To Overseed or not to Overseed: It's a Matter of "Degree"

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Bottom line: Deciding whether overseeding is the right strategy for your golf course depends on an overwhelming number of factors, including weather, soil quality, cultural practices and turf varieties. However, there is no single factor more important in this decision-making process than the daily air temperatures at your location. To demonstrate this, we have developed a turf growth model (TGM) that describes the critical role of air temperature in determining which turf type – warm season vs. cool season – will predominate at any give time, and in any given location. The model is useful for helping to explain the biological reasons behind the ups and downs that you experience with optimizing turf growth at your own golf course, and for providing a basis for improved future management strategies.

When successful, winter overseeding programs result in consistent, vigorous turf growth, and do not interfere with the spring transition back to warm season turf. Yet despite superintendent's best efforts, overseeding programs are not uniformly successful – from location to location, or even from year to year. Which forces drive the performance of overseeding programs? Are management practices, such as renovation, timing and rate of seeding, or irrigation and fertility responsible for overseeding successes or failures? Or does success hinge solely on the vagaries of Mother Nature – with temperature, rainfall, wind and humidity directing the show?

In this issue of *PACE Insights* we will show you the dramatic and overwhelming effect that temperature has on the success of warm season vs. cool season turf growth, and therefore on the success of overseeding programs. To illustrate this, we have developed a new tool, the "Turfgrass Growth Model" which can be used at your location to help shed some light on the reasons behind your past overseeding experiences. Even if you don't overseed, this model can be used to help you understand the behavior and needs of your turf – whichever variety or varieties you use.

Warm vs. cool season turf: Vive la différence!

Successful overseeding exploits the fact that there are important biological differences between warm season and cool season turf varieties. The most important contrast between the two turf types is that cool season turf grows best between air temperatures of 60° and 75°F, while warm season turf grows best at air temperatures between 80° and 95°F. This is illustrated in Figure 1 below.

Figure 1. Percent growth of cool season turf (blue curve) vs. warm season turf (red curve) at various average air temperatures.

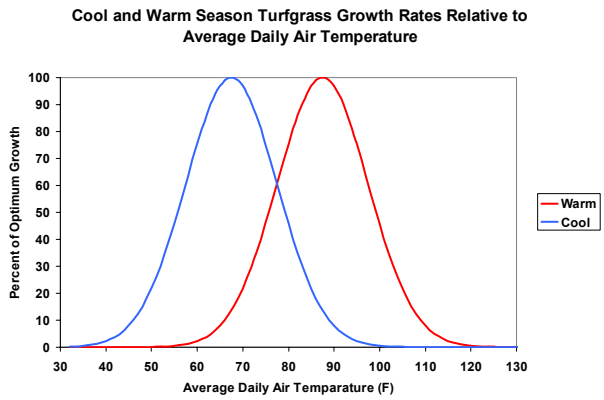


Table 1. Characteristics of cool and warm season turf species. Temperatures are air temperatures.

Cool season turf	Warm season turf
Grows best 60°-75°F	Grows best 80°-95°F
Minimum growth over 85°F and below 50°F	Minimum growth (dormancy) below 55°F
Bluegrass, fescue, bentgrass, ryegrass	Bermuda, paspalum, buffalo, zoysia, St. Augustine, centipede, bahiagrass
Sensitive to heat, drought and salts	Tolerant to heat, drought and salts
Plant uses C3 carbon fixing cycle in photosynthesis	Plant uses C4 cycle, a modification to help plant deal with heat

To overseed or not? That is the question

Figure 1 (see above) is a good graphic illustration of two well-known facts that nevertheless bear repeating:

- In locations where average air temperatures are lower than 80°F on a year-round basis, cool season varieties will perform best, and overseeding will be unnecessary (unless there are extenuating circumstances such as high salts, as described below). Most of the northern half of the U.S., as well as the coastal areas of the West fall into this category.
- In locations where average air temperatures range between 75° and 100°F on a year-round basis, warm season varieties will perform well at all times, and overseeding will be unnecessary. There are very few areas in the U.S. that fall into this category, with the exception of parts of Hawaii and Guam.

The TGM: A tool for evaluating turf performance

Most locations in the southern half of the U.S. do not fall into either of the categories above. In these areas, the decision to overseed becomes more complex, but is still driven primarily by temperature. To untangle some of this complexity, we have developed the "Turf Growth Model", or TGM, which summarizes the daily growth patterns of warm season and cool season turf when averaged over a 30-year period. To show you how the model works, we have used it to evaluate turf growth at three very different golf course locations in California (see page 4).

Where does your location fit in?

Do any of the three scenarios painted on page 4 describe your situation? Or do you fall somewhere in between? To get a better idea of what goes on nationwide, as well as at individual locations, we have used the TGM to estimate warm season and cool season turf monthly growth at different U.S. locations that were selected based on proximity to *PACE Insights* readers. This information appears on the enclosed **PACE Insights Reference 6:3** insert in the table entitled "Table A: Percent Warm Season and Cool Season Turfgrass Growth in Selected U.S. Locations". Here are some guidelines for using this table.

