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TURFAX™

Volume 6, Number 2

March–April 1998

of the International Sports Turf Institute, Inc.

The International Newsletter about Current Developments in Turfgrass

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Fast Putting Surfaces Cause Major Cultural Changes

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The golfer movement to more fast putting green surfaces has changed the cultural practices on greens, including very close mowing of 5/32 to 1/8 inch (4.0 to 3.2 mm). These very close mowing heights tend to cause a reduced shoot density in many cultivars, and a resultant decline in surface turf quality and increased *Poa annua,* moss, and algae problems. The very close mowing also has emphasized:

1. the potential for proper turf rolling.
2. the problem of spike marks caused by traditional metal spikes.
3. the need for turfgrass cultivars that sustain shoot density and rooting at 1/8 inch (3.2 mm) cutting height.
4. changes in turfgrass cultural practices.

Turf Rolling of Putting Greens Constructed With High-Sand Root Zones

The potential benefits of rolling putting greens reentered the cultural picture due to (a) the extensive use of high-sand root zones in putting greens, thereby greatly reducing the potential for soil compaction problems from turf rolling and (b) the preference of golfers for fast ball roll speeds which have been achieved principally through very close mowing heights, which also result in further shortening of the root system, reduced turfgrass health and canopy density, and an increase in moss and algae problems.

This situation leads to the possibility that increased ball roll distance can be achieved by turf rolling rather than by extremely close mowing heights. The result would provide the opportunity to raise the cutting height, thereby achieving better overall turf health, rooting, and canopy density, plus an associated reduction in moss and algae. Research findings from turf rolling on creeping bentgrass putting greens are summarized as follows:

- a single turf rolling in early morning consistently **increased distance of ball roll by 10%** at the morning reading.
- combinations of 1, 2, 3, and 4 consecutive turf rollings each morning increased the distance of ball roll by 10 to 20%.
- a **2-day post turf rolling effect** can be achieved in most situations.
- there was no increase in the distance of ball roll when the turf rolling pressure was increased from 4.8 to 11.9 pounds per lateral inch (0.86–2.12 kg per lateral centimeter).
- the distances of ball roll were similar when the turf was rolled with the direction of mowing in comparison to when the turf was rolled against the direction of mowing.
- operating speed during turf rolling did not influence the distance of ball roll.

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- **there was a decided visual improvement in surface smoothness** as a result of turf rolling.
- turf rolling **should not exceed 2 to 3 times per week** on a long-term basis on high-sand root zones.

Note: No research data are available on turf rolling for bermudagrass putting greens.

Trend to Alternative Spiked Shoes

The demand for fast greens produced via very close mowing has resulted in increased problems with spike marks. Thus, the introduction of alternative spiked golf shoes is receiving increasing acceptance. The primary benefit to golfers is a major reduction in spike marks on putting greens. The grass shoot density on greens is sustained at a higher, more acceptable level where play does not involve the metal spiked shoes. **Studies also have shown that golf balls roll significantly farther and more true on turfs where alternative spiked shoes were used in comparison to metal spiked shoes.** Furthermore, there is less damage to other high traffic turf areas, such as entrances and exists to greens and tees and to the actual teeing area itself, especially for tees of relatively small size.

Additional benefits are derived for the golfer in terms of reduced costs for golf course maintenance, including reduced damage to wooden bridges and stairs, cart paths, golf carts, clubhouse flooring, synthetic mats, and even mowing equipment when a metal spike is lost from a shoe and subsequently is hit by the mower bedknife and blade, which causes severe damage and high repair costs. This multiplicity of benefits of alternative spiked shoes is causing a major usage change within the golfing community. **Now the question requiring research is which of the alternative spike designs is most beneficial?**

New Bentgrass Cultivars for Very Closely Mowed Putting Greens

The trend to faster greens has led to the development of new very-high-density creeping bentgrass (*Agrostis stolonifera*) cultivars that are quite tolerant of very close (1/8 inch [3.2 mm]) cutting heights. Among them are Penn A-1, Penn A-2, Penn A-4, Penn G-1, Penn G-2, and Penn G-6, which have recently been released by Pennsylvania State University. These cultivars have received more comparative, documented quantitative assessments over multiple years of research than the others recently released. The findings are:

- superior shoot density, usually exceeding 2,500 shoots per square decimeter.
- a finer leaf width, typically less than 0.7 mm.
- top ranked visual estimates of surface quality.
- top ranked rooting, especially under midsummer heat stress.
- very good tolerance to mowing of less than 4 mm.

The higher shoot density and finer leaf texture contribute to surface quality in terms of greater ball roll distance on greens. Also, a higher shoot biomass can contribute to better overall wear stress tolerance.

With this diversity of newer high-density cultivars, there may be a potential to use them on a selective regional climatic basis, which will be influenced primarily by the heat stress resistance and relative susceptibility to various diseases. The overall comparative disease susceptibility or resistance is not fully known for these cultivars, but should evolve over time as they become more widely used in various climatic regions. For example, Penn G-2 is showing susceptibility to the *Typhula* blights in the northern climates.

