Turfgrass Water Use and Irrigation Scheduling

Turfgrass managers know their turfgrass on the surface, however below the surface there is a considerable amount of guess-work on the depth of water extraction, and the amount of water available for turfgrass growth. It is important that the turfgrass manager maximise rooting depth so that turf is able to draw moisture and nutrients from a greater portion of the soil profile (Beard, 1985).

Prior to a sporting event many factors need to be considered when deciding to water. By not watering there is a risk that the playing surface will not be suitable for the event. However by watering there is a chance that it will rain and the playing surface will again be unsuitable. Therefore the turfgrass manager needs to know exactly how much water is in the soil profile at each depth so it can be calculated how much water if any, needs to be applied to the turfgrass to maintain the desired quality of turfgrass for the event duration.

Recent government reports have highlighted the growing scarcity and rising costs of water, and the need for more efficient use of water by turfgrass managers for recreational areas. With the ever increasing demand for our finite resource water, efficient water management should be a high priority for turfgrass managers who aim to reduce costs.

To improve the water use efficiency on turfgrass, turfgrass areas should be watered according to the soil moisture status and turfgrass needs. It has been shown that by adjusting irrigations according to soil moisture sensing devices as opposed to a pre-planned routine, it is possible to reduce water consumption by 40-50% without reducing turfgrass quality (Shearman, 1985).

It is often stated that the most efficient way to water turf is to practice deep and infrequent waterings. However there is very little information that quantifies the amount of water, irrigation frequency and the depth of application required, and these form the objectives of this trial outlined below.

Experiment Background

Four neutron probe access tubes were installed on the 10th Fairway of the Narrabri Golf Course, Northern N.S.W.. The tubes were installed across the radius of the sprinkler as shown in Figure 1. The fairway consists of kikuyu grass growing in a clay soil and there were no trees within 50 metres of the tubes. The soil water content was measured regularly at depths of 10, 20, 30, 40, 50, 60, 70 and 80cm below the surface using a neutron probe.

How deep did the kikuyu extract water ?

The kikuyu roots have extracted 67 mm of water to a depth of 80 cm between the 30/12/88 and the 30/1/89 (Figure. 2). The soil profile measured 290 mm on the 30th December following a very wet Christmas/New Year period so it was called the full point. On the 30/1/89 the kikuyu reached its refill point, which represents the driest soil water profile prior to the turfgrass quality falling below an acceptable standard for its intended purpose. The depth of turfgrass water use is important because the turfgrass manager needs to know if they are gaining maximum benefit of the stored soil water and nutrients.

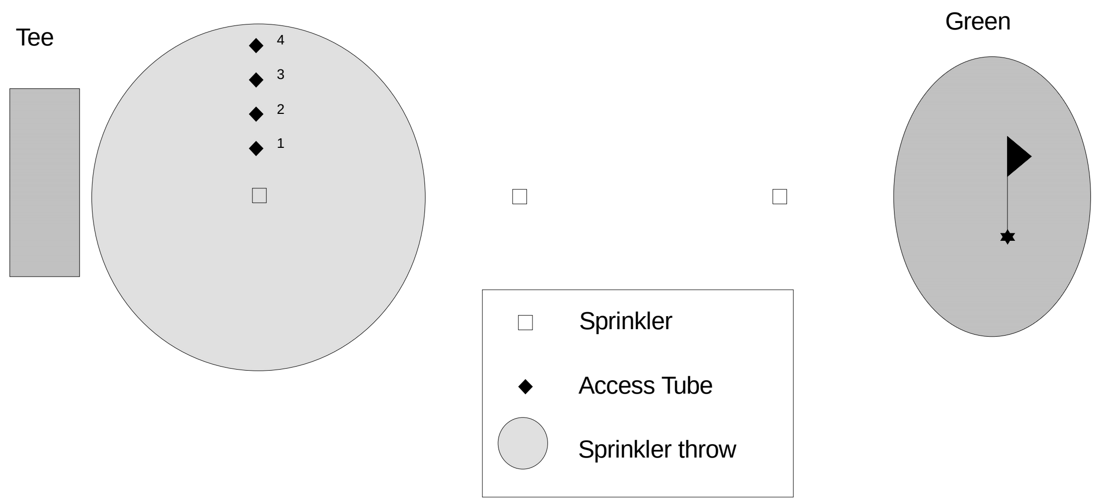

Figure 1. Position of Neutron Probe Access Tubes under Sprinkler.