- Start by looking at the extreme environments – for example, in Guam, where exclusive use of warm season turf is optimal. In contrast, in Boston, MA, where exclusive use of cool season turf is optimal, temperatures aren't sufficient to support warm season turf growth, even in the hottest months of the year.
- Next, take a look at some of the "ideal" overseeding environments – Palm Springs, CA; Phoenix, AZ or Tampa, FL. Note that all of these locations are characterized by four or more months per year that favor warm season turf growth and inhibit cool season growth, and with the remaining months too cool for active warm season turf growth. Many areas of Florida, Texas, Louisiana and Southern California fall into this category.
- If you don't fall into any of the above three categories, you are in that gray, borderline area where overseeding may or may not be beneficial. In these cases, factors that are **not** related to temperature come more heavily into play. These include the expectations of the membership, water and soil quality (which would favor warm season turf if quality is low), or shade (which would favor cool season turf if there is heavy shade), to name a few.

What you can do

Use the information in Table A to help educate your membership and yourself about the biology behind the performance of the turf varieties at your location. In addition, we have compiled Table B, which also appears on the **PACE Reference 6:3** insert and is entitled "Table B: Turfgrass Growth at Different Average Air Temperatures". Once again, the TGM was used to generate the turf growth values for each temperature listed. These should help give you an idea of whether the temperatures at your location are going to favor or inhibit growth of the turf varieties you have selected.

- Get the **average air temperature** for the day in question. This is usually available from your golf course weather station. You can also determine this temperature by taking the high and low readings for air temperature on a given day from a **Maximum/Minimum Thermometer** (available from a variety of sources for approximately $25; The Ben Meadows

catalogue number is 110135, and can be ordered by calling 800-241-6401).

- The average air temperature can then be calculated as follows:

$$\text{Average temperature} = \left(\frac{\text{Max Temp} + \text{Min Temp}}{2}\right)$$

- Look at Table B to see how well warm season and cool season turf varieties perform at that temperature. In general, growth values above 50% should result in vigorous turf growth. For example, if the average air temperature is 60F, cool season turf will grow very well, at 75% of its potential, but warm season turf will hardly be growing at all, with a growth potential of 2%.

- By keeping track of daily average air temperatures and the expected performance of warm and cool season turf, you should be able to get a good idea of how your turf varieties will perform in the near future.

In conclusion

As the examples we have provided here illustrate, there are fewer U.S. locations than you might expect where temperatures are optimal for overseeding success. Yet overseeding – particularly in the southern half of the country, is a fairly widespread phenomenon. This is because there are many extenuating circumstances – from membership demands, to salts, to highly variable climates – that are also valid reasons to support a decision to overseed. Whatever your situation is, the graphs and charts in this issue of *PACE Insights* will hopefully increase your understanding of the conditions leading to optimal turf growth, and can help you form a scientific basis for future decisions on variety selection and overseeding strategies.

How the TGM was developed

For those of you with a burning desire to understand the mathematics behind the TGM, we have summarized it here. This simple mathematical model is based on published research on the growth habits of warm and cool season turf varieties (as described in Table 1, above), as well as on our own observations and experiences. The model relies on that old statistical stand-by, the bell-shaped curve (for an example, see the curves in Figure 1), otherwise known as **the standard normal distribution,** which does a good job of estimating the relationship between air temperature and turf growth. We have modified the equation for the standard normal distribution to allow calculation of the **percent growth potential** of either cool season or warm season turf at a given temperature as follows:

Percent Growth Potential =

$$100 \times e^{\left(-\frac{1}{2}\left(\frac{\text{average temperature - optimum growth temperature}}{\text{variance}}\right)^2\right)}$$

Where:

<u>Average air temperature</u> = daily or monthly air temperature

<u>Optimum temperature</u> = 67.5°F for cool season and 87.5°F for warm season turf. These are the midpoints between the lower and upper optimal temperatures for each turf type.

<u>Variance</u> = 10. This value was selected so that the theoretical model estimates approximate the reported minimum and maximum growth of both warm and cool season grasses.

