

Forage Water Use
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As we move into the summer months of the year, many pastures across the state are again facing drought conditions. Because of the continued rainfall shortage, some producers have asked which plants utilize water most efficiently during drought conditions. In this article I'll review the concept of water use efficiency and discuss which of the common Georgia perennial forage crops make the best use of available water.

Plants, like metro Atlanta, require a lot of water for a variety of functions. Water is used as a solvent to transport nutrients and allow biochemical reactions to occur in plant tissue. Water is needed for cell division and elongation which are the basis of plant growth. Perhaps just as importantly, water cools plants on hot summer days much like a radiator cools your vehicle. Without this cooling mechanism, plant temperature can rise causing (1) enzymes to function less efficiently, (2) carbon dioxide solubility to decrease, and (3) nutrient transport to diminish from decreased plant transpiration. All of these factors decrease the rate of photosynthesis which reduces plant growth. At higher plant temperatures, chemical reactions required for growth and maintenance can not occur. Plants literally bake in the sun like hay cures in the windrow.

Because of all these plant water uses, it's not uncommon for forage crops to use over 1000 pounds of water (120 gallons) to produce one pound of dry forage if plant growth is less than optimal. That's over 2,000,000 pounds of water (almost 250,000 gallons) to produce one ton of dry forage. As you can see, plant water requirements are high and it can sometimes be difficult to justify irrigating forage crops from an economic standpoint unless substantial yield increases or hay premiums are realized.

How is water use compared between plants?

Water use efficiency is a production index that describes the amount of water needed to produce a unit of forage. For example, if one inch of water falls on an acre of bermudagrass (approximately 27,200 gallons or 226,000 lbs of water) and 300 lbs of dry forage are produced as a result of this rain then the water use efficiency is equal to 753 pounds of water per pound of dry forage. Water use efficiency of bahiagrass, tall fescue or orchardgrass grown under similar conditions could also be compared using this system.

What factors influence water use efficiency?

Anything that limits plant growth also has the potential to decrease water use efficiency. If plant growth rates are limited, proportionally more water is used for plant maintenance and survival at the expense of forage production. All of the following factors can lower the efficiency at which water is utilized: drought conditions, high ambient temperatures, low fertility, poor soil pH, and overly mature plants.

Which perennial forages have the highest water use efficiency?

Warm season forages like bermudagrass, bahiagrass and dallisgrass normally utilize water more efficiently than cool season forages like orchardgrass and tall fescue. To demonstrate this, I've included Alabama data that was previously summarized in the 2nd Edition of Southern Forages (Figure 1). In this study, Coastal bermudagrass produced about 50% more forage per inch of water than tall fescue or orchardgrass. Common bermudagrass and Pensacola bahiagrass produced slightly more forage per unit of water than cool season forages. Note that hybrid bermudagrass produced approximately 30% more forage per unit of water than common bermudagrass or bahiagrass. This demonstrates the value of elite forage varieties even when environmental conditions are suboptimal.

Several producers have suggested that bahiagrass is more productive than bermudagrass in drought situations because bahiagrass appears to green up more rapidly following a rain. This rapid green up can be misleading. Figure 2 is taken from the new 3rd Edition of Southern Forages and outlines the water use efficiency of Coastal bermudagrass and Pensacola bahiagrass under both wet and dry conditions. This Georgia study showed that hybrid bermudagrass utilized rainfall more efficiently than bahiagrass during a dry summer. This efficiency may be related to the deeper roots of Coastal bermudagrass or its higher yield potential. Among summer annual species, pearl millet is more drought tolerant than sorghum-sudan hybrids. Nitrate toxicity concerns for pearl millet and sorghum-sudan as well as prussic acid concerns for sorghum-sudan are additional problems that must be considered when summer annuals are used in drought years.

What does this mean?

Many factors affect how efficiently forage crops utilize water to produce plant material. Understanding these factors can help beef cattle producers select species and establish pastures that are more productive under hot and dry conditions. However, planting decisions should not be made solely on this information. Make sure that selected plants are (1) productive in your area (2) persistent in local conditions (3) fit in your grazing system and (4) fit your management style.

