



Managing soil water repellency in turfgrass on sands

The University of Western Australia recently completed a study on the incidence, severity and amelioration techniques of soil water repellency in kikuyu of two contrasting soil organic matter contents. Louise Barton and Tim Colmer highlight results from the study.

Throughout Australia, turfgrass producers and managers are under increasing pressure to restrict their water use. Irrigation scheduling based on the replacement of a proportion of evapotranspiration (ET) is being strongly advocated as a means to improving water use efficiency.

However, while ET-replacement irrigation can optimise watering regimes it may also increase the incidence of soil water repellency under turfgrass grown in sandy-textured soils (Augustin and Snyder 1984; Cisar et al. 2000). Soil water repellency decreases water use efficiency by causing irrigation water to unevenly infiltrate the soil surface, bypassing a proportion of the turfgrass roots (Dekker et al. 2001; Doerr et al. 2000).

In severe cases the applied water may run-off the soil surface before infiltration occurs. The development of soil water repellency may also invoke over-watering as the turfgrass manager attempts to overcome wilting turfgrass (Cisar et al. 2000), further undermining water conservation.

Managing soil water repellency is essential for maintaining high quality, water-efficient turfgrass systems. Decreasing the incidence of soil water repellency requires an understanding of the contributing factors and the development of corrective procedures.

Our project investigated, for kikuyu turfgrass of two contrasting soil organic matter contents:

- When does water repellency develop under a sand-based turfgrass system?
- By how much can soil wetting agents decrease soil water repellency, and does the timing and formulation affect efficiency of the treatment?
- Do turfgrass renovation techniques minimise the development of soil water repellency?

DO WETTING AGENTS ALLEVIATE SOIL WATER REPELLENCY?

Wetting agents are a particular type of surfactant that increase the wetting capacity of water in a hydrophobic soil by reducing the interfacial tension between water and soils, thereby making it easier for the water to be absorbed by the soil.

Wetting agents differ widely in their effectiveness, with their success dependent upon chemical composition (Cisar et al. 2000; Kostka and Bially 2005; Leinauer et al. 2007), application rate (Kostka 2000), frequency of application (Park et al. 2004), and relative performances of different types are not always consistent from site to site (Karnok 2006).

Prior assessments of liquid wetting agents have been conducted on intensively managed turfgrass systems (i.e., sports grounds and golf courses), but in the many less resource-intensive turfgrass systems in Australia, granular wetting agent formulations are often used. The turfgrass may also contain high organic matter content due to irregular renovation (Barton et al. 2009).

Consequently, we investigated the effectiveness of wetting agents to decrease soil water repellency in kikuyugrass grown in sandy soils of contrasting

organic matter content irrigated at 60 per cent replacement of net evaporation.

We found that applying an effective granular wetting agent can decrease soil water repellency and maintain turfgrass quality during the summer when under a conservative irrigation regime. However, not all products tested were as effective as one another. The relative effectiveness of granular soil wetting agents was strongly related to the total amount of active ingredient applied to the turfgrass, which was partly predicted by a laboratory-based test (Barton and Colmer 2009 – see ATM Vol 11.6; Barton and Colmer 2011).

In Mediterranean-type climates, our results indicate soil wetting agents should be applied early in the irrigation season so as to minimise the development of soil water repellency during summer. This is because turfgrass grown in sandy-textured soils, managed using ET-replacement irrigation, was found to be susceptible to the development of soil water repellency early in the irrigation season.

