# MANAGEMENT STRATEGIES TO FORESTALL DROUGHT INDUCED DORMANCY OF KENTUCKY BLUEGRASS

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Temperature induced dormancy is concept we were introduced to at a very early age. Most of us, before we headed off to grade school, knew that some animals dealt with cold weather by sleeping all winter. The hibernating bear, thus for many of us, was our first introduction to the concept of dormancy. Seeing leafless trees each winter further ingrained the concept of temperature induced dormancy into our psyche way before we had to sit through our first science class.

While nearly everyone has a basic grasp of what temperature induced dormancy is, far fewer individuals are aware that a lot of plants routinely enter dormancy when subjected to drought. No where is this more apparent than in the eastern half of the United States where the average well to do homeowner rushes out to water his (or her) lawn at the first sign of the grass losing its rich green color. Having taught introductory turfgrass management for the past ten years, I have come to the conclusion that students with no prior training in turfgrass management consider a brown turf to be a turf that is either dead or dieing. I don't think it to great a stretch to assume that this is what most homeowners think as well.

Of course anyone who as managed turf for a while knows that a lawn can go off color for weeks at a time without actual death of the turfgrass plant occurring. Kentucky bluegrass is one cool season turfgrass species that typically enters dormancy when subjected to moisture deficits. In this, and most other turfgrass species, when water first becomes limiting expansion of newly emerging leaves is the first plant growth process that is affected. As the water deficit increases, the leaf blades fold in response to collapse of the bulliform cells. At this point, because the stomates have been closed for an extended period, photosynthesis declines rapidly and the turf begins to appear a blue-gray color. If the water stress persists and further tissue dehydration takes place, photosynthesis stops altogether and the leaves begin to turn brown. It is at this point that most homeowners think that they have a rapidly dieing lawn on their hands. In most instances, what the homeowners actually have is a lawn that has began to enter drought induced dormancy.

As long has the rhizomes and crown of the plant remain sufficiently hydrated, new shoots will arise from the axillary buds of these structures once favorable moisture conditions return. There is a certain tissue hydration level however, below which, death of the turfgrass plant is inevitable. Long term droughts that remove all plant available water from the soil can cause the rhizome and crown hydration moisture contents to drop below the level that will allow these structures to survive. Typical field symptoms that indicate this level of hydration has likely been reached include the presence of brittle above ground shoots that break easily when walked upon and the presence of darken crown tissue material. The later of course, can only be seen by removing a plant from the ground and examining the crown.

The physiological and morphological processes that allow a plant to delay the onset of drought induced dormancy are collectively referred to has dehydration avoidance mechanisms. Plant mechanisms that assist in delaying dehydration, or avoiding it altogether, can be placed into one of two groups: (1) mechanisms that reduce either individual plant water loss or water loss from an entire plant community and, 2) mechanisms that facilitate enhanced plant water uptake. In the case of the former, research with warm season grasses has revealed that prior to the onset of tissue dehydration, the turfgrass canopy possesses a greater barrier to water loss that do the stomates and cuticular layer of individual turfgrass leaves. More recently, research specific to Kentucky bluegrass has revealed that the primary morphological attributes associated with low water use in this species include: slow leaf extension, reduced leaf sheath length, horizontal leaf orientation, and narrow leaf widths. The last of these attributes is most likely to be present under cultural management regimes that encourage high canopy shoot densities.

Deep root penetration is the primary means by which plants are able to enhance water uptake. Two of the most common lawn maintenance practices that can influence the rooting depth, and all of the morphological attributes mentioned in the preceding paragraph, are nitrogen fertilization and the height at which a turf is mowed. Use of quickly available forms of nitrogen promote rapid rates of leaf extension which in turn increase plant water use. The use of slowly soluble or slow release forms of nitrogen offer an advantage over quickly available forms of nitrogen in that increases in leaf extension are less rapid and occur over a longer period of time. Of greater importance is the effect improperly timed applications of nitrogen may have on the growth and development of turfgrass roots. High rates of quickly available nitrogen applied during the spring and summer promote rapid shoot extension at the expense of root growth. Similarly, constantly mowing Kentucky bluegrass at low cutting heights also discourages root penetration.

