

OFF-TYPE BERMUDAGRASS - A CLOSER LOOK



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Venue:

Sustainable Turfgrass Management in Asia
March 8-10, 2010
Pattaya Thailand

Seminar Summary:

1. Introduction
2. Hybrid bermudagrass characteristics
3. History of bermudagrass varieties on greens
 - Tifton 328
 - Tifdwarf
 - MS Supreme
 - Floradwarf
 - Champion
 - TifEagle
 - MiniVerde
 - Novotek
4. Off types, mutations and contamination in bermudagrass greens
5. Morphological and molecular DNA studies of off-type varieties within Australia
6. Things to consider when selecting a new variety
7. Resources

OFF TYPE BERMUDAGRASS – A CLOSER LOOK

Bermudagrass is the most highly adapted grass for use on golf greens in hot, humid regions due to its superior heat tolerance and low water consumption. Tifton 328 (Tifgreen) and Tifdwarf bermudagrass have been the two most popular cultivars planted on putting greens worldwide.

Over the past 30 years a significant problem started to increase in existing stands of bermudagrass greens. Typically 5 -7 years after establishment it is possible to observe the forming of small patches that look and grow differently. These patches can be anywhere from several centimeters to 50 centimeters in diameter. These off types would spread throughout the green, mainly due to maintenance practices and physical movement of the small patches.

James Moncrief from the USGA began to write and research about this phenomenon and noted that off type areas were occurring in both Tifton 328 and Tifdwarf. In the mid 1970's, the problem was so pronounced with Tifdwarf that its use drastically declined for a number of years.

Many of the off types are highly undesirable and occur under low and high intensity management and have caused legal problems and millions of dollars loss to the golf industry.

More recently extensive research has been conducted to understand the off type genetic make-up and to commercially use select off types that have worthwhile traits such as increased density, uniformity, color and can withstand stressful environmental and maintenance conditions.

In recent years, golf courses have begun replacing Tifton 328 and Tifdwarf with one of several new so-called vertical or horizontal dwarf or "ultradwarf" bermudagrass cultivars. This trend is being fuelled by three distinct factors:

1. Older greens are badly contaminated with off type bermudagrass resulting in blotchy, inconsistent greens that scalp easily.
2. Golfers and management are demanding quicker / smoother greens with stimpmeter readings between 9 -10 daily, requiring cultivars that tolerate lower mowing heights.
3. Turfgrass breeders and sod producers are releasing cultivars that are significantly better and suit certain local conditions.

This seminar will review the adaptation of bermudagrass, current bermudagrass greens type cultivars on the market today, causes of mutations / contaminations and discuss some of the recent research conducted in Australia in relation to the morphology and DNA of Australian off type selections.

1. Hybrid bermudagrass characteristics

Numerous sterile interspecific triploid hybrid couch grasses are being used in the golf industry. Hybridisation is a common successful method used to create variation in plants. Interspecific hybrids are difficult to make and will usually develop sterile F₁ hybrids

Morphological and growth characteristics of hybrid bermudagrass

Parameters	Couch grass characteristics
Morphological characteristics	
Leaf texture	fine (1-3 mm)
Lateral shoot type	stolons and rhizomes
Leaf vernation	folded
Ligule type / length	hair (1-3 mm)
Auricles	absent
Leaf blade tip	pointed
Inflorescence	4 or 5 digitate spike like racemes
Chromosome count	2n = 3x = 27
Seed viability	sterile
Growth characteristics	
Carbon metabolism type	C ₄ (warm season)
Sunlight requirements for max photosynthesis	100% full sunlight (1,200 umoles)
Photo respiration presence	absent
Optimum air temperature for shoot growth	29 to 38 ° C
Optimum soil temperature for shoot growth	27 to 35 ° C
Optimum soil temperature for root growth	24 to 35 ° C
Growth limiting high soil temperature	38 to 43 ° C
Lethal soil temperature	49 ° C
Minimum air temperature for growth	13 ° C
Air temperature which causes shoot dormancy	10 ° C
50% root loss soil temperature	-8 to -5 ° C
Food storage type	starch
Pesticide tolerance	very good
Disease susceptibility	low
Salinity tolerance	high (1,000 to 2,000 ppm)
Mean summer ET rates	0.4 to 0.7 cm

