FOCUS on South Plains Agriculture

Calvin Trostle, Extension Agronomy, 806-746-6101, ctrostle@ag.tamu.edu

October 10, 2012

Grain Sorghum and the Freeze & Frost of October 8th

An unexpected heavy frost/freeze occurred in the lower High Plains region October 8th. Due to later plantings, often after failed cotton, many grain sorghum acres were subject to extended hours of frost and freeze. Lubbock recorded the second earliest freeze on record (average first freeze is Oct. 31). Texas Tech Univ. "Mesonet" weather stations (http://www.mesonet.ttu.edu) recorded lows of 28°F at Muleshoe, Floydada, Hart, and as far south as Tahoka.

How does the Oct. 8 freeze compare to 2008?

The implications of this year's freeze are more difficult to assess than 2008 for two reasons: 1) in 2008 much of the sorghum was simply planted way too late for the maturity of the grain sorghum hybrid, hence development was delayed by 2 and 3 weeks, and 2) the 2008 freeze occurred on Oct. 23, where there was little to no potential left in the season to meaningfully mature grain any further, e.g. even if the freeze had not occurred the outcome—immature grain and low test weights—would have been essentially the same.

Did much of the region suffer a killing freeze on grain sorghum?

Frost damage and freeze termination of grain sorghum is well known in the High Plains but rarely catches much sorghum that is not yet at least somewhat near maturity e.g., late soft dough to early hard dough). Current assessment indicates foliage damage (Fig. 1) in the South Plains is largely limited to only the top 1/3 or less of the canopy. At this point I have not seen any fields that I believe received a killing freeze though reports indicate this might have occurred in a few fields. A killing freeze stops all growth immediately whereas a light freeze mostly affects the leaves only. Kansas State extension agronomist Dr. Kraig Roozeboom notes that plant death does not occur until the stalks are frozen, breaking the flow of nutrients and carbohydrates to the grain.

One indication of increased moderate freeze damage is the condition of the leaf sheath on the flag leaf (Figs. 2 & 3 and captions). In a light freeze the leaf sheath will not receive freeze damage like the upper leaves do.

Can grain sorghum recover from a light or moderate freeze and continue adding yield?

Grain fill can continue after a light freeze if:

1) sufficient leaf area remains undamaged,

2) the stalk is not frozen allowing the culm to continue to deliver nutrients and carbohydrates to the developing grain,
3) temperatures are warm enough after the freeze to drive growth again as the plants attempt to recover from cold shock.

With later freezes near the historic norm (Oct. 26 at Littlefield, Oct. 31 at Lubbock, and Nov. 3 at Lamesa) the needed warmth in #3 would not be expected and growth would essentially come to a standstill even if a freeze did not occur.

Base growing degree temperature in grain sorghum is 50°F. With an early freeze there is greater possibility that damaged sorghum may indeed have sufficient warmth left in the season to resume meaningful dry matter accumulation. The current daily average high and low temperatures in Lubbock are 77°F/50°F (October 10). If the freeze was light and there is still significant green foliage then the grain sorghum should be able to take advantage of available heat units to continue maturation, albeit slow, especially when days reach highs of 75°F and nights stay at 50°F or higher (12.5 heat units per day).

Figure 1. Freeze damage at decreasing levels (left to right) from grain sorghum. The area of the leaf that will die is readily observed within a day of a freeze. Most damaged leaves in the current October 8 freeze on grain sorghum in the Texas South Plains are on the top 1/4 to 1/3 of the canopy.

Figure 2. Greater freeze injury occurred on the left head and stalk as the leaf sheath is also freeze damaged, has turned tan-white, and will die. The plant on the right also has completely desiccated flag leaf but the leaf sheath is intact. The left head represents more pronounced freezing temperature. (Lubbock Co., Oct. 10, 2012). The white spot under the head on the left head is the talc-like powder or dust that naturally occurs on sorghum; is not a freeze lesion.

Sorghum dry matter accumulation and seed stage of growth

Milk stage—Seed squirts a milky liquid when squeezed. Grain in the milk stage during the Oct. 8th freeze is highly questionable if it will develop very well (likely not past soft dough) even if damage was moderate and warm temperatures return.

