

Warm-Season Greens Grass Trial – Environmental Conditions and Management Guidelines Suited for New and Old Cultivars

Matt Roche^{1A}, John Neylan² and Jon Penberthy^{1B}

^{1A} Acting Senior Research Scientist, ^{1B} Experimentalist, Queensland Department of Employment, Economic Development and Innovation (DEEDI)

² General Manager, Australian Golf Course Superintendents Association (AGCSA)

INTRODUCTION

Since the commencement of the Horticulture Australia funded project, Management Guidelines for Warm-Season Grasses in Australia (TU05001), the turfgrass industry found itself facing arguably its toughest period in decades. Drought and more recently fire, flooding and the financial crisis are just some of the hurdles the industry has had to deal with. In light of these challenging times it has been encouraging to see the golf, bowls and wider turf industry collaborate at a national level to undertake this study. Such a task is commendable and all parties involved should be congratulated for making this research possible.

The initiative has allowed for the detailed greens grass study to take place and enabled researchers and superintendents to work together to collect meaningful data on a range of *Cynodon dactylon* (L.) Pers. x *Cynodon transvaalensis* Burtt-Davy (*Cynodon* hybrid) and *Paspalum vaginatum* O. Swartz (seashore paspalum) cultivars suitable for golf or lawn bowls use. The end result will provide superintendents and greenkeepers with the added knowledge to accompany their skills in managing or upgrading their greens to produce a denser, smoother and faster putting or bowls surface. However, neither turfgrass selection nor finely tuned management program will overcome unrealistic expectations (especially in relation to usage), poor growing environments, or limitations due to improper construction techniques (Bevard et al., 2005).

AUSTRALIAN GOLF AND BOWLS INDUSTRY

In a study undertaken by Ernst and Young et al. (2006) the Australian Golf Industry had an annual economic value to the Australian GDP of AU\$2.7 billion and is by far the greatest sport industry contributor to the economy (AGIC, 2009). The golf industry directly employs in excess of 23,000 people with many thousands more employed in industries that have an association with golf (AGIC, 2009).

The Australian Golf Industry Council (AGIC) in May 2009 indicated that there were 1,530 golf courses in Australia, with 19% of these located in the metropolitan area and 81% in regional areas (AGIC, 2009). Of these 1,530 golf courses, 36 were opened between 2000 and 2009. Inevitably these new facilities along with others undertaking resurfacing, would have had to make a decision on what cultivar to plant on their greens.

In 2009, there were 2,011 registered lawn bowls clubs located across Australia. In a study undertaken by Bowls Australia and the State and Territory Associations (STA's) in 2007, results showed that 79% of the lawn bowls surfaces are of natural turf with 21% being synthetic (Hook, 2007). Of the clubs with natural turf surfaces, 72% of the 717 respondents indicated that they have warm-season (e.g. 'Tifdwarf', 'Santa Ana', 'common') turfgrass, while only 14% had Bentgrass

(*Agrostis* spp. a cool-season turfgrass) and the remaining 14% had a combination of the latter, or were listed as 'other' (Hook, 2007).

Of the 3,500 plus golf and bowls clubs located in Australia, the large majority of them are positioned along the eastern coast in New South Wales, Victoria and Queensland. This is not surprising given that a population of nearly 6.1 million people reside within this region (Table 1).

Table 1. Number of golf courses and lawn bowls clubs in Australia relative to the Australian population in 2009 [source (AGIC, 2009; Bowls Australia, 2009)].

State	Golf Courses	Bowls Clubs	Population '000
NSW	413	≈ 591	7,099.7
VIC	378	≈ 530	5,427.7
QLD	256	347	4,406.8
WA	231	217	2,236.9
SA	154	224	1,622.7
TAS	75	73	502.6
ACT	10	21	351.2
NT	13	8	224.8
Total	1,530	2,011	21,874.9 (a)

(a) Includes Other Territories comprising Jervis Bay Territory, Christmas Island and the Cocos (Keeling) Islands. Population data was acquired from the Australian Bureau of Statistics (2009).