Sourced from (McCarty and Miller 2002)

2. History of bermudagrass varieties on greens

Tifton 328 (Tifgreen)

- In 1946 a fine textured common bermudagrass was observed in a green in Charlotte, North Carolina, USA.
- Tifton 328 is a hybrid between the fine-textured common bermudagrass (Charlotte NC) and a fine leafed African bermudagrass (*Cynodon transvaalensis*) from East Lake Golf Club, Georgia.
- Tested as a group of individual hybrids from 1951-1956.
- Released from Tifton in 1956.
- Must be vegetatively propagated and produces no viable pollen or seeds ($2n=3x=27$).
- During the 1960's and 1970's Tifgreen was very popular because of the fine texture, dense turf and tolerance Tifgreen was suited for golf greens compared to the other varieties available at the time eg, Tiffine, Tiflawn and common bermudagrass.
- Tifton 328 has a lighter green appearance (lime color).
- Tifton 328 is still used today with success.

Tifdwarf

- Originated out of a vegetative mutant out of Tifgreen planting stock and was first tested in 1962.
- Discovered from two sources at a similar time.
- T.M Baumgardner and Marion McKendree at Sea Island, Georgia in 1962 (8 year old Tifton 328 greens).
- USGA agronomist James B. Moncrief discovered a small patch in a Tifton 328 putting green at the Florence Country Club, South Carolina.
- Southern Turf Nurseries, Georgia also started selling Tifdwarf from another source (Glen Alvin Country Club) at the same time after release.
- Tifdwarf is also a sterile Triploid hybrid as with Tifton 328.
- Tifdwarf was tested and compared with Tifton 328 for three years at the Georgia Experiment Station and demonstrated superior turf characteristics for putting greens, compared to Tifton 328.
- Tifdwarf has softer leaves and fewer seed head stalks than Tifton 328.
- Darker summer color is realized over Tifton 328, but Tifdwarf can exhibit a purple leaf earlier in the autumn / early winter compared to Tifton 328.
- In 1965, Tifdwarf was officially released.

MS Supreme

- Released from the Mississippi Agr. Experiment Station December 16, 1997.
- Originated as a selection in 1991 from a Tifgreen bermudagrass golf green collected from Gulf Shores Golf Club, Alabama USA.
- Internode length is shorter than Tifton 328, but similar to Tifdwarf.
- MS Supreme has finer leaf texture than Tifton 328 and Tifdwarf.
- Vigorous growth and its dwarf growth characteristics will require intense management programs for thatch control.

Floradwarf

- Off-type plant that was sourced from an eleven year old Tifgreen putting green in Kauai, HI.

- Floradwarf is a sterile triploid ($2n=3x=27$) requiring vegetative establishment.
- DNA analysis shows that Floradwarf is uniquely distinguishable from Tifton 328 and Tifdwarf bermudagrass.
- Floradwarf has high turf density compared to Tifdwarf due to the many short stolons, short internodes and shorter leaf blades.
- Unmowed, Floradwarf will grow to a height of 8mm.
- Floradwarf is capable of developing rapid thatch in a short period of time.
- Floradwarf has a highly horizontal growth habit.
- Floradwarf was released by the Florida Agr. Expt Station in 1997.

Champion

- One of 70 off type clones selected by Coastal Turf in 1970s – 1980's. Released in 1995.
- Characterized as a vertical dwarf, which exhibits a slow, vertical leaf elongation rate, which is 56% slower than Tifdwarf.
- It has 2.6 times greater stolon density than Tifdwarf.
- The internode length and number of internodes (per stolon) are no different than Tifdwarf and Tifton 328.
- Produces no seed heads.

TifEagle

- Starting at Tifton in 1969 research begun which was designed to produce mutants in Tifdwarf and Tifgreen 328 couch grass.
- TifEagle is an induced mutaton from irradiating dormant Tifway II stolons in 1990.
- Sterile triploid hybrids can be modified by exposing dormant sprigs to 7,000 to 9,000 rad of gamma rays from a cobalt-60 source.
- Off type genotype from one of 48 mutants.
- Vegetative variety selected for the ability to produce high quality turf when mowed at 4mm or less, along with lack of seed heads and low levels of mole cricket infestations.
- Produces more thatch than Tifdwarf, when mowed at 3mm.
- Produces more stolons that Tifdwarf.
- Sterile vegetative hybrid.
- TifEagle was cooperatively released by the USDA-ARS and the University of Georgia Coastal Plains Experiment Station in august 1997.
- Strict licensing and select producers were appointed to grow the grass (remember Tifdwarf became contaminated quickly once random nurseries started with poor quality).

