

# **Adaptation of warm-season turf grasses for tropical Australia**

Matthew Roche  
Australian Sports Turf Consultants Pty Ltd

Project Number: TU09001

## **TU09001**

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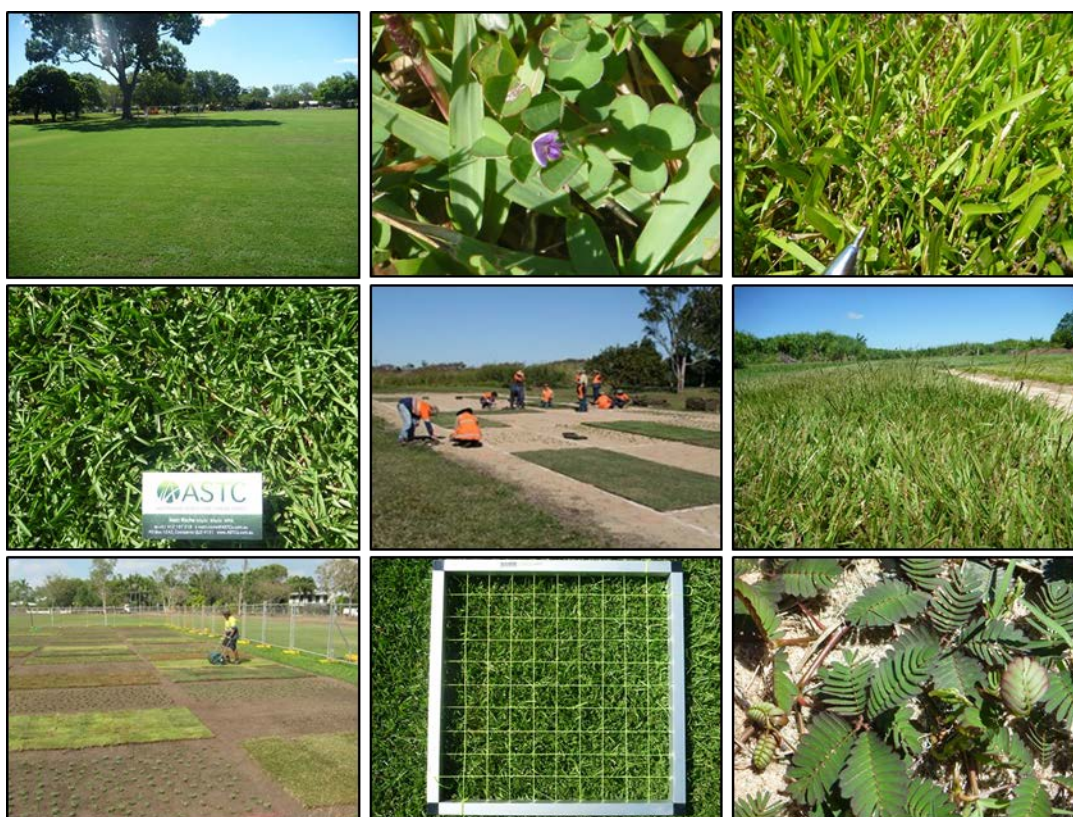


*Horticulture Australia*

**HAL Project TU09001**  
(Completion date 31 May 2013)

# **Adaptation of warm-season turf grasses for tropical Australia**

## **Final Report**



Matt Roche

Australian Sports Turf Consultants (ASTC) Pty Ltd



## Project Number TU09001

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This report summarises the process and outcomes of a two-year project, investigating the performance of 19 varieties, comprising of 13 species, of new and commercial warm-season turfgrasses planted within the tropics. The study was established to measure the strengths and weaknesses of the turfgrasses trialled against challenging environmental parameters and resources and identify grasses that are better suited to tropical conditions. This information is to assist consumers, including city councils, to choose turfgrass varieties that will meet their needs and suit their environment. This report also provides recommendations for further research associated with tropical turfgrasses following the complete of this study.

This project has been funded by HAL using voluntary contributions from industry and matched funds from the Australian Government. Financial or voluntary contributions utilising non-tax payer monies were provided by the Mackay Regional Council in Queensland, Darwin City Council in the Northern Territory and the Queensland Department of Agriculture, Fisheries and Forestry (DAFF).

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A special mention should be given to Mackay Regional Botanic Gardens (Mackay Regional Council) and Darwin City Council who was proactive in providing resources into warm-season turfgrass research for tropical environments. The commitment from both councils to undertake the study was unwavering even following the withdrawal of the Centre for Urban Greenery and Ecology (CUGE) in Singapore from the project.

ASTC acknowledges the initial work the now Queensland Department of Agriculture, Fisheries and Forestry (DAFF) had undertaken to initiate the project prior to disinvesting in the Lifestyle Horticulture R&D program in 2012. Their support prior to the termination of their contract with Horticulture Australia enabled ASTC and the two Australian councils to see the project through to completion.

A sincere thank you to former DAFF staff and colleagues which were involved in the early stages of the Tropical Turfgrass Project. They included: Jon Penberthy, Bartley Bauer, Alan Duff and Shane Holborn. I wish you all the best in your endeavours within the Lifestyle Horticulture industry.

Matt Roche

**Director**

Australian Sports Turf Consultants (ASTC)

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## Media Summary

Trials to determine how well different warm-season turfgrass cultivars are adapted to different tropical environments and their specific maintenance requirements are important for turf managers and homeowners. All too often decisions are made on price, (availability) and advertising, and not based on results on how well varieties perform in their local environment.

The aim of this study was to obtain a greater understanding of how a diverse range of warm-season turfgrasses would handle different tropical environments. A total of 19 varieties were selected to assess their performance against challenging environmental parameters (e.g. heat and drought) and resources (e.g. nutrition, maintenance) under different management regimes.

Two trial sites were established in mid-2011 in Mackay, QLD and Darwin, NT with the assistance and support from Mackay Regional Botanic Gardens and Darwin City Council respectively. A third trial site was to be established at HortPark in Singapore; however due to unforeseen circumstances this did not happen. Although, Singapore is very keen on utilising Australian warm-season turfgrass varieties to help improve their parks and recreational areas in the future.

The tropical turfgrass study identified a number of well suited species and varieties capable of producing an acceptable to high turfgrass quality in a tropical environment. The challenge was to provide the turfgrasses trialled adequate resources whilst they were in ground, but at the same time identify turfgrasses that require less fertiliser and mowing, to achieve the same acceptable to high turf quality. The selection of lower input grasses have the opportunity to save councils, turf managers and home owner's significant money and most importantly time. You can then be out enjoying and using the turf, not spending additional time maintaining it.

Now that the study has ended, Australian and international plant material are now located in either Darwin and or Mackay. Australian Sports Turf Consultants (ASTC) will be working with the respective councils to identify turf varieties they wish to utilise on a larger scale within their parks and recreational facilities. Discussions will then take place with the breeders of the particular varieties they are interested in and local turf producers about options going forward. The aim is to make commercially available the varieties each council believes will have merit in their environment. This effort will not only benefit councils, but their local communities and the wider turf production industry through increases in turf production and sales.

## Technical Summary

The aim of this study was to obtain a greater understanding of how a diverse range of warm-season turfgrasses would handle different tropical environments. A total of 19 varieties comprising 13 species were selected to assess their performance against challenging environmental parameters (e.g. heat and drought) and resources (e.g. nutrition, maintenance).

Two trial sites were established in mid-2011 in Mackay, Queensland and Darwin, Northern Territory with the assistance and support from Mackay Regional Botanic Gardens and in Darwin City Council respectively. A third site was to be established at the Centre of Urban Greenery and Ecology's (CUGE) HortPark in Singapore. Their participation would have resulted in international trade and the introduction of new and improved Australian and American turfgrass varieties into Singapore. However, due to unforeseen circumstances CUGE withdrew as a voluntary contributor (VC) and collaborator from the project, which resulted in no trial site being established in Singapore.

Within the present study, some species in particular produced higher thatch levels [(*Digitaria didactyla* (blue couch), *Stenotaphrum secundatum* (buffalo grass) and *Zoysia* spp. (*Z. japonica*, *Z. matrella* and *Z. macrantha*)] or greater vertical growth [(*Axonopus compressus* (broadleaf carpet grass), *Eremochloa ophiuroides* (Centipedegrass), *Paspalum* spp. (*P. nicorae* and *P. notatum*) and *Stenotaphrum secundatum*] compared to others. However, some of the latter species and varieties also have a long list of positive features. For example: wear, shade and drought tolerance and low fertility requirements. Councils and end users need to identify what their requirements are and ascertain what resources are available now and into the future to maintain their selection.

Now that the study has ended, plant material of up to 19 varieties, containing Australian and American turfgrass varieties are located in either Darwin and or Mackay. Australian Sports Turf Consultants (ASTC) will be working with the respective councils to identify turf varieties they wish to utilise on a larger scale within their parks and recreational facilities. Discussions will then take place with the breeders of the particular varieties they are interested in and local turf producers about options going forward. The aim is to make commercially available the varieties each council believes will have merit in their environment. This effort will not only benefit the individual council, but their local community and the wider turf production industry.

# Introduction

Establishing and maintaining grassed areas in urban open space is a major cost to local authorities in tropical environments. These situations range from sportsfields through urban parklands to roadsides, each with its own set of requirements, peculiarities and limitations with regards to the choice of a suitable turfgrass and detailed knowledge of how best to maintain it.

In the past, the choice was made relatively simple because the range of available grasses was limited, and sound local knowledge and experience had been developed through trial-and-error over a long period of time in relation to these grasses and their suitability for specific uses and situations. Their irrigation, fertiliser and mowing requirements are generally well known these days; but because of the limited choice available, some of them are high maintenance grasses with high input requirements.

Turf breeders and researchers elsewhere in Australia and around the world have been developing new turf varieties including species that are better suited in terms of their water and fertiliser use and the energy and labor required for their maintenance in a tropical environment. Over the past 10 years or so, a number of new warm-season turf varieties have become available in subtropical and tropical Australia; but most until now had not yet been trialled in tropical regions, despite their promising origins.

Understanding the optimal selection and management of turfgrass in the tropics is largely reliant on studies performed in the sub-tropics (Menzel and Broomhall, 2006a; Menzel and Broomhall, 2006b) although there is significant evidence to show that the relevant selection of varieties and cultural practices for tropical conditions is often specific to these climatic zones (Wiecko, 2006; Nishimoto et al., 1997; Murakami and Ray, 2000).

To address the current limitations on turfgrass options in tropical Australia for turf producers, councils, developers and homeowners, a range of commercial and test species/varieties were tested at two locations in the wet tropics of Australia. The ultimate objective of the project was to identify promising (new and commercial) varieties that increase turfgrass choice for each region, with an emphasis on products suited to municipal amenity areas that minimise input requirements (e.g. mowing and nutrition) with substantial environmental tolerances (e.g. drought, wear, shade).

By making available turfgrass varieties that are better suited to tropical conditions, both turf producers and end users (e.g. councils and homeowners) will benefit resulting in an increase in turf production due to customer satisfaction. Information contained within this report will assist turf producers and end users decide on potential turf species and or varieties for planting in tropical environments.

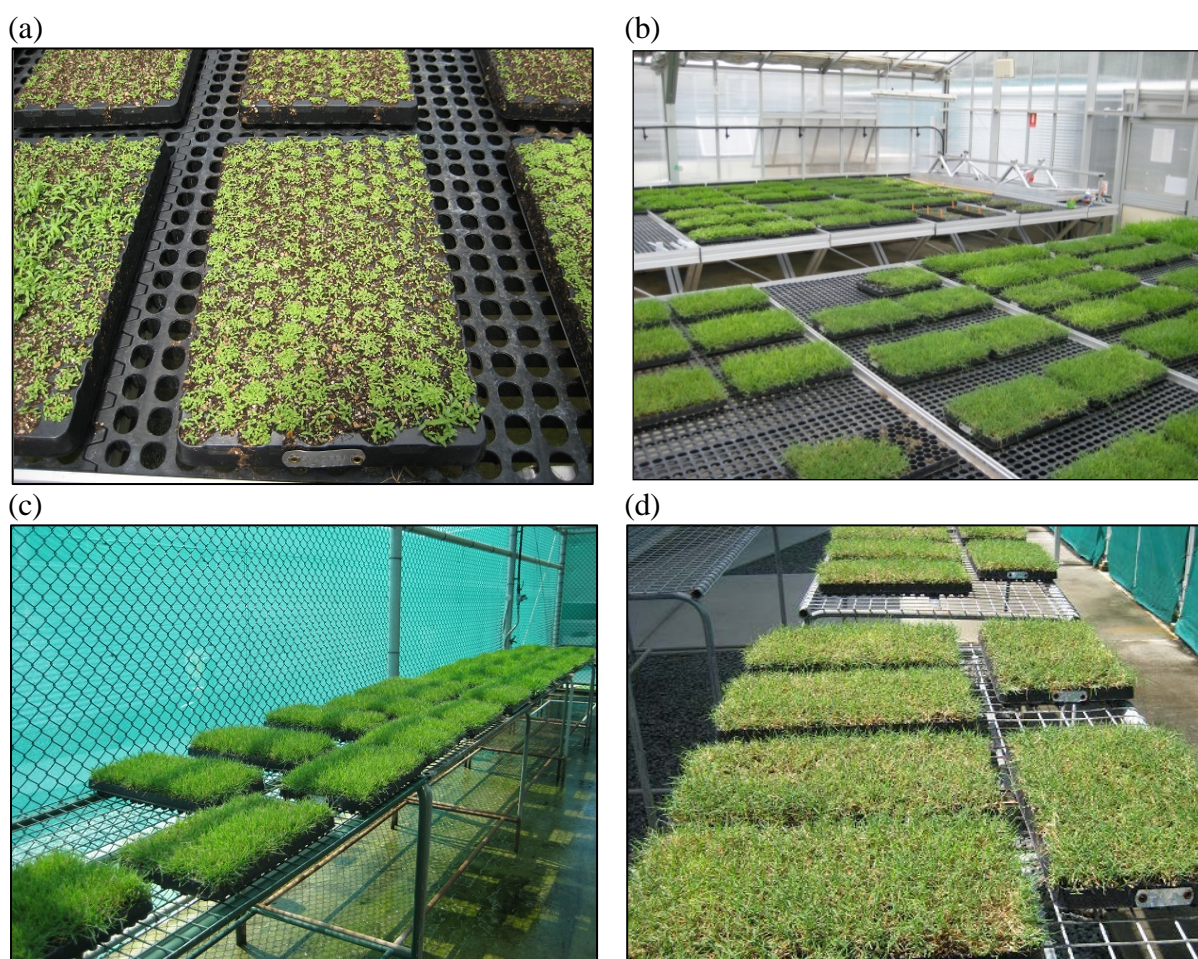
# Materials and Methods

## Turf varieties trialled

A total of 19 varieties comprising 13 species were selected and trialled to assess their performance against challenging environmental parameters (e.g. heat and drought) and resources (e.g. nutrition, maintenance) (Table 1). Not all 19 warm-season turfgrass varieties were trialled at both the Darwin and Mackay trial sites for various reasons, including the need for turf replacement and logistical issues during the establishment of the Darwin trial site (as detailed on subsequent pages).

Due to the availability of plant material, particularly international or (at the time) yet to be commercialised varieties, plant material was planted as seed, plugs or sod (Table 1). Plug material was produced from either seed (Plate 1a) or from vegetatively propagating rooted nodal cuttings (e.g. Plate 1b) and grown on at Redlands Research Station, QLD in the glasshouse, then shade house and finally under full sunlight to harden the plants off prior to transportation to either Darwin or Mackay. Plugs contained a peat vermiculite ratio of 50% peat and 50% vermiculite – grade 3.

**Plate 1** (a) Plugs established by seed, (b) trays containing seed and vegetatively propagated material growing in the Redlands Research Station glasshouse, (c) trays being hardened off under 50% shade cloth and (d) trays hardening off in full sun prior to transportation.



