Creating an excellent playing surface 1:

Managing the Plant

Micah Woods, Ph.D.
Asian Turfgrass Center
www.asianturfgrass.com

ASIAN TURFGRASS CENTER

Summary

The R&A define sustainability as *optimising the playing quality of the golf course in harmony with the conservation of its natural environment under economically sound and socially responsible management.* When we apply that broad definition to how we manage the plant, we can identify some concrete ways to *optimise the playing quality* and *conserve the natural environment* in an *economically sound* way.

- Mow and roll the turf to create the desired playing surface
- Apply the proper amount of nitrogen
- Choose the right nozzle for the desired application
- Choose the right grass
- Establish course maintenance standards & use benchmarking data

1. Mowing & rolling

Mowing the grass is the most important routine maintenance activity. Mower blades should always be sharp and well-adjusted so that grass blades are cut cleanly. The mowing pattern of the golf course should also be carefully considered so that the resulting pattern enhances the appearance of the golf course. Different mowing patterns require different times to complete. Mowing fairways in a pattern from tee to green can reduce mowing time on fairways by approximately 20% compared with a diagonal mowing pattern. I would encourage everyone to evaluate their mowing plan to ensure it is optimized for their facility.

Increasing mowing heights during times of stress on the turfgrass can help to maintain plant health. More leaf area means more photosynthesis and healthier grass. A side-effect of increasing the mowing height is also a turf that appears more green in color to the human eye. On golf course putting greens, rolling the turf can improve surface firmness and ball roll speed, so a slight increase in mowing height can be combined with an increased frequency of rolling to create healthier turfgrass and improved playing conditions. Some facts about lightweight rolling include:

- rolling does not increase the bulk density of a sandy soil (rolling does not compact the soil)
- rolling increases the ball roll speed measured by a stimpmeter by about one foot on the day of rolling and by about six inches on the day after rolling
- there is a measurable increase in green speed more than 48 hours after rolling but it is not an effect that golfers are able to notice
- rolling greens is faster than mowing with pedestrian mowers, so labor hours devoted to greens mowing can be reduced if greens are rolled sometimes instead of mowed

- rolling of bentgrass greens in Michigan reduced dollar spot disease, could rolling decrease dollar spot on seashore paspalum as well?
- rolling of bentgrass greens reduced algae infestation in the United States
- localized dry spot instensity may be reduced in frequently rolled turf

By optimizing the mowing and rolling plan, turfgrass health and playability can both be improved.

2. Predicting nitrogen requirement based on growth potential

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

What is this? This equation can be used to predict the growth potential of turfgrass. It was developed by scientists at the PACE Turf Research Institute. For more details about growth potential, see the PACE Turf website (which has a wealth of information), with specific information about growth potential here:

http://www.paceturf.org/PTRI/Documents/0401ref01.pdf

No one really knows the exact temperatures at which turfgrass growth is optimized, and there are differences between turfgrass species in the optimum temperatures. However, for warm-season grasses the optimum temperature for shoot growth is with temperatures from 27 to 35 degrees C, and for root growth with soil temperatures from 24 to 29 degrees C. We can set the optimum growth temperature in the growth potential equation above at 31 degrees C, and then calculate (on an hourly, daily, weekly, or monthly basis) what the growth potential for the turf will be. The growth potential values can be especially useful as a guide to scheduling nitrogen fertilizer applications and in predicting turfgrass nitrogen requirements. See Table 1 for predicted growth potential (based on average monthly air temperature) and also estimated nitrogen requirement (monthly, for bermudagrass) with adjustments for the expected release of nitrogen from soil organic matter. This is based on a nitrogen requirement of 5 g/m^2/month when the growth potential is at its maximum, which is 1. When the growth potential is 0, the nitrogen requirement is also 0.

Please note that this information is approximate, but it can be used as a baseline for the development of a management program, is particularly useful as a baseline to start from when developing a fertilization program, and can be adjusted with simple calculations to predict nitrogen requirements on a daily and weekly basis also. The growth potential equation does not include light intensity, which is the other driving factor of growth in Southeast Asia along with temperature. Correction factors can be introduced into the equation to account for light intensity.

See Table 2 for the predicted growth potential and estimated nitrogen requirement for seashore paspalum greens, and this is with an assumption that the maximum nitrogen requirement for seashore paspalum is 3 g/m^2/month when there is maximum growth potential.

