

# Smut diseases of wheat, barley, oats, and rye

Recognizing them  
in the field



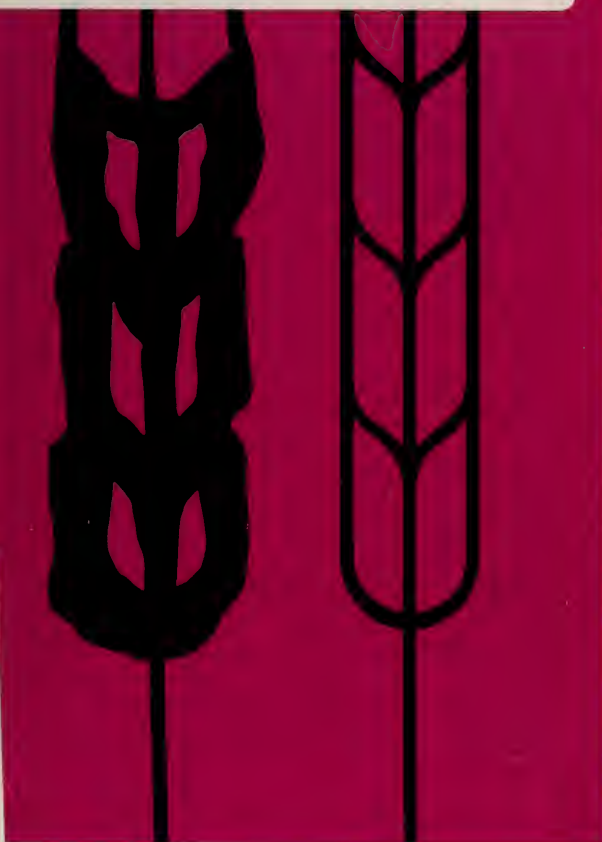
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## **Preface**

The first step for successful control of any disease is its correct identification. A producer growing wheat, barley, oats, or rye should, therefore, become familiar with the symptoms of the most common diseases that can affect these crops. When a plant disease is recognized early, prompt measures can usually keep the loss in yield or quality within economically acceptable limits. This pamphlet shows producers how to recognize the smut diseases of these four, small-grain crops, so that effective control measures can quickly be taken.

A few important characteristics are unique to the smut fungi that attack the small grains. First, with the exception of infection from soil-borne spores in bunt, the smuts described here are seed-borne diseases; therefore, only infested or infected seed can produce a crop with smutted plants. Generally, such infestation or infection is caused by spores produced by infected plants in the previous crop. Even the soil-borne spores of bunt originate from infection in an earlier crop. The aim, therefore, is to prevent a build-up either of infection in seed or of spores in the soil. Second, infection by these diseases is systemic. Either the disease is harbored in the seed or infection takes place very soon after seeding, and then persists in the plant. When smutted heads or panicles become noticeable in a field it is far too late for any control measure to be taken with the crop that year, because the disease has already taken its toll. The producer can only take note of its presence in the crop at this time and prevent its recurrence the following year. Growing a variety resistant to the smut encountered is the best method of disease prevention, for both economic and environmental reasons. If, however, a susceptible variety must be grown, apply a registered seed-treatment fungicide. Consult recent provincial guidelines specifying which varieties are resistant or recommending the choice of a fungicide.

## **Common bunt of wheat**

Common bunt of wheat, otherwise known as stinking smut or covered smut, is caused by two closely related fungi, *Tilletia tritici* and *T. laevis*. The disease cycle, symptoms,



*The head and seed on the right show symptoms of infection from common bunt of wheat or dwarf bunt of wheat. The seed and head on the left are those of healthy wheat.*

and control of these two pathogens are nearly identical. The two species differ primarily in microscopic characteristics. Common bunt occurs world wide, and before effective control measures were introduced, it caused major losses in yield and grain quality. Cool soil ( $5\text{--}15^{\circ}\text{C}$ ) favors infection. In spring wheat, infection is caused by seed-borne spores, whereas in winter wheat it may also come from soil-borne spores. Common bunt causes more damage to winter wheat than to spring wheat because of its requirement for cool temperatures and, in the case of seed- plus soil-borne spores, greater inoculum pressure. After infection of the young seedling the fungus penetrates to the growing point. During head formation it starts to grow profusely and replaces each developing seed with a bunt ball filled with black spores. In many infected heads no seed is produced, only bunt balls. Often, plants with infected heads have shorter tillers than healthy plants. This disease is usually difficult to detect in the field. However, while walking through the field after a rainfall or heavy dew, the producer may notice plants with shorter tillers and greener heads. The glumes on the head are spread wider than normal, and green to dull brown, spherical bunt balls are visible in place of the normal kernels. Furthermore when a bunt ball is crushed between the fingers, a pungent, fishy odor may be detected, caused by trimethylamine, which is produced by most races of common bunt. In many cases, however, common bunt goes unnoticed till harvest. In the threshed grain, the producer or elevator agent can easily detect the bunt balls, and the odor allows detection of common bunt at levels of less than 0.01%. Such wheat is usually downgraded ("smutty"), which together with the loss in yield, further decreases the return to the farmer.