**Table 1** Warm-season turfgrass cultivars being trialled in replicated plots in Darwin, NT and Mackay, QLD.

Species	Common name	Variety	PBR	Planted as	Darwin	Mackay
<i>Axonopus compressus</i>	Broadleaf carpet grass	Broadleaf Carpet Grass	-	Sod	Yes	Yes
<i>Cynodon dactylon</i>	Green couch	OZ Tuff™	(b)	Sod	Yes	Yes
		25a-1	-	Plugs	Yes	Yes
<i>Digitaria</i>	Qld blue couch	Tropika	-	Sod	Yes	Yes
		Aussiblu	(b)	Sod	Yes	Yes
<i>Eremochloa ophiuroides</i>	Centipedegrass	Centek	-	Sod	Yes	-
<i>Panicum laxum</i>	Lax panicgrass	ShadeGro™	(b)	Plugs	Yes	Yes
<i>Paspalum nicorae</i>	Brunswick grass	Blue Dawn	-	Plugs	Yes	Yes
<i>Paspalum notatum</i>	Bahia grass	LowGro™	-	Seed	Replaced*	Yes
<i>Paspalum vaginatum</i>	Seashore paspalum	Sea Spray	-	Seed	Yes	Yes
<i>Stenotaphrum secundatum</i>	Buffalo grass	Kings Pride	(b)	Sod	-	Yes
		Sir Walter	(b)	Sod	Yes	-
<i>Zoysia hybrid</i>	Zoysia grass	PristineFlora®	-	Plugs	Yes	Yes
<i>Zoysia</i>	Zoysia grass	Empire™	(b)	Sod	Yes	Yes
		Palisades	(b)	Plugs	Yes	Yes
		ZT-11	-	Sod	Yes	Yes
<i>Zoysia macrantha</i>	Zoysia grass	Nara™	(b)	Sod	Yes	Yes
<i>Zoysia matrella</i>	Zoysia grass	Royal	-	Plugs	Yes	Yes
		Shadetuff®	(b)	Sod	Yes	Yes

**Notes :**

- All plugs were planted at approximately 150 mm x 150 mm spacings.
- LowGro™ and ShadeGro™ seed was applied 20g/m<sup>2</sup>, additional ‘Blue Dawn’ seed was applied at 5g/m<sup>2</sup> and ‘Sea Spray’ seed was applied at 10g/m<sup>2</sup>.
- \* LowGro™ was replaced with ‘Centek’ on 22 Sep 2011 in Darwin due to poor establishment. ‘Centek’ was chosen following discussions with Darwin City Council staff and Northern Territory sod producers.
- Originally, ‘Kings Pride’ was to be planted at both the Mackay and Darwin trial sites. However, material could not be harvested nor transported in time to Darwin with the rest of the consignment. The buffalograss ‘Sir Walter’ was chosen as the alternative which was sourced locally within Darwin.
- The *Paspalum vaginatum* vegetative cultivar SeaDwarf™ was replaced with the *Paspalum* seeded variety ‘Sea Spray’ in both the Mackay and Darwin sites because sod of the former cultivar could not be harvested in time due to on farm flooding in Coffs Harbour, New South Wales.
- Protected by Plant Breeder’s Rights (PBR) which is denoted by the PBR symbol ‘(b)’. Refer to appendix A for a cross reference of trademark and or variety names and PBR names registered with IP Australia.

## Quarantine measures

For importation of turf material (plugs and sod only; not seed) into the Northern Territory for establishment of the Darwin trial site, numerous quarantine requirements needed to be met as requested by the NT Department of Primary Industries and Fisheries (DPIF). The procedure for inspecting and certifying turf material prior to refrigerated transport from the Jimbooma Turf farm in QLD to Darwin was as follows:

- Peat vermiculite potting media used to establish the plugs had to be sterilized in autoclaves at 121 °C, 103.4kPa for 30 minutes;
- Prior to the turf being harvested it had to be sprayed with the insecticide/miticide Talstar® 80 SC (active constituent: 80g/L bifenthrin) 72 hours before consignment. This was to control scale and Spiraling Whitefly (*Aleurodicus dispersus*). Each grower had to sign a declaration stating that this had been done;
- Turf needed to be soil-free at the time of inspection. Sod (only) was to be machine washed at the Jimbooma Turf farm;
- An officer of Biosecurity Queensland inspected for Western Flower Thrips (WFT) (*Frankliniella occidentalis*) and Spiraling Whitefly prior to loading the truck;
- Turf was inspected for freedom from Red Imported Fire Ants (RIFA) (*Solenopsis invicta*); and
- The RIFA, WFT and Spiraling Whitefly declarations were made on a Queensland Government plant health assurance certificate at the time of inspection by the Biosecurity Queensland officer.

The only quarantine procedure suppliers of turf material (QLD turf producers and Redlands Research Station staff) to Mackay had to follow was restrictions relating to Red Imported Fire Ants. Material coming from Redlands Research Station had a signed declaration stating that “the certifying facility and source property have been inspected by an officer of Queensland Department of Employment, Economic Development and Innovation within the past four weeks and been free from RIFA.

## Trial setup

Originally three trial sites were to be established within the present study with one in Mackay, QLD; one in Darwin, NT and a third site was to be located at HortPark in Singapore. The latter site is operated by the Centre for Urban Greenery and Ecology (CUGE) who were signed onto the tropical turfgrass project as collaborators and financial contributors. Unfortunately after eighteen months of deliberation, following the commencement of the project, CUGE informed the project leader that they had decided to withdraw from the TU09001 research project. The decision was made by CUGE because two organisations, CUGE and DAFF (the initial project leader), could not be listed on the Horticulture Australia Limited (HAL) head agreement. This meant that a collaborative agreement where DAFF was to act as a subcontractor and subsequent material transfer agreements (MTAs) protecting turfgrass varieties being exported to Singapore could not be agreed upon.

So with the loss of the Singaporean trial site, only two tropical turfgrass sites were established; one in Darwin, Northern Territory and the other in Mackay, Queensland.

## Darwin

Turf material (Table 1) of seed, plugs and sod were couriered to Jimboomba Turf farm, Jimboomba, Queensland on 19 to 20 July 2011. Seed and plugs were supplied from Redlands Research Station, whereas the sod had been sent from Queensland producers as far north as Gordonvale (17°13'S lat, 145°71'E long) and as far south as Boyland (27°94'S lat, 153°11'E long). All sod had to be washed free of soil at Jimboomba Turf farm and all material then had to be inspected by a Biosecurity Queensland Officer (DAFF) prior to the consignment being transported to Darwin on a refrigerated truck 21 July 2011. Jimboomba Turf was used as the collection and distribution point of movement of turf to Darwin because of their available washing facilities and experience in transporting turf interstate.

Plots measuring 5 m x 2 m in a randomised complete block design with three replications (Figure 1) were established by Darwin City Council staff at Wagaman Park (12°38'S lat, 130°09'E long), Darwin, Northern Territory on 26 July 2011 (Plate 3a). The site was initially established in a fenced off area which encompassed a natural clay loam soil profile.

Additional seed of the *Paspalum vaginatum* variety 'Sea Spray' was provided to Darwin City Council staff on 1 September 2011 for resowing. The *Paspalum notatum* variety LowGro™ plots were also replaced with sod of the *Eremochloa ophiuroides* cultivar 'Centek' by Darwin City Council staff on 22 September 2011 because of LowGro's poor performance.

**Figure 1** Plot layout at Wagaman Park, Darwin, NT.

Block I	Block II	Block III
Sir Walter	Empire™	Tropika
Broadleaf Carpet Grass	Centek	25a-1
Aussibblue	25a-1	Royal
Nara™	Aussibblue	Centek
ZT-11	PristineFlora®	Blue Dawn
Shadegro	Palisades	PristineFlora®
Blue Dawn	Sea Spray	Sea Spray
Royal	Nara™	Shadetuff®
PristineFlora®	Shadegro	Nara™
Shadetuff®	ZT-11	Shadegro
Tropika	OZ TUFF™	Broadleaf Carpet Grass
Sea Spray	Broadleaf Carpet Grass	Aussibblue
OZ TUFF™	Sir Walter	ZT-11
Centek	Tropika	OZ TUFF™
Palisades	Royal	Palisades
Empire™	Shadetuff®	Sir Walter
25a-1	Blue Dawn	Empire™



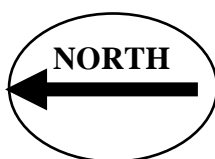
## Mackay

Seed and vegetative plugs were sent by courier from Redlands Research Station, Queensland on 6 July 2011 to Mackay Regional Botanic Gardens. Sod arrived from the Queensland turf producers at Mackay Regional Botanic Gardens between 11 and 13 July and was planted in a prepared area, on a sand profile, following their arrival at Mackay Regional Botanic Gardens (21°09'S lat, 149°09'E long) on the 12 and 13 July 2011 by Mackay Regional Council staff (Plate 7a). Turf material including seed, plugs or sod, was planted in plots measuring 5 m x 2 m in a randomised complete block design with three replications (Figure 2).

**Figure 2** Plot layout at Mackay Regional Botanical Gardens, Mackay, QLD.

<b>Block I</b>	Tropika	Palisades	PristineFlora®	Shadetuff®	ShadeGro™
	Sea Spray	Aussiblu	Empire™	Blue Dawn	ZT-11
	Nara™	Kings Pride	25a-1	Broadleaf Carpet	Royal
	OZ TUFF™		LowGro™		
<b>Block II</b>	ZT-11	Empire™	Kings Pride	Nara™	Blue Dawn
	LowGro™	ShadeGro™	Shadetuff®	25a-1	Broadleaf Carpet
	OZ TUFF™	Aussiblu	Tropika	Palisades	Royal
	Sea Spray		PristineFlora®		
<b>Block III</b>	Broadleaf Carpet	25a-1	Royal	Kings Pride	PristineFlora®
	OZ TUFF™	Blue Dawn	Aussiblu	Nara™	Empire™
	Shadetuff®	ZT-11	ShadeGro™	LowGro™	Tropika
	Palisades		Sea Spray		

(Figure is not to scale)



## Inspections and data collection

Both the Darwin and Mackay trial sites were inspected three times by the project leader following planting (Table 2). During each visit the following data was collected:

- Turf colour using a Field Scout Turf Colour Meter (TCM) (Plate 2a);
- Quadrat (Plate 2b) and subplot photos to measure turf cover; and
- Turfgrass observations encompassing quality (subjective measurements 1 (=worst) to 9 (=best); 6 = acceptable), performance, growth, nutrition status, thatch level, weed and pest and disease presence.

**Table 2** Dates when the Darwin and Mackay trial sites were inspected and data was collected following planting on 26 July and 12-13 July 2011 respectively.

Darwin	Mackay
1 September 2011	31 August 2011
27 June 2012	26 June 2012
8 May 2013	18 Mar 2013

The Field Scout TCM 500 portable unit (Spectrum Technologies Inc., USA) measures reflected light from turfgrass in the red (600nm) and near infrared (850nm – NIR) spectral bands. The difference between the two values relates to the chlorophyll concentration and plant health, providing a ‘Turf Colour Meter Rating’. Red & NIR data is presented in three forms: as an index (0 to 99) of Red/NIR in %, Normalised Difference Vegetative Index (NDVI - 0 to 1), and Grass Index (i.e. 1 (=worst) to 9 (=best); 6 = acceptable). The Grass Index approximates the rating a visual observer would assign to the turf grass. This provides a more objective value for this, generally, very subjective parameter. The Grass Index is calculated as follows (Spectrum Technologies Inc., no date):

$$\text{Grass Index} = (\text{NDVI} \times 6.6) + 2.26$$

**Plate 2** (a) The Field Scout TCM 500 portable unit and (b) quadrat used to collect data.

(a)

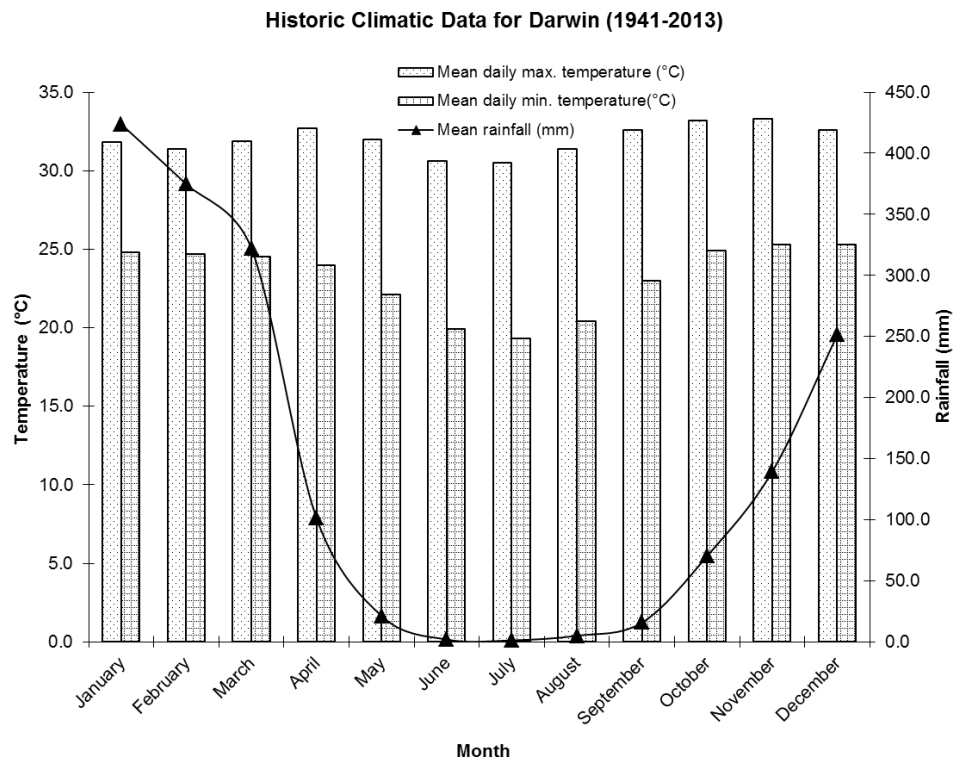


(b)

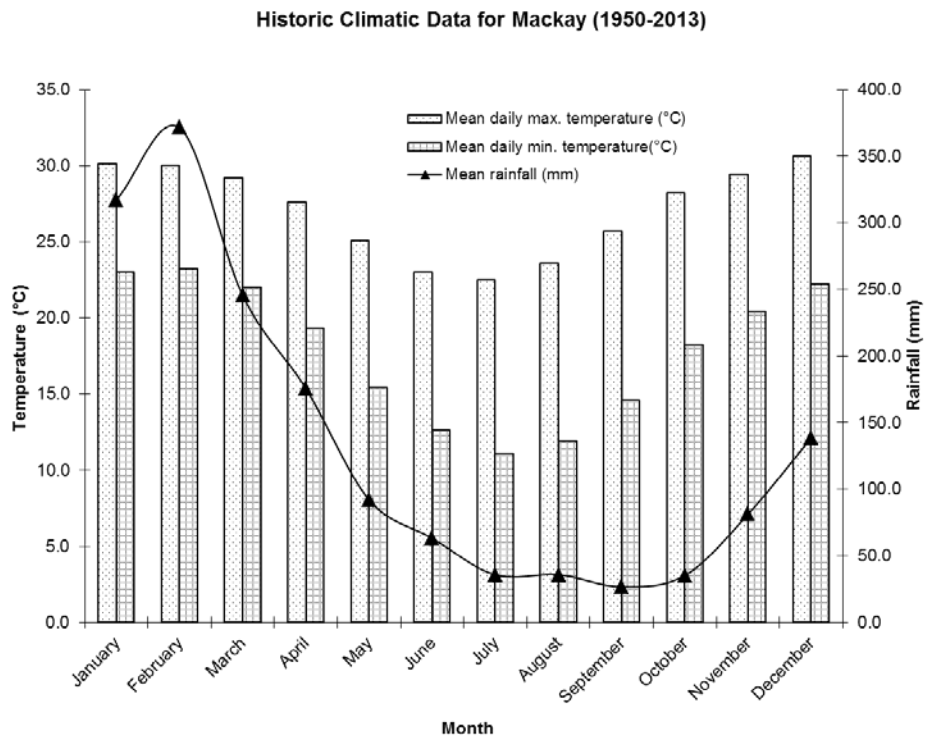


## Climatic data

**Figure 3** Historic climatic data for Darwin Airport (BoM, 2013a).



**Figure 4** Historic climatic data for Mackay Airport (BoM, 2013b).



# Results

## Darwin

A significant amount of resources was required in order to transport turfgrass from Queensland to Darwin. This included the costs associated with purchasing the turf, transportation to a central distribution point, in this case Jimboomba Turf farm, washing the turf free of soil, carrying out quarantine inspections, transporting the turf via refrigerated truck to the Darwin City Council depot and then transporting material from the depot to the trial site. Cost was one component; however time was the other important factor.

Turfgrass was harvested from the Queensland turf farms on the 18 and 19 July 2011. Sod had to arrive at the Jimboomba Turf farm for washing on the 20 July and be ready for inspection by Biosecurity Queensland and delivery to Darwin the following day. Turf arrived at the Darwin City Council depot on 25 July and was not planted until the following day. On average the turfgrass had been harvested 7-8 days prior to planting. Turf material had arrived with necrotic growth in the centre of the turf rolls and green only around the edges of the turf (Plates 3a) from heat and cooling stresses incurred during the long transportation process.

The two varieties of blue couch, ‘Aussiblu’ and ‘Tropika’ did not handle having the soil washed free from their roots. The stoloniferous root system present within this turf species struggled to keep the turf together as complete sod, and as a result had to be planted as clumps or sections of broken turf.

Throughout the course of the study, the Darwin turf plots were mown fortnightly by contractors using a front deck ride-on mower with the clippings being returned to the soil. Council staff had undertaken weed control by spot spraying selective pesticides and by mechanically removing weeds including encroaching varieties. Plots had also been scarified to remove undulations and build-up of thatch. Following scarification work, the trial area and surrounding field had been topdressed and fertilised with a high nitrogen base granular fertiliser. Plot edges were routinely sprayed with Basta® (active constituent: 200 g/L glufosinate-ammonium), a contact selective herbicide to limit stoloniferous encroachment between plots.

During the first inspection by the project leader on 1 September 2011 (Plate 3b) all sod which had been transported from Queensland, including the two varieties of blue couch, had overcome the stresses, bedded in and produced lush vigorous growth (e.g. Plate 4d). This process was assisted by the Darwin climate (e.g. Figure 3), good nutrition and sound maintenance practices by Darwin City Council staff. Varieties established by sod were doing best and were even sending fresh stolons out from the side of the turf rolls/plots (e.g. Plate 4c). Varieties established by plugs were growing and spreading well (e.g. Plate 4b). Of the latter, the *Zoysia* spp. varieties were the slowest to spread across the surface to produce a complete sward (e.g. Plate 4a). Generally speaking, *Zoysia* varieties grow one-third as fast as green couch varieties, vertically and laterally. This is a bonus for the consumer encompassing less mowing, but for a turf producer fewer harvests per calendar year will be obtained. The

two seeded varieties, ‘Sea Spray’ and LowGro™ were struggling at the time of inspection (37 days post planting). Additional seed of ‘Sea Spray’ was supplied to support the growing material. However, it was decided that since little growth had developed of the bahia grass variety LowGro™ it was to be replaced. Turf quality of both the plugged and seeded varieties planted were much lower than the varieties that had been planted using full sod (Table 4).

