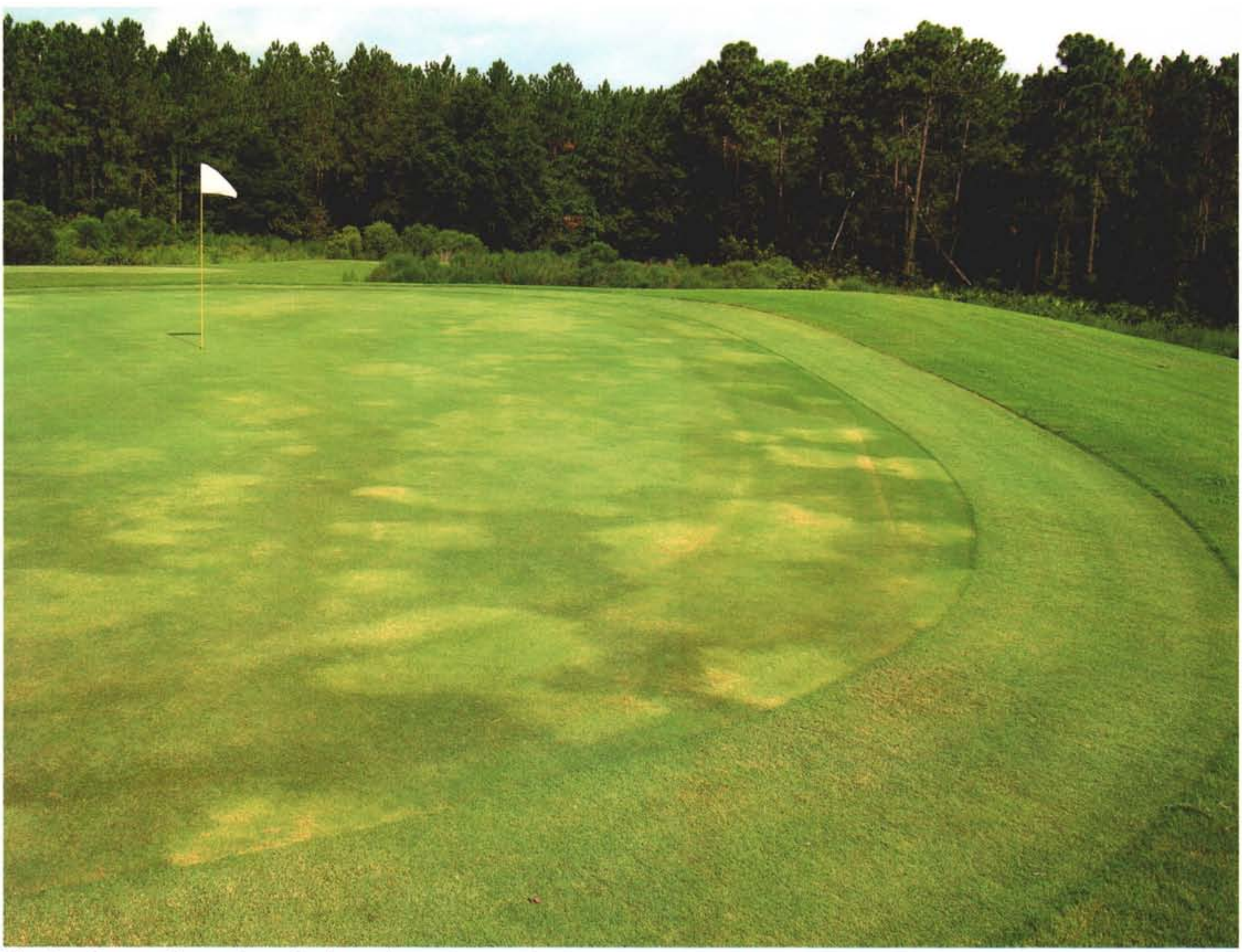
Are Ultradwarf Bermudagrass Cultivars Mutating?

Do the industry rumors that ultradwarf cultivars mutate mean that your putting greens will deteriorate?

