

## DESCRIPTION AND KEY OF WHEAT DISEASES IN NEW ZEALAND

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### KEY

#### LEAF DISEASES

1. Small superficial powdery 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. Also on the leaf sheath at maturity of the plant in association with black pustules.  
LEAF RUST [*Puccinia recondita* Rob. ex Desm.]
3. Light-brown irregular lesions, or tip burn, usually accompanied by yellowing over part or whole of the leaf.
  - (i) Lesions containing numerous tiny light-brown to black fruiting bodies.  
SEPTORIA LEAF SPOT [*Septoria tritici* Rob. (perfect state *Mycosphaerella* sp.)]
  - (ii) Lesions not normally containing fruiting bodies although light-brown pycnidia may form late in the growing season.  
SEPTORIA LEAF SPOT [*S. nodorum* (Berk.) Berk. (perfect state *Leptosphaeria nodorum* Muller)]
4. Yellowing or reddening of the leaves and general stunting of the plant. Affected plants in patches.  
BARLEY YELLOW DWARF VIRUS [BYDV]

#### STEM DISEASES

##### A. Leaf Sheath Infection

5. Small superficial lesions of powdery white or grey mycelium later fusing and containing black fruiting bodies (cleistocarps).  
POWDERY MILDEW [*Erysiphe graminis* DC]
6. Scattered brown pustules turning black with maturation of the plant.
  - (i) Small (1-2 mm) circular orange-yellow pustules.  
LEAF RUST [*Puccinia recondita* Rob. ex. Desm.]
  - (ii) Elongated red-brown pustules, partially covered by epidermal flakes.  
STEM RUST [*P. graminis* f. sp. *tritici* Pers.]

## B. Stem Base Infection

7. Lens-shaped areas of bleached tissue surrounded by a darker margin.
- (i) Well-defined dark-brown margin. No mycelium in central cavity of stem.  
SHARP EYESPOT [*Rhizoctonia solani* Kuhn (perfect state *Pellicularia filamentosa* (Pat.) Rogers)]
  - (ii) Lesions with light-brown margins. Grey mycelium in the internal cavity of the wheat stem. Stem weakened, crop lodges in direction of prevailing wind and rain.  
EYESPOT (*Cercospora herpotrichoides* Fron.)
8. 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. Hypocotyl dark-brown to black.  
TAKE-ALL [*Gaeumannomyces graminis* (Sacc.) v. Arx and Olivier]
  - (ii) No coarse, dark-brown hyphae. Scattered small brown lesions on the roots usually near the stem base and on the hypocotyl. Pink spore masses sometimes present.  
FUSARIUM FOOT-ROT [*Fusarium culmorum* W.G. Sm.; *F. nivale* (Fr.) Ces.; *F. avenaceum* (Fr.) Sacc.; and *F. graminearum* Schw.]

## HEAD DISEASES

9. White heads
- (i) Associated browning of stem base with dark brown mycelium and hypocotyl.  
TAKE-ALL [*G. graminis*]
  - (ii) Associated browning of stem base. No dark-brown mycelium.  
FUSARIUM FOOT-ROT
  - (iii) Associated eyespot lesions at base of plant.  
EYESPOT [*C. herpotrichoides*]
  - (iv) No discoloration at the stem base.  
SEVERE DROUGHT
  - (v) Associated with lens-shaped lesion at the base of the plant, each lesion containing a small exit hole through which an insect has emerged, or exit hole at the node. Plants fall in random directions (Straggle).  
STEM WEEVIL
  - (vi) Partial whitening as a result of sterility in a number of successive spikelets which have failed to develop. Most noticeable when confined to the terminal spikelets.  
FROST DAMAGE
  - (vii) Abnormal development of the spikelets, such as gaps in the spike, or clumped spikelets. Some split grain.  
HORMONE SPRAY DAMAGE (MCPA, or 2,4-D at 2 to 3 leaf stage)
  - (viii) Poorly filled ears with barren spikelets and/or pinched grain.  
HORMONE SPRAY DAMAGE (MCPA, 2,4-D or Dicamba at late jointing)

10. Black heads

The discoloration of the seed-heads is caused by secondary fungi such as *Cladosporium* and *Alternaria* species and is therefore not a direct result of a pathogen.

- (i) Associated with stunting and excessive tillering

BYDV

- (ii) Heads standing erect above the rest of the crop, usually in patches 1 to 2 m across. Cast aphid skins occasionally present in head. Feeding damage caused by the grain aphid.

GRAIN APHID [*Macrosiphum miscanthi* Tak.]

11. Black spore mass replacing the floral parts. Most conspicuous just prior to, or during flowering.

LOOSE SMUT [*Ustilago nuda* (Jens.) Rostr.]

12. Heads wider and blue green, becoming lighter in colour than normal heads after ripening. Ripe grain replaced by bunt balls of black spores.

- (i) Round bunt balls.

BUNT [*Tilletia caries* (DC) Tul.]

- (ii) Elongated bunt balls.

BUNT [*T. foetida* (Wallr.) Liro.]

**BARLEY YELLOW DWARF VIRUS (BYDV)**

Symptoms vary greatly with the age of plants at infection. In seedlings the most reliable symptom of infection is the "cut-leaf" effect where the margin of the leaf appears to have been cut in a number of places. With plants infected between tillering and "shooting" the only noticeable symptoms are a general stunting and a premature bright yellow or reddish discoloration at the tip of the fully grown leaves. At harvest the stunted heads are erect and take on a sooty appearance due to secondary fungi such as *Cladosporium* and *Alternaria*.

