong, egg-shaped, dark-brown, 2-celled, 20-25 x 7.5-10 µ. Asci are clavate, elongate, 120-140 x 12 µ. Ascospores are oblong-elliptical, yellow-brown, with 3-6 transverse walls and 1 incomplete londitudinal septum, 16-21 x 7-8 µ.

Distribution
European part of Russia

Wood-Decaying Diseases

Class/Order: Basidiomycetes, Aphyllopherales

Ganoderma Butt Rot of Beech

Pathogen
Ganoderma pfeifferi Bres. (syn. *Polyporus laccatus* Kalchbr.)

Host
Oriental beech (*Fagus orientalis*)

Diagnosis
Basidiocarps are perennial, semicircular, hoof-shaped, 10-30 x 7-15 cm. The surface of the basidiocarp is covered with a resinous, initially orange-red then brown, varnish-like crust that blackens with age. They have a yellow-red, shiney margin. Interior tissues are corky and fibrous and rusty- or chestnut-brown. The hymenophore is tubular; pores are round, 150 m in diameter. Basidiospores are yellow-brown, egg-shaped, with a thorny spore wall, 9-12 x 6-8 µ. Hymenium surface is yellow or gray-yellow and covered by a resinous material. The decay affects both heartwood and sapwood; the wood is white and pale-yellow, fibrous.

Biology
Sporulation occurs from early summer to autumn. Infection occurs by basidiospores in wounds at the stem base or exposed roots. The fungus requires warm temperatures for development; optimal temperatures ranges from 22°-30°C. Basidiocarps are resistant to temperature fluctuation, enduring even severe temperature drops in winter. Mycelium and basidiocarp development requires high moisture conditions. Basidiocarps rapidly absorb and retain water, so saturation can occur after a short period of rain. Spores are airborne but also can be spread by insects, animals, and humans.

Damage
The butt log of beech decays, often resulting in wind breakage

Distribution
Northern Caucasus Mountains

Control
• Conduct sanitation cuttings; remove trees with sporophores.

Vuillemenia Decay

Pathogen
Vuillemenia comedens Maire.

Host
Primarily species of oak (*Quercus*) but also beech (*Fagus*), hornbeam (*Carpinus*), buckeye (*Aesculus*), birch (*Betula*), and hazel (*Corylus*) species

Diagnosis
Basidiocarps arise under the epidermis of the stem or lower surface of branches. The bark splits open and basidiocarps emerge. They resemble pellicles, covering the entire length of the branch. Pellicles are 1-1.6 mm thick and closely attached to the substrate. The hymenial layer is smooth and waxy but cracks in dry weather. Hymenial layer ranges from white to light-brown. This layer produces clavate basidia, 80-100 x 3 µ. Basidiospores are cylindrical, with round ends, colorless, 12-24 x 5-9 µ. The fungus causes a white, peripheral decay.

Biology
Sporulation intensity depends on weather conditions; it ceases in dry weather and returns after rain. As a result, there are several periods of mass spore formation and dissemination during a year. Branch infection occurs by basidiospores through wounds, including insect injury **(Fig. 68).** Mycelium develops in the sapwood of stems and branches, causing rapid dieback of young trees.

Damage
Causes dieback in oak plantations less than 25 years old that are growing off-site. In young oak plantations, damage ranges from 10-70 percent.

Figure 68.—Infection of a branch stub by *Vuilleminia comedens* on a young white oak (*Quercus robur*).

Distribution
European part of Russia, southern Urals

Control
Observation
• Survey stands shortly after foliage emergence; affected dead stems and branches are prominent at this time.

Cultural
• Remove infected trees from plantations.

Trunk and Limb Rots

Pathogen
Hericium cirrhatum (Fr.) Nicol.

Hosts
Species of maple (*Acer*), birch (*Betula*) and lime (*Tilia*)

Diagnosis
Basidiocarps are annual, almost semicircular, one above another in clusters, joined at the base. They are initially white, turn yellow, and later are leathery-yellow or dirty-orange. The margin is blunt or thin, sharp, and wavy. The hymenophore is thorny **(Fig. 69);** each thorn is sharp, up to 10 mm long, white when fresh and dirty-yellow after drying. Interior tissue is thick, up to 3 cm, soft and then soft corky. Spores are widely ellipsoid or nearly globose, with 1 large drop of oil, 3.5-4 x 3-3.5 μ. Decay is white, laminately fibrous, and develops in sapwood and heartwood.

Distribution
European part of Russia, Urals, Far East

Figure 69.—Basidiocarp of *Hericium cirrhatum* on a broken limb of a fir (*Abies sibirica*).

Pathogen
Inonotus polymorphus (Rostk.) Bond. et Sing.