Scalping of some of the varieties was observed during the inspection conducted on 1 September 2011, but none more so than the damage incurred to the buffalo grass variety ‘Sir Walter’ (Plate 5f). Unfortunately due to contractor mowing, a “one height only” mowing regime was adopted for the maintenance of the turf plots and surrounding sportsfield.

Prior to the second inspection conducted on 27 June 2012 (Plate 3c) the temperature within Darwin had remained warm (min 14.5°C on 25 June 2012) and rain periods had been few and far between (June and July has the lowest mean monthly rainfall). An irrigation issue had moderately affected plant health (e.g. signs of water stress) of up to 7 turf varieties growing within the south west corner of Blocks 2 and 3 (Figure 1). However, overall the turf plots were doing well (Table 4). The majority of the 6 cultivars established by plugs (Table 1) were fully established (100% cover) producing a complete sward and looked as if they had been planted by sod (Plate 5d and e). Even the seeded variety ‘Sea Spray’ that was struggling nine months earlier had produced a moderately dense sward (Plate 5b) once additional seed had been applied by Darwin City Council staff.

During this inspection it was observed that possible couch mite damage had been effecting turfgrass growth and performance of the two *Cynodon dactylon* (green couch) turfgrass varieties OZ TUFF™ (Plate 6b) and ‘25a-1’. The damage caused significant problems in allowing these turfgrasses to develop and form complete swards. Varieties like PristineFlora® (Plate 5c) were also affected by mites but had largely recovered.

During the third and final inspection conducted on 8 May 2013 (Plate 3d) all plots were in a great condition (Tables 3 to 5), minus any contamination issues, given the timeframe they had been in the ground and the level of upkeep achieved by the few turf management staff present within Darwin City Council. All plots had achieved 100% cover, including the plugged and seeded varieties planted. However, undulations were present within the *Zoysia* spp. varieties that had been plugged, meaning that the turfgrass had not filled out (became dense). Some plots had high levels of contamination where others that formed dense swards had none (Table 3). Further scalping was observed of the *Zoysia* spp. and *Cynodon dactylon* varieties. It was not that scalping did not occur on other turfgrass species and varieties; it was just that the latter two species in particular were slower to recover from being scalped.

Throughout the study a number of varieties produced fast vertical growth (e.g. Plate 4e and 5e), comparable to “buffalo grass” (broadleaf carpet grass) (Plate 6c) commonly seen/used in the tropics. However, a number of grasses (Table 3) produced less vertical growth, provided contrasting (different) colours and textures which may appeal for a number of uses e.g. recreational and aesthetic environments. The performance of these varieties show significant promise for Darwin Council should they wish to lower maintenance costs and provide high quality turfed areas for the NT community and intrepid travellers alike.

**Table 3** Summary of each turf cultivar being trialled at Wagaman Park, Darwin following observations made on 1 September 2011, 27 June 2012 and 8 May 2013.

Variety	Comments
Broadleaf Carpet Grass	Planted as full sod. The variety produced rapid (vertical) growth. Good vigour. Less pigmentation (purpling of the leaves) than seen in Mackay. Plentiful green couch was present within the carpet grass which is commonly referred to as “Tropical Buffalo”. Turf colour was acceptable to good as too was turf quality (Tables 4 and 5 respectively). Nutritional requirement was low. Low thatch was observed.
OZ TUFF™	Good recovery (Plate 4f) post heat damage of sod during transportation. The turf initially had good lateral growth and dark green foliage, representing good nutrition levels. Possible couch mite damage was observed stunting growth and producing an open sward. This hampered the growth and performance of the turf for the second half of the study. Turf colour was acceptable (Table 5), but turf quality which started out good dropped to below acceptable (Table 4) due to the mite damage. Thatch level was moderate to high.
25a-1	Established by plugs. Good lateral growth was initially observed. However, couch mite damage slowed turf vigour and plots soon became heavily contaminated with other turfgrass species and were unable to compete. Turf colour (Table 5) was above acceptable, but turf quality was below average (Table 4). A low thatch level was observed.
Tropika	Good recovery post planting as clumps of sod. The turf fell apart during washing in Queensland while meeting quarantine requirements. The variety soon produced fast vertical and lateral growth. Some disease was observed growing within the canopy. Nutrition and turf colour was acceptable (Table 5). Thatch level was moderate to high.
Aussibblue	Same comments as ‘Tropika’ with the exception that ‘Aussibblue’ had marginally better turf colour and density. The thatch level was also less than ‘Tropika’, being moderate.
Centek	Established by sod (with existing soil) following the replacement of LowGro™. Moderate to fast vertical growth, possibly only behind ‘Sir Walter’ and ‘Blue Dawn’. Above acceptable turf colour and nutrition. Good turf density. Thatch level was moderate to high.
ShadeGro™	Planted as plugs. Good initial growth, however this variety produced more vertical growth than lateral growth at first (Plate 4e). Early on, prior to routine mowing, it was rated the fastest vertically growing variety within the study. Once routine mowing was undertaken the variety started to grow more laterally. A high level of contamination was present within the plots. However, where the variety had established itself, the sward was very healthy even under no shade (Plate 6d). (Within South East QLD the variety often struggles under full sun). Good turf colour, even some purpling of the leaves (Plate 5d) was seen. Thatch level was low.
Blue Dawn	Planted as plugs. This cultivar had good bi-lateral (upright and vertical) growth (Plate 4b). The density soon looked as if it had been established by sod, not plugs. Excellent cover/density. However, when established the grass possibly had the highest vertical growth rate of all varieties trialled (Plate 5e). ‘Blue Dawn’ had a good differentiating colour (blue in appearance) and a low thatch level.

Variety	Comments
LowGro™	Seed was sown at 20g/m <sup>2</sup> . Poor germination occurred with little to no strike visible. The variety was replaced with 'Centek' at this trial site.
Sea Spray	Seed was sown at 10g/m <sup>2</sup> . Initially poor germination occurred with minimal strike. Additional seed was provided and soon turf density and colour was excellent. However, a moderate to high level of contamination could be seen throughout all plots. Moderate to low thatch level.
Sir Walter	Established by sod. Good initial turf quality (Plate 4d) prior to scalping from mower blades and or scarification (Plate 5f) which was slow to recover. Moderate to fast vertical growth compared to blue couch varieties and 'Blue Dawn'. Nutrition level and colour was above acceptable. Thatch level was moderate to high even following scalping.
PristineFlora®	Planted as plugs. Slowly produced good branching to cover the surface. Similar lateral spread (speed) to 'Royal'. Mite damage was also visible (Plate 5c). Colour was acceptable, but additional nutrition was warranted. Minor undulations were present within the sward because of the planting method and scalping was also observed. Moderate inflorescence production could be seen. Thatch was moderate to high.
Empire™	Planted as full sod. Good growth. Scalping present from mower blades. Inflorescence production moderate to high at different periods during the trial. Nutrition level and turf colour was good. Thatch level was high.
Palisades	Planted as plugs. Good lateral growth and development (Plate 4a). One of the better rated turf quality/colour of the <i>Zoysia</i> spp. trialled. Some dieback within turf canopy from disease. Thatch level was moderate.
ZT-11	Planted as full sod. Turf quality was above acceptable. The variety produced a mix of low and high quantities of inflorescence depending on the season. 'ZT-11' had the fastest vertical growth of the <i>Zoysia</i> spp. varieties trialled. Good colour and density. Thatch level was high.
Nara™	Planted as full sod. Overall turf quality was above acceptable. The cultivar has fewer seedheads than Empire™. Some scalping from mower blades was observed. Some dieback within turf canopy from disease. Nutrition levels were moderate to low, however turf colour was acceptable (Table 5). Thatch level was moderate to high.
Royal	Established by plugs. Slow lateral growth with minimal branching initially. Minor undulations present within the sward throughout the duration of the study as the turf did not produce a dense sward. Was one of the better performing <i>Zoysia</i> turfgrasses (Table 4) given it was established by plugs. High inflorescence density. Nutrition and turf colour was acceptable (Table 5). Thatch level was moderate to high.
Shadetuff®	The sod had good nutrition and turf colour. The turf was initially slow to settle down and fill in the joins (division between two or more turf rolls). Scalping was observed across the Shadetuff® plots throughout the duration of the study. A moderate to high inflorescence density was seen. Thatch level was moderate.

For detailed comments of the performance of each turfgrass during the three visits to the Darwin trial site, visit the ASTC flickr® web site: <http://www.flickr.com/ASTCs>.

**Table 4** Turf quality rating (1 (=worst) to 9 (=best); with 6 being considered acceptable) of the Darwin plots observed on 1 September 2011, 27 June 2012 and 8 May 2013.

Species	Common name	Variety name	Turf Quality Rating		
			1 Sep 11	27 Jun 12	8 May 13
<i>Axonopus compressus</i>	Broadleaf carpet grass	Broadleaf Carpet Grass	6.5	7.0	6.3
<i>Cynodon dactylon</i>	Green couch	OZ TUFF™	7.5	6.0	5.2
		25a-1	4.5	4.0	3.2
<i>Digitaria didactyla</i>	Qld blue couch	Tropika	6.5	7.5	5.0
		Aussiblu	6.5	7.5	5.8
<i>Eremochloa ophiuroides</i>	Centipedegrass	Centek	NYP	8.5	6.8
<i>Panicum laxum</i>	Lax panicgrass	ShadeGro™	3.0	5.5	4.5
<i>Paspalum nicorae</i>	Brunswick grass	Blue Dawn	4.5	8.0	5.5
<i>Paspalum notatum</i>	Bahia grass	LowGro™	1	Replaced	Replaced
<i>Paspalum vaginatum</i>	Seashore paspalum	Sea Spray	1.0	7.5	5.5
<i>Stenotaphrum secundatum</i>	Buffalo grass	Sir Walter	7.5	7.0	6.3
<i>Zoysia hybrid</i>	Zoysia grass	PristineFlora®	3.5	5.5	6.0
<i>Zoysia japonica</i>	Zoysia grass	Empire™	7.5	7.0	6.7
		Palisades	4.0	6.5	6.3
		ZT-11	7.0	6.5	7.0
<i>Zoysia macrantha</i>	Zoysia grass	Nara™	7.5	6.0	7.3
<i>Zoysia matrella</i>	Zoysia grass	Royal	3.5	6.5	7.3
		Shadetuff®	7.0	6.5	7.3
<i>LSD (P=0.05)</i>			-	-	2.0

Notes:

- NYP, not yet planted.

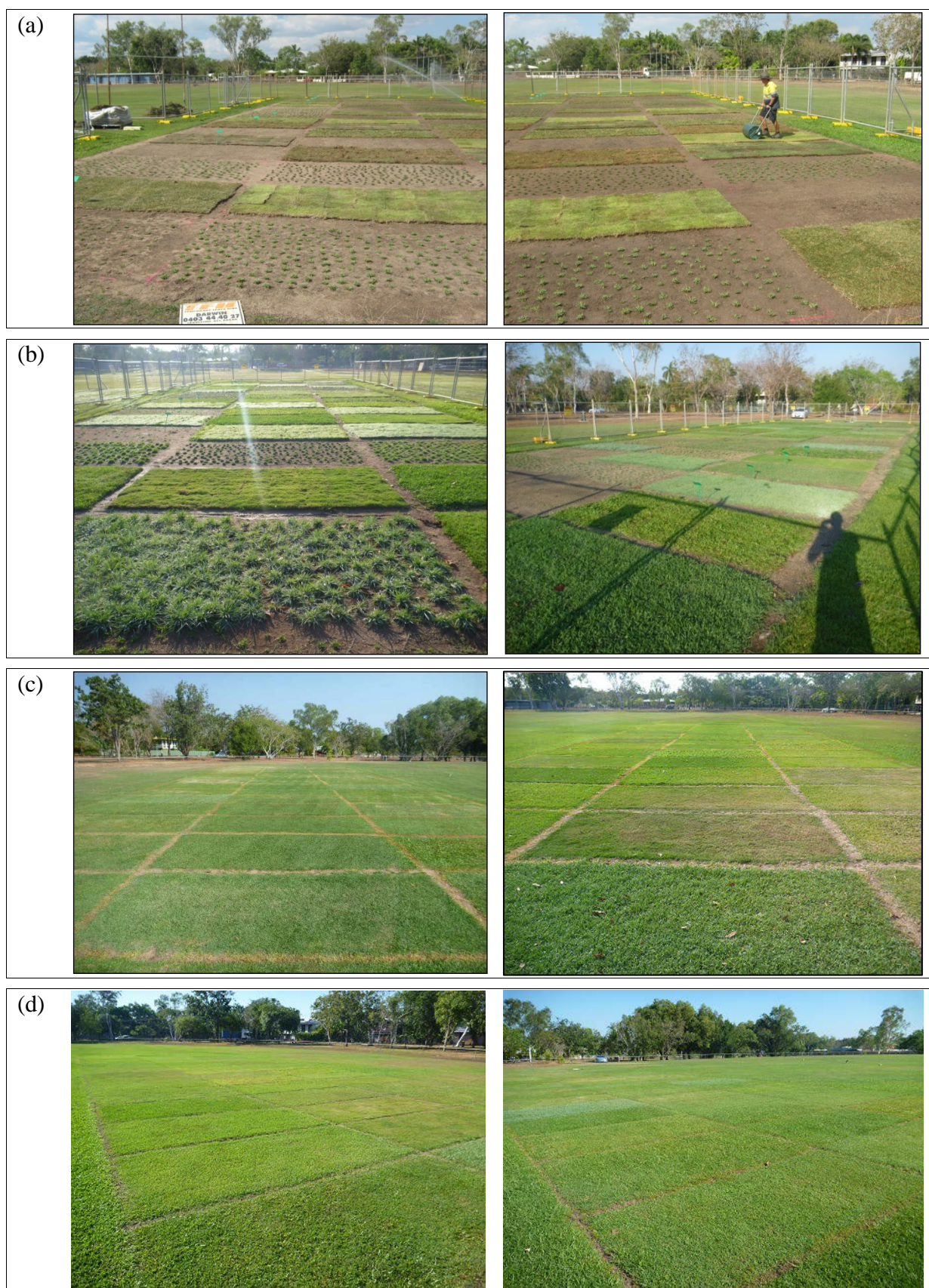
**Table 5** Turf Colour Meter (TCM) data collected from the Darwin plots on 1 September 2011, 27 June 2012 and 8 May 2013. The Grass Index correlates to a turf colour rating of 1 (=worst) to 9 (=best); with 6 being considered acceptable.