Applying either a granular or liquid wetting agent formulations is recommended, as based on a single product, both delivery forms appear to be equally effective when applied at the same rate of 'active' ingredient (Figure 1, page 75). Furthermore, applying the annual recommended application rate in early spring, or evenly splitting the annual application rate between early spring and early summer, were both effective at preventing

TABLE 1. RENOVATION TREATMENTS APPLIED TO KIKUYU PLOTS

Treatment	Description
Cored + topdressed	100 x 65mm spacing, 25mm (outside diameter) hollow tines, 100mm depth; applied each November with cores swept from plots. 5mm sand applied in November and May/April each year.
Cored	100 x 65mm spacing, 25mm (outside diameter) hollow tines, 100mm depth; applied each November with cores swept from plots.
Topdressed	5mm sand applied in November and April/May, each year.
Verticut	3mm blade, 38mm spacing, penetrated 20mm into the soil; Carried out each November.
No renovation	No treatment applied

the development of soil water repellency during the hotter summer months (Figure 1). Importantly, the effectiveness of soil wetting agents decreased when applied to sands containing high soil organic matter content (Figure 1) so application rates may need to be increased on these soil types.

DO RENOVATION PRACTICES ALLEVIATE SOIL WATER REPELLENCY?

Turfgrass renovation techniques that prevent thatch and mat accumulation may also be an approach to minimising the severity of water repellency. Thatch layers and surface soils high in organic matter have been shown to exhibit water repellency in a number of turfgrass sites in overseas studies (Dekker et al. 2005; Kostka et al. 1997).

TABLE 2. EFFECTS OF RENOVATION TREATMENT ON SURFACE HARDNESS

Date	Time ^a (months)	Surface hardness (Gravities) ^b				
		Cored + topdressed		Topdressed	Verticut	No renovation
Older kikuyugrass						
9 Nov. 05 ^c	0	50 (0.0)	50 (0.0)	50 (0.0)	50 (0.0)	50 (0.0)
15 Nov. 06 ^c	12	47 (5.1)	46 (4.0)	41 (1.1)	44 (3.0)	43 (0.0)
14 Nov. 07 ^c	24	40 (0.8)	40 (2.0)	35 (0.3)	41 (2.1)	40 (1.4)
17 Nov. 08 ^d	36	40 (2.0)	39 (1.9)	35 (0.9)	39 (1.0)	40 (0.5)
11 Nov. 09 ^d	48	41 (1.9)	41 (2.7)	37 (2.6)	38 (1.0)	42 (0.5)
Younger kikuyugrass						
9 Nov. 05 ^c	0	90 (0.0)	90 (0.0)	90 (0.0)	90 (0.0)	90 (0.0)
15 Nov. 06 ^c	12	79 (2.9)	77 (0.0)	79 (2.2)	87 (1.9)	92 (4.0)
14 Nov. 07 ^c	24	61 (1.4)	58 (1.6)	63 (0.6)	73 (0.5)	67 (0.3)
17 Nov. 08 ^d	36	55 (1.8)	61 (2.2)	57 (0.6)	79 (1.8)	65 (0.9)
11 Nov. 09 ^d	48	49 (1.4)	54 (1.0)	52 (0.7)	67 (2.9)	59 (1.1)

^a Time after initial treatment.
^b Measured using a 2.25kg Clegg Hammer. Values represent the mean (and standard error) of three replicates.
^c Data collected in a previous study (Barton et al. 2009), using same methods as present study.
^d Data from current study.

Various practices have been proposed for minimising the development of thatch and mat in turfgrass (Carrow et al. 1987; Waddington 1992), but the possible influence on water repellency had largely been untested. Consequently, we investigated the effectiveness of renovation techniques to decrease water repellency in kikuyugrass grown in sandy soils of contrasting organic matter.

Mechanical and topdressing techniques to reduce accumulation of thatch and mat, and the influence on soil water repellency, were evaluated. Treatments included two kikuyugrass ages of contrasting organic matter content, and five renovation techniques (cored plus topdressed, cored, topdressed, verticut, no renovation – see Table 1, page 73 for full treatment details). Irrigation water supplies were limited to 60 per cent replacement of net evaporation. Treatments had been applied annually to kikuyugrass plots each spring since 2005.

Diluting or removing organic matter in established kikuyugrass did not decrease the incidence of soil water repellency. Overall, regular renovations did not prevent the increase in organic matter content with time, although the rate of

increase differed between treatment; nevertheless all treatments contained an organic matter content greater than the critical value of 3.5 per cent (McCoy 1992) after four years of regular renovation.