**BUNT**

*Tilletia caries* (DC) Tul.

*T. foetida* (Wallr.) Liro

Unlike loose smut, bunt (stinking smut) is rarely detected at flowering, although bunted heads take on a blue-green appearance and are wider. During the development of infected grain, the entire grain contents are replaced by black bunt spores. These spore balls are shattered during harvesting operations and contaminate the healthy seed. Bunt is readily controlled by seed dressings at present in use and also by a number of new chemicals (Mulholland, 1972). This point is amply demonstrated by the virtual absence of this disease in New Zealand. All records of infected crops have been associated with a history of sowing untreated seed (Sanderson, 1964).

**EYESPOT**

*Cercospora herpotrichoides* Fron.

Although infection may take place at any stage during the growth of the plant, eyespot is most conspicuous near the end of the growing season owing to the lodging of infected plants. 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 a 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 wheat straw below the well-developed eyespot lesions. Wheat seedlings become infected by conidia produced on old crop debris. This is evidenced by the marked increase in lodging in successive crops grown in the same field. Of all the leaf and stem diseases affecting the wheat plant, in New Zealand, eyespot is the only one where a high level of control is being attained by the use of chemical sprays (Witchalls and Close, 1971).

#### **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.

#### **LEAF RUST**

*Puccinia recondita* Rob. ex Desm.

Leaf rust can occur on the leaf blade and leaf sheath at any stage in the growth of the wheat plant. Pustules of uredospores are small, 1 to 2 mm, round to slightly oblong, and orange-yellow. 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.

Loose smutted heads stand out during flowering as all the floral parts of the infected head have been replaced by a mass of black loose-smut spores. Spores are disseminated by wind during flowering, and if conditions are humid can invade the developing embryo of the ripening grain.

In the past, the incidence of loose smut has been maintained at a low level in wheat crops in New Zealand, by the hot-water-treatment of nucleus seed lines. Recent trials, however, have demonstrated the effectiveness of benomyl and carboxin in controlling this disease (Mulholland, 1970).

#### **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 wheat plant begins to senesce.

The disease is most severe in both winter and spring varieties 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 the early tillering and 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.

#### **SEPTORIA LEAF SPOT**

(i) *Septoria tritici* Rob. (perfect state *Mycosphaerella* sp.)

(ii) *S. nodorum* (Berk) Berk. (perfect state *Leptosphaeria nodorum* Muller)

First symptoms appear as light-green to yellow areas between the veins of the leaves. The lesions spread rapidly to form light-brown irregular patches which take on a speckled appearance as the small spore-producing bodies (pycnidia) develop. Often associated with the septoria lesion are extensive areas of yellowing and tip burn.

Initial infection is from ascospores produced on stubble or other crop debris. Ascospores can be carried by the wind for many miles.

Spores giving secondary spread within the crop are produced from pycnidia which develop within the lesions of infected leaves.

#### **SHARP EYESPOT**

*Rhizoctonia solani* Kuhn

(perfect state *Pellicularia filamentosa* (Pat.) Rogers)

There is considerable confusion between sharp eyespot (*R. solani*) and eyespot (*Cercospora herpotrichoides*) because of the similarity in symptoms produced on the lower leaf sheath.

Sharp eyespot, however, is more superficial and often confined to the outer leaf sheath. In outline the lesions produced are generally angular and more distinctly defined by a darker margin. There is no "pupil" caused by a mycelial mass in the necrotic area of the lesion, nor is there mycelium in the internal cavity of the wheat stem.

Sharp eyespot infection of the wheat plant may take place at any time during growth but is most severe as a root rot on young plants and seedlings which may be killed before they emerge above ground. On those which survive, small brown lesions may appear on the coleoptile, and later the centre of the lesion rots to leave a small hole surrounded by dark-brown tissue. On more mature plants, typical sharp eyespot lesions occur on the outer leaf sheath just above ground level (Blair and Morrison, 1949; Colhoun, 1971).

#### **STEM RUST**

*Puccinia graminis* f. sp. *tritici* Pers.

Unlike leaf rust which occurs each year, stem rust reaches epidemic proportions only in very humid seasons, being more severe in the late-sown crops.

Though occasionally on the leaves and floral bracts, the pustules of the uredial stage occur mainly on the leaf sheath and culm. 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 teliospores develop abundantly on the leaf sheath and culm just prior to the maturation of the plant.

Stem rust overwinters on volunteer wheat plants (Close, 1967). This may be the main source of infection, though wind-borne spores can be carried across the Tasman from Australia, and are the means by which new races are introduced.

#### TAKE-ALL

*Gaeumannomyces graminis* (Sacc.) v. Arx + Oliver  
(syn. *Ophiobolus graminis* (Sacc.) Sacc.)

Symptoms of take-all appear around heading when infected plants are seen to be stunted. The green colour of the wheat plant fades, and a rapid bleaching of the leaves, culm and head takes place finally resulting in white heads. The main roots, 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. Numerous black fruiting bodies (perithecia) may be associated with this mycelial mat. One of the main diagnostic features is a severe darkening of the hypocotyl region (between the seed and the crown at the base of the wheat stem).

As with eyespot, take-all infection is carried over on cereal crop residues. Growing wheat after successive barley or oat crops can result in severe crop losses and even complete crop failures.

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