New Bermudagrass Cultivars for Very Closely Mowed Putting Greens

The dominant hybrid bermudagrass cultivar used on putting greens for more than 30 years has been Tifdwarf. However, at the very close mowing heights now in use, Tifdwarf shoot density is substantially thinned, resulting in openings for the invasion of moss, algae and *Poa annua*. Four new dwarf hybrid bermudagrass (*Cynodon dactylon* x *C. transvaalensis*) cultivars have been released that may minimize these problems.

Floradwarf was released from the University of Florida, with significant quantities of vegetative planting material being available since 1996. Limited published comparative quantitative research data are available. It has been described as having a very low unmowed growth habit, and appears to have slower leaf and stem growth rates and a higher shoot density than Tifdwarf, and is essentially nonflowering.

Champion was released in 1995, with substantial quantities of vegetative planting material available in 1996. Research data have been published for Champion comparing it to Tifdwarf and Tifgreen. The documented results for Champion are summarized as follows:

- vertical leaf extension rate on the order of 56% slower than Tifdwarf.
- leaf width was 13% narrower than Tifdwarf.
- stolon numbers on the order of 2.6 times greater than Tifdwarf.
- the length and number of internodes no different than for Tifdwarf and Tifgreen.
- substantially better wear tolerance than Tifdwarf at a 1/8 inch (3.2 mm) cutting height.
- significantly more rapid divot-opening recovery rate, being 1.8 times more rapid than Tifgreen and 3.4 times more rapid than Tifdwarf.
- substantially higher shoot density was sustained at a 1/8 inch (3.2 mm) cutting height, being 93% greater than Tifdwarf.

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elevated phosphorus levels in tissues, Aliette Signature + Fore-treated leaves consistently contained greatly elevated manganese levels and sometimes elevated zinc, magnesium and sulfur levels. There was, however, no increase in manganese or other micronutrients in tissues from plants treated with the equally beneficial Aliette Signature + Daconil treatment. Hence, it appears that manganese and other enhanced micronutrient levels in fungicide-treated plants cannot be directly correlated with the improved color responses observed. Because color enhancement from the fungicides occurs during diverse environmental conditions in the absence of disease, it would appear that the improved quality is more physiological than chemotherapeutic. Perhaps these fungicide tank-mixes are enhancing other pigments (e.g., *anthocyanins, carotenoids*, etc.) or possibly they in some way promote more efficient rooting, photosynthesis, respiration, or other physiological processes.

The decline in bentgrass that we see in Maryland during mid-to-late summer appears to be mostly a combination of abiotic stresses including one or more of the following: high temperature, high humidity, shade, excessively wet soils; or mechanical injury from mowing too low or from grooming greens during hot weather when bentgrass is not actively growing. The research conducted at Kansas State University indicates that bentgrass roots will shorten and darken in color as soil temperatures rise in the summer. The decline in roots will naturally occur throughout the summer until root initiation and regrowth of the root system resume with the advent of cool and moist weather in the autumn.

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- has not been observed to form seedheads in over 9 years of observation.
- exhibited slightly better low-temperature hardiness than Tifdwarf and Tifgreen.
- Champion, Tifdwarf, and Tifgreen all had poor shade adaptation.

Based on these research assessments, Champion may be described as a **vertical dwarf hybrid bermudagrass in that it has a slow vertical leaf extension rate but rapid lateral stem development.** It is the first cultivar to exhibit this unique type of morphological-growth characteristics. The high shoot density, fine leaf texture, and slow vertical leaf extension rate of Champion contribute significantly to improved surface ball roll distance on putting green surfaces, with distances easily exceeding 9 feet (2.7 m) and well into the 10 foot (3.0 m) range. Champion has been successfully winter overseeded, but for best performance requires adjustments in the procedures followed.

MS Supreme was released by Mississippi State University in 1997, with significant quantities of vegetative planting material being available in 1998. Limited published comparative quantitative research data are available. It would appear to be a vertical dwarf type, with a substantially higher shoot density than Tifdwarf. It has good tolerance to a 1/8 inch (3.2 mm) mowing height.

TifEagle was released from the Georgia Coastal Plain Experiment Station in 1997, with some vegetative material available in 1998 and substantial quantities in 1999. Limited published comparative quantitative research data are available. TifEagle has improved shoot density compared to Tifdwarf, but preliminary data show it to be significantly lower in density compared to Champion, especially at a 1/8 inch (3.2 mm) cutting height.

At this time not much is known about the comparative characteristics and long-term performances among these four new dwarf bermudagrass cultivars. This is particularly true in the areas of growth-morphology, and in disease, insect, and nematode resistance and/or susceptibility. Further research is obviously needed.

Turfgrass Cultural Changes

The very high shoot density bentgrass and bermudagrass cultivars will perform best at mowing heights of 1/8 inch (3.2 mm). Less time, chemicals, and money will be spent on *Poa annua*, moss, and algae control. However, **it should be emphasized that these very-high-density cultivars will require some changes in the turfgrass cultural program to maximize their performance.** Included may be (a) up to weekly high-density, mini-tine cultivation, especially during periods of rapid shoot growth, (b) up to weekly, regular vertical cutting for biomass management, especially during periods of rapid shoot growth, and (c) a somewhat lower nitrogen fertility program.