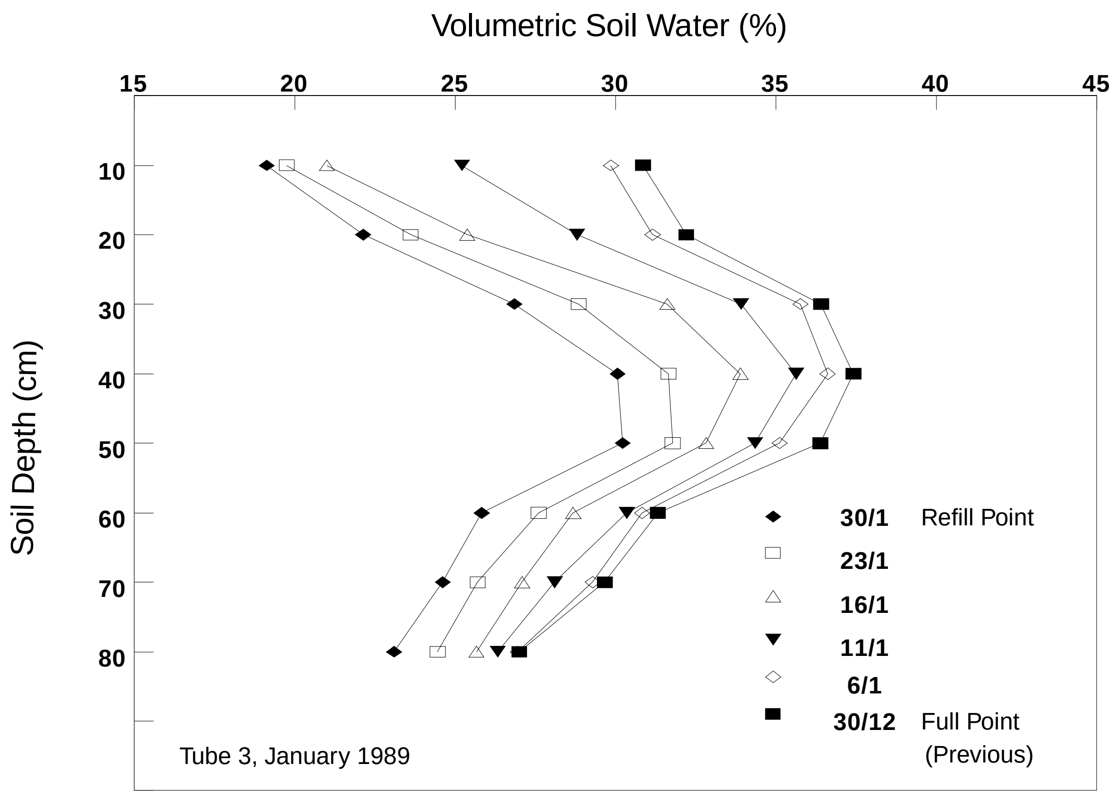

Figure 2 Soil water extraction, Kikuyu turfgrass

How do you determine the Refill Point ?

Regular neutron probe readings were taken during January, February and March 1989, and the 0-90 cm profile water content of Tube 3 is shown in Figure 3. The profile water content decreased as the kikuyu extracted water. The daily water used by the kikuyu is indicated by the slope of the graph. After the irrigations, the kikuyu used water at a greater rate (5 mm/day) than it did as it approached an irrigation (2 mm/day). This decline in daily water use indicates that the kikuyu is finding it harder to extract the available water from the profile. On the 30th January the daily water use dropped below 1 mm/day and it was decided to make this the refill point at 223 mm. This represents a deficit between irrigations of 67 mm. At this stage the quality of the kikuyu was still acceptable according to the local golfers. The fairway was then irrigated until it reached the previous full point.

