Some Thoughts on Drought

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Many areas of the southeastern USA suffered severe drought conditions this past summer. Good autumn rainfall may result in improved pasture conditions so that we may be tempted to forget about drought. However, drought will return in the future so it may be useful to think about why crops and pastures suffer drought, how plants respond to drought, and some ways to minimize the effects of drought.

What is drought?

This sounds like a dumb question but it is rather complex. Drought to the meteorologist and to most urban folks is a prolonged dry period when rainfall is below "normal." Popular weather reports in newspapers often cite how many inches the current rainfall is above or below normal for that time of year. As any farmer knows, this is a meaningless value as it is the distribution of rainfall over the growing season that often determines whether or not drought occurs. The puzzling thing to many people is why our region suffers drought with low yields of crops and pastures when we have an average annual rainfall of 50 inches or more. In contrast, the average annual rainfall in Iowa is only about 27 inches but average non-irrigated yields of corn and soybeans (both of which have little drought-tolerance) are about twice that of yields in Georgia. The main reason for this is that soils in Iowa are very different from most soils in Georgia. Midwestern soils are deep and soil pH is favorable for root development at depths of 3 to 6 feet. In addition, these soils at field capacity have about 1.5 inches of water per foot available to the plant while sandy and sandy loam soils of south Georgia may have as little as 0.5 inch/foot available to the plant. In many of our soils, rooting depth is greatly impeded by compacted soil layers or pans, subsoil acidity, and nematodes. All of this often results in shallow crop rooting depth, resulting in soil water at greater depths being unavailable to the plant. Another problem, especially on our clay soils, is that water infiltration rates are low so that heavy summer thundershowers of short duration have high rates of runoff. Thus, much of our high total rainfall ends up in the Atlantic Ocean or Gulf of Mexico instead of in the soil.

How do plants respond to drought?

It takes a lot of water for a growing plant to produce food during photosynthesis, about 300 to 1,000 pounds of water for each pound of plant dry matter. Plants lose most of this water from leaf stomata (tiny pores) which operate as an evaporative cooler or air conditioning system to cool the plant. Warm season grasses such as bermudagrass, bahiagrass, switchgrass, and pearl millet are much more efficient than cool season grasses such as tall fescue, orchardgrass, and Kentucky bluegrass in dry matter production per unit of water. Of course, the cool season grasses have an advantage over the warm season grasses in ability to grow and remain productive during cooler months of the year.

Plant response to drought is a gradual process that affects different biological processes. When soil moisture becomes limiting, the first thing affected is cell division and enlargement. Leaf growth and tiller production of grasses stops but photosynthesis of existing leaves continues at a reduced rate. As a result, soluble sugars and starch accumulate which can improve the digestibility of drought-stressed forages and improve animal performance. Nitrates will accumulate to toxic levels in some grasses and cause death of animals consuming them. As water stress continues, roots continue to grow and extract some water, maintaining a reduced rate of photosynthesis over a considerable period of time. With extreme water stress, photosynthesis eventually stops and leaves become overheated.

How to minimize the effects of drought

Irrigation is obviously a solution to drought but is usually not cost effective for most forage grasses except for silage corn, a high-value crop. If cost of irrigation equipment has been covered by row crops such as peanut or cotton, then it may pay to irrigate rye or wheat during autumn drought to secure rapid establishment and early grazing for stocker steers. However, the most realistic approach to drought problems is by planting drought-tolerant forage plants.

Warm season grasses such as bermudagrass and switchgrass perform much better than cool season grasses such as tall fescue and orchardgrass during drought. Among warm season perennial grasses, Coastal bermuda is deeper rooted and more drought-tolerant than common bermudagrass or bahiagrass. Where very acid subsoils are a problem, pearl millet roots will grow well and extract water much deeper than sorghum-sudan hybrids. Cool season grasses are generally less drought-tolerant than warm season perennial grasses. Endophyte-infected tall fescue is more drought-tolerant than endophyte-free varieties. Alfalfa, on soils where it is adapted, is more drought-tolerant and productive than any of the clovers. Sericea lespedeza, with a taproot capable of growing deep in acid subsoils, has amazing drought tolerance. Another perennial broad-leafed plant, Puna chicory, also remains green and makes considerable forage growth during dry periods. This is a result of a deep taproot which can extract water even in very acid subsoils. None of the clovers do well under very dry conditions but red clover tolerates more drought and heat than white clover.

Adequate fertilization to maintain good plant root development is helpful in dealing with drought. Productivity of well-fertilized forage plants is greater during dry weather because of better water use efficiency.

A common problem during dry weather is to delay hay feeding until pastures are badly overgrazed. This is especially serious when cool season grasses such as tall fescue are badly overgrazed during summer drought, resulting in much less autumn regrowth after rainfall begins. The result is that the hay feeding period may have to be extended. Limited hay feeding before pastures are closely overgrazed will result in faster regrowth after rains arrive.