

Maintaining high quality turfgrass while minimising water use requires good information on turfgrass water requirements as well as an understanding of how management factors may change these values. Researchers at the University of Western Australia are currently investigating how nitrogen fertiliser management influences water use by kikuyu during summer. Here they present their findings from the first year of a two year field study.



'Old' kikuyu turfgrass was collected from the Western Australian Golf Club. The sod was cut at a depth of 50mm so as to include a mat layer

Nitrogen fertiliser management and its influence on turfgrass water use

Australian turfgrass managers are continually seeking more water efficient approaches for managing turfgrass while maintaining high quality playing surfaces. In the last few years the pressure on turfgrass managers to justify water use has increased, while the need to develop well documented irrigation management plans has intensified. One of the first steps in developing an irrigation management plan is to establish how much water is required to maintain turfgrass to a particular standard.

Turfgrass water use varies depending upon a number of factors including turfgrass type, climate and cultural practices. Previous research conducted at The University of Western Australia (UWA) reported summer water use for 12 turfgrass genotypes, and demonstrated how warm-season, or C₄, grasses required less water than cool-season, or C₃, grasses, in Mediterranean-like climates such as Perth (Table 1).

The research concluded during the summer months, the minimum irrigation requirement for warm-season turfgrass was 50-60 per cent replacement of net evaporation, while cool-season grasses required 80-100 per cent replacement of net evaporation. Cultural practices thought to influence turfgrass water use include nitrogen fertiliser rate (Ebdon et al., 1999), mowing height and frequency (Huang and Fry, 1999), and the presence of thatch (Taylor and Blake, 1982).

Although we now have information on water use by different types of turfgrasses grown under Australian conditions (Short and Colmer, 2001; Ford, 2006), our understanding of how turfgrass management practices influence turfgrass water use is based mainly on data from cool-season turfgrasses grown in the Northern Hemisphere.

The aim of the following study, therefore, was to investigate the effect of nitrogen fertiliser management and presence of an organic mat

layer on kikuyu turfgrass water use when grown under Australian conditions. The study forms part of the Kikuyu Research Project based at UWA.

MEASURING TURFGRASS WATER USAGE

Kikuyu turfgrass water use was measured at the UWA Turf Research Facility at Shenton Park, Western Australia. The site includes a variable-speed fixed-boom travelling irrigator that allows water to be applied at known rates relative to net evaporation as calculated using an on-site weather station.

Plots were established in January 2005 from turfgrass of two ages – 20-week-old turfgrass ('young' turfgrass) and 20-year-old turfgrass ('old' turfgrass). The 'young' turfgrass was newly grown sod, cut to a depth of 15mm, while the 'old' turfgrass was cut from a golf course fairway to a depth of 50mm so as to include a mat layer (see photo above).

TABLE 1. DAILY WATER USE (% NET EVAPORATION) FOR EIGHT TURFGRASS TYPES GROWN DURING THE SUMMER MONTHS IN PERTH, WA.

Turfgrass genotype	Daily water use (% Net Evaporation)
Tall fescue	96 + 5
Ryegrass	102 + 4
Couch (wintergreen)	60 + 2
Saltene	64 + 2
Kikuyu	66 + 3
Buffalo	68 + 2
Zoysia	67 + 3
Tall fescue	51 + 5

(For further study details see Short and Colmer 2001).

Water use by kikuyu fertilised at different nitrogen rates was determined on six occasions during the summer of 2005/2006 (Table 2).

Each turfgrass age received one of the following nitrogen application rates: 0, 50 and 150kg N ha⁻¹ yr⁻¹ as ammonium sulphate. Each annual nitrogen fertiliser rate was evenly split across four applications (two in spring and two in autumn) and there were three replicates per treatment. Irrigation occurred every second day by replacing 60 per cent of the previous two days' net evaporation.

Turfgrass water use was measured using weighing lysimeters inserted in the plots of kikuyu (10m²). The weighing lysimeters comprised of turfgrass grown on a column of soil (205mm in diameter by 625mm in depth) with a container at the base for collecting leachate.

To measure water use, or evapotranspiration, the weight of the lysimeters was recorded following irrigation and then again 24 hours following the first weighing. Irrigation and rainfall did not occur during this 24 hour

period. The change in weight (g per day) was used to calculate daily turfgrass water use for each of the treatments, and took into account leachate losses.

Water use may be expressed as mm per day, but more often is expressed as a proportion of net evaporation (i.e. crop factor). Net evaporation was calculated using data collected from the site weather station and a modified Penman-Montieth equation.

KIKUYU WATER USE RESULTS

Kikuyu turfgrass water use ranged from 3.8-7.5mm per day, depending on environmental conditions and treatments.

The 'old' turfgrass containing 50mm mat used, on average, 27 per cent more water than the 'young' turfgrass. The average daily water use for the summer represented 57-81 per cent of daily net evaporation, with the 'old' turfgrass using water at a higher proportion of daily net evaporation than the 'young' turfgrass (Table 2). The 'old' turfgrass also used more water than previously documented for kikuyu (Short and Colmer, 2001).