Soft dough stage—Seed can be squeezed between the forefinger and thumbnail, but no liquid in the seed; it can be cut with your thumbnail. Dry matter accumulation is about 50% complete at the beginning of soft dough (lower kernels in Figure 4 A&B).

Hard dough stage—Seed will not yield to pressure nor will it cut with you thumbnail. Dry matter accumulation is about 75% complete at the beginning of hard dough (top kernels in Figure 4 A&B).

Black layer—The tip of the seed where it attaches to the plant forms a distinct black dot signifying physiological maturity.

Figure 3. Grain sorghum heads at different stages that have been exposed to modest freeze injury as the leaf sheaths are also frosted/frozen. In this field, significant undamaged leaf area remains in the lower 2/3 of the canopy suggesting the conditions did not represent a hard freeze in spite of the appearance of the top leaves. Field should be observed for the presence of stalks that are frozen above the canopy, which would indicate no further seed maturation. (Lubbock Co., Oct. 10, 2012).

Can grain color indicate seed growth stage of development?

This is not a reliable means of gauging seed development and maturation. It will vary due to hybrid and seasonal climate influence. You can't accurately gauge growth stage of development while driving past a field. That said, in my experience when the first tint of color is visible across a field then the hybrid is most likely at the beginning of soft dough. A general

pronounced coloration across the field is often hard dough. (These generalities do not work so well if the sorghum grain is white, yellow, or cream).

Grain coloration can vary; however, when the south and west side of a head has more coloration (see Fig. 4 A&B and caption).

The same heads: **A)** View from the southwest **B)** View from the northeast

Figure 4 A&B. Grain sorghum heads with ~20% hard dough (top 1 to 2") and ~80% soft dough grain. These are the same heads but viewed from different sides. When viewing a field during grain color transition the appearance of the field may differ due to the direction of view. Typical flowering pattern for these 7-9" long heads occurs from top to bottom, which is potentially 5 to 8 days hence differing grain maturity in the same head. (Lubbock Co., October 9, 2012)

What proportions of grain maturity stages are present in current late-planted sorghum fields?

Among representative later-planted irrigated fields in the region (medium-long before June 23; medium maturity by ~June 30 in the central South Plains; early maturity into the second week of July) I have found a common range of field maturity from about 30% hard dough/60% soft dough/10% milk stage (with 10% of the total grain at black layer) to about 50% soft dough/50% milk stage. This represents about 10 days difference in maturity with moderate (pre-October) heat unit accumulation. These are field averages whereas individual heads will vary far from this range, especially heads (perhaps on tillers) that are 100% milk stage (Fig. 5). If heat is available I believe we will get some further development in the soft dough grain (and potentially to early hard dough) provided freeze injury was moderate at worst and some heat returns.

I stopped assessing few dryland fields initially after observing a wide range of in-field maturity, often ranging from hard dough to milk stage.. Some dryland fields, which were obviously buster planted, may have emerged well after the actual planting date. Such fields, however, should be assessed the same way as described for irrigated fields.

Figure 5. Lubbock Co. grain sorghum field with heads ranging from limited hard dough in the upper tips (red heads) to mostly green heads that are mostly in the milk stage (Oct. 9, 2012). This field was rated at 5% hard dough/50% soft dough/45% milk stage (and 1% black layer). Top leaves are fully damaged, but green undamaged leaves, which will continue to function provided temperatures are adequate, are present under the top of the canopy. No leaf sheaths were damaged.

What about green fields where most sorghum heads are still in the milk stage?

Fields that show evidence of moderate freeze injury which ware >60% milk stage (still largely green across the field) should not be expected to develop any meaningful grain yield from this immature grain. <u>At this point no milk stage grain will reach hard dough even if weather is favorable.</u> If the injury is moderate and the leaf sheaths are not damaged (a positive indicator), then expectations of grain development with reduced test weight are still only modest.

Bottom line: If grain was largely at least in the soft dough stage I am hopeful it will progress meaningfully toward a marketable test weight, but if fields were still green and kernels in milk stage there is little expectation of any sufficient grain development that would achieve a marketable test weight (most likely at least 48 lbs./bu, but possibly 50 lbs./bu). Fields largely in milk stage should not be considered for grain harvest but may be assessed for hay or grazing value.

How much decrease in test weight might be expected from reduced maturity grain?