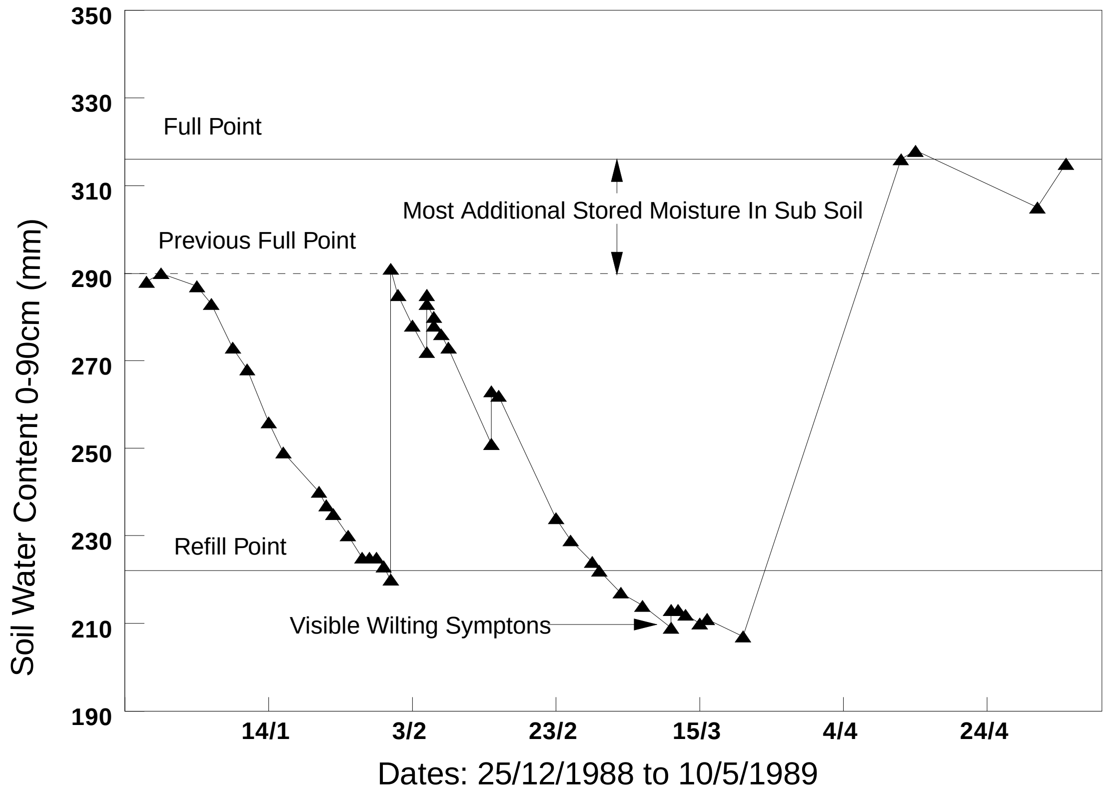

Figure 3 Soil water content 0-90 cm for turfgrass

During the second drying cycle some rain fell. The fairway also received a small irrigation on the 14th February when the profile was at 251mm which increased the profile water content to 262 mm. This irrigation occurred because the very outside of the fairway had reached its refill point. The uneven sprinkler distribution is discussed in the following section. The profile was then allowed to dry to the previous refill point. The daily water use again declined at the refill point, however this time the fairway was not irrigated to see how long it would be before the kikuyu would show visible wilting symptoms. This occurred about four days later as the daily water use was very low. This provided further evidence that the refill point was correct and the turfgrass manager could be confident in watering the fairway according to the refill point.

Dry Sub Soil

An additional trial site was installed on the course. This site was very dry and the kikuyu was brown in colour. On the 28th January a reading was taken which was well below the refill point. The site was then irrigated for four hours and another reading was taken the next day (29th January, Figure 4).