Increasing the nitrogen fertiliser rate

increased water use by both turfgrass ages (Table 2). For example, when the 'old' turfgrass was not fertilised it used water at 67 per cent of net evaporation, on average, where as when 150kg N ha⁻¹ yr⁻¹ was applied this value increased to 81 per cent (Table 2). Similarly for the 'young' turfgrass, water use increased from 57 per cent to 69 per cent of net evaporation after applying 150 kg N ha⁻¹ yr⁻¹ (Table 2).

The greater water use by the 'old' turfgrass appears to be due to greater turfgrass growth than the presence of mat, for as turfgrass growth increased (as determined by the weight of mower clippings) so did water use (Figure 1).

It is interesting to note that growth was more vigorous for the 'old' turfgrass plots than the 'young' turfgrass plots even when the same rate of nitrogen was applied (data not shown). The greater growth from the 'old' turfgrass plots was probably due to nitrogen 'mineralisation', or conversion of organic nitrogen to plant available nitrogen, in the mat layer supplying additional nitrogen to the older turfgrass.

Turfgrass quality also varied between

TABLE 2. AVERAGE DAILY WATER USE (% NET EVAPORATION) FOR KIKUYU TURFGRASS OF TWO AGES AND FERTILISED AT DIFFERENT NITROGEN APPLICATION RATES. VALUES ARE AVERAGE OF SIX MEASUREMENTS (+ STANDARD ERROR) MADE IN THE SUMMER OF 2005/06.

Turfgrass age	N rate (kg ha ⁻¹ yr ⁻¹)	Daily water use (% Net Evaporation)
Young	0	57 ± 4
	50	56 ± 3
	150	69 ± 3
Old	0	67 ± 2
	50	77 ± 5
	150	81 ± 5



Lysimeters being lifted from the kikuyu turfgrass plots at Shenton Park and weighed to determine water usage



turfgrass age and nitrogen fertiliser application rate. All the old turfgrass plots, and only the new turfgrass plots receiving 100 kg N ha⁻¹ yr⁻¹ or more, were of acceptable quality as judged by turfgrass colour, surface hardness, and the nitrogen content of plant tissue samples.

Our findings indicate that more vigorous turfgrass areas (e.g. 'active' sports fields) may require more water than less vigorous turfgrass areas (e.g. 'passive' turfgrass). Furthermore, the watering requirements for vigorously growing turfgrass may be higher than the current recommended rate (60 per cent replacement of pan evaporation every second day).

Further work is required to determine if the greater water use by the 'old' turfgrass than the 'young' turfgrass is sustained over longer periods between irrigation events, and to confirm if the greater water use by the 'old' turfgrass is related to higher plant growth and increased leaf areas. These questions will form the foundation of our 2006/2007 summer water use measurements.

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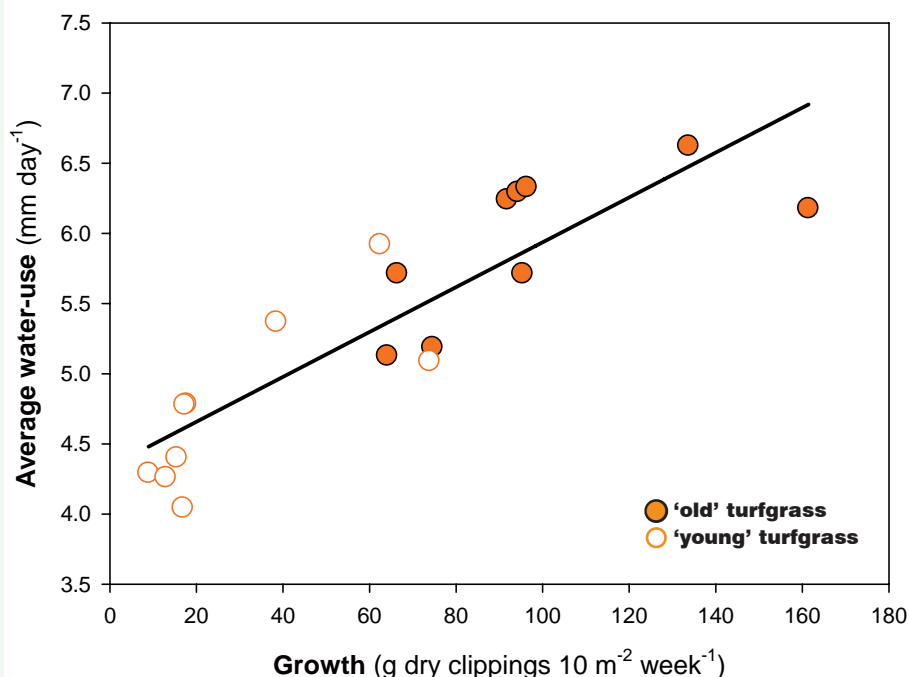


Figure 1. The relationship between turfgrass growth and water use for kikuyu