Species	Common name	Variety name	Grass Index		
			1 Sep 11	27 Jun 12	8 May 13
<i>Axonopus compressus</i>	Broadleaf carpet grass	Broadleaf Carpet Grass	6.7	6.5	6.2
<i>Cynodon dactylon</i>	Green couch	OZ TUFF™	7.0	6.4	6.4
		25a-1	N/A	6.9	6.9
<i>Digitaria didactyla</i>	Qld blue couch	Tropika	6.4	6.5	6.4
		Aussiblu	6.6	6.7	6.6
<i>Eremochloa ophiuroides</i>	Centipedegrass	Centek	NYP	6.6	6.9
<i>Panicum laxum</i>	Lax panicgrass	ShadeGro™	N/A	7.1	6.6
<i>Paspalum nicorae</i>	Brunswick grass	Blue Dawn	N/A	6.2	6.5
<i>Paspalum notatum</i>	Bahia grass	LowGro™	N/A	Replaced	Replaced
<i>Paspalum vaginatum</i>	Seashore paspalum	Sea Spray	N/A	6.9	6.6
<i>Stenotaphrum secundatum</i>	Buffalo grass	Sir Walter	6.8	6.1	6.4
<i>Zoysia hybrid</i>	Zoysia grass	PristineFlora®	N/A	6.4	6.6
<i>Zoysia japonica</i>	Zoysia grass	Empire™	6.8	6.3	6.6
		Palisades	N/A	6.4	6.7
		ZT-11	6.7	6.5	6.4
<i>Zoysia macrantha</i>	Zoysia grass	Nara™	6.7	6.5	6.7
<i>Zoysia matrella</i>	Zoysia grass	Royal	N/A	6.1	6.6
		Shadetuff®	6.8	6.2	6.7
LSD (P=0.05)			0.36	0.64	0.34

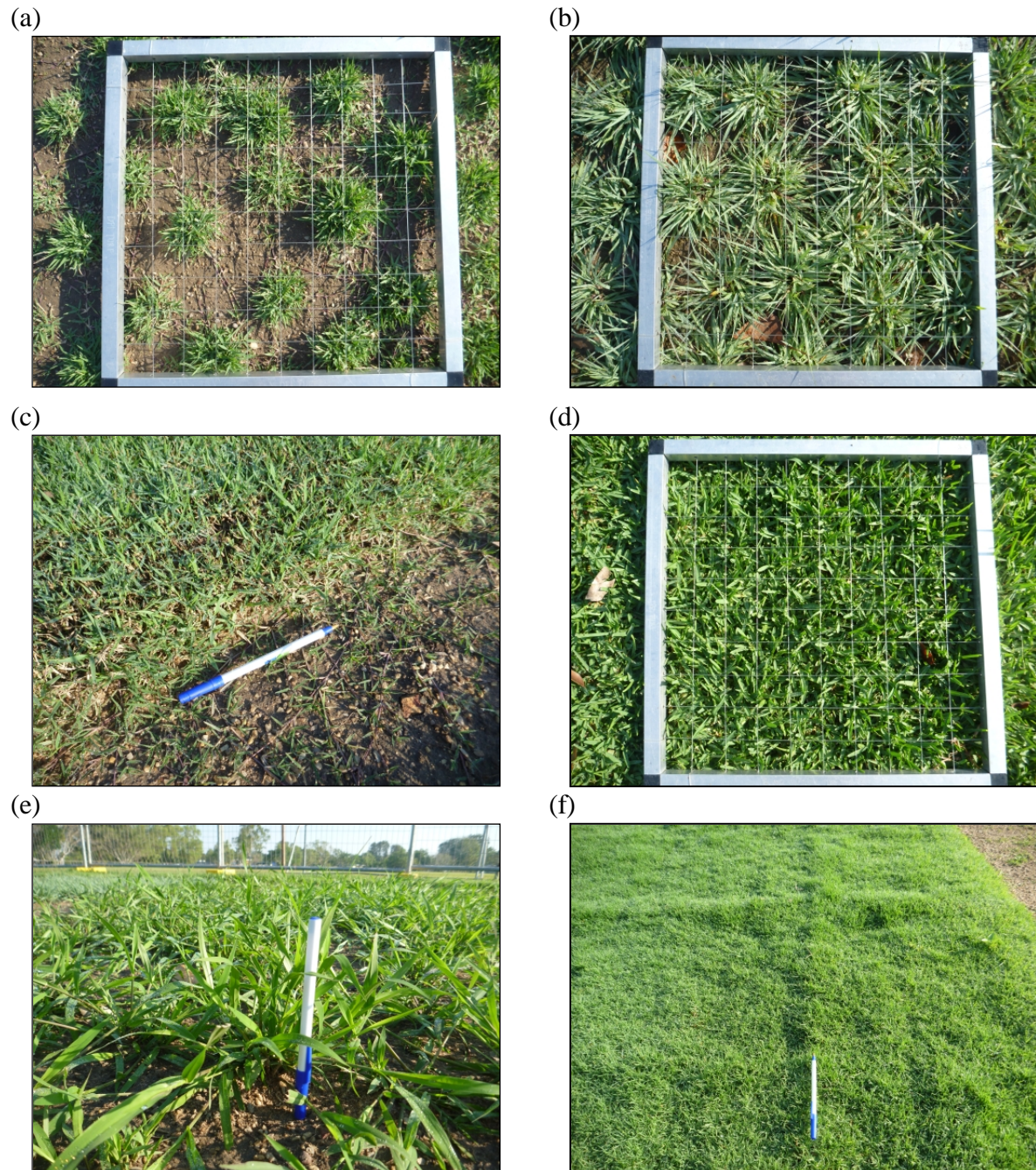
Notes:

- N/A: Plots established by seed or plugs and if an insufficient turf cover (full sward) was present during the time of inspection, a turf colour reading (TCM) was not taken.
- NYP, not yet planted.

**Plate 3** Photographs taken of the Wagaman Park, Darwin trial site (a) during planting 26 July 2011 and when inspections were conducted on (b) 1 September 2011, (c) 27 June 2012 following mowing and (d) 8 May 2013.



**Plate 4** Digital photos taken at the Wagaman Park Darwin trial site 1 September 2011 of (a) ‘Palisades’ producing good lateral growth from the plugs, (b) ‘Blue Dawn’ producing good dense growth from the plugs, (c) contamination (couch) present in Nara™ sod, (d) dense ‘Sir Walter’ sod, (e) ShadeGro™ growing vigorously, however more vertical growth than lateral, and (f) vigorous recovery of OZ TUFF™ sod following die back during transportation. The lush identifiable lines were upon arrival the only green parts of the sod (edges of the roll on the pallet).



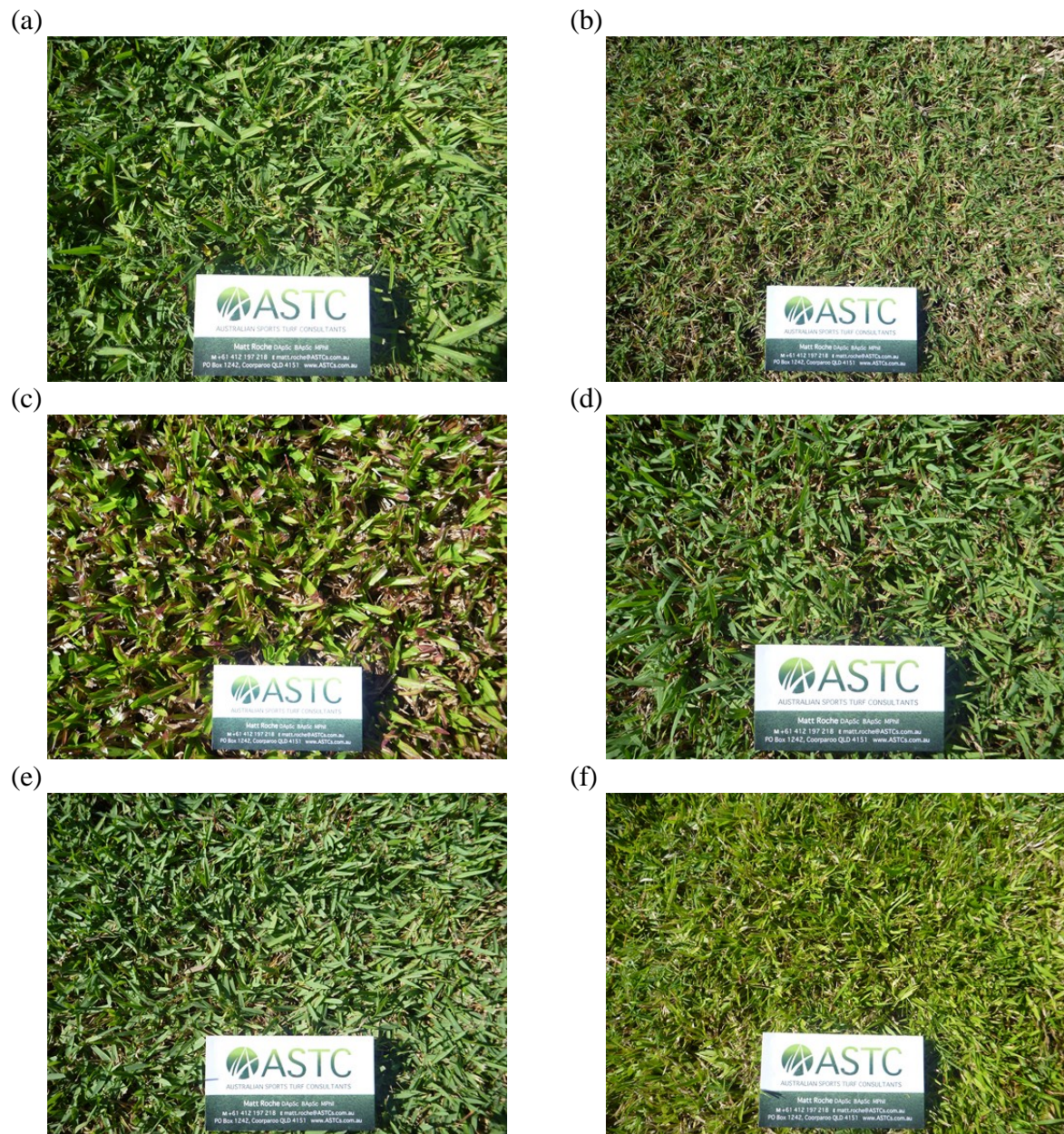
Higher quality and additional images including plot, subplot and close up photos taken from the Darwin site on 1 September 2011 can be viewed on the ASTC flickr® web site: <http://www.flickr.com/ASTCs>.

**Plate 5** The following photos were taken during the inspection of the Darwin trial site on 27 June 2012: (a) close up of the *Eremochloa ophiuroides* variety ‘Centek’, (b) close up of the *Paspalum vaginatum* variety ‘Sea Spray’, (c) turf mite damage within the PristineFlora® canopy; (d) purplish foliage of ShadeGro™; (e) fast vertical growth of Blue Dawn; and (f) damage to the ‘Sir Walter’ turf from scalping and or verticutting (dethatching).



Higher quality and additional images including plot, subplot and close up photos taken from the Darwin site on 27 June 2012 can be viewed on the ASTC flickr® web site. <http://www.flickr.com/ASTCs>.

**Plate 6** The following photos were taken during the inspection of the Darwin trial site on 8 May 2013: (a) the *Cynodon dactylon* variety ‘25a-1’ heavily contaminated with other turfgrasses, (b) the *Cynodon dactylon* variety OZ TUFF™ which has an open sward and is recovering from possible mite damage, (c) the *Axonopus compressus* variety ‘Broadleaf Carpet Grass’ showing anthocyanin pigmentation (purpling of the leaves), (d) the *Digitaria didactyla* variety ‘Aussiblu’ showing some disease in the lower turf canopy, (e) the *Zoysia macrantha* variety Nara™ and (d) the *Panicum laxum* variety ShadeGro™ producing a complete turf cover in areas where contamination or competition does not exist.



Higher quality and additional images including plot, subplot and close up photos taken from the Darwin site on 8 May 2013 can be viewed on the ASTC flickr® web site: <http://www.flickr.com/ASTCs>.

## Mackay

Turf plugs and seed were sent to Mackay Regional Botanical Gardens staff from Redlands Research Station on 6 July 2011 which arrived two days later. Turf was transported from Queensland producers to the trial site on either the 11 or 12 July and all turf varieties were planted either on the 12 or 13 July 2011 (Plate 7a). This timeframe and the need for not having to wash the soil free from the turf saved significant resources, but it also provided the Mackay staff with the best quality turf for planting.

A routine maintenance program was adopted and meticulously followed by a dedicated team within the Mackay Regional Botanic Gardens to uphold the rigour of the Mackay trial site. This included weekly mowing in summer and fortnightly mowing in winter, the spraying of plot borders and the adoption of a pre-emergence (Ronstar®) weed control program.

Plots were first inspected by the TU09001 Project Leader on 31 August 2011 (Plate 7b). Overall the turf plots were doing well, with the exception of the seeded cultivars LowGro™, ShadeGro™ and ‘Sea Spray’ (Plate 8e). To enable Mackay Regional Botanic Gardens staff to effectively manage the plots (e.g. mowing) it was initially decided that the latter three cultivars be replaced with alternate grasses planted as full sod. However, due to constraints this did not take place. Additional seed was then supplied of all three varieties in an effort to achieve cover of the bare areas within the respective plots. Successful germination was achieved following the resowing of ‘Sea Spray’, however problems continued with the germination process of the *Paspalum notatum* variety LowGro™ and *Panicum laxum* variety ShadeGro™ (refer to discussion and recommendations for additional information).

Many of the varieties that had been planted by plugs were struggling to establish within the sand profile (e.g. Plate 8a). Lack of nutrition was a significant factor and supplementary applications would have promoted lateral branching of plugs (e.g. Plate 8f), seed tillering (Plate 8e) and sod grow in (Plate 8c). Supplementary nutrition would have also increased the turf quality (Table 7) and turf colour (Table 8) readings collected. However, due to available and changing resources, restraints needed to be made.

The second visit to inspect the Mackay Regional Botanical Gardens trial site was conducted on 26 June 2012 (Plate 7c) immediately following a scheduled fertiliser application. All turfed varieties had established well and even some of the plugged varieties had developed to form a complete, dense sward and new runners were even porpoising through the turf canopy (e.g. Plate 9d).

The initial struggling plots of LowGro™ had formed dese areas of turf within sections (not the entirety) of each replicated plot. However, material of LowGro™ was slowly encroaching into other areas of its own plot following the turfgrasses ability to spread by stolons and rhizomes (Plate 9e). Interestingly it was observed that the LowGro™ leaf blades comprised very distinctive white hairs present on both sides of the leaf (Plate 9f).

Plots were mown on the morning of the inspection on the 26 June 2012. Damage to the leaf tips was observed across a number of *Zoysia* and buffalo grass (*Stenotaphrum*) varieties (e.g.

Plate 9a to c). This was caused by the mower having dull cutting blades. The *Zoysia* varieties are high in lignin and fiber which if the mower blades are not sharp will result in unsightly, straw-coloured, ragged edges on the cut leaves (Plates 9a and 10d). Disease was also noticeable in a number of *Zoysia* (Plate 9b) and *Stenotaphrum* (Plate 9c) varieties; however most varieties had seemed to have outgrown the damage incurred.

The third and final visit to inspect the Mackay trail site was conducted on 18 March 2013 (Plate 7d). All plots with the exception of the three LowGro™ plots had 100% turf cover. Plots were doing OK given the timeframe they had been in the ground. However, turfgrass quality for broadleaf carpet grass, green couch, blue couch, lax panicgrass, seashore paspalum and buffalo grass varieties were rated all below acceptable (Table 7). This was largely due to lack of nutrition and various levels of contamination found within some of the latter turf species.

Many of the turf species were producing medium to high inflorescence production during the time when the third inspection was conducted.

**Table 6** Summary of the each turf cultivar being trialled at Mackay Regional Botanic Gardens, Queensland following observations made on 31 August 2011, 26 June 2012 and 18 March 2013.

Variety	Comments
Broadleaf Carpet Grass	Planted as sod. Approximately 50% of the turf sward is contaminated with green couch. This is commonly referred to as “Tropical Buffalo” in the north. The variety is very fast growing, even in winter (June) 5 days after mowing the turf needed to be cut again. The vertical growth is comparable to the two blue couch varieties (Aussiblu and Tropika) being trialled. Nutrition levels were moderate during the first two visits. However by the third visit the plots were in need of supplementary nutrition. Distinct purpling of the leave (pigmentation) can also be seen throughout the seasons. A moderate to high thatch level was observed with contamination.
OZ TUFF™	Planted as sod. Good lateral growth observed from the edges of the plots. However, the turf is hungry for nutrition. Some die back was observed possibly due to disease. An acceptable or at worst near acceptable turf quality was observed (Table 7). Turf colour was above acceptable (Table 8). A moderate to high thatch level was present.
25a-1	Planted as plugs. Fast lateral growth was initially observed when fertility levels were maintained (Plate 8f). Runners (stolons) spread on average 1-2 feet within one month. The variety produced an even, dense sward which looked as if it had been planted by sod. At the same time other varieties that had been planted using plugs were still reaching for 100% turf cover. However, turf quality was generally just below and turf colour was just above acceptable (Tables 7 and 8 respectively). Thatch level was moderate.
Tropika	Planted as sod. The variety is very fast growing (equal to Aussiblu) and is already in need of a mow after having been cut 5 days ago. Good colour and density. Nutrition requirements were less than other species trialled. Thatch level was moderate. Excess clippings remained on the turf surface following mowing. Similar to ‘Aussiblu’, high moisture levels within the <i>Digitaria</i> species makes it is difficult to catch and remove grass clippings.

Variety	Comments
Aussibleue	Same comments as ‘Tropika’; however the thatch level observed was moderate to high. Like ‘Tropika’, turfgrass quality and colour was near acceptable (Tables 7 and 8 respectively).
ShadeGro™	Planted as plugs but additional seed was needed to fill out the plots. Variable growth and density formed across the plots. The foliage produced distinct purple and lime green colours. Some necrosis was present within the lower turf canopy; possible disease and or sun damage (the variety prefers a shady environment). Nutrition requirements were low. Inflorescence production was moderate to high; however flowers developed low within the mown canopy (Plate 10c). Low level of thatch.
Blue Dawn	Planted as plugs. A number of the plugs struggled to grow on (Plate 8a). The variety was slow to spread laterally, but was very fast to grow vertically (e.g. mowing needed within a 5 day period). ‘Blue Dawn’ and LowGro™ were the fastest vertically growing varieties being trialled in Mackay. Nutrition requirement was low. Turf colour was acceptable using the turf colour meter, however the blue colour provides an excellent contrast of colour. Turf quality was also acceptable (Table 7). Thatch level was moderate to high.
LowGro™	Much like ShadeGro™, LowGro™ was planted as plugs and additional seed was also required. Slow to spread, but has excellent root development (Plate 9e). Fast vertical growth for mowing, similar to ‘Blue Dawn’. Good (contrasting/different) colour of leaves which are also hairy on both sides of the leaf blade (Plate 9f). Tall unsightly seed heads approx. 20 cm tall in medium to high density. Seed head growth is fast developing. Thatch level was moderate to high.
Sea Spray	Seed was applied at 10g/m <sup>2</sup> . Initially achieved poor germination (Plate 8e) and supplementary seed was needed. Sparse cover was obtained and a high level of contamination was observed. Disease and scalping was also observed during visits. Nutrition requirements were low to moderate and turf colour was acceptable (Table 8). Turf quality was below acceptable (Table 7). Thatch levels recorded were moderate.
Kings Pride	Planted as sod. Fast vertical growth. Growth however is not as fast as ‘Aussibleue’, ‘Tropika’, ‘Blue Dawn’ or LowGro™. Disease was also observed growing within the turf canopy during visits (e.g. Plate 9c). Porpoising of the stolons is noticeable. Damage is evident to the leaf tips from the self-propelled mower blades. Turfgrass colour and quality was above acceptable (Tables 7 and 8) Very high thatch level, the most of all varieties trialled an the Mackay site.
PristineFlora®	Planted as plugs. Very slow to settle and send out runners and rhizomes. But once established, growth in particular rhizome activity was dominant. Additional nutrition would have helped the establishment period. PristineFlora® produced high levels of seed heads (Plate 10b). However, this variety was one of the better performing varieties in the study (Plate 10e). Turfgrass colour and quality was high. Some scalping could be seen during visits. Minor undulations were present at the end of the study and the thatch level was low due to its establishment method.

