

Comparison of *Zoysia* species for salinity tolerance.

Methods

The different grass cultivars in each of the experimental runs received complete nutrients in solution, as well as variable amounts of salt to impose six different treatment levels through a flood-and-drain hydroponic system operating twice a day initially, then once a day during experiment 3. Each experiment was a completely randomised design with 6 replications. The nutrient + salt solutions for each treatment were replaced monthly. Treatment salinity levels were checked 3 times per week and adjusted as necessary. Each run involved three phases: a **salt-free settling-in phase** (4-6 weeks) following planting into 85 mm x 85 mm square pots, 100 mm deep; a **transitional phase** of c.3 weeks in which the different treatments were gradually applied; and an **experimental phase** in which measurements were taken on the grasses in the different salt treatments (12-16 weeks). During the transitional phase, salt was added at a rate to achieve an increase of 2 dS/m per day to avoid the occurrence of “salt shock”.

Three standards were included in every experimental run to provide a consistent scale against which the results of grasses in the different experimental runs can be assessed. The three standards chosen to cover a range from high to low salt tolerance were *Paspalum vaginatum* ‘Sea Isle 2000’, *Cynodon dactylon* FLoraTeX™ and *Digitaria didactyla* ‘Aussiblué’.

In runs involving less salt-tolerant turfgrasses, the range of salinity covered by the six treatments were 0, 6, 12, 18, 24, and 30 dS/m. The six salt treatments for the more tolerant turfgrasses were 0, 8, 16, 24, 32, and 40 dS/m covering a range to c.75% of sea water.

All grasses were clipped to a constant height (~5 mm) at the start of the experimental phase. Subsequent fortnightly clippings were collected and oven dried at 70°C for 24 hrs to obtain dry matter production. Leaf height (mm) was measured prior to each cut. Per cent leaf firing was visually assessed fortnightly. At completion of both the second and third runs, the grasses were removed from pots and crown and root material separated, washed and dried for dry weight determination.

To facilitate comparisons among the different varieties and species, dry matter production data for each cultivar/accession was standardised by dividing the dry matter production for each salinity treatment by that produced in the corresponding control treatment as represented in Equation 1.

$$DM_{ST} = \frac{DM_T}{DM_C} \text{ (Equation 1)}$$

where DM_{ST} = Standardised dry matter, DM_T = Treatment dry matter, and
 DM_C = Control dry matter

The following cultivars were investigated in the first run under the Horticulture Australia Limited funded study TUO2005 (2003-2005):

<i>Zoysia matrella</i>	Cavalier
<i>Zoysia matrella</i>	Diamond
<i>Zoysia matrella</i>	A-1
<i>Zoysia matrella</i>	Royal
<i>Zoysia matrella</i>	Zorro

Results and discussion

Defining a single parameter by which to assess the relative salt tolerance of the different entries is not possible given the non-linear nature of the growth response. This non-linearity of function was particularly noticeable in the more salt tolerant species where different salt tolerance come into play at different salinity thresholds (R.R. Duncan and R.N. Carrow 2004 ,

pers. comm. 5 October). To address this issue, three points on the growth reduction curve were derived by interpolation for each cultivar/accession: the electrical conductivity at which dry matter production was 80%, 50% and 20% of that occurring in the control. These values are listed in Table 1.

Table 1. Electrical Conductivity (EC_w) at which growth was reduced to 80%, 50% and 20% of that occurring in the control treatment (0.1 dS/m).

Species	Cultivar/ accession	EC at 80% DM production:			EC at 50% DM production:			EC at 20% DM production:		
		Trial			Trial			Trial		
		1 (2003)	3 (2009)	4 (2010)	1 (2003)	3 (2009)	4 (2010)	1 (2003)	3 (2009)	4 (2010)
<i>Zoysia matrella</i>	Cavalier [Ⓛ]	4			14			34		
<i>Zoysia matrella</i>	Facet [Ⓛ]	5			21			na		
<i>Zoysia matrella</i>	A-1 [Ⓛ]	13			24			36		
<i>Zoysia matrella</i>	Royal	5			23			na		
<i>Zoysia matrella</i>	Zorro	9			20			29		
<i>Zoysia tenuifolia</i>	Common form		18			20			22	
<i>Zoysia japonica</i>	Zoyboy [™]		22			26			30	
<i>Zoysia japonica</i>	ZT-11		6			14			22	
<i>Zoysia japonica</i>	Palisades [Ⓛ]		5			14			23	
<i>Zoysia japonica</i>	Empire [™]		6			14			23	
<i>Zoysia japonica</i>	El Toro [Ⓛ]		6			16			26	
<i>Zoysia japonica</i> x <i>tenuifolia</i>	PristineFlora [™]		22			26			30	
<i>Zoysia macrantha</i>	Nara [™]			19			23			26

As stated, *Zoysia matrella* was investigated under an earlier project (TUO2005) with salinity response illustrated in Figure 1. This follows a similar pattern to that of most *Zoysia japonica* varieties excluding Zoyboy[™], which shows a response more typical of a salt tolerant turfgrass as discussed above. Figure 2 illustrates the salinity response of *Z. macrantha*, *Z. tenuifolia*, *Z. japonica* x *Z. tenuifolia* and *Z. japonica*, clearly showing the non-linearity in response of Zoyboy[™], PristineFlora[™], Nara[™] and common *Z. tenuifolia* accession. Series 3 and 4 of TUO6006 were run at two different salinity ranges. However there was sufficient overlap to allow for direct comparison. The results for the standard comparators were not significantly different between the two series providing further justification for direct comparison between varieties. The salinity level 24 dS/m was common to both series, therefore used to directly compare relative dry matter as per the above equation. Results for this treatment were analysed using GenStat® 11th edition.

