Frost injury of wheat

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Late spring frosts commonly reduce yields and affect the quality of grain in many wheat crops, especially throughout the southern, eastern and north-eastern districts. The damage is usually localised on individual farms, but occasionally widespread damage occurs in the south of the State.

By S. C. CHAMBERS, M.Sc., Plant Pathologist

Although frosting is a relatively common form of injury many growers fail to recognise it, and often confuse the symptoms with those of fungal diseases, such as foot and root rots. Frost injury may occur at any stage of growth but is most damaging as the ear emerges and during the flowering period.

Leaf Symptoms
Frost usually causes a leaf blighting which extends from the tip to approximately half way down the leaf blade. Under conditions of severe frosting, this injury may even extend down the leaf sheath. The affected tissue develops a brown scorched appearance (Fig. 1) and the leaf margins tend to roll in from the under surface.

Such injuries are not always a certain indication of frost, as similar damage can result from dry soil conditions and hot dry winds. However, the appearance of these symptoms can usually be related to previous weather conditions.

Stem Symptoms
One of the most characteristic symptoms of frost injury is the development of a white ring on the green ear-bearing stalk, between the head and upper-most leaf sheath (Fig. 2). Another more common diagnostic symptom is silvering or blistering of the stem tissues immediately above the top-most nodes (joints). This blistering, which can be readily felt with

Fig. 1.—Leaf blighting caused by frost. Note the scorched appearance of the affected tissue and the tendency to twist and roll.
cracking and swelling of the nodes as well as swelling, splitting and distortion of the stem (Fig. 4.) When swelling occurs on only one side of a node (Fig. 5) the stem bends over and often breaks off at this point. Usually the lining of the stem cavity in the region corresponding to the external browning, shows a dark reddish brown or sileage-like discoloration. Occasionally frosting causes the nodes to shrink instead of swell and sometimes the stems are swollen, soft and spongy.

**Head Symptoms**

Destruction of the pollen during the flowering period is one of the serious effects of frost damage. As all the flowers in the head do not develop simultaneously, this usually results in partial failure to set grain. Occasionally grain formation is completely suppressed and the ear remains empty although it may appear quite normal. However, when the heads are frosted at flowering time, the glumes usually have a wide open appearance.

Perhaps the commonest symptom is a browning of the nodes and internodes near the base of the stems. A similar discoloration is sometimes caused by the fungi, which also attack and discolour the roots. However, plants affected by frost only, can be distinguished by the fact that their root systems are well developed, white in colour and free from obvious rotting. Another difference is that plants with severe stem frosting tend to re-stool profusely, whereas stooling is reduced in plants affected by root rotting fungi.

A number of other symptoms are often associated with the brown stem discoloration caused by frostling. These include...
A common symptom of head frosting, is the shrivelling and dwarfing of spikelets. Sometimes, all the spikelets are blighted, but more often only a few are affected at the tip, central or basal part of the ear (Fig. 6). These malformed spikelets often fall off, leaving the rachis bare in the frosted portion of the head.

On other occasions the heads are found to be completely bleached and empty (whiteheads) without any shrivelling of the spikelets. Partial and complete head blighting may also be caused by hot, dry winds. However, wind injury always involves the terminal spikelets and so may be distinguished from frosting, which can injure the central or basal spikelets, without affecting those at the top.

Developing grain may be affected in various ways depending upon its moisture content at the time of frosting. Grain frosted in the milk stage tends to become shrivelled, whereas cracking of the seed coat is a common feature of grain frosted in a more advanced state.

PREDISPOSING FACTORS

There are several factors which predispose wheat crops to frost injury. Some of the more important are:

1. **Seasonal Conditions:** In abnormally mild seasons, crops do not have a chance to harden and so produce a soft lush type of growth, which is particularly susceptible to frost damage.

2. **Time of Planting:** Early maturing varieties sown too early may come into head during the late winter months and be more severely affected by frost.
3. **Type of Soil:** Reports indicate that crops growing on the light or fluffy soils, such as the morrel and kopi types in the Esperance district, are especially prone to frost injury.

4. **Soil Moisture:** Crops growing under relatively dry conditions, appear to be more sensitive to frost injury.

5. **Condition of Seed Bed:** In some cases severe losses have occurred in crops sown on poorly consolidated seed beds. However, this may be due in part to the poor moisture-retaining capacity of such land.

6. **Situation:** Crops in low lying situations or in the depressions of undulating land are more severely frosted than adjoining areas of crop.

7. **Effect of Timber:** Patches of crop adjacent to timber or scrub, appear to be more severely affected by frost than more exposed plantings.

**PREVENTATIVE MEASURES**

Adoption of the following measures will materially help to reduce losses from frost:

1. In districts with a history of severe frosting, avoid as much as possible sowing in low lying situations.

2. Sow in a thoroughly worked, well-compacted seed bed.

3. Plant, at the correct time, those wheat varieties recommended for the district.

4. Feed off or cut crops which are forward because of planting too early or as a result of mild weather conditions.
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