Root penetration of cool season turfgrasses is most vigorous in the spring and fall. During the summer months a dramatic reduction in the depth of root penetration takes place. Two cultural practices widely recommended to maximize root penetration in Kentucky bluegrass lawns are avoiding late spring and summer applications of nitrogen, and maintainence of high mowing heights. In the case of the latter a mowing height as low as 2.0 inches is acceptable however 3 inches is preferable. Maintaining Kentucky bluegrass at high mowing heights increases its consumptive water use when compared to lower mowing heights. This is probably due to the greater amount of leaf area present in the higher mowed turf and the more horizontal leaf orientation that is present in a turf maintained at a lower mowing height.

Maintaining high mowing heights during the summer months appears to present a paradox if one is interested in delaying or avoiding the onset of drought induced dormancy. If die back of the root system of Kentucky bluegrass is an inevitable event each summer how then does maintaining a high mowing during this time of the year help maintain a deep root system ? More specifically, to what extent will maintaining a high mowing height during this time of year delay the onset of drought induced dormancy ? Is it not possible that the greater water use associated with maintaining Kentucky bluegrass at high mowing heights during the summer actually accelerate drought induced dormancy in the absence of irrigation and natural rainfall?

A field study was conducted at the University of Maryland to investigate this apparent paradox. The primary objective of the study was to determine if mowing height influenced the onset of drought induced dormancy in Kentucky bluegrass. More specifically, there was an interest in seeing if altering the mowing height at different times of the year would affect the onset of summer drought induced dormancy. In addition, since nitrogen fertilizer practices can also influence turfgrass water use and rooting, a secondary objective of this study was to determine if the use of different nitrogen sources could also influence the onset of drought induced dormancy. How each of the mowing height and nitrogen source treatments affected recovery of the turf once the drought ended was also of interest.

A large block of Touchdown Kentucky bluegrass was established from seed in September of 1990. The following September mowing and N-source treatments were initiated. The mowing treatments consisted of mowing the turf at 1.25 inches (low) or 2.50 inches (high) in the spring, summer and fall of the year. All possible seasonal mowing height combinations were investigated. The seasonal mowing periods were defined as follows: Spring, 1 March to 1 June; Summer, 1 June to 1 September; Fall, 1 September to 1 December. In general, the turf was mowed weekly from April to November. Seasonal mowing height changes from "high" to "low" were accomplished by lowering the mowing height to 1.75 inches on the first mowing of a new season and then to the prescribed mowing height of 1.25 inches on the second mowing of the new season. In most instances scalping was readily apparent in these "high to low" plots during the one week transition period required to lower the mowing height. No intermediate mower height setting was used in the plots where the mowing height was raised from the preceding seasons mowing height. One pound of nitrogen per thousand square feet was applied in late March, early September, October, and Mid-November using either urea, Nitroform or sulfur coated urea.

A drought event occurred the summer of 1993 that permitted the mowing and nitrogen treatment effects to be examined. On 7 July all supplemental irrigation to the plot area was terminated. From 7 July to 2 August only 0.87 inch of rain occurred. Most of the rain (.70 inch) occurred during a single rainfall event (14 July). Severe drought stress was noticed in all plots by 25 July and by 2 August most of the plots were very close to being completely drought dormant. During the two weeks following 2 August 3.36 inches of rain fell effectively ending the drought event. Supplemental irrigation was also applied during this two week period. By 17 August most of the visual symptoms associated with the drought began to disappear from the plots. Visual ratings of the turf during this six week period were collected periodically using a 1 to 9 rating scale. A rating of 9 was indicative a turf displaying optimum density, uniformity and color. A rating of 5 indicated that the turf was beginning to turn a gray-blue cast in response to water stress. During the recovery period a rating of 5 was representative of a turf possessing approximately 90% green turf. A rating of 3 indicated that about 50% of the turf foliage within the plot was bleached or light brown in appearance. Plots in which all foliage was brown or severly bleached were considered to be drought dormant and were given a rating of 1.

