DESCRIPTION AND KEY OF BARLEY DISEASES IN NEW ZEALAND

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KEY

LEAF DISEASES

1. Small superficial lesions of white, grey or buff mycelium scattered over the surface of the leaf.
Powdery Mildew (*Erysiphe graminis* DC)
2. Numerous orange-yellow pustules occasionally in concentric rings. Associated with black pustules on the leaf sheath at maturity of the plant.
Leaf Rust (*Puccinia hordei* Otth.)
3. Water soaked areas soon becoming lens shaped in outline, greyish green with distinct brown margins. Old lesions assume a bleached straw colour while retaining the distinct brown margin.
Scald (*Rhynchosporium secalis* [Oudem] J. J. Davis)
4. Striping of the leaves and leaf sheaths. Initially yellow though soon turning brown.
Stripe (*Pyrenophora graminea* [Died] Ito. & Kurib.)
5. Lesions exhibiting characteristic network effect produced by numerous longitudinal, transverse, and oblique, dark brown lines.
Net Blotch (*Pyrenophora teres* [Died] Drechsler)

STEM DISEASES

A Leaf Sheath Infection

6. Small superficial lesions of powdery white mycelium later fusing and containing numerous black fruiting bodies (cleistocarps).
Powdery Mildew (*Erysiphe graminis* DC)
7. Scattered brown pustules turning black with maturation of the plant.
 - (i) Small (1 to 2 mm) circular orange-yellow pustules.
Leaf Rust (*Puccinia hordei* Otth.)
 - (ii) Elongated red-brown pustules, partially covered by epidermal flakes.
Stem Rust (*Puccinia graminis* Pers.)
8. Water soaked areas soon becoming lens shaped in outline greyish green with distinct brown margins. Old lesions assume a bleached straw colour while still retaining the distinct brown margin.
Scald (*Rhynchosporium secalis* [Oudem] J. J. Davis)

B Stem Base

9. Lens shaped areas of bleached tissue surrounded by darker margins. Often associated with grey mycelium in the internal cavity of the stem. Stem weakened and some lodging.
Eyespot (*Cercospora herpotrichoides* Fron)
10. General browning of the stem base.
 - (i) Rapid bleaching of the whole plant at maturation. Mat of coarse, dark brown mycelium around the stem base.
Take-all (*Gaeumannomyces graminis* [Sacc] v Arx & Olivier)
 - (ii) No coarse dark brown hyphae. Scattered small brown lesions on the roots, usually near the stem base. Pink spore masses sometimes present.
Fusarium Foot-Rot (*F. Avenaceum* [Fr.] Sacc.; *Fusarium culmorum* [W. E. Sm.] Sacc.; *F. graminearum* Schw.; *F. nivale* [Fr.] Ces.)

HEAD DISEASES

11. White heads
 - (i) Browning of stem base associated with dark brown mycelium.
Take-all (*Gaeumannomyces graminis*)
 - (ii) Browning of stem base. No dark brown mycelium.
Fusarium Foot-Rot (*Fusarium* spp.)
 - (iii) Associated with eyespot lesions at the base of the plant.
Eyespot (*Cercospora herpotrichoides*)
 - (iv) No discoloration of the stem base.
Severe drought
12. Black spore masses replacing the floral parts. Most conspicuous just before flowering.
 - (i) Spore masses retained inside an outer membrane. Awns usually remain attached and erect.
Covered Smut (*Ustilago hordei* [Pers.] Lagerh.)
 - (ii) Black powdery spore mass not retained within an outer membrane. Awns become lost or shaggy.
Loose Smut (*U. nuda* [Jens.] Rostr.)

COVERED SMUT

Ustilago hordei (Pers.) Lagerh.

Infected heads become obvious just prior to flowering, as all the floral parts of the infected head have been replaced by a powdery spore mass enclosed in a persistent membrane. Infection heads are initially greyish in colour later turning black. The awns tend to remain attached and erect. Covered smut spores are liberated during harvesting and contaminate the healthy grains. This disease has been of minor importance in New Zealand since the introduction of seed treatment.

Cereals

EYESPOT

Cercospora herpotrichoides Fron.

Although eyespot infection may take place at any stage during the growth of the plant, infection is not conspicuous till near the end of the growing season due to the lodging of the infected plants. Lodging of barley plants is, however, neither as widespread nor as devastating as it is in wheat.

Eyespot lesions are elliptical or oval with light-straw-coloured centres and light-brown margins. Similar spots occur on the culm beneath the lesion of the leaf sheath. A black "Pupil" can be formed by the mycelial mat in the necrotic area of the lesion. The main distinguishing feature between eyespot and sharp eyespot is the presence of grey mycelium in the central cavity of the barley straw below the well developed eyespot lesion.

