



Impact of Cold Temperatures on Warm-season Perennial Grasses

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Warm-season perennial grasses are the basis of pasture systems and livestock production in Mississippi. The most prominent warm-season species in Mississippi are bermudagrass (seeded and hybrid) and bahiagrass. However, they can go dormant from the first killing frost in the fall (early to mid-November) to the green-up stage in the spring (early to mid-April). Although they are more adapted to low fertility soils than other species, they can be greatly impacted by cold winter temperatures.

Some of these forage species vary a lot in their tolerance of growing conditions which is usually referred as plant hardiness. Plant hardiness is based on the ability to tolerate cold, heat, drought, flooding, wind, and other environmental conditions. Hardiness is also defined by the geographic location based on longitude, latitude and elevation. The most common use of this term is based on cold or winter hardiness. Cold hardiness is measured by the lowest temperature a plant can withstand and survive. By using these parameters, 10-degree F hardiness zones has been established across the USA (Fig. 1) by the US Department of Agriculture (USDA) and also at a more defined level within the state (Fig. 2). The map is based on the average annual minimum winter temperature.

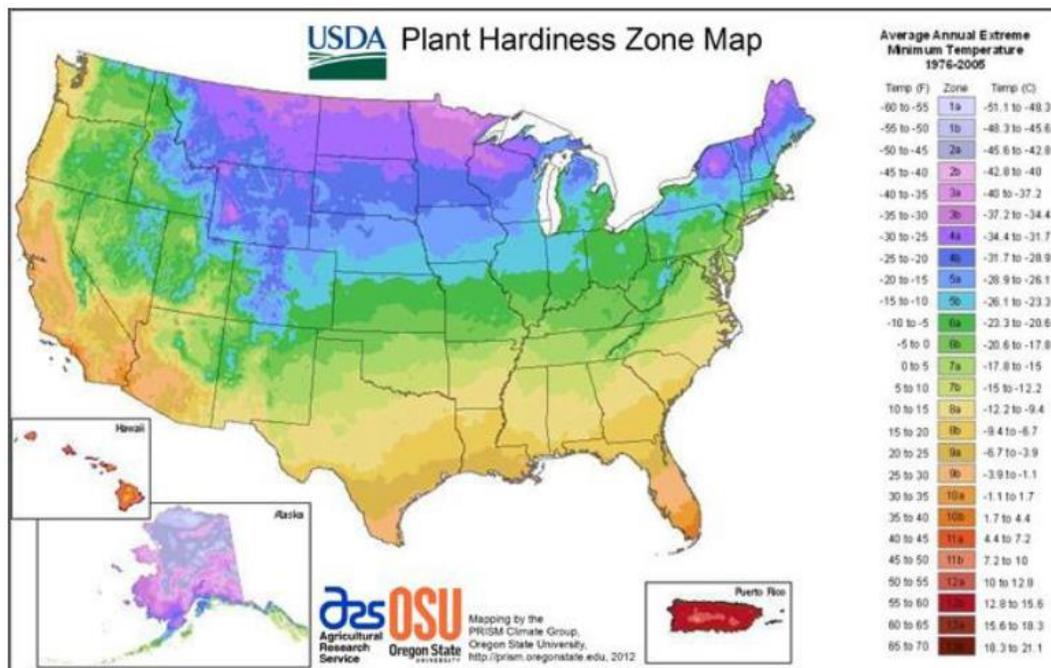


Figure 1. Plant hardiness zones for the United States. Source: US Department of Agriculture.

Bermudagrass and bahiagrass grow best when soil temperatures are above 70 °F. These temperatures usually occur when daytime air temperature reaches approximately 80 °F. Night temperatures are usually a good indicator of soil surface temperatures. Keep in mind that soil temperatures can be affected by soil color, surface residue, water content, etc. Warm-seasons grasses will not produce roots (rhizomes and stolons) unless the soil temperature exceeds 55 °F for several weeks. This is the stage usually known as dormancy. As day length becomes shorter and temperature drop below 50 °F, bermudagrass and bahiagrass cease shoot growth, lose chlorophyll, and begin nutrient translocation (carbohydrates, nitrogen, potassium and phosphorous) for storage in the below ground tissue (rhizomes). Without proper plant nutrition, even the most winter hardy variety can succumb to winter kill or injury. Injured plants are slow to recover in the spring and after every grazing cycle or cut of hay.

