# High Quality Fairways and Roughs vs. Low Quality Irrigation Water: The Fairbanks Ranch Study

by Wendy Gelernter, Ph.D. and Larry J. Stowell, Ph.D.

Golf courses around the country are increasingly facing turf management problems brought about through the use of low quality irrigation water. Whether it is poor quality well water, reclaimed water or even domestic water, the high salts, boron and other elements that characterize these waters are a threat to turfgrass health that require new management practices to overcome.

In July of 2000, the PACE Turfgrass Research Institute initiated a 3 year study deisgned to answer the following questions:

- Is it possible to grow high quality, uniform fairway and rough turf on a year-round basis when irrigated with low quality water?
- If so, what management changes (overseeding, irrigation practices, variety selection) will be necessary?

In this issue of *PACE Insights*, we will provide you with a report on our progress, half-way through this three year study. In addition, a public information website for the Fairbanks Ranch Research Project is periodically updated to provide you the most recent data: (**www.pace-ptri.com/fairbanks/fairbanks.htm**).

## Turf varieties and water sources tested

A total of nine turf varieties are being tested -- 6 cool season turfs for use in the rough (mowed at 2"), and 3 warm season varieties for use in fairways (mowed at 1/2"). Both standard varieties and new, salt tolerant varieties were included:

1. Brightstar II: standard rye
2. Charger II: salt tolerant rye
3. 2SLX: salt tolerant rye
4. Bonsai: standard tall fescue
5. Tomahawk E: salt tolerant fescue
6. 5TOR: salt tolerant fescue
7. Tifway II hybrid bermudagrass: standard bermuda
8. Excalibur/Adalayd paspalum: standard paspalum
9. Sea Isle I: improved paspalum

Twelve plots of each variety were planted in September, 2000. To test the effect of water quality on their performance, a salinity gradient irrigation system was designed and installed. Four plots of each variety were irrigated with one of three different water qualities:

1. **Well water (poor quality)**
2. **Domestic water (good quality)**
3. **One half domestic water, one half well water (mid quality)**

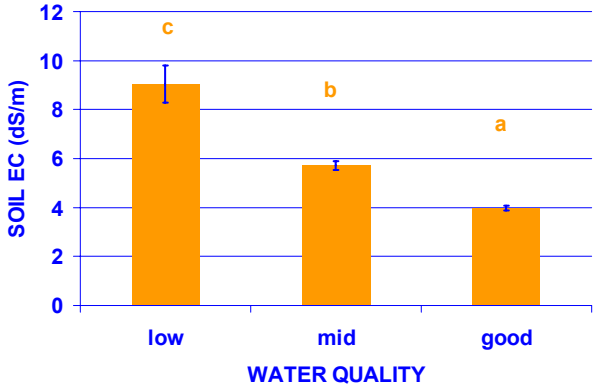
**Table 1.** Water sources used. EC = electrical conductivity, measured in decisiemens/meter; SAR = sodium absorption ratio.

| | Well water | Domestic water | Desired values |
|---|---|---|---|
| EC (dS/m) | 2.97 | 0.84 | less than 1.2 |
| $SAR_{adj}$ | 10.09 | 3.72 | less than 11 |
| Boron ppm | 0.9 | 0.15 | less than 0.5 |

## Progress on the salinity gradient

A salinity gradient has been successfully established in the test plot area, with soil ECs reaching higher than 9 dS/m in the poor quality well water plots, an average of 6 in the mid quality water plots, and an average of 4 dS/m in the good quality water plots (Figure 1). As the trial progresses, we expect soil salts and boron to continue to accumulate to even higher levels, which will help us determine which turf varieties do the best job of tolerating these adverse conditions.

**Figure 1.** Soil salinity accumulation in areas irrigated with poor, mid and good quality water. Samples taken 12/7/01.