BY J. EARL ELSNER

In the late 1990s, ultradwarf bermudagrass cultivars challenged the dominance of Tifdwarf on warm-season golf courses. In 2008, they are the cultivars of choice on a majority of southern golf courses. Their green speed, smoothness, and firmness delight golfers. The apparent absence of mutations encourages superintendents. Ultradwarf cultivars are planted on more than 14,000 greens, and it does not appear that the putting greens are developing off-type patches or deteriorating surface quality like Tifdwarf. There are examples of collar encroachment by Tifway and other cultivars. There are a few situations where plants from previous putting greens have survived and very few situations where contaminants were introduced from production fields or nurseries. Ten years and 14,000 greens with very few contamination issues is a remarkable accomplishment.



Mutations disrupt surface putting quality due to the ensuing contamination.

A stoloniferous or above-ground stem mutation is observed at an ultradwarf production field. These mutations can occur in various morphological forms, but certification agencies and producers work hard to ensure these rarely appear on putting greens.

However, it has not been uncommon to find apparent mutant off-type plants in ultradwarf production fields. Usually, but not always, these are individual patches that are tennis ball to basketball size. The morphology varies and is similar to typical off-type plants in Tifgreen and Tifdwarf putting greens and production fields. So the question becomes — why do ultradwarf mutations survive in production fields, but not in putting greens?

This article considers several questions about mutations in bermudagrass putting green cultivars. Hopefully, it will relieve superintendent concerns that ultradwarf green surfaces will deteriorate like Tifgreen and Tifdwarf. An important point is to encourage continued diligence by growers and certification agencies.

All DNA-based organisms have mutations, some more than others. Germ line nuclear DNA mutations are an important source of heritable characteristics used to develop superior cultivars. Mitochondrial DNA mutations are the basis of Darwinian evolutionary models, which suggest that modern humans have a common female African ancestor and support theories about human migration routes out of Africa. Somatic DNA mutations are the source of nectarines, navel oranges, novel ornamental plants, as well as Tifdwarf (Burton, 1965) and the ultradwarfs.

Discussions about mutations in putting greens cause fear and dread, but with the absence of somatic mutations, Tifdwarf and the ultradwarfs would not exist. None of the many thousand *C. dactylon* x *C. transvaalensis* seedlings in Drs. Glen Burton (1971), Wayne Hanna, and Charles Taliaferro's programs has equaled Tifdwarf or the ultradwarfs' close mowing tolerance. Therefore, mutation breeding and selection of naturally occurring mutants in the Tifgreen complex has been necessary for the development of cultivars capable of providing fast green speeds and surface quality required by golfers.

In the grand scheme of vegetative turfgrass propagation, the number of naturally occurring somatic mutation events resulting in different plant morphology is variable, but quite small. Caetano-anollés described the Tifgreen genome as unstable and calculated somatic mutation events in the Tifgreen complex to be less than 1 per 10^8 nucleotide generations (Caetano-anollès, 2002). On the other hand, the Tifway genome was described as being stable. Caetano-anollès' data confirm the extensive experience with Foundation and other Tifway nurseries where mutation occurrences have never been documented. Thus far, all off-types that have been investigated in Tifway plantings have been contaminants introduced from outside sources.

One mutation event in 10^8 nucleotide generations seems to be an almost negligible number. However, if the assumption is made that each bermudagrass stolon node (a node has the potential of at least two lateral buds and each lateral bud equals one nucleotide generation) represents one nucleotide generation, then considering the number of nodes in a production field or putting green, it should not be surprising that mutations may be an issue in Tifgreen and its derivative ecotypes. This simple correlation also emphasizes that freqently harvested sprig fields have a higher risk of mutations as compared to the relatively stable putting green environment. In a production field, massive numbers of vegetative buds are produced after each harvest. Each time a new vegetative bud forms, chromosomes are at risk to have changed, which can give rise to a new plant with different morphology and growth characteristics. Fortunately, a majority of mutations are not competitive and do not persist in the population, but those that do persist can cause considerable havoc.

This author has seen examples of many of the morphological types described by Burton and Powell (1971) in turf farms and putting greens around the globe. They vary from growth rates like Tifgreen to more dwarf than the ultradwarfs, leaf color from canary yellow to intense dark green, prolific seedhead production to almost an absence of seedheads, long narrow to short broad leaf blades, along with different responses to herbicides, high temperatures, and cool nights. It appears that an almost infinite number of morphological types can occur in the Tifgreen complex.