Mean Air Temperature (ºC)	Growth potential	Soil OM%						
		0.0	0.5	1.0	1.5	2.0	2.5	3.0
10	0.00	*0.00*	*0.00*	*0.00*	*0.00*	*0.00*	*0.00*	*0.00*
12	0.00	*0.02*	*0.02*	*0.01*	*0.01*	*0.01*	*0.01*	*0.01*
14	0.01	*0.05*	*0.05*	*0.05*	*0.04*	*0.04*	*0.04*	*0.04*
16	0.03	*0.14*	*0.14*	*0.13*	*0.13*	*0.12*	*0.11*	*0.11*
18	0.07	*0.35*	*0.33*	*0.32*	*0.31*	*0.29*	*0.28*	*0.27*
20	0.15	*0.75*	*0.72*	*0.69*	*0.66*	*0.63*	*0.61*	*0.58*
22	0.28	*1.41*	*1.36*	*1.30*	*1.25*	*1.20*	*1.14*	*1.09*
24	0.47	*2.34*	*2.25*	*2.17*	*2.08*	*1.99*	*1.90*	*1.81*
26	0.68	*3.42*	*3.29*	*3.16*	*3.03*	*2.90*	*2.78*	*2.65*
28	0.88	*4.38*	*4.22*	*4.05*	*3.89*	*3.72*	*3.56*	*3.39*
30	0.99	*4.94*	*4.75*	*4.56*	*4.38*	*4.19*	*4.01*	*3.82*
32	0.98	*4.88*	*4.70*	*4.51*	*4.33*	*4.15*	*3.96*	*3.78*
34	0.85	*4.24*	*4.08*	*3.92*	*3.76*	*3.60*	*3.44*	*3.28*
36	0.65	*3.24*	*3.12*	*2.99*	*2.87*	*2.75*	*2.63*	*2.51*
38	0.44	*2.17*	*2.09*	*2.01*	*1.93*	*1.84*	*1.76*	*1.68*

Table 1. The values in blue italicized text are the estimated ***monthly*** *nitrogen requirement for bermudagrass, in units of grams N/m^2/month, based on average daily air temperature and corrected for predicted nitrogen release from soil organic matter.*

Mean Air Temperature (ºC)	Growth potential	Soil OM%						
		0.0	0.5	1.0	1.5	2.0	2.5	3.0
10	0.00	*0.00*	*0.00*	*0.00*	*0.00*	*0.00*	*0.00*	*0.00*
12	0.00	*0.01*	*0.01*	*0.01*	*0.01*	*0.01*	*0.01*	*0.01*
14	0.01	*0.03*	*0.03*	*0.03*	*0.02*	*0.02*	*0.02*	*0.02*
16	0.03	*0.08*	*0.08*	*0.07*	*0.07*	*0.06*	*0.06*	*0.05*
18	0.07	*0.21*	*0.20*	*0.18*	*0.17*	*0.16*	*0.14*	*0.13*
20	0.15	*0.45*	*0.42*	*0.39*	*0.36*	*0.34*	*0.31*	*0.28*
22	0.28	*0.85*	*0.79*	*0.74*	*0.69*	*0.64*	*0.58*	*0.53*
24	0.47	*1.41*	*1.32*	*1.23*	*1.14*	*1.06*	*0.97*	*0.88*
26	0.68	*2.05*	*1.93*	*1.80*	*1.67*	*1.54*	*1.41*	*1.28*
28	0.88	*2.63*	*2.47*	*2.30*	*2.14*	*1.97*	*1.81*	*1.64*
30	0.99	*2.97*	*2.78*	*2.59*	*2.41*	*2.22*	*2.04*	*1.85*
32	0.98	*2.93*	*2.75*	*2.57*	*2.38*	*2.20*	*2.02*	*1.83*
34	0.85	*2.55*	*2.39*	*2.23*	*2.07*	*1.91*	*1.75*	*1.59*
36	0.65	*1.95*	*1.82*	*1.70*	*1.58*	*1.46*	*1.34*	*1.22*
38	0.44	*1.31*	*1.22*	*1.14*	*1.06*	*0.98*	*0.90*	*0.81*

Table 2. The values in blue italicized text are the estimated ***monthly*** *nitrogen requirement for seashore paspalum, in units of grams N/m^2/month, based on average daily air temperature and corrected for predicted nitrogen release from soil organic matter.*

Just as the irrigation water requirement of the turfgrass can be estimated very accurately by evapotranspiration, so also can the nitrogen fertilizer requirement be estimated by considering the air temperature. Nitrogen is the primary element controlling turfgrass growth and turfgrass demand for other nutrients. Because we know the ratio of nutrients as found in turfgrass leaves as they are related to the leaf nitrogen content, we can develop a complete fertilization program based on the nitrogen requirement, assuming that other essential elements are already at a sufficient level in the soil.