In central and north Mississippi, the most susceptible periods for bermudagrass and bahiagrass injury have typically been early winter (late November to late December) and early spring (late-March to mid-April). In late November, bermudagrass and bahiagrass are still green due to a mild fall and a drastic change in dropping temperatures from the 70s

to the 40s. Mild temperatures in early March along with plenty of precipitation will trigger bermudagrass green-up and then a severe cold snap or freeze occurs. When this green-up occurs, complexed carbohydrates are converted into simple sugars for growth that are not cold-tolerant and causes cell ruptures. In some cases, dry air and windy conditions cause the grass crown to dry out and making them more cold susceptible by reducing the cell wall buffering. In other instances, in a cold, wet spring, any standing water can freeze the crowns when a drastic drop in temperature occurs causing also cell rupture and leakage. Some of the research done in the turf industry has indicated that 50% bermudagrass stand losses can occur when temperatures are between 18 and 23 °F.



Yield will always be limited by winter kill or injury, and stands will begin to thin as injured plants eventually die out. This can be equally costly over the long-term when producers are forced to renovate their pastures or hay fields. Most of the winterkill in warm-season perennial grasses (especially bermudagrass) is related to poor fertility. Nutrient deficient plants are more susceptible to disease, regrow more slowly, yield less and die off more quickly. The most common fertility issues associated with stand losses due to winter kill include low pH, low potassium (K) and low phosphorus (P). Low pH can restrict root mass development deeper in the soil profile and also restrict root mass for nutrient translocation and storage. Bahiagrass and bermudagrass that are growing under optimum pH tend to have deeper growing, more dense rhizomes which escape low temperature damage by being better insulated in the deeper soil profile. Soil sampling to determine pH and nutrient levels is always a prudent choice in developing a management program for forage production, especially if a soil test has not been done within the past three years.

Late nitrogen (N) management, especially when overseeding annual ryegrass into a perennial warm-season grass sod, can impact the warm-season grass stand by maintain them active. If nitrogen needs to be applied to annual ryegrass in this case, wait until bermudagrass or bahiagrass is dormant. It is not recommended to apply nitrogen to warm-season grasses late in the season (30 to 45 days before frost) because excessive nitrogen levels during the late-season may deplete nutrients stored in rhizomes as shoots compete for plant reserves. Late nitrogen applications increases tissue hydration, stimulates new growth, producing tissues that have thin cells and are more susceptible to winter kill or injury. Minimizing N movement to new leaves may increase nitrate assimilation in the roots and increase translocation of additional nutrients (P and K) for storage in the belowground tissues. Nitrogen retranslocation may also stimulate root growth as nitrate directs carbohydrates for amino acid synthesis and storage.

Warm-season perennial grasses needs an excellent source of phosphorus and especially potassium to reduce winter injury. Phosphorus is important in the overall plant health, especially in root development. Potassium is essential in over