## Establishment of warm season turf

In general, warm season turf varieties are more tolerant of high soil salts than cool season varieties. And among warm season varieties, seashore paspalum is one of the most salt tolerant (Table 2). For this reason, our observations on the establishment of the warm season turf varieties came as a bit of surprise (Figures 2 and 4). We found that salinity had a negative effect on establishment of warm season turf -- particularly Sea Isle paspalum. However, by September of 2001 (approximately 1 year after planting), both the bermudagrass and paspalum had fully established and were performing well in all three water qualities (Figure 3)

**Table 2**. Relative tolerance of turfgrasses to soil salinity. dS/m = decisiemens per meter, and is a measure of salinity, or electrical conductivity. **Blue type** = cool season turf; **Red type** = warm season turf.

| Sensitive<br><3 dS/m | Moderate<br>3-6 dS/m | Somewhat tolerant<br>6-10 dS/m | Tolerant<br>>10 dS/m |
|---|---|---|---|
| Annual bluegrass | Annual ryegrass | Bentgrass cv. Seaside | Alkaligrass |
| Colonial bentgrass | Chewings fescue | Perennial ryegrass | Bermudagrass |
| Kentucky bluegrass | Creeping bentgrass | Tall fescue | Seashore paspalum |
| Rough bluegrass | Hard fescue | Buffalograss | St. Augustinegrass |
| Centipedegrass | Bahiagrass | Zoysiagrass | |

Data adapted from: Harivandi, M.A., Butler, J.D., Lin, W. 1992. Pp. 207-230 In "Turfgrass", Waddington, D.V., Carrow, R.N. and Shearman, R.C. eds. Monograph no. 32, American Society of Agronomy, Madison, WI.

**Figure 2**. On March 8, 2001 (6 months after sprigging), both Tifway II and Sea Isle had only sparse cover in the poor quality water plots.

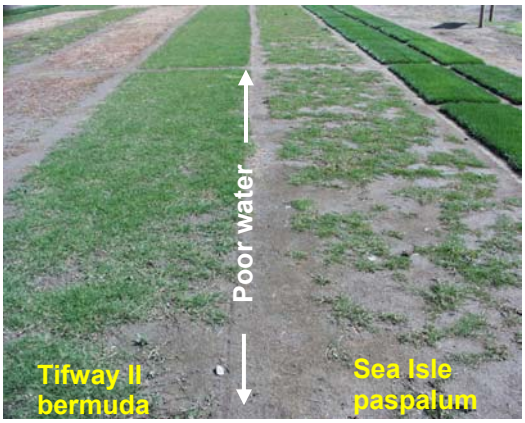
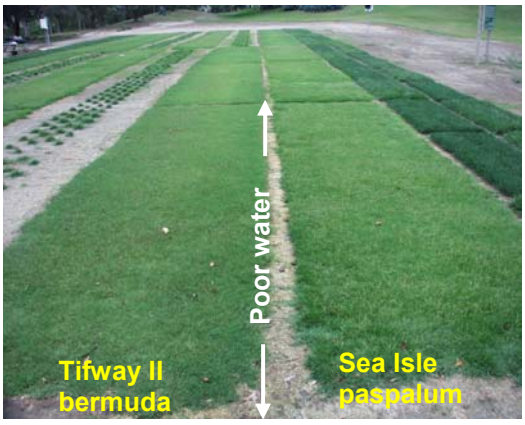


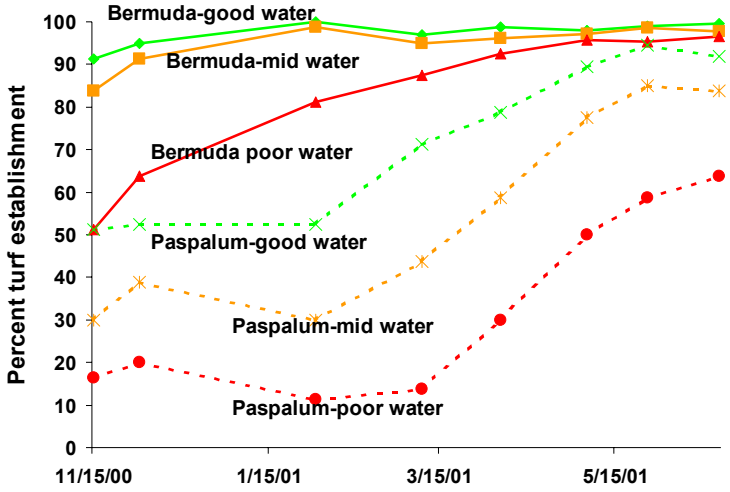

**Figure 3.** On 9/10/01, one year after sprigging, both Tifway II and Sea Isle paspalum had fully established in all three water treatments.