FUSARIUM FOOT-ROT

Fusarium nivale (Fr.) Ces. (Perfect state *Micronectriella nivalis* [Shaffn.] Booth)

F. culmorum (W. E. Small) Sacc.

F. avenaceum (Fr.) Sacc. (Perfect state *Giberella avenancea* Cook.)

F. graminearum Schw. (perfect State *G. zeae* [Schw.] Petch.)

The four species of *Fusarium* are widespread in the soil, causing both pre- and post-emergent death of seedlings. Infection of seedlings results in brownish lesions at the base of the coleoptile or on the roots, usually in the vicinity of the crown. Symptoms on mature plants are a general browning of the stem base associated with stunting and white heads if the plants have been subject to severe water stress during the growing season.

FUSARIUM HEAD BLIGHT

Fusarium culmorum (W. E. Small) Sacc.

Infection becomes apparent when the plants are in "boot" and occurs on the flag leaf sheath, level with the base of the developing head. Small water soaked lesions soon enlarge and become blue-grey with a distinct darker margin. As infected areas expand the centre of the lesion may become bleached. Developing grain, if infected, turn brown then black. Characteristic of head blight infection is a web of cottony white or pink mycelium and small, pin head size, powdery pink spore masses.

BROWN RUST

Puccinia hordei Otth.

Brown rust can occur on the leaf blade and leaf sheath at any stage in the growth of the barley plant. Pustules of uredospores are small, 1 to 2 mm, round to slightly oblong and orange-brown. The ruptured epidermis is inconspicuous around the pustule. Covered black teliospores form adjacent to the uredospores especially on the leaf sheath.

LOOSE SMUT

Ustilago nuda (Jens.) Rostr.

Infected heads become obvious just prior to flowering as a black spore mass, enclosed in a fine membrane, replaces the floral bracts and developing grain. Unlike covered smut, this membrane soon ruptures. Spores are liberated to infect the healthy plants at flowering. Infections remain dormant in the embryo until the grain germinates.

NET BLOTCH

Pyrenophora teres (Died) Drechsler

Well developed lesions are easily recognised by the characteristic network effect produced by a number of very narrow dark-brown lines either running along or across the axis of the leaf. The area of the leaf immediately adjacent to the lesion usually becomes yellow, forming a narrow zone surrounding the blotch. Lesions may join together to form more or less parallel stripes on the leaf which are difficult to distinguish from leaf stripe.

POWDERY MILDEW

Erysiphe graminis DC

Mildew develops on the epidermis of the leaf blade, leaf sheath and floral bracts, and is conspicuous as scattered light-grey to brown superficial mycelium. This may coalesce, completely covering the leaf blade, accompanied by yellowing and a gradual dying of the leaf tissue. On the basal leaf sheaths the mycelium may coalesce and form numerous small black fruiting bodies (cleistothecia), especially as the barley plant begins to senesce.

The disease is most severe in both winter and spring sown crops when plants are grown in conditions which either favour the fungus, such as cool, humid and cloudy weather or when the plant is under stress such as drought. Yield reductions occur when infection is severe during early tillering, the period of stem extension and/or during grain development.

Infection mainly occurs from wind-blown conidia although some infection from ascospores during the autumn and spring is likely.

SCALD

Rhynchosporium secalis (Oudem) J. J. Davis

Scald has only been observed in epidemic proportions on autumn and winter sown feed crops. In spring sown crops it is of minor importance only. The lesions are conspicuous on the leaf blades and sheaths, initially as water-soaked areas, which soon become oval, or lens shaped, greyish-green, with distinct brown margin. Older lesions finally change to a bleached straw colour though still retaining their distinct brown margin.

Cereals

STEM RUST

Puccinia graminis Pers.

Stem rust is of minor importance on barley and occurs on the leaf sheath and culm, and to a lesser degree on the leaves and floral bracts. The uredia are reddish-brown in colour, usually oblong, with the epidermis still present though pushed back away from the pustule in flakes. The black telio-spores develop on the leaf sheath and culm just prior to the maturation of the plant.

STRIPE

Pyrenophora graminea (Died) Ito & Kurib.

The symptoms of stripe, a comparatively common disease in New Zealand, are quite distinctive. The first symptoms are a yellow striping of the older leaf blades and sheaths. The yellow stripes soon turn brown as tissue necrosis progresses, and finally the tissues dry out and fray as the leaf matures.

TAKE-ALL

Gaeumannomyces graminis (Sacc.) v. Arx & Oliver.
(Syn. *Ophiobolus graminis* [Sacc.] Sacc.)

Symptoms on barley are similar to those occurring on wheat, though normally to a lesser degree. Infected plants lose their green colour before maturity becoming bleached and slightly stunted. The main root, crown and basal culm tissue of such plants exhibit a dry rot accompanied by a dark-brown surface mat of coarse mycelium. This fungal mat is especially conspicuous under the leaf sheath.

This disease is of minor importance in reducing yields of barley as this crop has a high degree of tolerance to take-all. However, the disease is carried over on barley crop residues. Growing wheat after successive barley crops can lead to severe crop losses and even to complete crop failures.