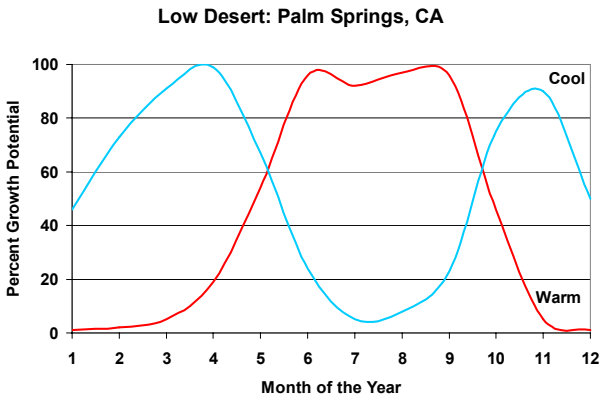
PACE Insights inserts

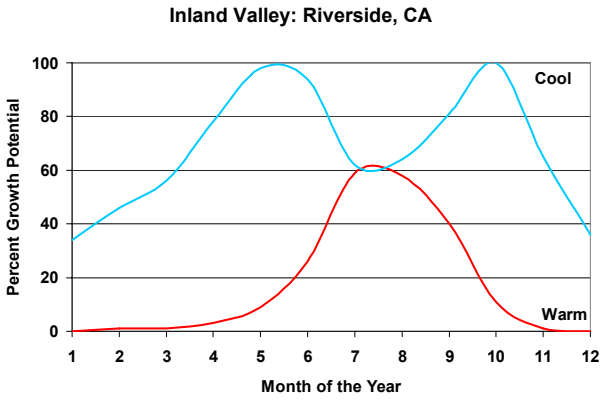
Your monthly *PACE Insights* newsletter will periodically contain two different types of inserts:

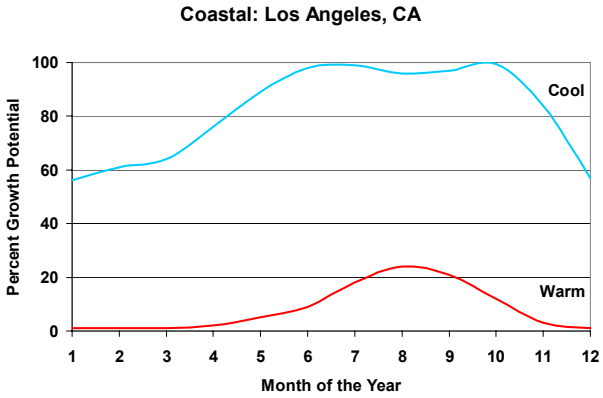
- *PACE Clubhouse Edition:* Suitable for posting in the clubhouse or other areas where golfers congregate, the *Clubhouse Edition* is directed towards golfers, and explains in non-technical terms the science behind management practices such as leaching, pesticide use, or aerification practices.

- **PACE Reference**: Reference pieces provide background technical information that you may want to refer to on a regular basis. These can be filed in the "References" section of your PACE Notebook.

Growth of warm season (red curve) and cool season (blue curve) turf over a 12-month period in three different California locations. Turf growth potential values were calculated using the TGM. Temperatures used were based on 30 year normal average monthly air temperature data obtained from the National Oceanic and Atmospheric Administration (NOAA).







Low desert = the "ideal" overseeding situation: Cathedral City, CA, which is in the Palm Springs area, represents an excellent overseeding environment. There are usually 5 months each year (May – September) where warm season turf growth conditions prevail, and another 7 months where conditions are good for cool season turf. It is important to point out, however, that despite this "ideal" environment, there are years (1999 was one of them!) where a cool Spring and/or warm Autumn result in poor growth of cool season turf and/or poor spring transitions from cool season to warm season turf. So be warned – even in the ideal location, overseeding is not always an unqualified success.

Inland valley = a borderline overseeding situation: A much more difficult situation is illustrated in Riverside, CA. Although summertime temperatures can be high enough to stop cool season turf growth (therefore requiring warm season turf to fill the gaps), this does not happen with the frequency, or regularity of the Low Desert. As a result, there are several months when warm and cool season turf are both growing at the same time. This is illustrated nicely in the graph by the fact that the red (warm season) and blue (cool season) curves barely touch one another. The unfortunate result is warm season turf that is weakened by its competition from overseeded cool season turf, as well as from sub-optimal temperatures. Turf managers must therefore baby the warm season turf – by reducing traffic, pushing fertility, using gentler renovation and overseeding practices and monitoring closely for decline and other diseases.

Coastal Southern California = the ideal cool season situation? The Los Angeles weather is seemingly perfect for the exclusive use of cool season turf. The moderate temperatures rarely favor warm season turf growth, and conditions are good every month of the year for cool season growth. In the graph for this location, cool season turf growth (blue curve) is dramatically higher than warm season growth. Yet contrary to what this graph suggests, the majority of golf courses in coastal Southern California rely on bermudagrass or paspalum fairways, many of which are overseeded in the winter. The explanation for this apparent contradiction is simple: **salts.** The Southern California coast is an arid region with minimal rainfall, all of which occurs between November and March. The heavy demand for irrigation during the summer months leads to salt build-up in the soil, with no rain to leach the salts below the rootzone level. Because cool season turf is sensitive to high salinity, cool season turf typically suffers serious damage during the dry, California summers. Superintendents are therefore forced to grow warm season turf in a cool season region. The consequences include stressed turf that is grown under sub-standard light and heat conditions, loss of color in the winter (for those who don't overseed), and the risk of patchy transitions (for those who do overseed).