## Dwarf bunt of wheat

Dwarf bunt, caused by *Tilletia controversa*, can be differentiated from common bunt in the field by the marked stunting of affected plants. Diseased plants often achieve less than half the height of healthy plants. In addition, dwarf bunt usually causes excessive tillering in the affected plant. The fungus differs from common bunt in other important characteristics. Because it requires a minimum of 5 weeks of continuous snow cover and soil temperatures of 0–5°C in order to infect, it occurs only in winter wheat. The infection stems primarily from soil-borne rather than seed-borne spores. These spores can overwinter and survive in the soil up to 7 years; fungicides applied to seed do not control the soil-borne spores. The best control method is the development and use of resistant varieties. Dwarf bunt, fortunately, occurs only in discrete areas in Canada. It is found in the intermountain regions of British Columbia and in the counties in Ontario bordering on Georgian Bay and Lake Huron. In these areas, when severely stunted, bluish green, excessively tillering plants are found in the wheat, and bunt balls filled with black spores can be identified toward maturity, dwarf bunt has to be suspected. To confirm it, the spores must be checked in a laboratory.

## Loose smut of wheat

This disease is caused by the fungus *Ustilago tritici*, which occurs wherever wheat is grown. Infection can occur only during flowering of the wheat plant. Spores of the loose smut fungus that land in flowers of healthy plants germinate there, and the developing mycelium penetrates the ovary

*Heads infected with loose smut of wheat are on the right.*



and establishes itself in the embryo. As the seed matures the mycelium becomes dormant; such infected seed does not differ outwardly from healthy seed. When an infected seed germinates, the mycelium also starts growing again and penetrates the growing point of the plant. As the head begins to form, it is so thoroughly invaded by the fungus that a mass of spores develops instead of the normal spikelets. The spores mature by heading time and are dispersed by wind and rain; those that land in flowers of healthy plants complete the disease cycle.

Only the head shows the effects of the disease; the other parts of an infected plant appear normal. Infected heads emerge at the same time as healthy ones and all their parts except the central stalk are replaced by a loose mass of dark brown spores. The spores are blown away by wind or washed off by rain, so that at maturity only the bare stalk remains. Traces of the dark spores can still be seen on the stalk, as well as some grayish remnants of glumes or awns if the tissues of the host plant are not completely destroyed. Because nearly all the spores of loose smut are dispersed before a crop matures, the spores do not accumulate on the seed. Therefore, the quality of grain for food or feed is not affected, and it is not degraded as is the case when it is contaminated with spores of bunt.

## Loose smut of barley

This disease, caused by the fungus *Ustilago nuda*, can cause serious losses wherever susceptible barley is grown. Infection can occur only during flowering of the barley plant. Spores of the loose smut fungus that land in flowers

*Heads infected with loose smut of barley are on the right.*



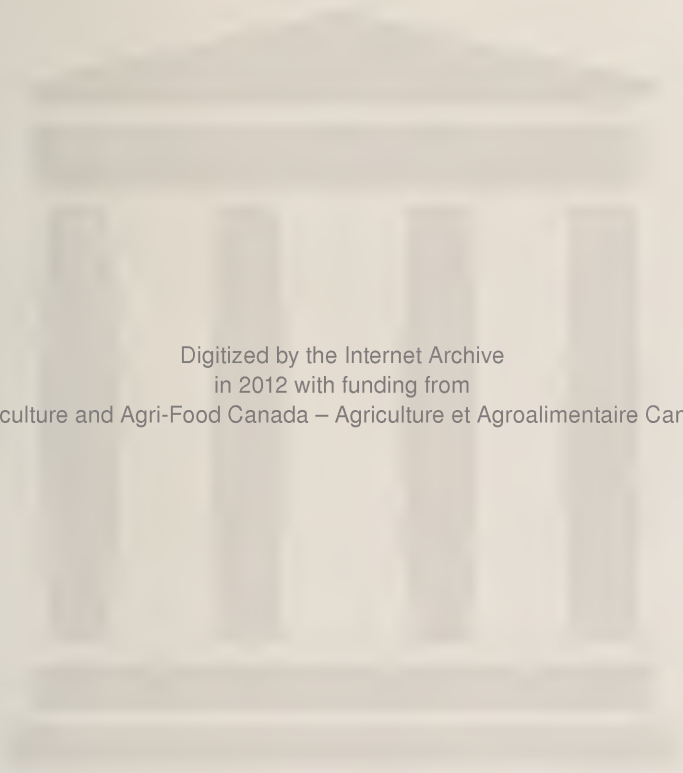
of healthy plants germinate there, and the developing mycelium penetrates the ovary and establishes itself in the embryo. As the seed matures the mycelium becomes dormant; such infected seed does not differ outwardly from healthy seed. When an infected seed germinates, the mycelium also starts growing again and penetrates the growing point of the plant. As the head begins to form it is so thoroughly invaded by the fungus that a mass of spores develops instead of the normal spikelets. The spores mature by heading time and are dispersed by wind and rain; those that land in flowers of healthy plants complete the disease cycle.

