Efficient Practices

Phillip Armitage discusses Bentgrass Water use rates and efficient water management practices.

Prehistoric man seems to have appreciated waters importance. He realised that rainfall was often inadequate for his crops because irrigation was being practiced at the beginning of recorded history. The Egyptians and Babylonians built dams to store water in 5000BC; the Persians (Iran) built extensive tunnels to bring the water down from the hills, many of which are still in use today. The Spanish invaders of America found elaborate irrigation projects in Peru and Mexico, while the Indians of south western Arizona had extensive canal systems (Masse, 1981).

Throughout time we have understood and appreciated the importance of plant and water relationships. In recent years we have become more aware that a good quality water source is an increasingly restricted commodity. It is now absolutely essential that golf course managers encourage techniques that reduce water wastage and encourage more efficient watering practices whenever possible. Professors all around the world are currently involved in research aimed towards identifying and understanding plants individual traits at a molecular level. This information helps us all to understand more about the abilities of individual cultivars and their capability to respond to high levels of drought, wear and shade.

Fan operating behind the bentgrass swards

BENTGRASS TRIAL

An experiment aimed to identify the exact level of water required by different types of bentgrass subjected to a variety of environmental conditions was carried out (Armitage, 2001). Mature bentgrass swards were used in this experiment and were grown in Bingley, West Yorkshire, at the Sports Turf Research Institute (STRI) and then transported to Preston to start the experiment.

These swards were constructed in 1998 on a USGA profile and subjected to a close mowing trial there on, until March 2001. The bentgrass swards were cut at 5mm during the summer months and 7mm during the winter months. The bentgrass swards were broken down into the following varieties:

Bentgrass varieties (Species, Common name, Commercial name);
A - Agrostis tenuis, Browntop bentgrass (cv. BAR AT 894)
B - Agrostis stolonifera, Creeping bentgrass (cv. Penn A-1)
C - Agrostis canina, Velvet bentgrass (cv. Avalon)
D - Agrostis castellana, Highland bentgrass (cv. Highland)

The bentgrass swards were transplanted from outdoors into plastic plant pots (130mm in diameter). The plant pots had been prepared earlier by tagging and placing circular pieces of matting into the bases with stapled strands of matting on the underside which would then loosely hang through the plant pots and then through holes in the water pots lids.

The water pots located directly under each of the bentgrass sward pots, contained a set level of water of 400ml. These water pots were refilled daily and a record of the water used up in mm was measured. This method was chosen as it enabled plants to uptake water in response to stress at its own rate. Another reason was that by applying water to the plant through the roots the potential for water wastage was significantly decreased from potential problems such as uneven distribution, wind drift and evaporation.

16 bentgrass swards - four of each cultivar of bentgrass - were kept in this condition in the greenhouse, which was still for one month. Two further sets of 16 bentgrass swards were also kept in the greenhouse house.

One set was placed in front of a fan at low speed. The second set was placed in front of a fan at a higher speed. This was done to replicate wind conditions.

RESULTS

Table to summarize the results of the average daily water use rates (WUR) of each bentgrass variety in each microclimate

	WUR (mm)		
	No wind	Low wind	High wind
Browntop	3.00	4.25	5.00
Creeping	3.25	4.00	4.50
Velvet	3.75	5.00	4.75
Highland	4.00	4.00	5.00

Table 1. Results of the water use rates (WUR) for the bentgrass experiment (mm)

The bentgrass results were reasonably accurate, although some bentgrass plots died off due to an inability to cope with sudden changes to watering through the root systems. However, the majority of the plots were able to withstand the stresses exerted upon them.

This experiment shows that the daily uptake of water from the bentgrass was around 3-5mm depending on the cultivar, and environmental stress. This information should be treated with great interest when selecting a grass cultivar for a particular environment! Precise water use rates that demonstrate the performance of any grass under different environmental stresses, in particular - heat and wind, offer the potential to make a better judgement of water requirements, resulting in improved water efficiency and better performance by the turfgrass.