Variety	Comments
Empire™	Empire™ had produced good lateral growth from the side of sod rolls and an even, consistent sward. The cultivar was seeding profusely during the winter/spring visit (Plate 8b). Damage was evident to the leaf tips from the self-propelled mower blades, but excellent regrowth followed. Nutrition requirement was low. Turf quality and colour was above acceptable (Tables 7 and 8 respectively). Empire™ had a high thatch level.
Palisades	OK to good lateral growth following the planting of ‘Palisades’ plugs. ‘Palisades’ produced significantly faster lateral growth compared to PristineFlora® and ‘Royal’ during grow-in. Palisades produced a good consistent sward, but received damage to the foliage from having dull mower blades (Plate 9a). Disease was also visible on leaf blades (Plate 9b). Low incidence of flowering. Nutrition requirements were minimal. Turf quality and colour was above acceptable once established (Tables 7 and 8). Thatch level was deemed high.
ZT-11	Sod had above acceptable turfgrass quality and colour. However, additional nutrition was warranted. Moderate inflorescence production at times was observed, so too was a moderate to high level of thatch.
Nara™	Planted as sod. Variable inflorescence production rate depending on the season. Some die back was evident from disease. Damage to leaf blade tips was seen following the use of dull mower blades. Scalping of turf was also observed. Turf quality and turf colour were above acceptable throughout the duration of the study. Good turf density was present. High thatch levels present.
Royal	Plugs were very slow to grow and were in need of additional nutrition. Once plugs were rooted down, a dense turf formed and strong stolons porpoising across the establishing sward (Plate 9d). Low to moderate inflorescence production. Low thatch level because of the establishment method. Turf colour was good and turf quality was above acceptable.
Shadetuff®	Planted as sod. The turf was slow to fill in the joints (division between two or more turf rolls) (Plate 8c). Above acceptable turf colour, density and turf quality (Plate 10f). Variable inflorescence production observed throughout the study. Some minor dieback within turf canopy from possible disease and scalping was also observed. Very high level of thatch was observed.

For detailed comments of the performance of each turfgrass during the three visits to the Mackay trial site, visit the ASTC flickr® web site: <http://www.flickr.com/ASTCs>.

**Table 7** Turf quality rating (1 (=worst) to 9 (=best); with 6 being considered acceptable) of the Mackay Regional Botanic Gardens plots 31 August 2011, 26 June 2012 and 18 March 2013.

Species	Common name	Variety name	Turf Quality Rating		
			31 Aug 11	26 Jun 12	18 Mar 13
<i>Axonopus compressus</i>	Broadleaf carpet grass	Broadleaf Carpet Grass	5.0	5.5	5.0
<i>Cynodon dactylon</i>	Green couch	OZ TUFF™	6.5	6.0	5.5
		25a-1	4.5	5.5	5.5
<i>Digitaria didactyla</i>	Qld blue couch	Tropika	5.0	6.5	5.5
		Aussibue	7.0	6.5	5.0
<i>Panicum laxum</i>	Lax panicgrass	ShadeGro™	1.0	4.5	4.5
<i>Paspalum nicorae</i>	Brunswick grass	Blue Dawn	4.5	6.0	6.5
<i>Paspalum notatum</i>	Bahia grass	LowGro™	1.0	3.0	6.0
<i>Paspalum vaginatum</i>	Seashore paspalum	Sea Spray	1.0	5.0	4.5
<i>Stenotaphrum secundatum</i>	Buffalo grass	Kings Pride	6.5	6.5	7.0
<i>Zoysia hybrid</i>	Zoysia grass	PristineFlora®	2.0	6.5	8.0
<i>Zoysia japonica</i>	Zoysia grass	Empire™	6.5	7.5	7.0
		Palisades	4.5	7.0	7.0
		ZT-11	6.0	8.0	7.0
<i>Zoysia macrantha</i>	Zoysia grass	Nara™	6.5	6.0	7.5
<i>Zoysia matrella</i>	Zoysia grass	Royal	4.0	5.5	7.5
		Shadetuff®	6.0	6.5	7.5
<i>LSD (P=0.05)</i>			-	-	-

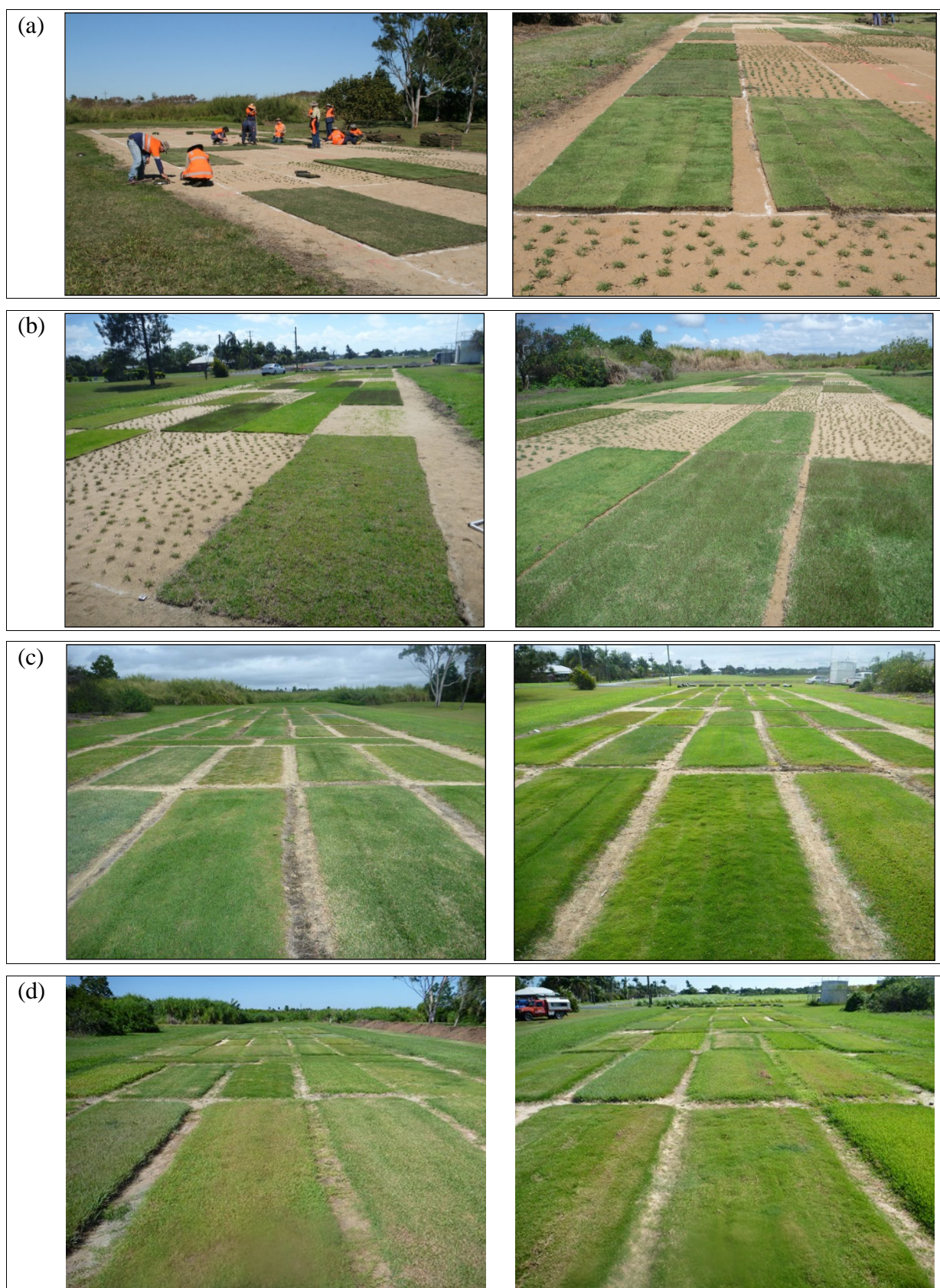
**Table 8** Turf Colour Meter (TCM) data collected from the Mackay Regional Botanic Gardens plots on 31 August 2011, 26 June 2012 and 18 March 2013. The Grass Index correlates to a turf colour rating of 1 (=worst) to 9 (=best); with 6 being considered acceptable.

Species	Common name	Variety name	Grass Index		
			31 Aug 11	26 Jun 12	18 Mar 13
<i>Axonopus compressus</i>	Broadleaf carpet grass	Broadleaf Carpet Grass	6.5	6.7	6.2
<i>Cynodon dactylon</i>	Green couch	OZ TUFF™	7.0	6.8	6.5
		25a-1	N/A	6.9	6.4
<i>Digitaria didactyla</i>	Qld blue couch	Tropika	5.8	6.7	6.1
		Aussiblu	6.8	6.8	6.1
<i>Panicum laxum</i>	Lax panicgrass	ShadeGro™	N/A	6.5	6.4
<i>Paspalum nicorae</i>	Brunswick grass	Blue Dawn	N/A	6.4	5.8
<i>Paspalum notatum</i>	Bahia grass	LowGro™	N/A	6.4	6.3
<i>Paspalum vaginatum</i>	Seashore paspalum	Sea Spray	N/A	6.9	6.4
<i>Stenotaphrum secundatum</i>	Buffalo grass	Kings Pride	6.6	6.1	6.3
<i>Zoysia hybrid</i>	Zoysia grass	PristineFlora®	N/A	7.0	6.9
<i>Zoysia japonica</i>	Zoysia grass	Empire™	6.6	6.8	6.5
		Palisades	N/A	6.2	6.4
		ZT-11	N/A	6.7	6.5
<i>Zoysia macrantha</i>	Zoysia grass	Nara™	6.8	6.8	6.4
<i>Zoysia matrella</i>	Zoysia grass	Royal	N/A	6.4	6.9
		Shadetuff®	6.6	7.1	6.5
<i>LSD (P=0.05)</i>			<i>0.49</i>	<i>0.32</i>	<i>0.46</i>

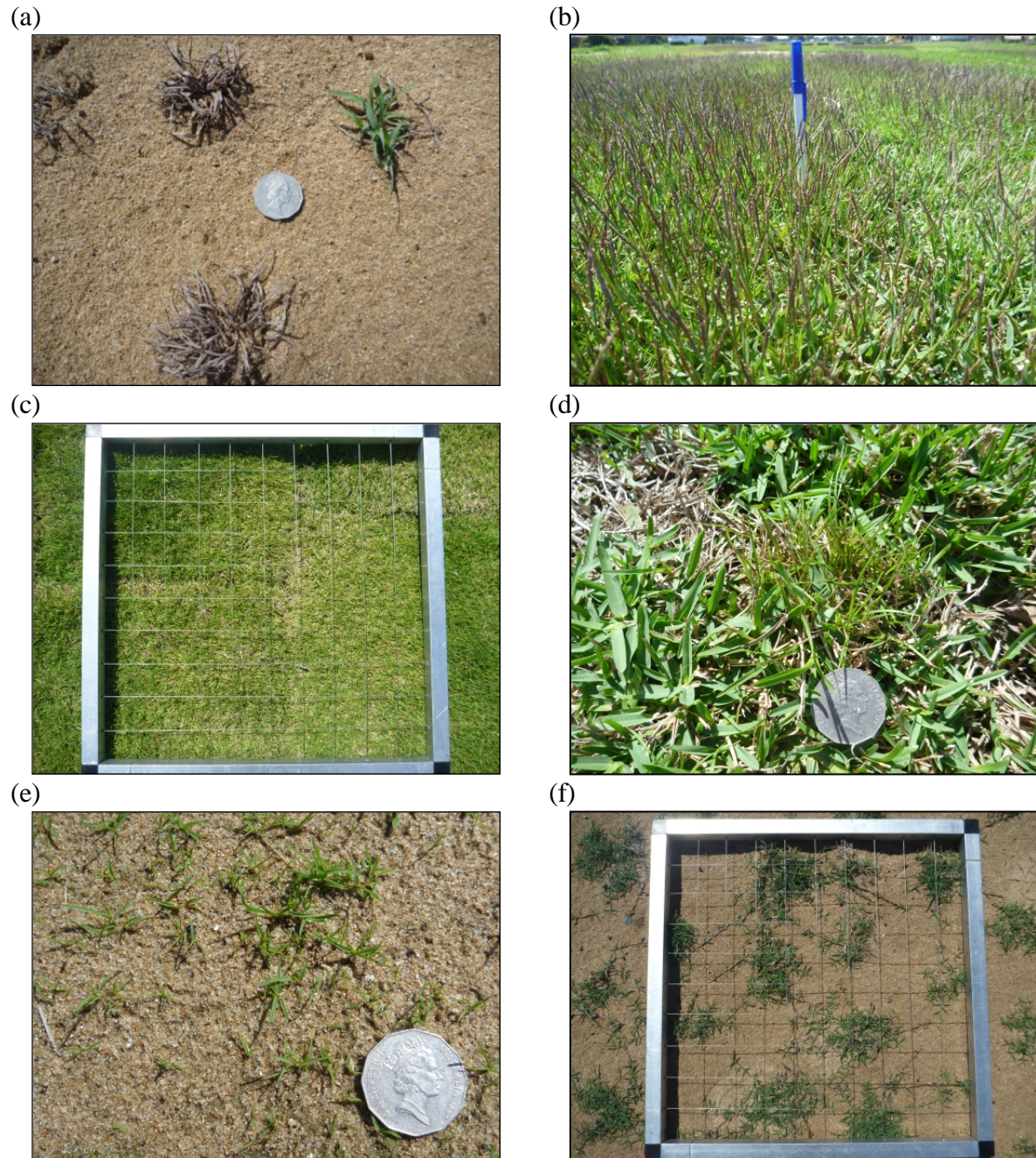
Notes:

- N/A: Plots established by seed or plugs and if an insufficient turf cover (full sward) was present during the time of inspection, a turf colour reading (TCM) was not taken.

**Plate 7** Photographs taken of the Mackay Regional Botanic Gardens trial site (a) during planting 12 July 2011 and when inspections were conducted on (b) 31 August 2011, (c) 26 June 2012 following mowing and (d) 18 March 2013.



**Plate 8** Digital photos taken at the Mackay Regional Botanic Gardens trial site 31 August 2011 of (a) ‘Blue Dawn’ plugs performing poorly during establishment, (b) Empire™ profusely seeding, resulting in mowing action required, (c) join lines within the Shadetuff® sod still visible, (d) sedge contamination present in Kings Pride sod, (e) germination of ‘Sea Spray’ seed was very sparse, and (f) fast lateral growth of ‘25a-1’ plugs.



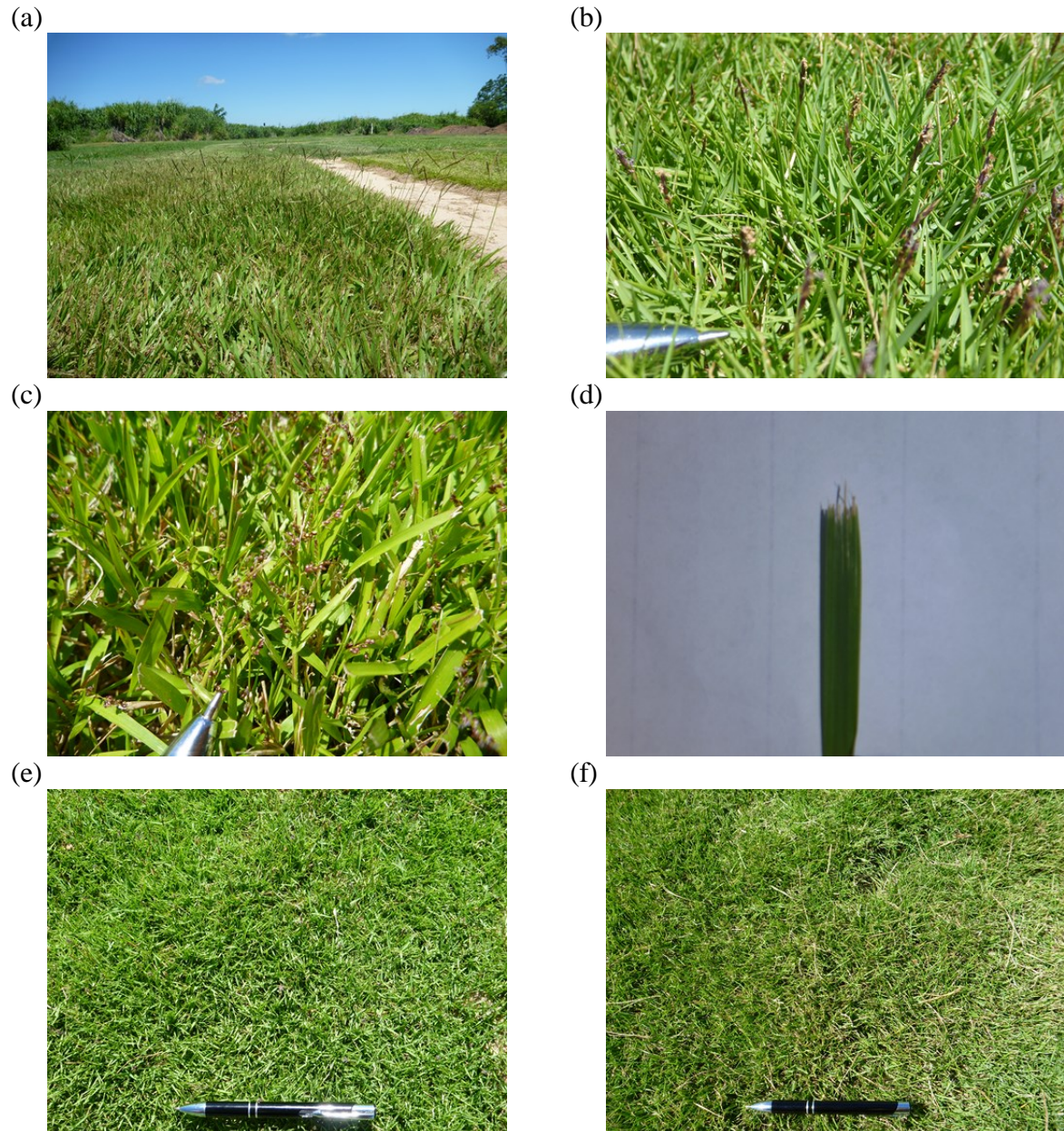
Higher quality and additional images including plot, subplot and close up photos taken from the Mackay site on 31 August 2011 can be viewed on the ASTC flickr® web site: <http://www.flickr.com/ASTCs>.