The visual ratings for 25 July, 2 August and 17 August are summarized in Table 1. The data represent a single drought stress event, thus should be viewed as preliminary findings rather than as conclusive results. Although differences between the various treatments were not particularly large, the 25 July data do show that for most mowing combination treatments, maintaining Kentucky bluegrass at 2.5 inch during the summer slightly delayed turfgrass quality deterioration caused by the drought event compared to turf that was mowed at 1.25 inches during the summer. The higher mowing height also appeared to enhance the recovery of Kentucky bluegrass once drought stress was alleviated. One surprising trend noted was that maintaining Kentucky bluegrass at 1.25 inches in the spring and fall of the year did not appear to lower turf quality when the turf was subjected to drought stress in the summer. The combination of mowing

Kentucky bluegrass at 1.25 inches in spring and then raising the mowing height to 2.5 inches in summer appeared to actually delay the deterioration in turfgrass quality caused by the drought event compared to turf that was mowed at 2.5 inches all the time. A possible explanation for this may be that raising the mowing height a month before the drought event increased the proportion of young fully emerged leaves present in the turfgrass canopy compared to a turf that was constantly maintained at a high mowing height. Younger leaves are less likely to lose color when exposed to drought stress than are old leaves. A second possible explanation is that water use by the turf that was mowed high all year was greater than the turf that was mowed low in the spring and high in the summer. Another seasonal mowing height study conducted at Cornell University found that Kentucky bluegrass maintained at 3 inches all year used 14% more water than when maintained at 1 inch in the spring and at 3 inches the rest of the year.

*Table 1. Mowing and nitrogen source affects on the visual quality of Kentucky bluegrass subjected to drought stress.*

| **Mowing Regime** | **Visual quality** | | |
|---|---|---|---|
| (Sp:Su:Fall) | July 28 | August 2 | August 17 |
| HHH | 1.4 cd | 1.5 a | 4.3 bc |
| HHL | 1.9 bc | 1.5 a | 4.9 b |
| HLH | 1.4 cd | 1.3 a | 3.8 c |
| HLL | 1.4 d | 1.4 a | 4.0 c |
| LHH | 2.3 a | 1.8 a | 4.9 ab |
| LHL | 2.1 ab | 1.5 a | 5.1 a |
| LLH | 1.9 abc | 1.3 a | 4.3 bc |
| LLL | 1.8 bcd | 1.4 a | 4.1 c |
| Nitrogen | | | |
| Urea | 1.5 b | 1.1 c | 4.0 b |
| Sulfur Coated Urea | 1.9 a | 1.5 b | 4.6 a |
| Nitroform | 2.0 a | 1.8 a | 4.7 a |

One mowing practice that hastened deterioration of the turf during the drought and slowed recovery once water stress was alleviated was reducing the mowing height from a high mowing height in the spring to a low mowing height in the summer. Possible explanations for the poor performance of turf that was mowed in this manner include: 1) reduced water uptake caused by minimal summer root penetration, 2) increased heat stress caused by reduced plant transpiration and high soil surface temperatures and, 3) low nonstructural carbohydrates levels

High nonstructural carbohydrates levels facilitate rapid shoot regeneration once plants emerge from drought induced dormancy. Abruptly lowering the mowing height in late spring removed most of the verdure present in plots that were mowed high in the spring. This subsequently caused a flush of new shoot growth which likely lowered the nonstructural carbohydrates levels in the turf prior to the drought event. Depletion of the carbohydrate reserves would have delayed the turf's recovery once water stress was alleviated.

Nitroform and sulfur coated urea lessen deterioration in turfgrass quality caused by the drought event when compared to urea. These two fertilizers also enhance the recovery of Kentucky bluegrass once drought stress was alleviated. It is likely that the slow solubilization of nitroform nitrogen, and the slow release of nitrogen from the sulfur coated urea, provided some nitrogen to the turf over the summer which enhanced turfgrass quality during this time. It should be noted that prior to this drought stress event, the urea treated turf consistently had higher quality ratings than the Nitroform treated turf. The higher quality ratings were primarily due to darker green turf in the urea treated plots.

Mowing and nitrogen fertilization practices can also significantly effect the severity of diseases that strike turfgrasses. In Kentucky bluegrass, for example, summer patch is a disease that frequently occurs in lawns that undergo drought induced dormancy that are at least two years old. Low mowing during periods of heat stress and late spring application of high levels of nitrogen increase the severity of this disease. In areas of the country where this disease is a common occurrence low mowing (< 2.0 inches) during the summer months is a practice that should be avoided. Also, the long term use of slow-release acidifying fertilizers, such as sulfur coated urea, have been shown to reduce the severity of this disease.

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