Please remember that these figures do not take into account several

Overhead irrigation system operating on a golf green

other influential factors that are typically associated on a golf course such as height of cut, close mowing, verti-cutting and high wear; mainly because these issues are sometimes difficult to replicate on an experimental basis. However, it is possible to see that as each stress is added into the equation the likelihood of increasing the turgor pressure on the plant becomes higher.

EFFICENT WATER MANAGEMENT PRACTICES

These water use rates can be used to help coordinate an efficient watering programme. The basic level of watering needed by the plant therefore ought to be around the 3-5mm of water per day. Irrigation systems that are directly connected to weather stations that aim to monitor wind, rainfall, and humidity and soil temperatures will also help us to understand plants requirements and the correct amount of water required.

It is recommended that water is applied to a surface in a uniform distribution pattern. Ideally, irrigation systems should be designed with appropriate spacing in order to suit the requirements of the grass on each surface, i.e. approximately 21 - 35mm per week.

The irrigation should be delivered through mains pipe work to each sprinkler at an even rate of flow and pressure. Energy efficient pump units, pipe work with no leaks and pressure sensors connected to solenoid valves are encouraged to help apply exact levels of water evenly. Additional sensors ought to be used to ensure that sprinklers are operated during the correct weather conditions. Watering during windy periods with rainfall is highly wasteful and should be avoided at all cost.

It is also recommended that water is applied in large quantities, such as 8mm in one application, ideally directly after aeration in order to reach down into the soil profile. Three days after this application of water the next review for watering should take place. The two days between should apply water using the following techniques;

SYRINGING

Supplemental irrigation (syringing) is another irrigation technique that is crucial to enhancing summer turf survival on golf greens. Mid-day wilt, even with seemingly abundant soil moisture, is common with creeping bentgrass and annual meadow grass, especially with close mowing. Head Greenkeepers are forced to keep greens at low cutting heights, even during summer stress and heavy traffic.

This results in a shallow root system that cannot effectively use water, even if soil moisture is adequate deeper in the rootzone. Syringing applies water to correct plant deficits, reduces plant tissue temperature and removes substances from the leaves. Syringing calls for 2.5mm or less of water, primarily to the turfgrass leaves.

HAND WATERING

Hand watering is similar to syringing, this involves applying more water. Hand watering treatments apply enough water to penetrate into the crown and soil surface interface. This allows the water direct contact with the bentgrass' shallow root system. As the name implies, hand watering is often labour intensive. It should be restricted to those greens or green areas where moisture stress symptoms have been visually noted.

Water management practices that encourage root depths to be extended can significantly help nutrient uptake and the plants ability to withstand other stress factors in the long term. Several grasses on existing greens shall suffer to cope with such an aggressive watering regime in the short term, and these practices should be slowly worked towards over a period of time. These watering techniques require daily inspections of the greens throughout the mid morning/afternoon for any signs of drying out.

It will also be necessary to hand water individual areas with a light syringe. These individual areas or micro-climates are often termed 'hot spots' by Interns working in the US and shall occur mainly on heavily worn areas, around the flag stick, or on high undulations. By carrying out this style of watering on greens, it is possible to apply water in a more specific amount for each individual plant.

SUMMARY

In summary, the main principles encouraged to help golf course managers are:

- Monitor and record current and future water usage, applications and weather patterns.
- Check irrigation systems performance regularly.
- Apply a base level of water to the greens on a controlled basis using the automatic irrigation system.
- Top up greens water requirements through daily inspections of the greens and light syringing where necessary.
- Water immediately after aeration in order to encourage deep rooting.
- Aim to apply water appropriate to the environmental conditions.

It is clear that more knowledge of individual micro climates around the golf course are needed in order to help grasses survive under heat stress and meet the demands of optimal water efficiency. It is also clear that while improvements have clearly taken place over time, a great deal of further research in this area is certainly encouraged to be carried out.

REFERENCES

Armitage, P.D. The effect of wind and heat on water use rates for bentgrass. Unpublished.

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