Of the various treatments, topdressing turfgrass twice a year with sand was most successful to restrict the accumulation of organic matter in newly planted kikuyugrass and decreased the organic matter content of the older kikuyugrass. Since soil wetting agent effectiveness can be decreased in sands containing high soil organic matter content (Figure 1), conducting renovations would still likely provide benefits when in combination with the use of a soil wetting agent.

Renovation can also have other benefits to turfgrass surface quality. Verticutting was the most effective approach for restricting the progressive softening of the younger kikuyugrass with time, whereas the older kikuyugrass continue to soften irrespective of the renovation treatment (Table 2). The colour and clipping nitrogen concentration of both kikuyugrass ages were maintained to local standards by all mechanical and topdressing techniques.

CONCLUSIONS

Utilising an effective soil wetting agent, in combination with practices that limit the accumulation of soil organic matter, is recommended for decreasing the incidence of soil water repellency in turfgrass grown on sandy soils, and irrigated based on the replacement of a proportion of net evaporation.

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REFERENCES

A full list of references for this research article can be obtained by emailing Louise Barton louise.barton@uwa.edu.au

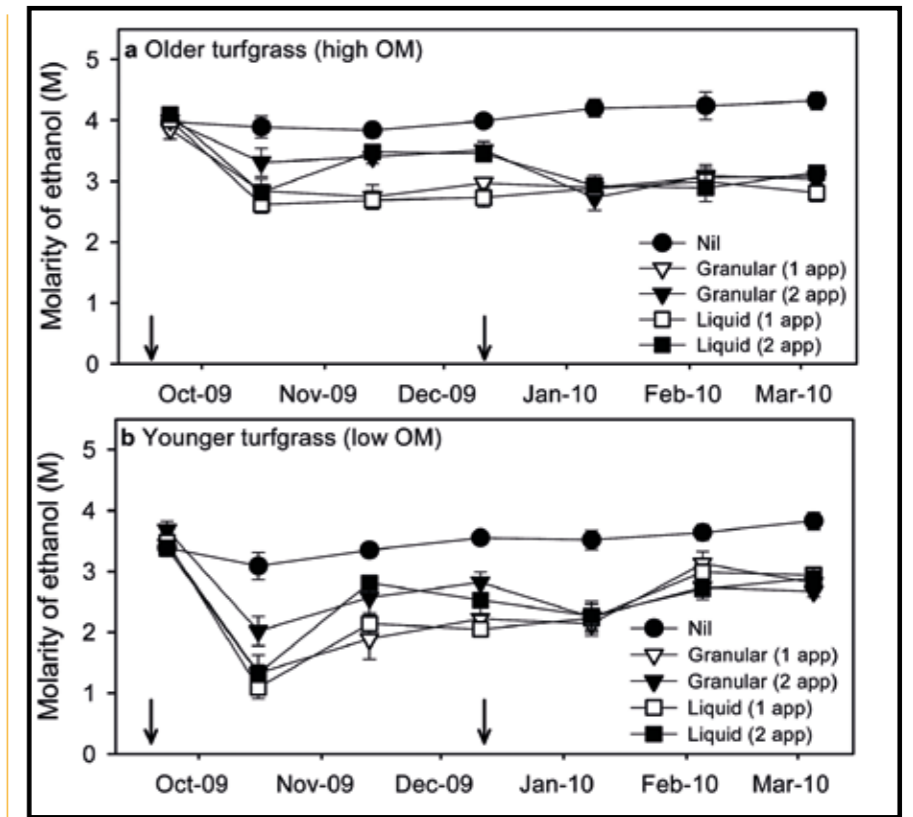


Figure 1. Influence of soil wetting agent formulation and application frequency on the molarity of ethanol droplet test (MED) beneath an older (high organic matter content) and younger (low organic matter content) kikuyugrass with time. Increasing MED indicates increasing soil water repellency. Arrows indicate when soil wetting agents were applied



Dry patch in kikuyugrass under 60 per cent ET-replacement irrigation during summer