**Plate 9** The following photos were taken during the inspection of the Mackay trial site on 26 June 2012: (a) damage is evident to ‘Palisades’ leaf tips from the self-propelled mower blades; (b) disease present on the leaves of the ‘Palisades’ turf; (c) disease present on the leaves of ‘Kings Pride’; (d) Strong stolons of ‘Royal’ porpoising across the establishing sward; (e) strong fibrous and rhizome root development of LowGro™; and (f) the contrasting/different) leaf/sward colour LowGro™, also showing the dominant hairs present on both sides of the leaf.



Higher quality and additional images including plot, subplot and close up photos taken from the Mackay site on 26 June 2012 can be viewed on the ASTC flickr® web site: <http://www.flickr.com/ASTCs>.

**Plate 10** The following photos were taken during the inspection of the Mackay trial site on 18 March 2013: (a) the *Paspalum notatum* variety LowGro™ producing tall seedheads approx. 20 cm tall, (b) the *Zoysia* hybrid variety PristineFlora® producing a vast amount of seedheads within the turf canopy, (c) low growing inflorescence within the *Panicum laxum* ShadeGro™ canopy, (d) dull cut to leaf blades, particularly the *Zoysia* spp. varieties, (e) close up of the *Zoysia* hybrid variety PristineFlora® and (f) close up of the *Zoysia matrella* variety Shadetuff®.



Higher quality and additional images including plot, subplot and close up photos taken from the Mackay site on 8 March 2013 can be viewed on the ASTC flickr® web site: <http://www.flickr.com/ASTCs>.

## Discussion

Initially three trial sites were to be established within the present study. CUGE's withdrawal meant a significant loss of resources to the project. Initially the project was also to investigate nutritional studies aimed to reduce nitrous oxide emissions through reduced fertiliser applications and "traffic stress" studies (implementing wear and compaction) as by Roche et al. (2012) at all trial sites. However, due to a significantly reduced budget these parameters were unfortunately unable to be researched. The present study had to concentrate largely on genotype (variety) x environment interaction.

Turf material utilised within the present study was a mixture of sod (turf), plugs and seed. The reason behind utilising a mix of the latter three methods was because of availability and or cost associated with transportation of material to the regional trial sites. Ideally it would have been preferred to trial all varieties as fully established sod, and therefore apples with apples, in terms of performance when inspections were made. However, this was not possible and it was decided best to include some of the newer turfgrasses varieties that needed to be established by plugs and or seed.

During the preparation of growing on plug material for planting, project staff had difficulties in germinating LowGro™ seed. Eventually plugs were grown, but additional seed was also requested at the Mackay trial site to fill in dead or troubled areas within the LowGro™ plots. Further discussions with Steve Walsh, Sales Manager for Australian Pacific Seeds recommended that seeds be acid-treated just prior to sowing to improve germination. This was not undertaken at the Mackay trial site, or during the early stages of growing on material at Redlands Research Station, but could have helped improved the strike rate.

To establish two trial sites in Queensland and Northern Territory required considerable effort and collaboration between all project staff and turf producers. Needing to transport live plant material of up to 19 varieties was difficult, particularly to the Darwin trial site. Unfortunately, little could be done about the time spent, 5 days, in transporting turf material from Jimboomba to Darwin. The timeframe and requirement to wash the sod free of soil no doubt placed significant stress on each turfgrass variety during establishment.

The Mackay Regional Botanic Gardens trial site was established on a sand profile. The soil media used was free draining and therefore was quick to use applied fertiliser. Routine fertiliser applications were being applied by Mackay Regional Botanic Gardens staff, yet the rates and frequency could have been higher. However, by increasing the amount of fertiliser to the plots this would have also increased the immediate management requirements of the site such as mowing and spraying (maintaining plot borders to prevent/limit encroachment between cultivars). Dale Arvidsson who is the Curator at Mackay Regional Botanic Gardens expressed concern stating if the plots were to become higher maintenance they would struggle with the upkeep due to a shortage in resources.

Lack of fertility was not an issue at the Darwin trial site because the native soil (clay loam) was utilised. However, the aim of the study was to identify turfgrasses that would suit their requirements (e.g. low fertility), not try to provide a "showcase" of lush green plots all year round. However, achieving both would have been nice.

Maintenance issues were encountered at both trial sites relating to thatch control and mowing. Scarification (de-thatching) practices were able to be undertaken at the Darwin trial site because of available equipment. However, the Mackay trial site did not have access to a dethatcher/verticutter. The Mackay plots were routinely mown by Botanical Gardens staff using a rotary push mower; but at the Darwin trial site a front deck ride on mower was used to mow the turf plots and the surrounding sportfield by a contractor. Removal of clippings and therefore potential contamination was not possible, nor was it possible to have the contractors adjust their management plan in order to mow a trial that contained 13 different species of turf that produced variable growth during each season.

Even though turf varieties were established by different means (i.e. seed, plugs and sod), some turf species stood out by producing higher levels of thatch [i.e. *Digitaria didactyla* (blue couch), *Stenotaphrum secundatum* (buffalo grass) and *Zoysia* spp. (*Z. japonica*, *Z. matrella* and *Z. macrantha*)] or greater vertical growth [(*Axonopus compressus* (broadleaf carpet grass), *Eremochloa ophiuroides* (Centipedegrass), *Paspalum* spp. (*P. nicorae* and *P. notatum*) and *Stenotaphrum secundatum*] compared against other throughout the duration of the study. However, some of these varieties also have a long list of positive features. For example: wear, shade and drought tolerance and low fertility requirements. Councils and end users need to identify what their requirements are and then ascertain what resources are available now and into the future to maintain their selection.

# Technology Transfer

## Presentations

- Project update provided by Project Leader at The National Turf Validation Meeting 2011, Byron Bay Golf Club, Byron Bay, 13 Dec. 2011.

## Publications

- Bauer, B. (2011). Improving the selection and management of turfgrass in the tropics. *Australian Turfgrass Management* 13 (3) 76-77.
- Roche, M.B. (2012). Turf tested in the tropics. *Australian Turfgrass Management Journal* 14 (5) 54-57.
- Roche, M.B. (2012). Turf performance compared in the tropics. 146 Sep-Oct, pp. 58-59.
- Project update written for the Sports Turf Association Queensland (STA QLD) newsletter, Issue 4 Winter 2012.

## Media

- An update was written for the DEEDI Lifestyle Horticulture direct e-newsletter (<http://www.vision6.com.au/em/message/email/view.php?id=816225&u=13082>), 7 December 2011 which was sent to 1,706 subscribers.
- Milestone #105 was sent to all Turf Queensland members on 5 July 2012, and it was placed on the Australian Golf Course Superintendents Association's (AGCSA) 'The Cut' weekly email newsletter – 6 July 2012 <http://www.agcsa.com.au/enewsletter/060712> (accessed 7 July 2012) which at this point in time distributed to over 2,900 inboxes across Australia every week.
- DAFF web site: [http://www.daff.qld.gov.au/26\\_17826.htm](http://www.daff.qld.gov.au/26_17826.htm) (accessed 1 Sep 2012).
- Project update provided to 'The Cut' (24 May 2013 - <http://www.agcsa.com.au/enewsletter/240513> which is now distributed to over 3,250 inboxes across Australia every week) and Turf Mate (27 May 2013, <http://www.turfmate.com.au/article/1001/hal-s-tropical-turfgrass-project>) web site.
- Throughout the study, whilst under project lead by Matt Roche at DAFF, images and videos acquired throughout the duration of the study, prior to being terminated by DAFF, were added to the Redlands Turf Research flickr® web page. Prior to the latter site being decommissioned on 1 Mar 2013 saw the site visited 4,991 times. Before this, prior to the submission of TU09001 Milestones #5 and #6, the same site had been visited 1,500 and 2,800 times.
- A project summary and milestone reports were added to the Australian Sports Turf Consultants (ASTC) web site: [www.ASTCs.com.au](http://www.ASTCs.com.au).

- Regular posts on the projects status were uploaded to the Australian Sports Turf Consultants (ASTC) Facebook page: [www.facebook.com/AustralianSportsTurfConsultants](https://www.facebook.com/AustralianSportsTurfConsultants).

## Recommendations

Varietal selection for consumers including councils, turf managers and homeowners in the tropics will soon expand. How these turfgrass varieties get utilised will depend on the cooperation between turf breeders, councils and turf producers. Australian Sports Turf Consultants (ASTC) staff will work with councils, breeders and respective turf producers to introduce and make commercially available turfgrass varieties suited for tropical environments.

To aid new and improved warm-season turfgrasses to perform in tropical conditions the following management practices need should be implemented:

- Routine scarification practices (e.g. yearly at best) be undertaken to control thatch development of selected warm-season turfgrasses being grown in the tropics. If councils do not have access to such equipment it is recommended that they make arrangements to rent or buy the necessary machinery to target thatch reduction;
- Depending on fertiliser budgets, turfgrass selection is to be made on identifying a turfgrass that looks good, is fit for purpose (e.g. sportsfield, park area, home lawn) and does not require excessive nutrition to achieve the latter objectives; and
- A number of the turf species, as identified within this report, have fast vertical growth. If these varieties are to be chosen, end users need to make sure sufficient resources are made available to maintain these grasses.

For new and improved turfgrass varieties to be utilised in the tropics the following additional research is also warranted to complete information gaps or to resolve issues project staff experienced within the present study. These include:

- Determine the appropriate application rate and time, seed of the *Paspalum notatum* LowGro™ variety needs to be acid treated to increase the germination rate and or seek a more user friendly option (non-chemical);
- Identify if the current quarantine restrictions in place by Queensland and Northern Territory governments are still warranted e.g. to apply pesticides to control particular pests and to wash turf/sod free of all soil material prior to transporting turf into Northern Territory; and
- Should refrigerated trucks be the best way to transport turf interstate; investigate more advanced, low cost, ways to transport turf without causing heat and or cold stress to the turfgrass plant.

## Bibliography

Bureau of Meteorology (BoM). (2013a). Darwin Airport climatic statistics, [http://www.bom.gov.au/climate/averages/tables/cw\\_014015.shtml](http://www.bom.gov.au/climate/averages/tables/cw_014015.shtml) (accessed 30 May 2013).

Bureau of Meteorology (BoM). (2013b). Mackay Airport climatic statistics, [http://www.bom.gov.au/climate/averages/tables/cw\\_033045.shtml](http://www.bom.gov.au/climate/averages/tables/cw_033045.shtml) (accessed 30 May 2013).

Chung, Y. and Chang Y. (2003). "The effect of nitrogen fertilization and the application of chlorophyll meter to evaluate the nitrogen status on *Axonopus compressus* (Swartz) Beauv." *Journal of the Chinese Society for Horticultural Science* 49(4): 361-374.

Menzel, C.M. and Broomhall, P. (2006). "Nutrient uptake in tropical turfgrasses growing in winter in southern Queensland." *Australian Journal of Experimental Agriculture* 46(9): 1217-1224.

Menzel, C.M. and Broomhall, P. (2006). "Response of tropical turfgrasses to recycled water in southern Queensland." *Australian Journal of Experimental Agriculture* 46(12): 1645-1652.

Murakami, G. A. and C. Ray (2000). "Turf irrigation in Hawaii using R-1 effluent: Microbial and chemical effects." *Journal of Environmental Science and Health Part a-Toxic/Hazardous Substances & Environmental Engineering* 35(7): 957-980.

Nishimoto, R.K., Murdoch, C.L., McCarty, L.B. and Weinbrecht, J.S. (1997). "Purple nutsedge control by halosulfuron or imazaquin/MSMA in turfgrass in the tropics." *Journal of Turfgrass Management* 2(3): 23-33.

Roche, M.B., Penberthy, J.D. and O'Brien, L. (2012). TU08018: Traffic Tolerance of Warm-Season Turf Grasses under Community Sports Field Conditions. Final Project Report for Horticulture Australia Ltd (HAL).

Spectrum Technologies Inc. (no date). Feld Scout TCM 500 Turf Meter manual, pp. 24.

Wen, Y., Zhu, X. and Sun, J. (2000). "Similarities between climatic zones of turf-grass selection in China and world." *Acta Prataculturae Sinica* 9(3): 82-88.

Wiecko, G. (2006). Fundamentals of tropical turf management. Fundamentals of tropical turf management: viii + 205 pp.

## Appendix

### Appendix A – Varietal descriptors

Species	Common name	Variety name	PBR name	Commercially available	Page
<i>Axonopus compressus</i>	Broadleaf carpet grass	Broadleaf Carpet Grass	-	Yes	41
<i>Cynodon dactylon</i>	Green couch	OZ TUFF™	Oz-E-Green(ℓ)	Yes	47
		25a-1	NYI	Yes	57
<i>Digitaria didactyla</i>	Qld blue couch	Tropika	-	Yes	55
		Aussiblu	Aussiblu(ℓ)	Yes	39
<i>Eremochloa ophiuroides</i>	Centipedegrass	Centek	-	Yes	42
<i>Panicum laxum</i>	Lax panicgrass	ShadeGro™	ShadeGro(ℓ)	Yes	52
<i>Paspalum nicorae</i>	Brunswick grass	Blue Dawn	-	Yes	40
<i>Paspalum notatum</i>	Bahia grass	LowGro™	-	Yes	45
<i>Paspalum vaginatum</i>	Seashore paspalum	Sea Spray	-	Yes	51
<i>Stenotaphrum secundatum</i>	Buffalo grass	Kings Pride	Kings Pride(ℓ)	Yes	43
		Sir Walter	Sir Walter(ℓ)	Yes	54
<i>Zoysia hybrid</i>	Zoysia grass	PristineFlora®	-	Soon	49
<i>Zoysia japonica</i>	Zoysia grass	Empire™	(SS-500)(ℓ)	Yes	44
		Palisades	Palisades(ℓ)	Not yet	48
		ZT-11	-	Yes	56
<i>Zoysia macrantha</i>	Zoysia grass	Nara™	(MAC03)(ℓ)	Yes	46
<i>Zoysia matrella</i>	Zoysia grass	Royal	-	Not yet	50
		Shadetuff®	(A-1)(ℓ)	Yes	53

PBR = Plant Breeder's Rights

**Scientific name:***Digitaria didactyla***Variety name:**

Aussibblue

**Plant Breeder's Rights name:**

Aussibblue(l)

**Common name:**

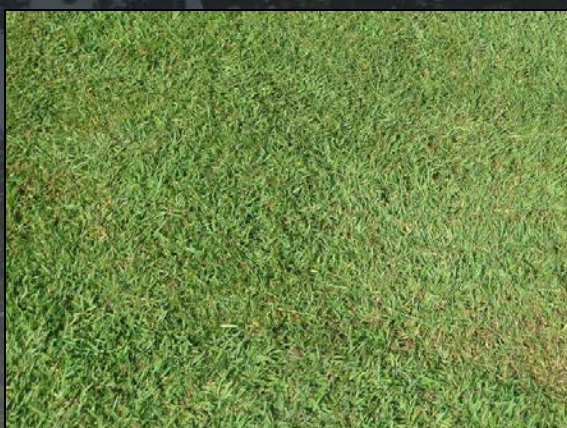
Blue couch

**Commercially available:**

Yes (sod)

**IP protection:**

PBR certificate #2058 (7 Jul 2002)



Aussibblue(l) sward



Aussibblue(l) close up

**Description:**

Aussibblue(l) is a fine-medium textured grass with a soft leaf, suited for domestic and commercial lawns, low usage recreational areas. The variety maintains a dense sward when mown between 25-35 mm. Regular mowing is required to keep the variety maintained. Turf clippings can also become a nuisance when mowing, clumping blocking the catcher entry or mower blades, because of the moisture within the turf sward. Aussibblue(l) is more resistant to weed invasion (possible allelopathic effects). Seed head production is minimal (if any under routine mowing). The variety is not tolerant to MSMA or DSMA herbicide. Wear tolerance is poor, however good recovery is encountered following fast spreading stolons/runners. Aussibblue(l) has better shade tolerance than Queensland blue couch.