Hosts
Species of beech (*Fagus*) and hornbeam (*Carpinus*)

Diagnosis
Basidiocarps form on dead branches, are annual, small, tightly grown, rounded, later coalesced and elongate, about 50 x 6-10 x 1-1.5 cm. The margin is wide, sterile, and disappears with time. The hymenophore is tubular. The tubes are sloped, about 3-4 mm long, brown or yellow-brown, angular. Spores are ellipsoid, initially yellow, later brown, with thick covers, 4-6.5 x 3-5 μ. Decay is white and fibrous, and develops in sapwood and heartwood.

Distribution
Southern area of European part of Russia

♦ ♦ ♦

Pathogen
Phellinus baumii Pil.

Hosts
Amur honeysuckle *(Lonicera maakii),* coralline honeysuckle *(L. chrysantha),* amur lilac *(Syringa amurensis),* and cranberry tree *(Viburnum opulus)*

Diagnosis
Basidiocarps form on the trunks of living and dead trees and stumps, are perennial, semicircular or hoof-like, 1.5-8 x 3-13.5 x 1-5.3 cm. The upper surface of young conks are swollen and furrowed, brown with an orange margin, covered with short bristles. The upper surface of old basidiocarps is dark-brown, almost black, roughened by tile-shaped cracks. The margin is sharp, rarely blunt. The interior tissue is radially fiberous, hard, golden-brown, with a silky shine, 0.2-1 cm thick. The hymenophore is tubular, with a smooth, chocolate-brown, lower surface. Tube length is 1-4 mm. Pores are circular or angular, inconspicuous. Spores are widely ellipsoid to nearly globose, with thin coverings, colorless, 3.7-4.6 x 3.5-3.7 μ. Decay is white, laminately fibrous, and develops in sapwood and heartwood.

Distribution
Far East

♦♦♦

Pathogen
Phellinus microporus (Pil.) Parm.

Hosts
Species of fir (*Abies*), spruce (*Picea*), and pine (*Pinus*)

Diagnosis
Basidiocarps form on the trunks of living and dead trees and roots of windthrown trees, are perennial, attached to the substrate at one point or by the entire base, 2-5.5 x 1.5-4 x 0.2-0.6 cm. The upper surface is brown-yellow, chestnut-brown or black, bristly or velvety, with narrow furrows. The margin is straight, thin, and sharp. Interior tissue is thin, 1-2 mm thick, corky to woody, and brown. Tubes of the hymenophore are stratiform, 2-5 mm long, lighter in color than the trama. The lower surface of the hymenophore is brown. Pores are circularly-angular. Spores are widely ellipsoid, slightly ovoid, with thin covers, colorless but turn yellow with age, 4.5-5.1 x 3.5-4 µ. Decay is brown with white spots, pocket-fibrous, and develops in sapwood and heartwood.

Distribution
East Siberia, Far East

♦♦♦

Pathogen
Piptoporus quercinus (Schrad. ex Fr.) Pil.

Hosts
Species of oak (*Quercus*)

Diagnosis
Basidiocarps form on the trunks of living and dead trees, are annual and are elongate, fan- or tongue-shaped conks, 4-9 x 6-11 x 1.5-3 cm, with a thickened base on stalks. The upper surface is initially velvety, later rough, initially pale-yellow, later light-chestnut to chestnut-brown. The margin is blunt. The interior tissue is 2-3 cm thick. The young trama initially is soft and wet, then soft-corky, white and pale-cream after drying. The hymenophore is tubular. Tubes are 2-3 mm long, with rounded or angular pores, 0.3-0.5 mm in diameter. The lower surface of the hymenophore shrinks after drying, and the margins turn white to yellowish with age. Spores are fusiform or ovoid, with sharp ends and several oil drops, colorless, 6.5-9 x 3-3.5 µ. Red-brown decay develops in the heartwood, cracks into prismatic chunks, and later crumbles to dust.

Distribution
European part of Russia

♦♦♦

Pathogen
Spongipellis litschaueri Lohw.

Hosts
Species of oak (*Quercus*), elm (*Ulmus*), maple (*Acer*), poplar (*Populus*), lime (*Tilia*), and pine (*Pinus*)

Diagnosis
Basidiocarps form on the trunks of living and dead trees, are primarily annual but sometimes 2-5 years old, flat, hoof- shaped, 3-12 x 4-20 x 2-6 cm. They are initially soft, spongy, or fibrous but later become hard. The upper surface is nearly white, later yellow to brown, and becomes soft felty-bristly, bare or rough; the margin is sharp. The interior tissue is white, pale-brown after drying, radially fibrous. Hymenophore tubes are 1-2 cm long, initially white or creamy, later orange with fringy or tattered margins. Pores are irregular, rounded angular, 0.3-2 mm in diameter. The lower surface of the hymenophore is white to cream and turns brown after drying. Spores are widely ellipsoid, nearly globose, colorless, with 1 large oil drop, 5.5-7 x 4.5-6 µ. The decay is white and fibrous; initially, it develops in heartwood but later spreads to sapwood.