There is a great deal of evidence that the mutation potential of the Tifgreen complex is maintained in other members of the family, whether it is Tifdwarf, an ultradwarf, or other selections. Also, research in several laboratories utilizing various DNA fingerprint techniques has consistently shown that each of the current ultradwarf cultivars is closely related to Tifgreen and Tifdwarf and distantly related to the more genetically stable Tifway (Goatley et al., 2005; Williams, 2003). Therefore, it should not be unexpected that mutations occur in ultradwarf production fields. Field inspections support these conclusions.

Theoretically, the survival of a mutant depends on its selective advantage or disadvantage relative to the management of the matrix population where it occurs. Experience has shown the following relationships:

- When an ultradwarf type plant develops from a mutation event in a Tifdwarf putting green, the more dwarf plant should have a selective advantage for mowing height. If other physiological characteristics are at least equal, the mutant produces an expanding, dense, thatchy, and grainy circular patch. It also may contaminate other putting green areas via mechanical operations (vertical mowing, aeration, and cup placement).
- If contaminant sprigs with growth characteristics similar to Tifgreen or Tifdwarf are planted in a newly sprigged ultradwarf putting green, the contaminant will grow very rapidly and out-compete the ultradwarf. When mowing height is lowered, the competitive relationship shifts in favor of the ultradwarf. Ultimately, the non-ultradwarf plants will be suppressed by mowing and may disappear entirely, but in the interim, putting surface quality may be compromised.

The preponderance of evidence supports the premise that successful mutations occur in ultradwarf production fields, but mutants have not been an issue when the event occurs in ultradwarf putting greens. The reason for the ultradwarf mutants' apparent lack of competitiveness in putting greens is not known. It may be that they have physiological or other disadvantages, preventing the establishment of a distinct population in the putting green. It may be that the mutants' colors and leaf morphology under greens management is similar to the ultradwarf cultivar such that they blend in and do not disrupt the uniform putting green surface. Or, it may be a combination of these factors and others, depending on the characteristics of specific mutations.

Ultradwarf mutations in sprig fields, however, are and should be a cause for concern.

- If a mutant plant with growth characteristics similar to Tifgreen or Tifdwarf becomes established in an ultradwarf production field, each time the sprig field is harvested, the more aggressive plant will expand faster than the ultradwarf. After multiple harvests by traditional sprig digging equipment, the aggressive plant will likely become the dominant type.
- If a mutant plant with growth characteristics similar to or more dwarf than an ultradwarf occurs in a sprig field, the mutant may persist, but should not expand. However, if this mutant has significantly different leaf color and contaminates harvested sprigs, it may be noticeable in the new ultradwarf green.

Meticulous roguing is required to maintain genetic and morphological uniformity in ultradwarf production fields. One of the keys to the low frequency of contamination in ultradwarf putting greens is the attention that producers and certification agencies have placed on morphological uniformity as compared to the emphasis during most of Tifdwarf's tenure. It is important for turf growers and certification agencies to be even more attentive as the ultradwarf cultivars become older. The mutation potential should not change, but each new successful mutant adds to the potential cumulative off-type load that may be present in a production field. Each must be identified and removed, or else there may be a disaster waiting to happen.

The final question: When is a variant plant considered to be an off-type? Observant superintendents many times see plant variation in their bermudagrass putting greens and want a DNA fingerprint. The rule of thumb in the Georgia Certification program, almost a paradigm, is that DNA fingerprints are tools but not necessarily the final answer. *If a plant looks different, grows differently, or reacts differently, it is an off-type.* In certain situations the micro-environment will cause confusion such that a normal plant may take on characteristics of an off-type. Under these conditions, a uniform pot grow-out is used to confirm whether it is an off-type by comparison to a known standard of the cultivar.

A recent situation with seashore paspalum illustrates the reason that morphology and growth characteristics may be more effective than DNA fingerprints for labeling a plant an off-type. A putting green had off-color patches of suspect off-types. Three samples were obtained from areas with different color or growth characteristics. The DNA fingerprints indicated that one was different from the matrix cultivar, one was slightly different, and one was indistinguishable. However, all three plants met the off-type definition because they had different morphological and/or growth characteristics. The opposite also occurs when a DNA fingerprint may falsely label a plant as an off-type because the fingerprint utilized polymorphorisms that do not influence plant growth characteristics.