For example, if all essential mineral elements (except for nitrogen) are at sufficient levels in the soil, we could then use the growth potential to estimate the nitrogen requirement, and for bermudagrass we would tend to have a leaf N:P:K ratio of approximately 8:1:5. We can then apply those elements in that ratio and have excellent turfgrass quality. And if phosphorus and potassium are present in the soil at levels well above their minimum sufficiency level, we can "mine" those nutrients from the soil by applying only nitrogen fertilizer, saving money on fertilizer cost without any detrimental effects to the turfgrass.

3. Nozzle selection

Many fertilizers, pesticides, growth regulators, and wetting agents are applied with a sprayer. But just choosing the right product to apply is not enough. The right droplet size and water volume must be used to get the best effect from the product. Does a wetting agent perform well when applied to coat the leaves? Does a fungicide applied to control fairy ring have any effect on that pathogen when the fungicide is applied to the leaves? Does Glyphosate provide good control of weeds when it is applied in spray drops that fall to the soil? The answer to each of those questions is no. Understanding the mode of action of the product being applied, and then choosing the optimum sprayer configuration and nozzle to apply the product in the most effective way is of critical importance in getting the optimum effect from the products you apply.

There is great information available at the Tee-Jet website. Every golf course superintendent should be familiar with the turfgrass nozzle selection guide, available for download here:

http://www.teejet.com/media/328895/002-008_cat50a-m.pdf

Additional reference material about nozzles and spray distribution is available here:

http://www.teejet.com/english/home/tech-support/nozzle-technical-information.aspx

As a general guideline, use the lowest water volume and the largest droplet size possible after considering the mode of action of the product you are applying. Some products must be applied to coat the leaves, so in that case a fine droplet should be used. Applying contact fungicides with a nozzle producing a coarse droplet size is a sure way to have inefficient disease control. Applying a liquid fertilizer with a nozzle producing a very fine droplet is not necessary because the drift potential of the spray increases. Understanding different nozzles and spray volumes and the combination of product and droplet size and spray volume that will produce the best results is not a challenging task, but it is very important in the development of any disease, insect, weed, fertilizer, etc spraying program.

4. Grass selection

There are clear differences in performance and maintenance requirements among the different grasses that can be chosen for planting on a golf course. Because climate, soils, course design, and desired playing conditions all vary from course to course, it is not possible to make a generalized recommendation. If possible, consult with an independent turfgrass professional before making a decision; certainly study all available information before making a decision.

Don't be afraid to try a new grass variety, but at the same time recognize that some grass varieties, although they have been around for a while, will still produce exactly the surface you are looking for. The best bermudagrass greens I saw in 2009 were . . . Tifdwarf, at Waialae Country Club in Hawaii. The best seashore paspalum greens I saw were Sea Isle 2000. A big part of grass performance is how it is managed, not what exact variety it is. At the same time, some grasses perform better than others. Do your homework and be aware of what grasses would work best for you.

5. Maintenance standards & benchmarking

Setting standards for the desired ball roll speed, surface firmness, soil moisture, or even the color of the grass -- does that sound like too much? This is what is done for major tournaments, and it is not something out of reach of the ordinary golf course. Every golf course should have a stimpmeter for measuring ball roll speed. Every golf course should have a soil moisture meter for measuring soil moisture content. At major tournaments the fairways and greens are measured for firmness, and at some golf courses a firmness meter would be a useful tool. And a chlorophyll meter can be used to measure the amount of chlorophyll in the leaves, which in addition to being an index of color is also an index of plant health. For more information on some useful meters:

Theta-probe soil moisture meter
http://www.delta-t.co.uk/products.html?product2005092818876

Hydrosense soil moisture meter
http://www.campbellsci.com/cs620

TDR-300 soil moisture meter
http://www.specmeters.com/Soil_Moisture/TDR_300_Soil_Moisture_Probe.html

CM-1000 chlorophyll meter
http://www.specmeters.com/Chlorophyll_Meters/CM_1000_Chlorophyll_Meter.html

The Trufirm surface firmness meter is available by special order from the USGA.

The Clegg Impact Hammer is also used to measure surface firmness:
http://www.clegg.com.au/