**Bottom line on warm season turf establishment:** Establishment of Sea Isle paspalum will be most easily accomplished if a source of good quality irrigation water is used during grow-in. Once turf cover is full, poor quality irrigation water can be used.

Although Sea Isle paspalum is a more visually attractive turf once established, it's failure to establish when irrigated with low quality irrigation water is a yellow flag for this variety.

**Figure 4**. Establishment of warm season turfgrass varieties. Note that both Tifway II bermudagrass and Sea Isle paspalum had much slower rates of establishment when irrigated with poor quality water. However, the bermudagrass appears to establish more rapidly than paspalum with poor quality water.




## Performance of warm season turf following establishment

During the spring and summer months, Sea Isle I paspalum had a darker green, denser and overall higher quality appearance than Tifway II bermudagrass. However, as winter approached and temperatures dipped below 55F, Sea Isle I paspalum appeared to lose its color more rapidly than the bermudagrass, as seen in Figure 7.

**Bottom line on performance of warm season turf:** Paspalum appeared to lose its color during cool weather more rapidly than bermudagrass. However, this has not been observed in all locations. At this point, it is too early to draw firm conclusions about the winter time performance of either variety.

## Performance of cool season turf

All cool season turf varieties established well in all water qualities tested (seeding rate was 350 lb/A). We have yet to see a turf quality decrease that is related to high soil salts (Figure 8). We expect this to change as the salinity gradient becomes steeper.

At this point, the most dramatic results are related to turf variety. We see that tall fescue, particularly Tomahawk and 5TOR, consistently performed better than the perennial ryegrass varieties -- in all water qualities tested (Figures 5, 6 and 8).

**Figure 5.** All cool season varieties performed well during the spring (5/25/01).

**Figure 6.** During the heat of the summer, all three ryegrass varieties suffered decreases in quality, while the fescues continued to perform well (8/1/01)


**Bottom line on cool season turf performance:** Tall fescue is a much more hearty and robust turf type for use on roughs than ryegrass, especially during the hot summer months. However, the coarser and less upright growth habit of fescues is less appealing to golfers, and tolerance to traffic under high soil salt conditions still remains to be evaluated. We will continue to evaluate the ryegrasses, fescues and other cool season varieties and blends for performance under higher soil salt and heavy traffic conditions.

**Figure 7**. Turf quality, as quantified by chlorophyll meter readings. Data taken 12/7/01 from non-renovated, non-overseeded plots illustrates that paspalum may enter dormancy earlier than bermudagrass.