PROJECT BACKGROUND

After more than 30 years in which 'Tifgreen' and 'Tifdwarf' were the only greens-quality cultivars available, the choice for golf courses and bowls clubs in northern Australia has been expanded to include six new *Cynodon* hybrids. Five of these – 'Champion Dwarf' (Texas), 'MS-Supreme' (Mississippi), FloraDwarf™ (Florida), 'TifEagle' (Georgia), MiniVerde™ (Arizona) - are from US breeding programs, while the sixth, 'TL2' (marketed as Novotek™) was selected in north Queensland. The finer, denser and lower growing habit of the "ultradwarf" cultivars allows very low mowing heights (e.g. 2.5 mm) to be imposed, resulting in denser and smoother putting and bowls surfaces. In addition to the *Cynodon* hybrids, four new greens quality seashore paspalum cultivars including 'Sea Isle 2000', Sea Isle Supreme™, Velvetene™ and Sea Dwarf™ (where tolerance of salty water is required) expands the range of choices for greens in difficult environments.

The hybrid *Cynodon* cultivars differ in their rates of vertical extension and lateral stem development, and in their shoot density. The finer, denser and lower growing new varieties result in a denser, smoother and faster putting surface under optimum management. However, these also require intensive management for thatch control and behave differently to the older standard (first-generation) varieties in terms of their response to mowing height, nitrogen fertiliser rates, and even winter over-seeding with ryegrass (*Lolium perenne* L.).

The first of the new generation *Cynodon* and *Paspalum* greens varieties from the US are now available commercially through Australian licensees, though licensing arrangements are still to be finalised for two of these, 'Champion Dwarf' and MiniVerde™. All of them however, are being grown by the Queensland Department of Employment, Economic Development and Innovation (DEEDI) turf research team

at Redlands Research Station, Cleveland, in agreement with the breeders and their Australian licencees.

To enable effective evaluation of these new and old turfgrass cultivars it was essential to have a number of regional trial sites participating in the study along with the centralised test facility being constructed at DEEDI Redlands Research Station (Table 2). Industry contact was made by staff of the Australian Golf Course Superintendents Association (AGCSA) and DEEDI to seek interest from golf and bowls clubs to see if they wanted to be involved in the collaborative study. Drought and financial hardship of many clubs presented an initial setback with numerous clubs wanting to be involved in the study but were unable to commit due to their financial position at the time. The study was fortunate to have seven regional sites from Queensland, New South Wales, Victoria and South Australia volunteer to be involved in the four year Horticulture Australia Ltd (HAL) funded study.

By having numerous regional trial sites actively participate in the study it allowed superintendents, teachers, researchers and technical staff to assess the selection of warm-season turfgrasses being grown under a “typical” management regime. Management practices, however, often varied from the regime used on their existing greens and also from conditions imposed on the same or other varieties at other courses. A protracted period of trial and error by adjusting and fine tuning management regimes was common to allow for unjustified prejudices and debate about their relative merits, until rational assessments slowly emerged.

The opportunity to support this process was to construct a centralised test facility (at Redlands Research Station) keying it to regionally distributed comparisons of all varieties under similar management by experienced superintendents/greenkeepers at the regional trial sites. Rather than a protracted commercialisation process in which individual courses/clubs grow the new varieties under “typical” management regimes, this coordinated approach accelerated the rational assessment of the new cultivars and greatly improve understanding of their characteristics and management requirements such as nitrogen fertiliser rates, cutting height and grooming treatments.

The end result was to provide faster, more affordable determinations by each club/course/facility of the grow-in or replacement strategy which best met its requirements, together with a sound knowledge of these new greens grasses much earlier than would otherwise have been the case.

Table 2. Location of trial sites participating in the warm-season greens grass study.

