



Factors Affecting Wheat Germination and Stand Establishment in Hot Soils

Jeff Edwards
Assistant Professor

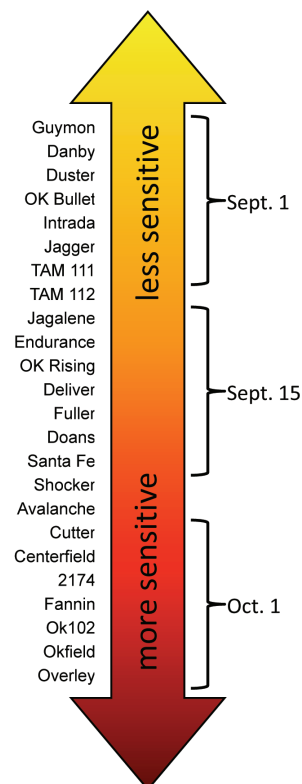
One of the most cost-effective ways to increase fall forage production by winter wheat is to sow early. Sowing prior to September 20 generally provides enough time for wheat to establish canopy, produce some forage, and develop sufficient roots to anchor the plant in the soil. Therefore, dual-purpose wheat in the southern Great Plains is typically sown from late August through late September. Several factors may delay germination or prevent seedling emergence during this time of the year including, seed dormancy, high temperature sensitivity, and reduce coleoptile length. Everything that delays or inhibits germination and emergence results in less forage production and lower stocking rates, so it is important for dual-purpose wheat producers to understand and avoid such conditions.

A wheat seed is dormant when it will not germinate, even when favorable conditions for germination are present. Seed dormancy is highest just before harvest, and some degree of seed dormancy is a favorable varietal trait. Dormancy prevents premature sprouting of wheat prior to harvest and is essential to preventing pre-harvest sprouting. Seed dormancy is gradually lost with time, but the rate of seed dormancy loss is affected by several factors. Inhibitory substances found in the seed coat of hard red winter wheat varieties, for example, can strengthen post-harvest dormancy. Wheat stored under extremely hot or cold conditions after harvest will generally germinate more readily than seed stored at ambient air temperatures. This is why it is advisable to place seed samples in the refrigerator for a day or two prior to running germination tests. The strength of dormancy also increases with decreasing temperatures during grain fill. So, seed of the same variety but harvested from different areas of the state or region might behave differently when sown early. Post-harvest dormancy of most hard red winter wheat varieties will sufficiently dissipate by October. A result of early sowing, however, is less time between harvest maturity and wheat sowing, and seed dormancy may not have dissipated enough to allow germination.

In addition to post-harvest dormancy, some varieties have seed dormancy that is accentuated by high soil temperature. This is commonly referred to as high-temperature germination sensitivity. Varieties differ greatly in their level of post-harvest dormancy and high-temperature germination sensitivity. Varieties with high temperature germination sensitivity are generally not suitable for early sowing (Figure 1). Wheat can germinate in soil temperatures from 40 to 99° F, but temperatures from 54 to 77° F are considered optimal. Soil temperatures in western Oklahoma, however, frequently exceed 80° F well into the fall. Soil temperatures at Altus, for example, typically exceed 90° F until mid-September and frequently do not fall below 80° F until October (Figure 2). These temperatures are

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Figure 1. High temperature germination sensitivity is a variety-specific trait. Sensitive varieties should only be sown after soil temperatures cool. Relatively "safe" planting dates for varieties are indicated on the right side of the figure.



sufficient to prolong dormancy in sensitive varieties such as 2174, Ok102, Overley, and Shocker. A good-rule-of-thumb is to plant less sensitive varieties, such as Duster or Jagger first and wait to sow sensitive varieties until after October 1. In most years, the combination of time after harvest and cooler soil temperatures is sufficient to allow germination for most hard winter wheat varieties by October 1.

Hot soil conditions at sowing also reduce coleoptile length. The coleoptile is a rigid, protective structure that covers the emerging shoot to aid it in reaching the soil surface (Figure 3 A). Once the coleoptile breaks the soil surface, it stops growing and the first true leaf emerges. If the coleoptile does not emerge through the soil surface, the first true leaf emerges below ground, takes on an accordion-like appearance, and the wheat plant typically dies (Figure 3 B). For this reason,