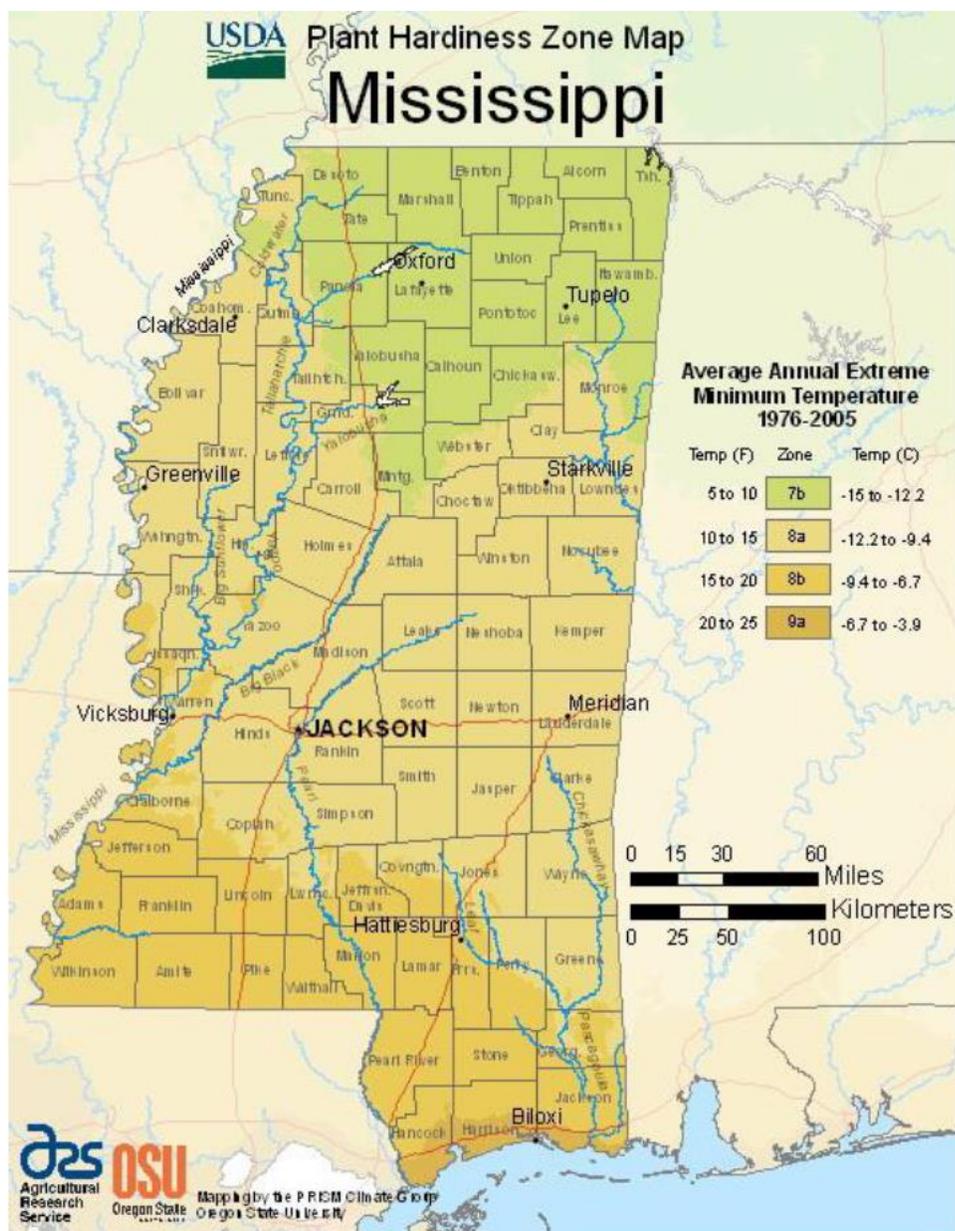


Figure 2. Plant hardiness zones for Mississippi. Source: US Department of Agriculture.

-wintering capability of bahiagrass and bermudagrass because it acts as the plant's natural antifreeze within the cells. Potassium enhances winter hardiness and resistance to frost. This is very important in poorly drained fields that are highly vulnerable to a larger array of winter injuries. Low potassium levels have shown to have the biggest effect in winter survival, yield production and disease resistance (Table 3).



It is important to note that winter kill in warm-season perennial grasses is highly variable and difficult to estimate because it could be affected by genetics, temperature extremes, geographical location, soil drainage, nutrient management factors and endless combination of the factors that interact with each other to cause a highly variable impacted phenomenon. Fall fertility and plant health does affect winter kill, but the pattern is not always clear. However, using "best management practices" that encourage healthy stands, better nutrient utilization along with rotational grazing and hay production practices that extend the longevity of the stand is the producer's best line of defense.

Table 1. Effect of Potash (K₂O) Rate on Yield and Stand of Coastal Bermudagrass (6-year Avg.) with low soil potassium level.

K ₂ O Rate	Hay Yield	Year 1	Year 6
----- (lb/ac) -----		----- Stand (%) -----	
0	8919	57	29
100	12399	47	84
200	13583	45	89
400	14341	41	88

Source: Fudenburg and Twidwell, 2000.



On behalf of the MSU Forage Program, We wish each of you a great holiday season and thank you all for the support and trust that you provided to make our program a success in 2015. We look forward to the bright future of the forage industry and the growth of the Mississippi State University Forage Extension Program. In this holiday season, cowbells will be ringing true maroon!

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<http://forages.pss.msstate.edu/events.html>

January 10-12, 2016 – American Forage and Grassland Annual Conference, Bouton Rouge, LA

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