After four hours of watering the profile had been wet to 60cm (Figure 4). The kikuyu responded very quickly to the applied water regaining its green colour. The profile was allowed to dry until the 8th February - the refill point. It was not possible for the kikuyu to extract any water deeper than 60cm because of the dry sub soil which was not wet during the irrigation unlike the kikuyu on the fairway (Figure 2) which had a wet sub soil. Hence this grass wilted much more quickly than on the fairway.

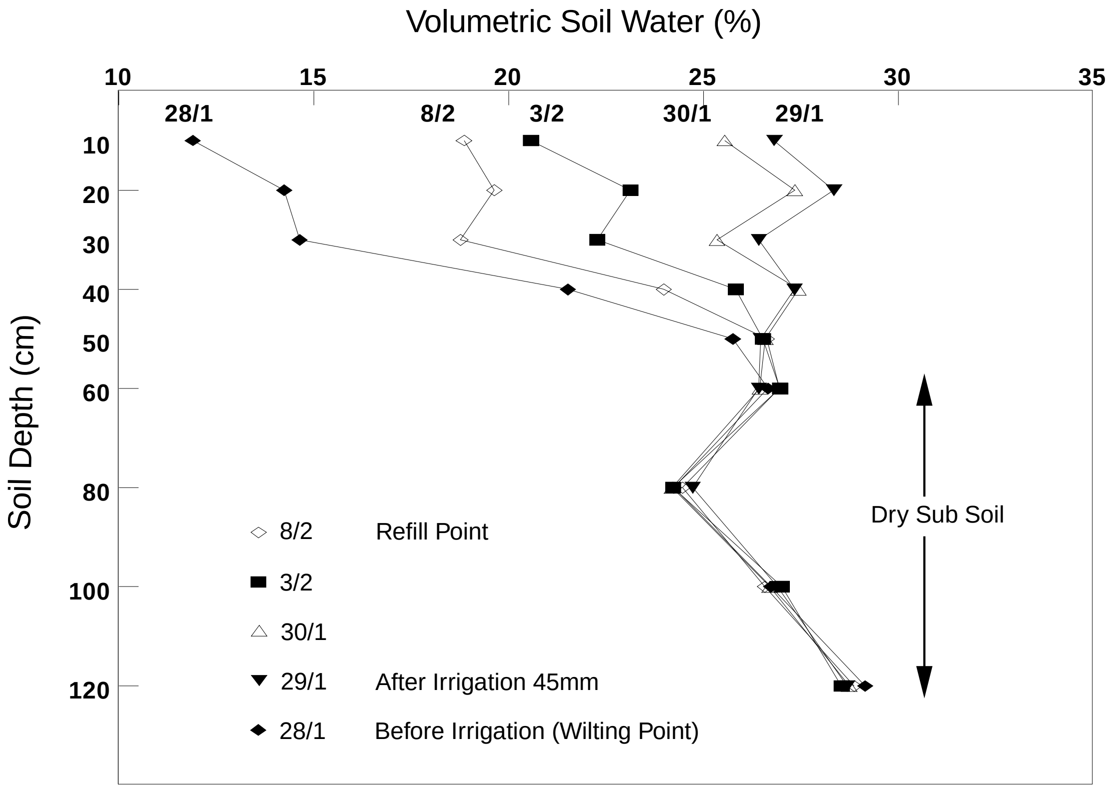

Figure 4 Monitoring depth of infiltration after irrigation

Problems with the Irrigation System

As shown in Figure 1, four neutron probe tubes were installed across the radius of the fairway sprinkler. The profile water contents of Tubes 2, 3 and 4 are shown in Figure 5. On the 30th January Tube 3 reached the refill point as discussed in other sections of this paper. However tube 4 on the same day is shown to be much drier and hence why the kikuyu on the outside of the fairway was severely wilted. Tube 2 on the same day still has some time before it will reach the refill point. Clearly there are large differences in the soil moisture content across the fairway being caused by an uneven wetting pattern of the sprinkler.

Following a period of wet weather during March and April the neutron probe readings showed that all four tubes had returned to the same moisture content. It was also necessary to modify the previous full point 290 mm, set on the 30/12/88 to the full point 315 mm, set on the 12/4/89 (Figure. 2). Most of this additional stored moisture is in the sub soil (Figure. 5).