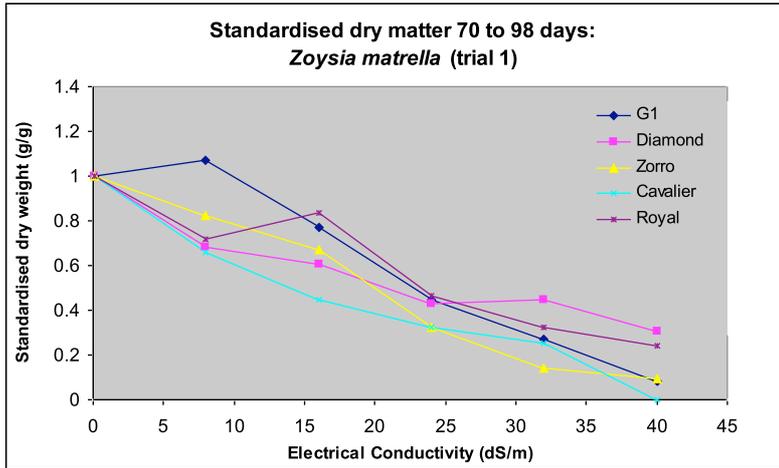


Figure 1. Standardised dry matter for the five *Zoysia matrella* cultivars over the final 4 weeks of trial 1, taken from final report TUO2005 (Loch, Poulter et al. 2006). Note: G1 = A-1.

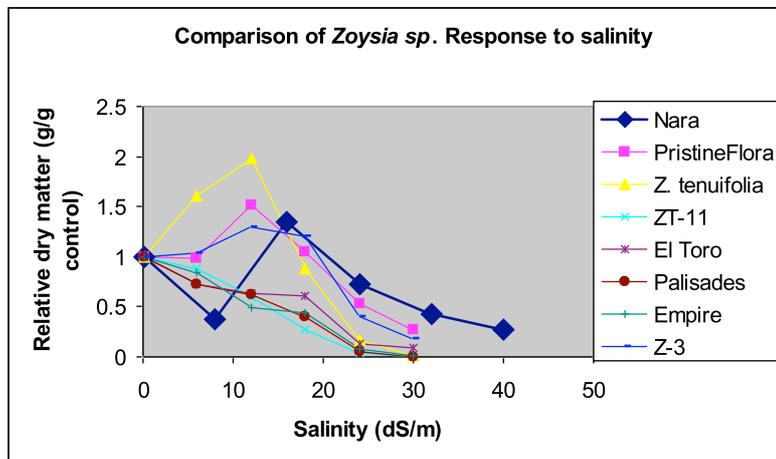


Figure 2. Standardised dry matter for the five *Zoysia japonica* cultivars, one hybrid *Zoysia*, and one *Zoysia macrantha* over the final four weeks of trials 3 and 4 of TUO6006. Note: Z-3 = Zoyboy.

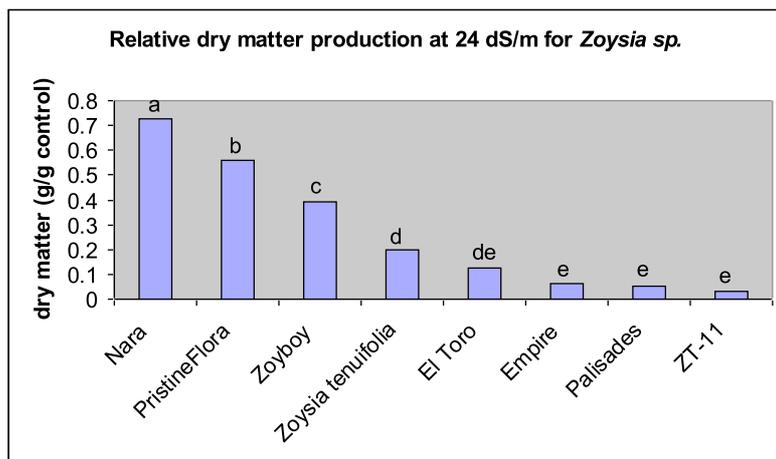


Figure 3. Standardised dry matter at 24 dS/m for the five *Zoysia japonica* cultivars, one hybrid *Zoysia*, and one *Zoysia macrantha* over the final four weeks of trials 3 and 4 of TUO6006. Cultivars with a different letter are statistically different at 95% confidence limits (least significant difference = 0.099).

Loch, D. S., R. E. Poulter, et al. (2006). Amenity Grasses for Salt-Affected Parks in Coastal Australia, Department of Primary Industries & Fisheries, Queensland, Redland Shire Council, and Horticulture Australia Ltd. HAL project number: TU02005.