Applying surfactants decrease turf water use under high evaporative demands in glasshouse conditions

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Introduction

Surfactant-based wetting agents (referred as surfactants) are amphiphilic molecules that decrease the surface tension of water and their effects on soil properties have been widely assessed[1]. Surfactant molecules decrease the contact angle between water molecules and soil particles, enhancing infiltration rate on hydrophobic substrates which can improve soil moisture distribution within the soil profile[2,3].

Much research on the impact of surfactants on plant growth has focused on turfgrass, as this is the current main market target of these products. Surfactant application to turfgrass improved plant colour, plant quality and biomass[4,5], by alleviating soil hydrophobicity that causes localised dry spots (LDS) in sand-based amenity pitches[6].

In non-hydrophobic soils, applying surfactants enhanced plant growth at drying soil[7]. However, very little research has explored the impact of surfactants on the regulation of plant water use. Surfactants decreased transpiration rates in New Guinea Impatiens, without compromising net photosynthesis, ultimately increasing plant water use efficiency[8]. However, such studies have not been conducted in turfgrass species.

Atmospheric vapour pressure deficit (VPD) is defined as the difference between the saturation vapour pressure and the actual vapour pressure. It is widely recognized that VPD is the evaporative driving force for transpiration[9]. To our best knowledge, no com-

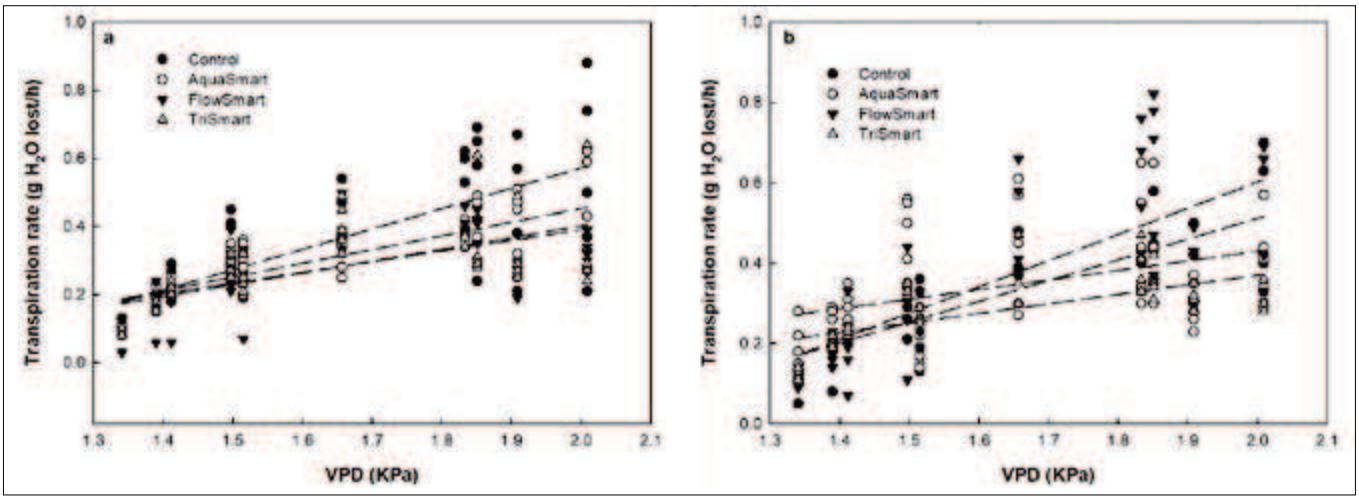

Fig. 1: Relationship between E and VPD of *Lolium perenne* growing in low and high organic matter soils (panels a and b, respectively) without (black circles) and with addition of AquaSmart, FlowSmart, TriSmart (hollow circles, black triangles, hollow triangles, respectively). Each point is an individual plant and linear regressions are fitted.