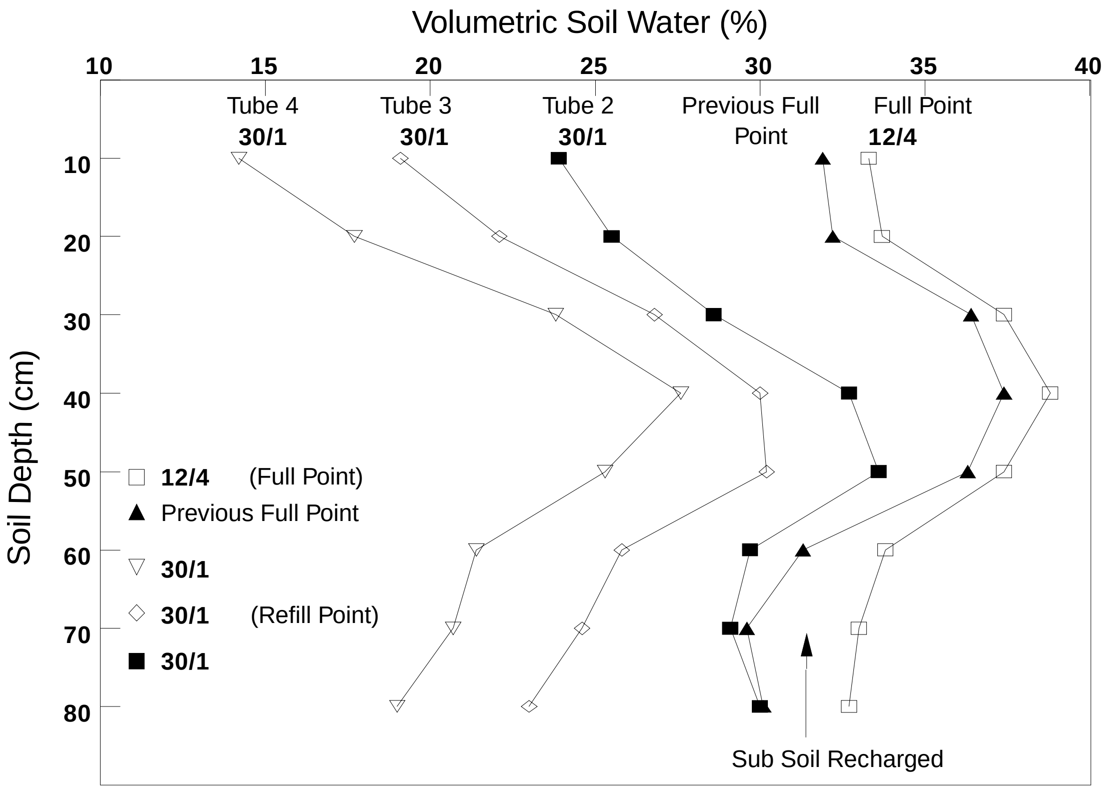

Figure 5 Uneven soil moisture profiles under sprinkler

Summary

There exists considerable scope for improvement of water use efficiency on turfgrass areas in Australia. Turfgrass areas should be watered according to the soil moisture status and turfgrass needs rather than on a set routine of once a week for example.

By monitoring the soil moisture status the turfgrass manager will need to spend less time watering and mowing, reduce disease and nutrient leaching, highlight problems with irrigation system design, identify soil management problems such as compaction, conserve water and most importantly reduce costs.

Measuring the soil moisture status allows the turfgrass manager to know...

1. The depth of the root zone.
2. Amount of water needed for an irrigation.
3. Establish a refill point.
4. Measure the effectiveness of rainfall.
5. Daily turfgrass water use.
6. Infiltration rates and drainage.
7. Soil management problems such as compaction.
8. Set an irrigation schedule.

References

Beard, J.B (1985), A new prospective on root growth. University of California Publication 21404.

Shearman, R.C. (1985) Turfgrass culture and water use. University of California Publication 21405

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