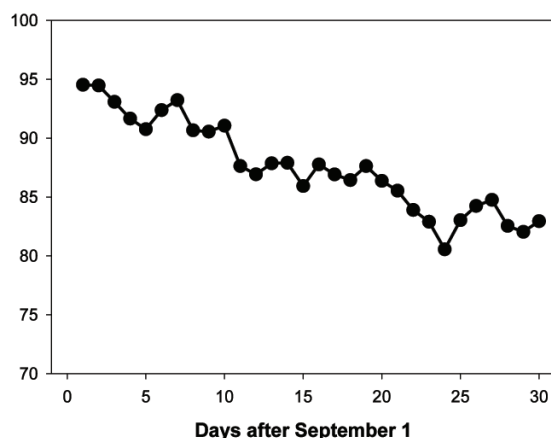


Figure 2. Average maximum observed temperature at a two-inch depth under bare soil at Altus, OK from 1997 to 2007.

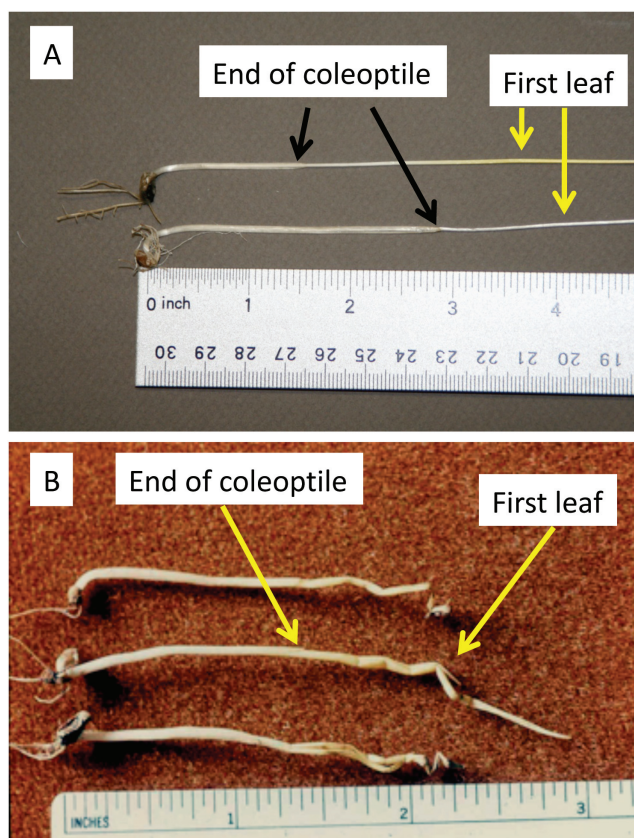


Figure 3 A & B. The wheat coleoptile is a protective structure that ensures the first true leaf emerges above the soil surface (A). If the coleoptile does not penetrate the soil surface, the wheat will not emerge (B).

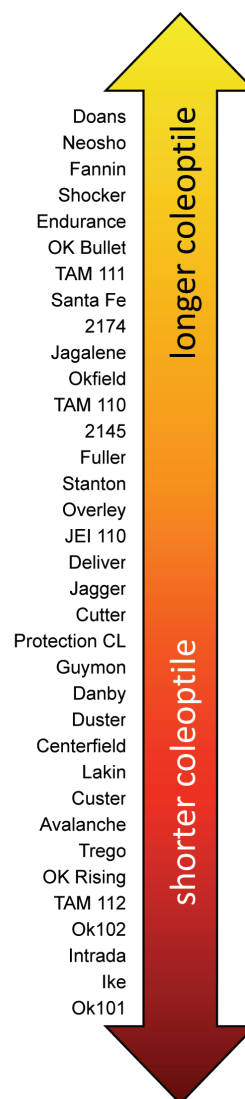


Figure 4. Varieties with longer coleoptiles should be chosen when sowing deeper to reach moisture, especially when hot soil conditions are prevalent.

wheat should never be sown deeper than the coleoptile length. Wheat coleoptile length is related to mature plant height, and most modern, semi-dwarf varieties have shorter coleoptiles than old, tall varieties. Most modern wheat varieties can safely be sown at a one-inch depth, but many will not emerge when sown deeper than one inch into hot soils (Figure 4). For this reason, “dusting in” early-sown wheat and waiting on a cool rain to reduce high-temperature germination sensitivity and increase coleoptile length frequently results in more uniform emergence than planting deeper to reach moisture.

In conclusion, when sowing early, producers should carefully choose varieties and avoid those with varietal characteristics that can reduce germination. Reduced or erratic wheat germination will result in less fall forage production and reduced stocking rates. Soil temperatures generally cool enough to allow full germination of most hard red winter wheat varieties by October 1.

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