Only the head shows the effects of the disease; the other parts of an infected plant appear normal. Infected heads emerge at the same time as healthy ones and usually all their parts except the central stalk are replaced by a loose mass of dark brown spores. The spores are blown away by wind or washed off by rain, so that at maturity only the bare stalk remains. Traces of the dark spores still remain visible on the stalk, as well as some grayish remnants of glumes or awns if the tissues of the host plant are not completely destroyed. Loose smut and false loose smut (*Ustilago nigra*) are not easily distinguished in the field; only a microscopic examination of germinating spores can positively differentiate between the two species. Producers should be aware of this similarity because not all seed-treatment chemicals that are effective against false loose smut can control loose smut.

## Covered smut and false loose smut of barley

Covered smut and false loose smut of barley, caused by *Ustilago hordei* and *U. nigra*, are quite distinct in appearance but are listed together here because their life cycles and their control are the same. Both smuts cause significant losses in Canada and will continue to do so if susceptible varieties are grown and no other control measures are taken. They are carried over from season to season as seed-borne spores, with those lodged under the hull being the most effective in causing new infection. When infested seed is planted, the spores germinate and their germ tubes penetrate the very young barley seedlings. The fungus invades the growing point and develops with the host plant until finally the flowers are destroyed and the seeds and most of the chaff are replaced by spores. The spores of false loose smut are easily dispersed by wind; if they land in healthy florets they complete the disease cycle. Covered smut reinfects in the same manner, but the spores are more often dispersed during the harvesting and handling of the grain.

Covered smut, in addition to destroying the florets, causes stunting of affected tillers, so that many of the smutted heads appear at a lower level and develop later than



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the healthy heads. Smutted heads are compact and hard, and they usually still bear the remains of chaff and deformed awns. The compacted spores of covered smut are not readily blown or washed away by wind or rain in a standing crop.

The description of the symptoms of loose smut of barley, immediately preceding, also applies to false loose smut of barley.



*Heads on the right are infected with covered smut of barley.*



*Heads infected with false loose smut of barley are on the right.*



## Loose and covered smuts of oats

Two smut diseases with a similar disease cycle affect oats: loose smut caused by the fungus *Ustilago avenae* and covered smut caused by *U. kollerii*. Both smuts occur in Canada and in all countries where oats are grown. They are carried over from season to season as seed-borne spores.



*Heads on the right are infected with loose smut of oats.*



*Heads infected with covered smut of oats are on the right.*

Spores lodged under the hull are the most effective in causing new infection. When infested seed is planted, the spores germinate and their germ tubes penetrate the very young oat seedlings. The fungus invades the growing point and develops with the host plant until finally the flowers are destroyed and the seeds and most of the chaff are replaced by spores. The spores of loose smut are easily dispersed by wind; if they land in healthy florets they complete the disease cycle. Covered smut reinfects in the same manner, but the spores are more often dispersed during the harvesting and handling of the grain.

Symptoms of these smuts are seen chiefly on the panicle. Diseased panicles emerge at the same time as healthy ones, but they usually have a more narrow and erect habit and may be borne on somewhat shorter plants. In loose smut the seeds, hulls, and glumes are replaced with a powdery mass of dark brown spores. As the crop matures, most of the spores blow away in the wind or are washed off by rain, leaving only a few spores and small, light gray fragments of host tissue on the panicle. In covered smut the somewhat compacted spores also replace the seeds and hulls but remain more or less enclosed in the still partly intact glumes or outer chaff, which becomes light gray toward maturity.

## **Stem smut of rye**

Stem smut of rye is caused by the fungus *Urocystis occulta*. This disease occurs primarily on fall rye and has been reported only occasionally, at low levels, on spring rye. It occurs throughout the world but is found most commonly in the drier areas where fall rye is produced. In most regions of Canada, the disease has been found sporadically over the years. However, in southern Alberta, stem smut has occurred consistently since 1971. Cool (5–15°C), dry soil favors infection by the fungus. It can infect by either seed- or soil-borne spores. The pathogen penetrates either the seedling or young stem and leaf tissue and develops until it reaches the growing point. Symptoms become visible after the plant starts to shoot up and form heads. At this stage, masses of black spores on leaves and stems are at first covered by a grayish membrane that soon breaks to expose the spores. Diseased stems are stunted and diseased heads are often distorted, if they emerge at all from the boot. As the plant matures, the disease becomes less noticeable because wind and contact with surrounding plants tend to disperse the exposed spores or break off the head. The disease may therefore go unnoticed until swathing. Then, with heavy infection, spores within the stems are released as a black cloud.



*Stalks on the right are infected with stem smut of rye.*

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