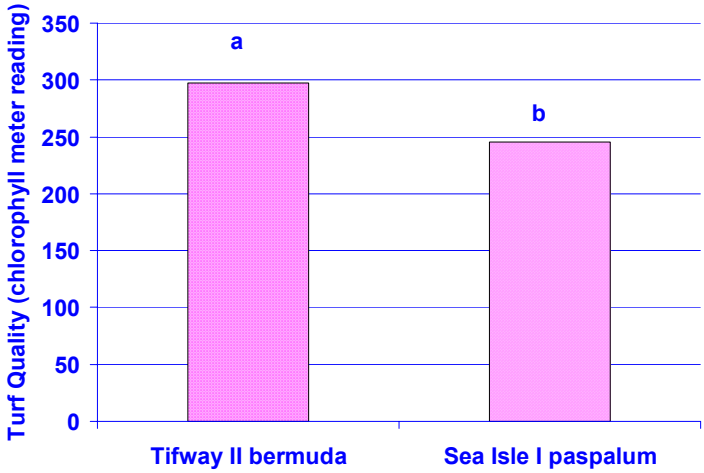
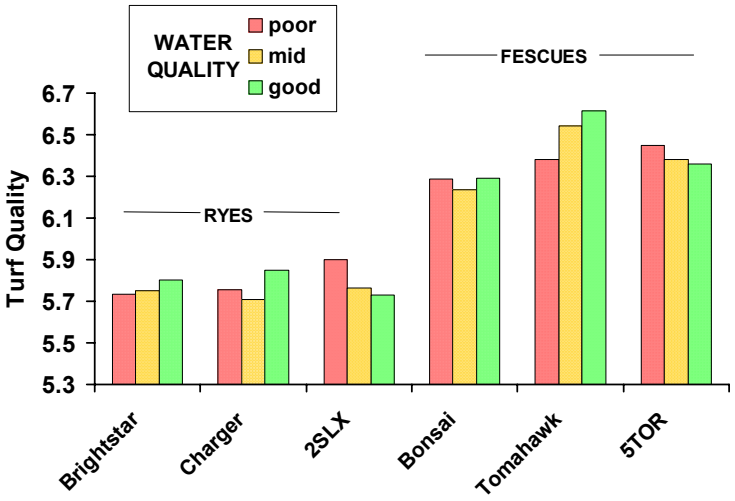



**Figure 8**. Performance of cool season turf varieties. Quality was rated on a 0 - 9 scale, where 0 = dead turf and 9 = best possible quality turf. Quality ratings are an average of biweekly ratings made from 11/15/00 - 11/12/01.




## Performance of overseeded turf

In October 2001, we initiated overseeding studies on the warm season turf varieties to investigate the effect of the factors below on the success of overseeding and on the spring transition.

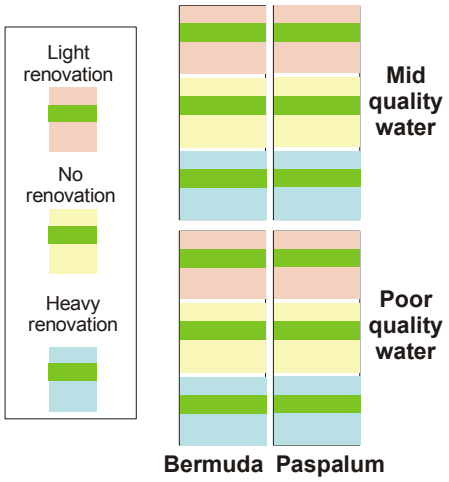
- 3 different renovation strategies: none, light [2 passes with a McClane mower] or heavy [Ryan Ren-O-Thin followed by scalping with McClane mower)
- overseeding (400 lbs/A perennial ryegrass) or no overseeding
- water quality
- turf variety

**Bottom line on overseeding practices:**
Although we must wait until the spring transition to draw firm conclusions, our preliminary results show that:

- Initial germination and growth of ryegrass was decreased in the poor quality irrigation water plots.
- A soil EC of 4.0 dS/m or below was necessary for optimum rye germination and establishment.
- Due to its denser growth habit, paspalum was more difficult to renovate.

**Figure 9a.** Overseeding study, two weeks after overseeding, 10/16/01. See diagram (Figure 9b) below to identify the treatments illustrated in the photo. Note that ryegrass germination is minimal in the poor quality water areas, but increases in density as water quality improves. The denser growth habit of the paspalum made it more difficult to renovate. 8 weeks after this photo was taken, the dark green color of the paspalum had faded due to cooler weather.

**Figure 9b**. Diagrammatic illustration of photograph above. Green bars indicate areas where turf was overseeded in either heavily, lightly or non-renovated turf.




## Study support

In many ways, this study is a model of the way that we hope future research efforts will be funded -- through a collaboration among golf courses, consultants, superintendent organizations, private companies and universities.

Financial support of the study has been provided by:

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