**Tolerances:**Heat: goodDrought: moderate to poorWear: poorThatch production: moderate to highShade: moderate to poorFertility requirement: lowMowing frequency: high**Further information:**

- Scattini, W (2001) *Digitaria didactyla* (syn. *D. swazilensis*). Swazi grass. 'Aussibblue'. Plant Varieties Journal 14(2):33-34.

Australian Sports Turf Consultants Flickr® page: [www.flickr.com/ASTCs](http://www.flickr.com/ASTCs)

**Scientific name:***Paspalum nicorae***Variety name:**

Blue Dawn

**Plant Breeder's Rights name:**

Not applicable

**Common name:**

Brunswick grass

**Commercially available:**

Yes (seed)

**IP protection:**

No



Blue Dawn sward



Blue Dawn close up

**Description:**

Blue Dawn is a promising landscape or recreational grass because of its bluish colour and root structure. Blue Dawn is established by seed, but spreads by dense rhizomes (underground stems). Thick rhizomes can assist in turfgrass wearability and also aid in turfgrass recovery. The variety can be mown to a comfortable mowing height of 30-40 mm; but the variety is very fast growing requiring regular mowing to maintain an even turf cover. Blue Dawn can grow to 30-40 cm tall. Seeding rate for a recreational lawn is 80-100 g/100m<sup>2</sup>.

**Tolerances:**Heat: goodDrought: goodWear: goodThatch production: moderateShade: goodFertility requirement: lowMowing frequency: very high**Further information:**

- NSW Department of Primary Industries: <http://www.dpi.nsw.gov.au/agriculture/pastures/pastures-and-rangelands/species-varieties/a-z/blue-dawn> (accessed 30 May 2013)
- Australian Sports Turf Consultants Flickr® page: [www.flickr.com/ASTCs](http://www.flickr.com/ASTCs)

**Scientific name:***Axonopus compressus***Variety name:**

Broadleaf carpet grass

**Plant Breeder's Rights name:**

Not applicable

**Common name:**

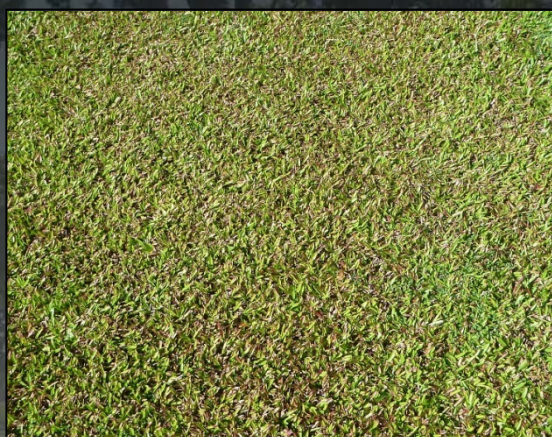
Broadleaf carpet grass

**Commercially available:**

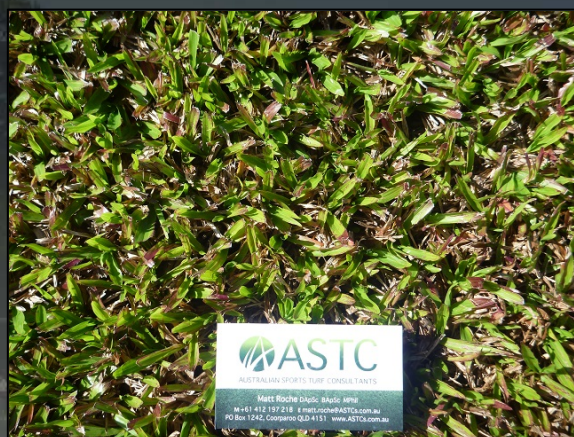
Yes (sod); Yes (seed)

**IP protection:**

No



Broadleaf carpet grass sward



Broadleaf carpet grass close up

**Description:**

A coarse-textured turf variety commonly found growing in tropical and sub-tropical environments that encounter moderate to high levels of humidity. Broadleaf carpet grass or “buffalo grass”, as referred to in the tropics, is fast growing requiring regular mowing. The variety likes moist, well watered soils and loves shaded areas. Sensitive to broadleaf herbicide, broadleaf carpet grass is difficult to maintain as a monoculture (single turf sward). Foliage can be green and purple.

**Tolerances:**Heat: goodDrought: poorWear: poorThatch production: moderateShade: goodFertility requirement: low to moderateMowing frequency: high**Further information:**

- Cameron, A.G. (2006) Suitable Lawn Grasses for the NT, Dept. of Primary Industry, Fisheries and Mines, Northern Territory Government, Agnote No. A21, pp. 4.
- Australian Sports Turf Consultants Flickr® page: [www.flickr.com/ASTCs](http://www.flickr.com/ASTCs)

**Scientific name:***Eremochloa ophiuroides***Variety name:**

Centek

**Plant Breeder's Rights name:**

Not applicable

**Common name:**

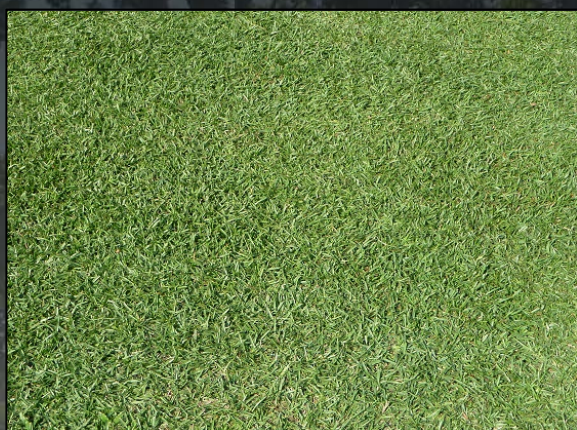
Centipedegrass

**Commercially available:**

Yes (sod)

**IP protection:**

No



Centek sward



Centek close up

**Description:**

A bright green, medium- to coarse-textured grass that forms a dense stolon mat. Centek and other centipedegrasses are considered 'low maintenance', but largely because of its fertility requirement which is low. If additional fertiliser is applied thatch levels will increase drastically. Leaf blades are shiny, dark green and have a waxy feel to the touch. Under subtropical and temperate climatic conditions in winter Centek has the ability to go dormant (foliage may turn brown).

**Tolerances:**Heat: goodDrought: moderateWear: moderate to poorThatch production: moderate to highShade: poorFertility requirement: lowMowing frequency: high**Further information:**

- Islam, M.A. & Hirata, M. (2005). Centipedegrass (*Eremochloa ophiuroides* (Munro) Hack.): growth behaviour and multipurpose usages. *Grassland Science*, vol. 53, no. 3, pp. 183-190.
- Australian Sports Turf Consultants Flickr® page: [www.flickr.com/ASTCs](http://www.flickr.com/ASTCs)

**Scientific name:***Stenotaphrum secundatum***Variety name:**

Kings Pride

**Plant Breeder's Rights name:**

Kings Pride(l)

**Common name:**

Buffalo grass

**Commercially available:**

Yes (sod)

**IP protection:**

PBR certificate #3430 (20 Dec 2007)



Kings Pride(l) sward



Kings Pride(l) close up

**Description:**

A coarse-textured buffalo grass used for recreational (parks), commercial and domestic lawns. The fast growing variety is well suited for low usage, shady environments. Routine mowing is needed to keep the variety in check. Mower blades should also be sharpened regularly to prevent damage to leaf blade tips. Light scarification or grooming practices should be undertaken within the upper turf canopy only to remove excessive thatch and prevent stolons from "porpoising". Dethatching practices must be undertaken minimal and often because buffalo grass grows by stolons and does not produce underground rhizomes like most other warm-season turfgrasses. New selective herbicides are now available for the successful control of broadleaf weeds within buffalo turf species.

**Tolerances:**Heat: goodDrought: moderateWear: poor to moderateThatch production: highShade: goodFertility requirement: low to moderateMowing frequency: high**Further information:**

- Duff, A. et al. (2009). TU04013: Adaptation and management of Australian buffalograss cultivars for shade and water conservation, Final Report for Horticulture Australia Ltd.
- Australian Sports Turf Consultants Flickr® page: [www.flickr.com/ASTCs](http://www.flickr.com/ASTCs)

**Scientific name:***Zoysia japonica***Variety name:**

Empire™

**Plant Breeder's Rights name:**

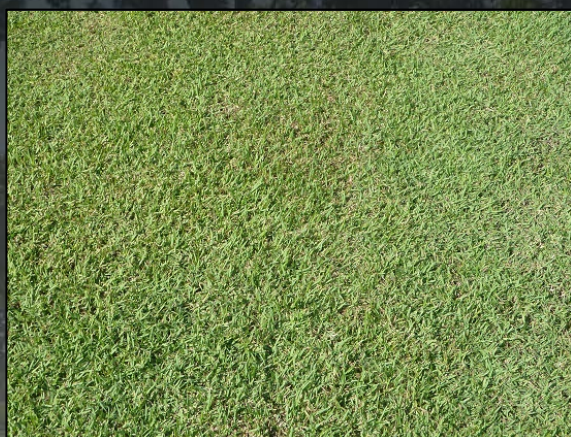
SS-500(b)

**Common name:***Zoysia* grass**Commercially available:**

Yes (sod)

**IP protection:**

PBR certificate #2015 (25 May 2002)



Empire™ sward



Empire™ close up

**Description:**

Empire™ Zoysia is a broad leaf japonica grass suitable for recreational (parks), commercial and domestic lawns. The main pro or con about Zoysia grass is its slow establishment and growth rate. However, for a maintenance view point, Zoysia grass like Empire™ requires less attention than other common warm-season turfgrasses like blue and green couch. If infrequently mowing the turfgrass, Empire™ will scalp and take time to recover. Operators need to make sure mower blades are sharp and will not tear or damage leaf blades when the turf is mown. This is unsightly and can cause secondary problems like disease occurrence.

**Tolerances:**Heat: goodDrought: moderate to goodWear: goodThatch production: highShade: goodFertility requirement: lowMowing frequency: low to moderate**Further information:**

- Patton, A.J. & Reicher, Z.J. (2006). Establishment rate of zoysiagrass cultivars-2005. *2005 Annual Report-Purdue University Turfgrass Science Program*.
- Australian Sports Turf Consultants Flickr® page: [www.flickr.com/ASTCs](http://www.flickr.com/ASTCs)

**Scientific name:***Paspalum notatum***Variety name:**

Aussiblu

**Plant Breeder's Rights name:**

Not applicable

**Common name:**

Bahia grass

**Commercially available:**

Yes (seed)

**IP protection:**

No



LowGro™ sward



LowGro™ close up

**Description:**

LowGro™ is a hard-wearing, coarse-textured grass with soft leaves that possess white hairs on both sides of the leaf blade. It is used in low maintenance parks and roadsides. The variety is slow to establish by seed, but once established it out-competes other more desirable turf species due to its robust rhizomatic (underground) root system. Bahia grass is a major warm-season grass weed species found in parks and urban open space areas, where it requires frequent mowing to remove the numerous unsightly seed heads which can grow between 20 and 60 cm tall. Seeding rate 2kg/100m<sup>2</sup>.

**Tolerances:**Heat: moderateDrought: poor to moderateWear: highThatch production: moderate to highShade: poor to moderateFertility requirement: lowMowing frequency: high**Further information:**

- Carson, C. (2010). *Bahia grass*. Queensland Dept. of Agriculture, Fisheries and Forestry ([www.dpi.qld.gov.au/turf](http://www.dpi.qld.gov.au/turf) accessed 30 Jun 2013).
- Australian Sports Turf Consultants Flickr® page: [www.flickr.com/ASTCs](http://www.flickr.com/ASTCs)

**Scientific name:***Zoysia macrantha***Variety name:**

Nara™

**Plant Breeder's Rights name:**

MAC03(d)

**Common name:***Zoysia* grass**Commercially available:**

Yes (sod)

**IP protection:**

PBR certificate #3654 (16 Dec 2008)



Nara™ sward



Nara™ close up

**Description:**

The *Zoysia macrantha* turfgrass variety Nara™ is recognised by the Australian Cultivar Registration Authority (ACRA) as being an Australian native. The medium-to coarse-textured variety is well suited for domestic, commercial, other general landscaping and amenity horticulture environments. Nara™ handles wear and shady conditions and has been identified as having a level of salt tolerance. The main pro or con about *Zoysia* grass is its slow establishment and growth rate. However, for a maintenance view point, *Zoysia* grass like Nara™ requires less attention than other common warm-season turfgrasses like blue and green couch. If infrequently mowing the turfgrass, Nara™ will scalp and take time to recover. Operators need to make sure mower blades are sharp and will not tear or damage leaf blades when the turf is mown. This is unsightly and can cause secondary problems like disease occurrence.

**Tolerances:**Heat: goodDrought: moderate to goodWear: goodThatch production: highShade: goodFertility requirement: lowMowing frequency: low to moderate**Further information:**

- Layt, T. (2011). MAC03. United States Plant Patent, US PP 21,789 P3.
- Australian Sports Turf Consultants Flickr® page: [www.flickr.com/ASTCs](http://www.flickr.com/ASTCs)

**Scientific name:***Cynodon dactylon***Variety name:**

OZ TUFF™

**Plant Breeder's Rights name:**

Oz-E-Green(l)

**Common name:**

Green couch

**Commercially available:**

Yes (sod)

**IP protection:**

PBR certificate #2844 (22 Aug 2005)



OZ TUFF™ sward



OZ TUFF™ close up

**Description:**

The green couch variety selected from North Queensland is suitable for residential, commercial/industrial, parks and sportsfields. OZ TUFF™ has shown to have improved wear tolerance than other turf species like blue couch and kikuyu and other green couch varieties. In a tropical environment additional fertility is required and integrated pest management (IPM) practices are warranted to keep couch mite under control, to achieve optimum turfgrass quality. Thatch production of OZ TUFF™ is higher than other green couch varieties; however this provides protection of the crown (growing point) and reduces the occurrence of wear damage.

**Tolerances:**Heat: goodDrought: goodWear: goodThatch production: moderate to highShade: poorFertility requirement: moderate to highMowing frequency: moderate**Further information:**

- Roche, M. B., Penberthy, J.D. and O'Brien, L. (2012). TU08018: Traffic Tolerance of Warm-Season Turf Grasses under Community Sports Field Conditions. Final Project Report for Horticulture Australia Ltd.
- Australian Sports Turf Consultants Flickr® page: [www.flickr.com/ASTCs](http://www.flickr.com/ASTCs)

**Scientific name:***Zoysia japonica***Variety name:**

Palisades

**Plant Breeder's Rights name:**

Palisades(l)

**Common name:**

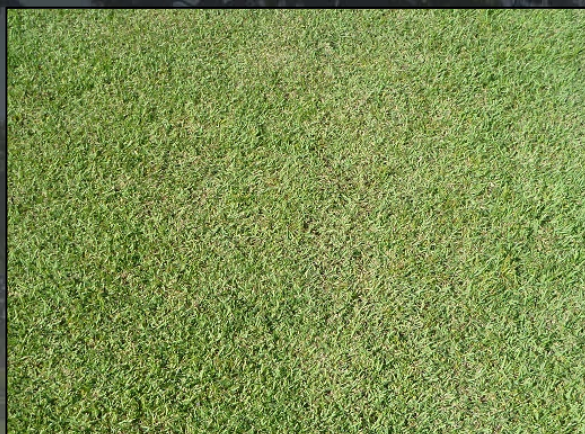
Zoysia grass

**Commercially available:**

Yes (sod)

**IP protection:**

PBR certificate #2594 (26 Oct 2004)



Palisades(l) sward



Palisades(l) close up

**Description:**

Palisades is a medium- to coarse-textured turfgrass variety suitable for use in home lawns, domestic and recreational areas. Palisades handles wear and shady conditions. The main pro or con about *Zoysia* grass is its slow establishment and growth rate. However, for a maintenance view point, *Zoysia* grass like Palisades requires less attention than other common warm-season turfgrasses like blue and green couch. If infrequently mowing the turfgrass, Palisades will scalp and take time to recover. Operators need to make sure mower blades are sharp and will not tear or damage leaf blades when the turf is mown. This is unsightly and can cause secondary problems like disease occurrence.

**Tolerances:**Heat: goodDrought: moderate to goodWear: goodThatch production: moderate to highShade: goodFertility requirement: low to moderateMowing frequency: low to moderate**Further information:**

- Engelke, M. (2000). Palisades, United States Plant Patent, USPP11515, pp. 6.
- Australian Sports Turf Consultants Flickr® page: [www.flickr.com/ASTCs](http://www.flickr.com/ASTCs)

**Scientific name:***Zoysia japonica* x *Z. tenuifolia***Variety name:**

PristineFlora®

**Plant Breeder's Rights name:**

To be advised

**Common name:***Zoysia* grass**Commercially available:**

Soon (sod)

**IP protection:**

In progress



PristineFlora® sward



PristineFlora® close up

**Description:**

PristineFlora® is a fine-textured turfgrass variety suitable for use in home lawns, domestic, commercial and recreational areas. PristineFlora® handles wear and shady conditions. The main pro or con about *Zoysia* grass is its slow establishment and growth rate. However, for a maintenance view point, *Zoysia* grass like PristineFlora® requires less attention than other common warm-season turfgrasses like blue and green couch. If infrequently mowing the turfgrass, PristineFlora® will scalp and take time to recover. Operators need to make sure mower blades are sharp and will not tear or damage leaf blades when the turf is mown. This is unsightly and can cause secondary problems like disease occurrence.

