

## Section 11

# Supplemental Materials

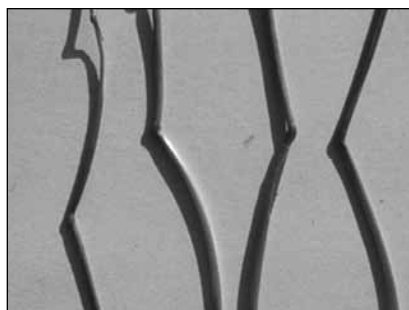
## Freeze Damage



**Photo 11-1.** Varietal differences in spring freeze injury have been observed, but differences are mostly caused by variations in plant growth stages when freezes occur. The variety on the left has more leaf burn than the variety on the right.



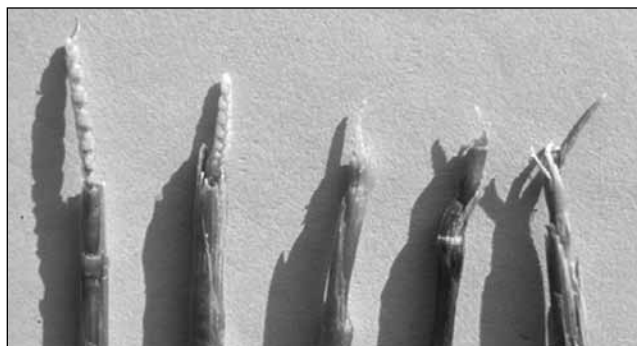
**Photo 11-2.** Leaf burn is a symptom of freeze damage to wheat that has broken dormancy and has had prolonged exposure to low temperatures (24°F or lower) during lush, rapid growth.



**Photo 11-3.** Bent elbow (bending of the stem at the lowest node forming an elbow) is another symptom of freeze damage to the stem. Bent stems usually resume an upright position but lodging can be a problem with the added weight of the grain as heads begin to fill.



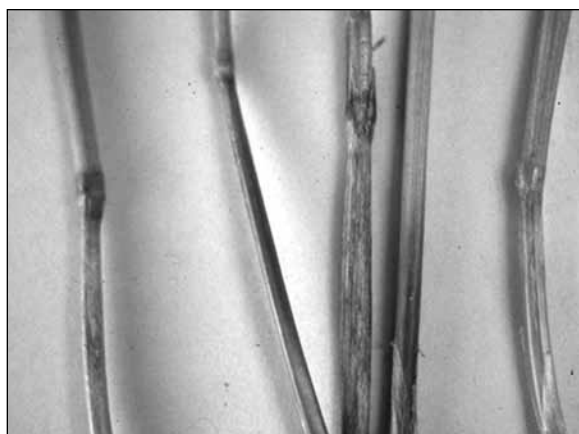
**Photo 11-4.** The pollination (flowering) stage is the most freeze-sensitive stage. Exposure to temperatures of 30°F at pollination can kill the male parts (anthers) of the flower and cause sterility without any symptoms appearing on plant vegetative parts. The head on the right is sterile due to freeze damage at pollination. No kernels developed in the florets because the anthers and pollen were killed. The undamaged head on the left has a developing kernel in each floret.



**Photo 11-5.** Growing point damage. After the jointing stage, the growing point (developing wheat head) is susceptible to freeze damage. To check for damage, cut into the stem. A normal, uninjured head (two plants on the left) is glossy, turgid, and yellow-green. A freeze damaged (killed) head (three plants on the right) is pale white or tan, limp, shrunken, and not developed in size. Plants were collected 13 days after the freeze.



**Photo 11-6.** Freeze injury to the head at the boot, heading, or flowering stage can result in death of the heads or floret sterility. The most obvious symptom is a white head color. Due to differences in maturity of the florets along the length of the head at the time the freeze occurred, there is a range in the location of the injury to the head. The center or one or both ends of the head may be sterile. In some cases, the whole head may be sterile.



**Photo 11-7.** Stem freeze damage can occur after the jointing stage and usually occurs to the lower stem. Symptoms include discoloration, lesions, splitting, collapse of internodes, and enlargement of nodes. Damaged stems usually deteriorate further by breaking or rotting. The four stems on the left show freeze damage.

## Other Problems



**Photo 11-8.** Color banding (purple or yellow banding on young leaves at emergence) is an environmental problem caused by warm days with cool nights. Seedlings will become cold-tolerant, and symptoms will fade.



**Photo 11-9.** Poor stands can be caused by a number of factors, such as drill problems, poor seed quality, dry soil, deep planting, soil crusting, low seeding rates, diseases, and insects. Close examination of the situation helps determine the causes of poor stands.



**Photo 11-10.** Deep planting (past the depth to which the coleoptile can elongate) can slow emergence or cause stand establishment problems. The coleoptile is the embryonic leaf that penetrates the soil so the seedling can reach the surface. Varieties differ in their coleoptile lengths.



**Photo 11-11.** A healthy wheat head has green anthers and white stigmas, as in the lower left floret. The yellow anthers of the middle floret indicate pollen has recently been shed. The developing kernel in the upper floret indicates fertilization has occurred and there has been no freeze damage.



**Photo 11-12.** Lodging can be caused by many factors. Heavy winds and rains at the heading stage are largely responsible for most lodging problems. Lodging tends to occur in low field areas or when high nitrogen rates, tall varieties, or high seeding rates are used.



**Photo 11-13.** Heaving results in plants being uplifted from the soil with the crowns above the soil surface and only a few roots attached into the soil. This is a common problem with frequent, alternate freezing and thawing of the soil, particularly with shallow plantings. As wheat begins its spring green-up, some plants begin to die.

