

Drought Tolerant Turf is Built from the Ground Up

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Australia is the driest inhabited continent on earth. In size, it is around 80 percent of the USA's land area but supports a population of only 20.8 million people, most of them living along the eastern, southern and south western coasts in the limited areas with higher rainfall. The wide brown land has:

- One percent of the world's surface fresh water resources
- Almost no snow fed- rivers
- <Twelve in. annual rainfall across 60 percent of the country (while another 20 percent receives <25 in.)
- Highly variable rainfall from year to year
- Experienced 12 major droughts in the past 150 years

So, in a dry continent currently in the grip of one of the worst droughts on record and with unprecedented water restrictions, in most cities and towns likely to increase still further, it's a no-brainer: Making better use of our water is THE absolute priority.

At Redlands Research Station near Brisbane, water use is a theme that runs through much of our turf research programs on warm-season grasses.

No Silver Bullet Solution

Homeowners and the media want a quick fix: "Just give us your most drought tolerant grass" is their usual request. But even the most drought tolerant grass will not survive in an inch of soil over rock-not an unusual situation in new housing developments.

Drought tolerant turf is built from the ground up by making a series of incremental improvements, not through one simple solution that will somehow fix

everything. The basic steps are to:

- Put a good soil profile in place
- Ensure that water can enter the soil and be stored there for the plants to use
- Plant a well adopted turfgrass, bearing in mind other site restrictions such as shade, wear or salinity

Check water quality, particularly for alternative irrigation supplies

Water Use Efficiency or Drought Tolerance?

First, we need to be clear about our objectives: are we looking for better water use efficiency or the ability to survive for longer while losing water through evapotranspiration. This depends on climatic conditions and the changes of rainfall.

In a desert climate where there are very little changes of rainfall any time soon. The turf is reliant on total irrigation. In this context, water use efficiency is important, even though recent research in Arizona showed only small differences among the various species and cultivars used.

In a humid sub-tropical climate like Brisbane where there is much higher probability of rain in the near future, irrigation is generally used to supplement rainfall on turfed areas. This means drought-tolerant turf that can go for longer between drinks(by which time rain may have fallen anyway) can mane substantial savings in irrigation water use over a turf site that is more easily affected by drought and needs water from rain or irrigation more frequently.



Plate 1 - An apparently dead patch of blue couch (left) completely recovered following good rainfall (right)

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Start with the Soil Profile

When grown on a properly constructed soil profile in Brisbane, warm-season turf grasses will survive long periods of drought without any irrigation, in the case of most drought-tolerant species-bermuda grass (*Cynodon dactylon* and hybrids), blue couch (*Digitaria didactyla*) and with no more than an occasional strategic watering to save the life of the less drought-resistant ones.

For turf to cope with extended dry periods, the soil profile should be a minimum of four in. (10 cm) and preferably six in. (15 cm) deep to provide adequate soil water storage. Where the profile depth varies, shallow patches will dry out more rapidly and the turf on these may even appear dead by the next rain fall. But with moisture in the profile once again, many such "dead" patches of bermudagrass and blue couch can stage a complete recovery, as shown in Plate 1.

Not only is the depth of topsoil under the turf important, so is the quality of that topsoil. For example, second-rate soil stripped from a building site will not give the desired result. Increasingly, soil suppliers are mixing components to create artificial soils as sources of good natural topsoil become scarcer.

Products with raw compost that is still decomposing should be avoided. And soil mixes with high organic matter (>25 percent will eventually slump to lower levels as that organic matter decomposes. This is an area where more research and more regulation are required to improve the quality of topsoil used under new turf plantings.

Soil Water Entry and Storage

At low moisture levels, many soils will become water repellent. Rainfall and irrigation are much less effective; water tends to run off or through the soil; and it does not easily wet up again. While this is a widely recognised problem on gold greens due to organic acid coating the



Plate 2 – Surfactant plot showing improved turf quality on bermudagrass

sand/soil particles, it is not well known that soil water repellency is also a common condition on the extensive areas of infertile forest soils found in urban areas around Brisbane.

The normal treatment for soil water repellency in high quality turf areas is to make regular applications of surfactants, which improve water entry by reducing surface tension. Dr. Richard Poulter's work with new generation surfactants has demonstrated their effectiveness in improving infiltration. By maximising the amount of water captured in the soil during short, high intensity storms, improving infiltration translates into better turf quality on treated areas (Plate 2).