**Tolerances:**Heat: goodDrought: goodWear: goodThatch production: moderate to highShade: goodFertility requirement: lowMowing frequency: low**Further information:**

- Scully, B.T., Nagata, R.T., Cherry, R.H., Trenholm, L.E. and Unruh, J.B. (2009). Registration of 'Pristine' Zoysiagrass, Journal of Plant Registration, Vol. 3, pp. 65-68.
- Australian Sports Turf Consultants Flickr® page: [www.flickr.com/ASTCs](http://www.flickr.com/ASTCs)

**Scientific name:***Zoysia matrella***Variety name:**

Royal

**Plant Breeder's Rights name:**

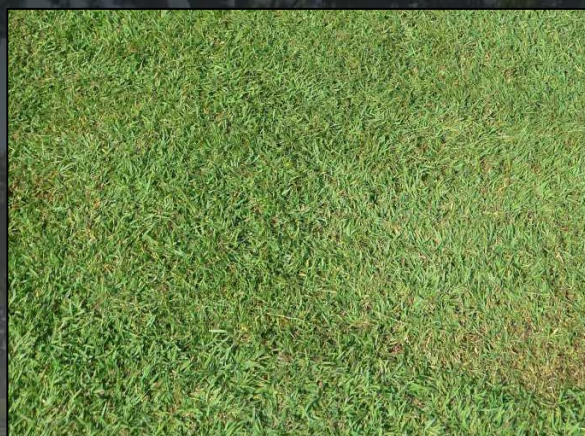
Not applicable

**Common name:***Zoysia* grass**Commercially available:**

Not yet

**IP protection:**

No



Royal sward



Royal close up

**Description:**

Royal is a fine-textured turfgrass variety suitable for use in home lawns, domestic, commercial and recreational areas. Royal handles wear and shady conditions. The main pro or con about *Zoysia* grass is its slow establishment and growth rate. However, for a maintenance view point, *Zoysia* grass like Royal requires less attention than other common warm-season turfgrasses like blue and green couch. If infrequently mowing the turfgrass, Royal will scalp and take time to recover. Operators need to make sure mower blades are sharp and will not tear or damage leaf blades when the turf is mown. This is unsightly and can cause secondary problems like disease occurrence.

**Tolerances:**Heat: goodDrought: goodWear: goodThatch production: moderate to highShade: goodFertility requirement: lowMowing frequency: low to moderate**Further information:**

- Staton, T.A. (1994). *Zoysia* grass plant 'Z3', United States Patent, USPP8553, pp. 5.
- Australian Sports Turf Consultants Flickr® page: [www.flickr.com/ASTCs](http://www.flickr.com/ASTCs)

**Scientific name:***Paspalum vaginatum***Variety name:**

Sea Spray

**Plant Breeder's Rights name:**

Not applicable

**Common name:**

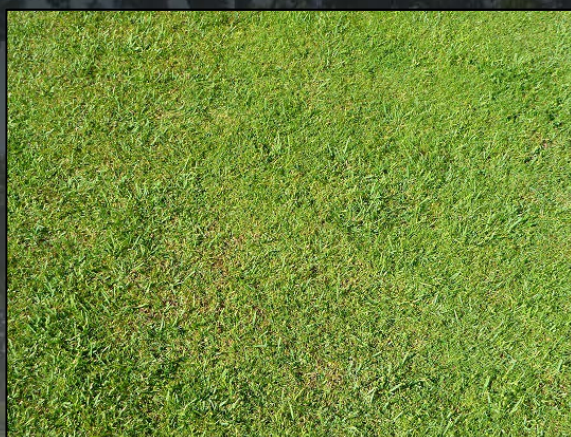
Seashore paspalum

**Commercially available:**

Yes (seed)

**IP protection:**

No



Sea Spray sward



Sea Spray close up

**Description:**

Sea Spray is a warm-season seeded variety that forms a moderately dense but uniform sward. Sea Spray prefers tropical and sub-tropical climatic conditions and handles shade better than most varieties of bermudagrass. Sea Spray like other seashore paspalum varieties is tolerable to poorer quality water supplies, including recycled, bore and salt water. The variety can be used in coastal areas enduring short-term inundation, home lawns and recreational areas. Sea Spray has dark green waxy foliage that can provide a visually aesthetic surface by 'striping up'. Seeding rate is 1kg per 100m<sup>2</sup>.

**Tolerances:**Heat: goodDrought: poor to moderateWear: poorThatch production: moderate to lowShade: low to moderateFertility requirement: moderateMowing frequency: moderate**Further information:**

- Flickr et al. (2007). Sea Spray. United States Plant Patent US7262, pp. 5.
- Australian Sports Turf Consultants Flickr® page: [www.flickr.com/ASTCs](http://www.flickr.com/ASTCs)

**Scientific name:***Panicum laxum***Variety name:**

ShadeGro™

**Plant Breeder's Rights name:**

Shadegro(l)

**Common name:**

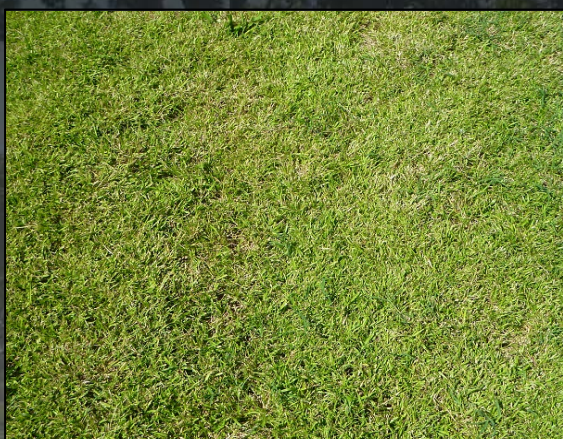
Lax panicgrass

**Commercially available:**

Yes (seed)

**IP protection:**

PBR certificate #447 (19 May 1995)



ShadeGro™ sward



ShadeGro™ close up

**Description:**

ShadeGro™ is a turf variety that is established by seed. Following initial investigations its growth habit under 'mown' conditions identified that the variety was well suited as an ornamental turf variety. ShadeGro™ grows best in sub-tropical and tropical conditions and handles lowlight conditions exceptionally well. In tropical conditions the variety can be grown under full sun. However, in tropical environments shady environments are better suited to provide optimum growing conditions. ShadeGro™ has bright dark green leaves when fertility is (above) acceptable, but when nutrition is low, the turf foliage is yellow-green in colour. Leaves can turn also turn purple at the tips. ShadeGro™ requires minimal growing. Seeding rate is 2kg per 100m<sup>2</sup>. Optimum seed germination occurs at 39°C.

**Tolerances:**Heat: moderateDrought: moderateWear: poorThatch production: lowShade: goodFertility requirement: moderateMowing frequency: low**Further information:**

- Brede, D. (2000). Turfgrass Maintenance Reduction Handbook: Sports, lawn and golf, Sleeping Bear Press, MI.
- Australian Sports Turf Consultants Flickr® page: [www.flickr.com/ASTCs](http://www.flickr.com/ASTCs)

**Scientific name:***Zoysia matrella***Variety name:**

Shadetuff®

**Plant Breeder's Rights name:**

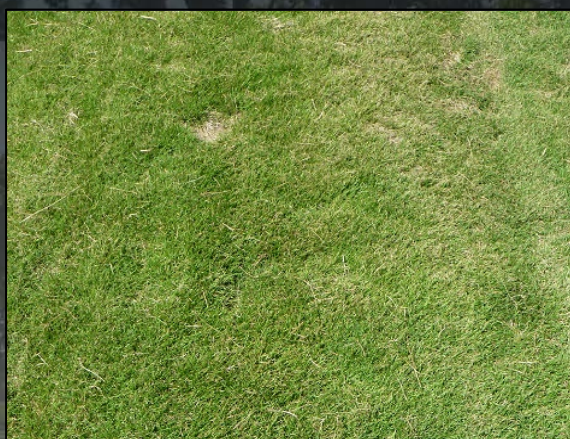
A-1(b)

**Common name:***Zoysia* grass**Commercially available:**

Yes (sod)

**IP protection:**

PBR certificate #3649 (16 Dec 2008)



Shadetuff® sward



Shadetuff® close up

**Description:**

Shadetuff® is a fine-textured turfgrass variety suitable for use in home lawns, domestic, commercial and recreational areas. Shadetuff® handles wear and very shady conditions. The main pro or con about *Zoysia* grass is its slow establishment and growth rate. However, for a maintenance view point, *Zoysia* grass like Shadetuff® requires less attention than other common warm-season turfgrasses like blue and green couch. If infrequently mowing the turfgrass, Shadetuff® will scalp and take time to recover. Operators need to make sure mower blades are sharp and will not tear or damage leaf blades when the turf is mown. This is unsightly and can cause secondary problems like disease occurrence.

**Tolerances:**Heat: goodDrought: goodWear: goodThatch production: highShade: goodFertility requirement: low to moderateMowing frequency: low**Further information:**

- Murray, J. and Morris, K. (1998). Establishing and maintaining zoysiagrass. *Grounds Maintenance*, Vol. 23, no. 5, pp. 38,40-42.
- Australian Sports Turf Consultants Flickr® page: [www.flickr.com/ASTCs](http://www.flickr.com/ASTCs)

**Scientific name:***Stenotaphrum secundatum***Variety name:**

Sir Walter(®)

**Plant Breeder's Rights name:**

Sir Walter(®)

**Common name:**

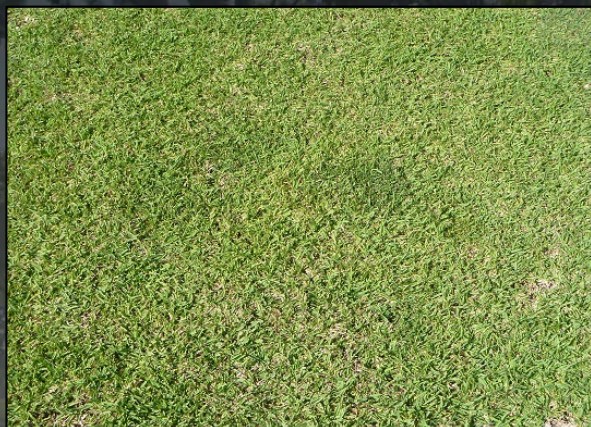
Buffalo grass

**Commercially available:**

Yes (sod)

**IP protection:**

PBR certificate #1028 (27 Mar 1998)



Sir Walter(®) sward



Sir Walter(®) close up

**Description:**

Sir Walter(®) is a coarse-textured buffalo grass used for recreational (parks), commercial and domestic lawns. The fast growing variety is well suited for low usage, shady environments. Routine mowing is needed to keep the variety in check. Mower blades should also be sharpened regularly to prevent damage to leaf blade tips. Light scarification or grooming practices should be undertaken within the upper turf canopy only to remove excessive thatch and prevent stolons from “porpoising”. Dethatching practices must be undertaken minimal and often because buffalo grass grows by stolons and does not produce underground rhizomes like most other warm-season turfgrasses. New selective herbicides are now available for the successful control of broadleaf weeds within buffalo turf species.

**Tolerances:**Heat: goodDrought: moderateWear: poor to moderateThatch production: highShade: goodFertility requirement: low to moderateMowing frequency: high**Further information:**

- Duff, A. et al. (2009). TU04013: Adaptation and management of Australian buffalograss cultivars for shade and water conservation, Final Report for Horticulture Australia Ltd.
- Australian Sports Turf Consultants Flickr® page: [www.flickr.com/ASTCs](http://www.flickr.com/ASTCs)

**Scientific name:***Digitaria didactyla***Variety name:**

Tropika

**Plant Breeder's Rights name:**

Not applicable

**Common name:**

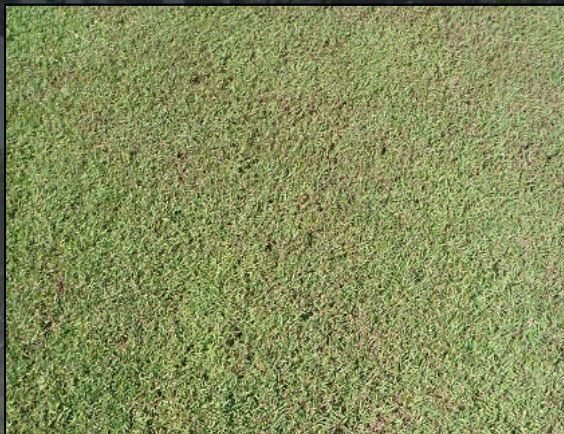
Blue couch

**Commercially available:**

Yes (sod)

**IP protection:**

No



Tropika sward



Tropika close up

**Description:**

Tropika is a fine-medium textured grass with a soft leaf, suited for domestic and commercial lawns, low usage recreational areas. Leaves are blue-green in colour and are slightly wider than 'Aussiblu'. The variety maintains a dense sward when mown between 25-35 mm. Regular mowing is required to keep the variety maintained. Turf clippings can also become a nuisance when mowing, clumping blocking the catcher entry or mower blades, because of the moisture within the turf sward. Tropika is more resistant to weed invasion (possible allelopathic effects). Seed head production is minimal (if any under routine mowing). Wear tolerance is poor, however good recovery is encountered following fast spreading stolons/runners. Tropika has better shade tolerance than Queensland blue couch.

**Tolerances:**Heat: goodDrought: moderate to poorWear: poorThatch production: moderate to highShade: moderate to poorFertility requirement: lowMowing frequency: high**Further information:**

- Carson, C. (2010). *Tropika*. Queensland Dept. of Agriculture, Fisheries and Forestry ([www.dpi.qld.gov.au/turf](http://www.dpi.qld.gov.au/turf) accessed 30 Jun 2013).
- Australian Sports Turf Consultants Flickr® page: [www.flickr.com/ASTCs](http://www.flickr.com/ASTCs)

**Scientific name:***Zoysia japonica***Variety name:**

ZT-11

**Plant Breeder's Rights name:**

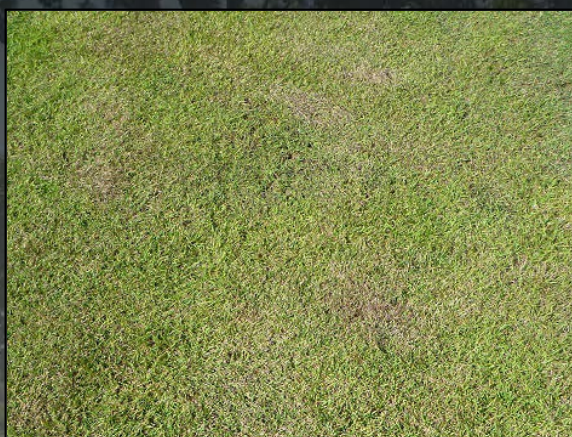
Not applicable

**Common name:***Zoysia* grass**Commercially available:**

Yes (sod)

**IP protection:**

No



ZT-11 sward



ZT-11 close up

**Description:**

ZT-11 is a medium- to coarse-textured turfgrass variety suitable for use in home lawns, domestic and recreational areas. ZT-11 handles wear and shady conditions. The main pro or con about *Zoysia* grass is its slow establishment and growth rate. However, for a maintenance view point, *Zoysia* grass like ZT-11 requires less attention than other common warm-season turfgrasses like blue and green couch. If infrequently mowing the turfgrass, ZT-11 will scalp and take time to recover. Operators need to make sure mower blades are sharp and will not tear or damage leaf blades when the turf is mown. This is unsightly and can cause secondary problems like disease occurrence.

**Tolerances:**Heat: goodDrought: moderate to goodWear: highThatch production: highShade: goodFertility requirement: low to moderateMowing frequency: low to moderate**Further information:**

- Whiting, H.F. (1989). *Zoysia japonica* grass plant 'ZT-11'. United States Plant Patent PP07074.
- Australian Sports Turf Consultants Flickr® page: [www.flickr.com/ASTCs](http://www.flickr.com/ASTCs)

**Scientific name:***Cynodon dactylon***Variety name:**

25a-1

**Plant Breeder's Rights name:**

Not applicable

**Common name:**

Green couch

**Commercially available:**

Soon (sod)

**IP protection:**

No



25a-1 sward



25a-1 close up

**Description:**

The green couch variety selected from Northern Territory is suitable for commercial/industrial, erosion control and sportsfields potentially. The variety was chosen following research studies undertaken by the University of Queensland and the Queensland Department of Agriculture, Fisheries and Forestry. 25a-1 has a medium-to coarse-textured leaf for a green couch and the variety has a very dense rhizome (underground) root system. In a tropical environment additional fertility is required and integrated pest management (IPM) practices are warranted to keep couch mite under control, to achieve optimum turfgrass quality.

**Tolerances:**Heat: goodDrought: goodWear: goodThatch production: moderateShade: poorFertility requirement: highMowing frequency: moderate**Further information:**

- Australian Sports Turf Consultants Flickr® page: [www.flickr.com/ASTCs](http://www.flickr.com/ASTCs)