MiniVerde

- A vegetative selection from what is believed to be a mutant of "Tifdwarf".
- The variety was produced in 1992.

- MiniVerde has very fine leaves, a rapid lateral growth rate and is uniform in color.
- Thomas Brother Grass company launched the cultivar.

Novotek (TL2)

- Vegetative material was taken from a disease resistant mutant plant from a golf green in Cairns, Northern Queensland, Australia in 1996.
- First sold commercially in Australia in 2003.
- Dense, fine texture.
- Shown to actively grow in the tropical wet season.

3. Off types, mutations and contamination in bermudagrass greens

Several possible reasons for the cause of these off type have been reported including:

- Contamination of breeding stock.
- Introduction of off type seed or vegetative parts into established greens
- Genetic mutations.

We know that there is a lot of variation that we see in nature. Variation is a combined product of a genetic effect and an environmental effect.

A mutation is an induced or randomly occurring shift in the grass genome. Alterations in the DNA that change its information content and thus produce new alleles are called mutations. A true mutation can occur on a bermudagrass green, and has been known to do so. The mutation is a genetic change, which may be induced by environmental pressure (low and frequent mowing, herbicides, heat, drought, solar radiation etc..)

Remember that:

1. Tifton 328 is a sterile, triploid hybrid,
2. Tifdwarf is a mutation out of Tifton 328.
3. Champion is a mutation, probably out of Tifton 328 or Tifdwarf
4. MS Supreme is a mutation out of a Tifton 328 green in Alabama etc...

Studies have shown that the application of dinitroaniline class of preemergence (Pendamethalin) herbicide can affect mitosis, cell division, root growth and has caused abrupt mutations in triploid bermudagrass.

Remember we as Turfgrass Managers are constantly putting the greens under stress...!!!

4. Morphological and molecular DNA studies of off-type varieties within Australia

The origins of off-types and mutations is unknown in many golf greens, they are probably the results from either contamination or genetic variation of the original planted material. Morphological differences can easily be seen over time which is the first sign of variation within the turfgrass stand. Proper analysis is required at the DNA level to characterize and specify relationships of organisms.

Darren Moore conducted extensive morphological and molecular DNA testing on off type selections that originated from hybrid (triploid bermudagrass) greens within Australia.

Twelve Australian off types were tested against the existing commercial varieties present in Australia (Tifton 328, Tifdwarf and TifEagle).

Morphological testing and measuring included:

<ul style="list-style-type: none"> • Internode Length • Internode Width • Stolon Width • Leaf Width • Longest Runner 	<ul style="list-style-type: none"> • Average 5 Longest Runners • Seed Head Counts • Top Growth • Plug Spread Rate • Sprig Establishment Rate
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Weekly measuring for all of the above parameters took place for 3 months.



Significant differences were recorded after morphological testing in many of the parameters. Several Australian off types established quicker, had finer leaf widths and had lower top growths compared to commercial varieties.

DNA analysis is more difficult to separate off type varieties as they are all so closely related. Several of the off type varieties showed different DNA banding pattern differences.

5. Things to consider when selecting a new variety / ultradwarf in the future

New type ultra dwarf bermudagrass demand unique care. Before committing on a new variety one must consider many factors such as

- Clubs / management / members expectations
- Budget
- Equipment needs such as topdressors, verticutters, groomers, corers
- Labor number and ability
- Ability to perform extra cultural management programs to reduce thatch
- Advisable to trial new type cultivars at your own club

Always take the time to inspect local cultivars or ultradwarfs that have performed in your area – just because one type is doing well in the USA, doesn't mean it will perform in your area.

Superintendents who are willing to take on the management needs of these grasses will be rewarded with turf quality that often exceeds that of Tifton 328 and Tifdwarf.

6. Resources

- **United States Golf Association**
USGA Green Records
www.usga.org/course_care/green_section_record/Green-Section-Record/