Historically grain elevators will not accept any grain, even if heavily discounted, for test weight <45 lbs./bu, and many elevators will not accept grain sorghum at <50 lbs./bu.

I expect reduced test weights on many acres of grain and in some cases little to no further grain development if the freeze was hard. Thus grain will now simply dry down without further significant starch accumulation. Standard test weight in grain sorghum is 56 lbs./bushel. Market discounts for low test weight begin at grain <55 lbs./bushel.

Grain that is currently in hard dough but has not reached black layer will give marketable test weights in light of our current situation even if little or no further development occurs. Remember that at the beginning of hard dough about 75% of dry matter (starch) accumulation has occurred. If soft dough grain can continue development and reach hard dough before drying down then test weights can still reach the 50s. Otherwise if soft dough grain does not develop much further the grain will be shriveled and small in size after drying, it will be light, and I project the test weight will fall in the mid and high 40s.

Harvest management of freeze-damaged grain sorghum

For additional information on handling grain sorghum damaged by a freeze consult "Harvesting Grain from Freeze-damaged Sorghum (~2001)" from Kansas State Univ., http://www.agronomy.ksu.edu/extension/p.aspx?tabid=86 This includes decisions for low test weight grain sorghum and its level of price discount. Two key considerations include:

1) Allow time to take a preliminary test cutting to assess your test weight.
2) If low, you may reset the combine to blow out more of the lighter immature kernels.
3) Your decision will depend on what the level of discount is and the value of the grain.

What is the current discount on grain price for low test weight grain sorghum?

I received requested discount schedules from two of four grain buyers in the South Plains (Table 1). The other two are in the process of determining their discount schedules in light of high grain prices. Producers who are harvesting low test weight grain will need to factor net price into their decision on where to market their grain as well as to what extent they need to clean grain of low-test weight, shriveled kernels. Make sure the discounts are identified as 'per bushel' or 'per cwt.' (If $/bu, then convert to $/cwt. by dividing by 0.56.)

Table 1. Available examples of discount schedules for low test weight grain sorghum, Texas South Plains (Oct. 11, 2012).

Test Weight	Elevator #1	Elevator #2	% of $12/cwt. grain for #2
(lbs./bu)	*$/cwt*	*$/cwt†*	
≥55.0	0.00	0.00	0.0%
54-54.9	-0.01	-0.04	-0.3%
53-53.9	-0.02	-0.05	-0.4%
52-52.9	-0.05	-0.23	-1.9%
51-51.9	-0.08	-0.36	-3.0%
50-50.9	-0.11	-0.45	-3.7%
49-49.9	?‡	-0.54	-4.5%
48-48.9	?	-0.80	-6.7%
47-47.9	?	?‡	--
46-46.9	?	?	--
45-45.9	?	?	--

†Elevator #1 quoted discounts based on bushel basis which was converted to cwt.
‡Elevators have not committed at this point to receive grain at or below this test weight.

Low test weight grain sorghum as cattle feed

Freeze damaged and low test weight grain sorghum on a pound-per-pound basis has similar feed value to mature grain sorghum, however, the small kernel size makes grinding more difficult in order to crack the seed and capture the grain's full nutritional value. Thus some cattle feeders may not be interested in the grain however great the price discount.

Were AgriLife's last recommended planting dates for grain sorghum appropriate?

Texas A&M AgriLife has last recommended grain sorghum planting dates based on hybrid maturity and county (see the annual hailout/replant/late-plant guide at http://lubbock.tamu.edu). Our long-running goal has been that a producer planting by the last recommended planting date is highly likely to avoid risk from an early freeze or cool fall. Would these guidelines protect a producer from an Oct. 8 freeze at Lubbock? No, and they are not necessarily intended to for a near record early freeze. This was a near record early freeze. The last recommended guidelines do protect against a freeze that might arrive as much as two weeks early in that maturity is close at hand in an early freeze but significant risk is avoided.

Acknowledgement

Thanks to fellow extension agronomists Dr. Kraig Roozeboom, Kansas State; Dr. Mark Marsalis, New Mexico State; and Mr. Rick Kochenower, Oklahoma State, for advice and discussion.

Educational programs of Texas AgriLife Extension Service and the Texas A&M University System Agriculture Program are open to all people without regard to race, color, sex, disability, religion, age, or national origin.