Newly laid sod of all turfgrasses has only a very limited root system and is vulnerable to drying out. Water use during turf establishment is also highly visible to politicians, administrators and the general public because regular irrigation is needed until deeper roots have grown through the turf underlay.

A number of soil amendment products (e.g. cross-linked polyacrylamides, water-absorbent foam) have been developed to improve soil water-holding capacity. The role of these products in turf establishment is currently being assessed by the Redland Turf Team under a research grant from TPI.

Plant a Well-Adapted Turfgrass

There is no such thing as the perfect turfgrass, or one that will grow everywhere and under all conditions. Drought tolerance is not the only attribute to be considered when selecting a turfgrass.

For example, some 25 percent of turfgrass sites are affected by shade where the most drought-tolerant species, bermudagrass and blue couch, do not perform well. St Augustinegrass (*Stenotaphrum secundatum*),

Redlands Research Station

- 166-acre research facility run by the Queensland (state) Department of Primary Industries & Fisheries
- Humid subtropical climate with an average of 52 inches of predominantly summer rainfall
- Ample recycle water for irrigation
- One-third with fertile red volcanic soils, two-thirds with an infertile loamy grey forest soil
- Key Queensland (and Australian) centre of Lifestyle (Amenity) Horticulture and turf research

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Manilagrass (*Zoysia matrella*) and Durbangrass (*Dactyloctenium australe*) grow much better than bermudagrass and blue couch under shade, and also maintain green healthy turf much longer than they would in full sunlight.

While larger differences in drought tolerance are found among species, difference within species also occur and will help maximise water savings in the future. The Redlands Turf Team and collaborating scientists from the University of Queensland have recently received a national government grant to develop more drought-tolerant turfgrass cultivars for a range of uses. Over the next four years, this exciting new project will focus on collecting and evaluating Australian bermudagrass genotypes for turf quality and drought tolerance.

Water Quality

Using poor quality alternative water sources, including grey water, invariably means that salinity will be an issue. Ongoing research at Redlands has been directed towards growing turf on salt-affected soils, and has identified salt-tolerant turfgrasses that can also be used with poor quality water.

To date, 41 turfgrass cultivars from nine different species have been screened hydroponically to assess their tolerance to salt levels up to 40 dS/m, or 74 percent of the salt level in seawater. In addition to confirming

the high levels of salt tolerance in seashore paspalum (*Paspalum vaginatum*) and Manilagrass, Dr. Rachel Poulter found considerable variation in salt tolerance among St. Augustinegrass and bermudagrass cultivars (Plate 3), enabling selection of the more tolerant cultivars for moderately saline sites.

Turf vs. Landscape Water Use

Garden commentators promoting shrubs and trees in the media often describe turf as a high water user. This could not be further from the truth.

Further savings in water use are still possible without compromising turf quality or playability. Craig Henderson looked at the year-round water use across a number of soil-based community sportsfields in Brisbane. Under normal frequent irrigation scheduling, the average field uses around 500,000 gallons/acre (5 ML/ha). Strategic weekly irrigation (applied only when no rain had fallen in the previous week, and surface soil moisture was rapidly declining) still maintained good turf quality and a safe playing surface, but on average required less than half the irrigation water, about 240,000 gallons/acre (2.4 ML/ha). By comparison, tree crops like citrus typically require 500,000-750,000 gallons/acre.

These and other facts about water use should be publicized by the turf industry now, in addition to

commissioning further research to compare reticulated water use on turf and on shrubs and trees. In Florida, Drs. Dara Park and John Cisar showed that, after the first year when more water was used to establish the turf, their shrub landscape used more water than the turfed landscape, and this continued to increase as the shrubs grew larger, whereas turf water use stabilized.

We need studies of this kind in Australia to help in getting the message across to the public that turf is not a high water user, but rather a sustainable and environmentally friendly option as the pressure on urban water supplies increases.

Introducing the Redlands Turf Team

- Dr. Don Loch—grass breeding and adaptation, turf agronomy
- Craig Henderson—irrigation use, sportsfield management
- Dr. Rachel Poulter—soil science and hydrology, salinity management
- Matt Roche—turf agronomist, sportsfield instrumentation and management
- Kaylene Bransgrove—plant pathologist, sportsfield management
- Cynthia Carson—information/turf extension
- Jon Penberthy—practical greenkeeping
- Alan Duff, Larry Cooper, Russel Durant, Lin O'Brien and Gary Nahrung—provide technical support



Plate 3 – Selected examples showing variation in salinity tolerance among bermudagrass cultivars. In each case, treatment shown from left to right increase from 0 to 30 dS/m