In conclusion, ultradwarf putting greens have a good track record of providing excellent putting surfaces with no indication of deterioration due to putting green mutations. Ultradwarf sod and sprig producers have been diligent in maintaining genetic, morphological, and physiological uniformity. Diligence will have to be increased if the next ten years are to be as successful as the first ten years of ultradwarf sprig and sod production.

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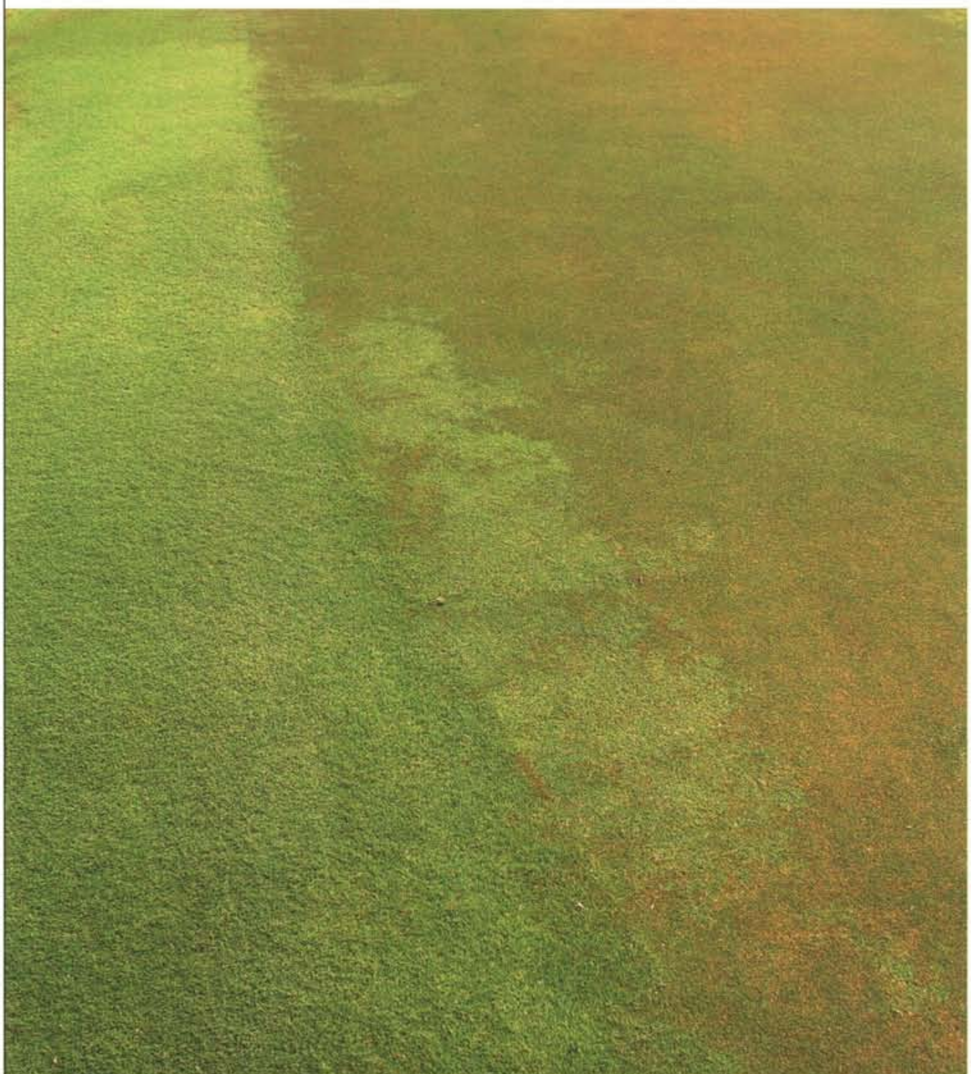

Tifway bermudagrass encroachment into an ultradwarf putting green surface occasionally happens, but it is very rare. Ultradwarfs usually have a significant advantage over bordering turfgrasses at low mowing heights on putting greens.