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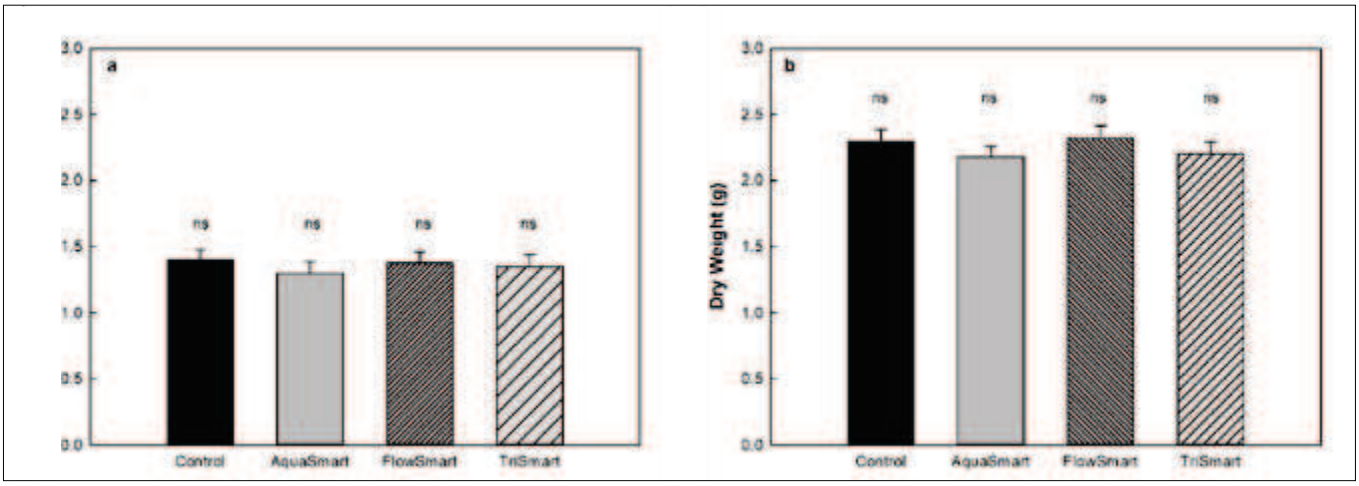

Fig. 2: Dry weight of *Lolium perenne* growing in low (a) and high (b) organic matter soils without (black bars) and with addition of AquaSmart, FlowSmart, TriSmart (light grey bars, dark grey/striped bars, light grey/striped bars, respectively). Bars are means ± SE of six replicates, with no significant effects (p > 0.2) in either soil, thus non-significant results are reported as ns.

prehensive evaluation of surfactant effects on plant water use under elevated VPD has occurred. Hence, the objective of this study was to determine the pot water losses in a high-throughput gravimetric platform installed at Lancaster Environment Centre[10], to evaluate the effect of surfactants on evapotranspiration (ET) in turfgrass species. Additionally, transpiration (E) responses under elevated VPD were compared between treatments, by distinguishing evaporative and transpiration components of ET.

Materials and Methods

Turfgrass (*Lolium perenne*) was grown in pots filled with three different soils of contrasting organic matter content, in a glasshouse at Lancaster Environment Centre, in June 2019. Three different surfactant types and a no surfactant control were tested in a factorial 4 (surfactants) x 3 (soil types) experiment where ET losses were hourly estimated, and relative humidity and temperature were recorded (to calculate VPDs) using data loggers (hourly). Plant transpiration (E) was calculated as the difference between ET and evaporation of nearby bare soil pots. E and VPD data between 09:00 - 19:00 were selected and the E versus VPD relationship was established for well – watered (WW) plants whereas measurements occurred 21 days after seeding, when plants covered the entire surface of the pot.

Results

Under well-watered conditions, E of surfactant-treated plants was lower under elevated VPD, in two of three substrates (low and high contents of organic matter). Hence, surfactant – treated plants tended to consume less water as evaporative demand was increasing (Figure 1). Since no differences were observed in biomass accumulation between treatments (Figure 2), surfactants increased water use efficiency of the turfgrass.

Conclusion

Surfactant application decreased turf water use under high evaporative demand conditions without limiting plant growth, thereby increasing water use efficiency.

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