Figure 1. Water use efficiency of selected warm and cool season grasses (Adapted from Doss et al. 1962, Bennett and Doss, 1963).

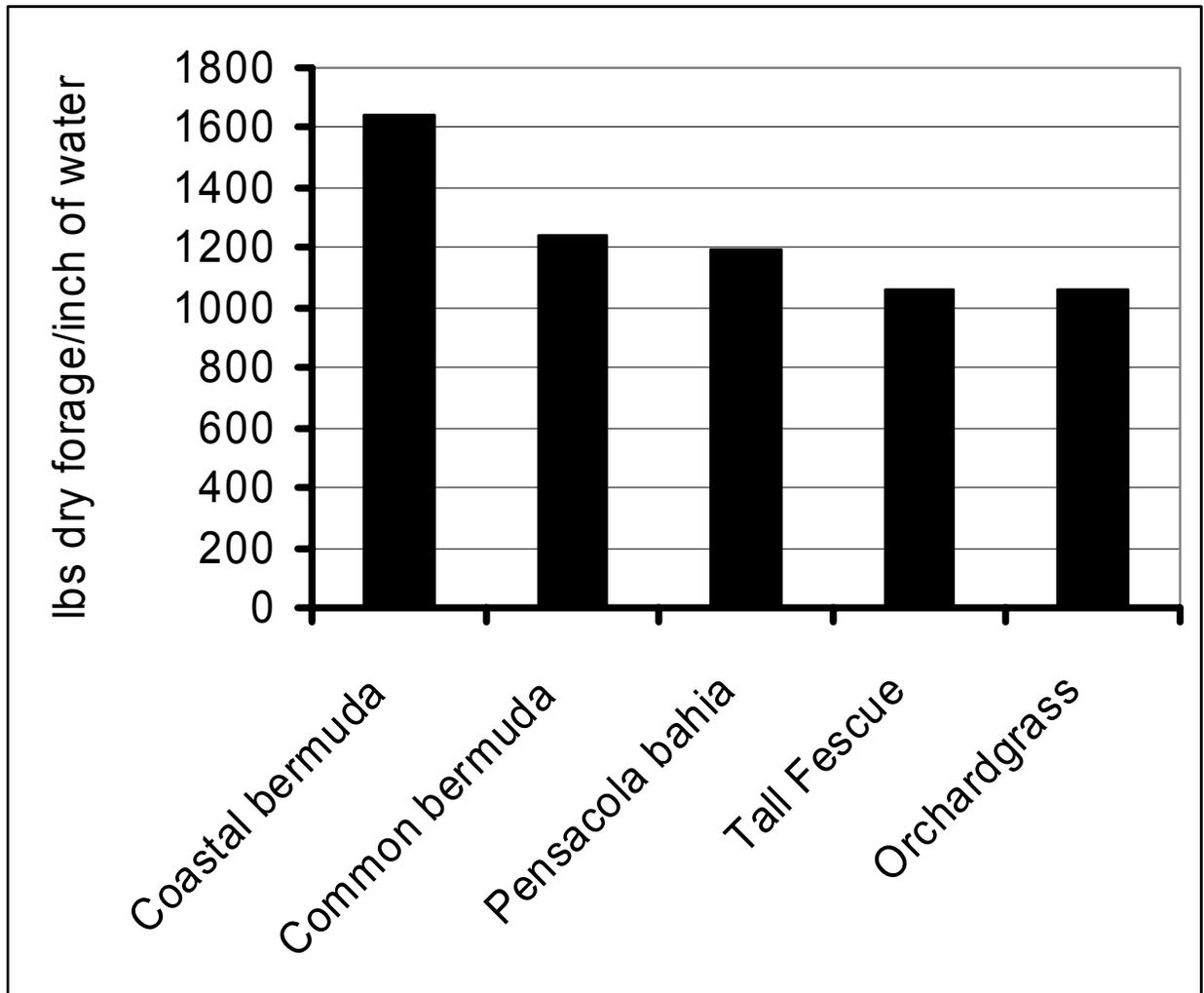


Figure 2. Water use efficiency of bermudagrass and bahiagrass in wet (135% normal) and dry (47% normal) years (Adapted from Burton et al.).