Location of trial site	State
Glenelg Golf Club, Novar Gardens	SA
Chisholm TAFE, Mornington Peninsula	VIC
Bermagui Golf Club, Bermagui	NSW
Coolangatta Tweed Golf Club, Tweed Heads South	NSW
Indooroopilly Golf Club, Indooroopilly	QLD
Horton Park Golf Club, Maroochydore	QLD
Twin Waters Golf Club, Twin Waters	QLD
DEEDI Redlands Research Station, Cleveland	QLD

GENERAL PROJECT CONCLUSION AND RECOMMENDATIONS

Introduction of the newer *Cynodon* hybrids (“ultradwarfs”) and greens quality seashore paspalums will be dependent on largely one component; thatch accumulation and successful management being undertaken from a very early stage in the grow-in of the greens. Frequent light dusting or topdressing is recommended every seven to fourteen days with material fine enough to filter through the turf canopy. Some “ultradwarf” cultivars may require higher levels of sand and paspalums more so than the *Cynodon* hybrids. Groomers should be utilized where possible during the growing season (e.g. weekly) to continuously reduce thatch accumulation and prevent “porpoising” seen in the seashore paspalums. Such practices will assist in thatch reduction and result in denser, smoother and faster putting and bowls surfaces. Prevention is the key to ensuring long term success.

The following observations and recommendations on the *Cynodon* hybrids (or couchgrass) and the seashore paspalums have been compiled from the eight trial sites (7 x regional trial sites and DEEDI centralised testing facility) following routine assessments undertaken throughout the duration of the warm-season grasses trial (TU05001). The information reflects the site specific observations and do not necessarily reflect the performance of each species and cultivar at different sites around Australia. The information provides an overview of the field performance of the grasses under typical golf course maintenance conditions, however, the data suggests that there can be variation depending on the site and climatic conditions. Such evidence highlights the need to undertake genotype by environment (G x E) studies on new and old cultivars.

These observations should be used as a means of selecting potential cultivars for on-site evaluation.

Cynodon hybrids

Sward Characteristics (turf density, growth characteristics etc.)

All of the eight *Cynodon* hybrids can be characterised as follows:

- Very high turfgrass density
- Forms a very tight surface
- Stolons and leaves are very low growing and prostrate
- ‘Champion Dwarf’ potentially has the most prostrate growth habit with ‘Tifgreen’ having the tallest growth habit.
- ‘Tifgreen’ has the most open growth habit and lowest turf density
- ‘Tifdwarf’ provides a low growing turf of high density but has a lower density compared to ‘TifEagle’ and Champion Dwarf
- FloraDwarf™ was slow to establish (including root development) but performed well over time
- All cultivars except ‘Tifgreen’ produce a dense, tight and even putting surface
- All cultivars display an improvement in turf colour when day length increases
- The “ultradwarfs” produced faster green speeds than ‘Tifgreen’ and ‘Tifdwarf’. However, all *Cynodon* hybrids were considerably faster than the seashore paspalums under trial conditions

Disease

All trial sites reported the occurrence of disease in the *Cynodon* hybrids with the main incidence of disease occurring during the dormancy period (autumn and winter). The main disease reported was “patch diseases” which includes both *Gaumannomyces* and *Rhizoctonia* species. There was differences in the severity of

the disease between cultivars, however, the severity of the disease was not consistent between cultivars and is largely attributed to an environment (location) effect. Of the eight *Cynodon* hybrids, 'MS-Supreme' is potentially the least affected by disease.

The following observations were made:

- *Victoria (VIC):*
 - All cultivars were equally affected by "patch disease"
- *South Australia (SA):*
 - All cultivars were equally affected by "patch disease"
- *Queensland (QLD):*
 - Most cultivars were affected by disease in some form
 - Horton Park GC – MiniVerde™ and 'TifEagle' worst affected by "patch disease"
 - Indooroopilly GC – All cultivars affected by *Drechslera* sp. leaf disease
 - Coolangatta-Tweed GC – All cultivars with the exception of 'TifEagle' were affected by "patch disease"
 - DEEDI Redlands – All cultivars were effected by disease
 - Novotek™ a cultivar which was chosen for its disease resistance is not performing as well in South East Queensland compared to North Queensland.
- *New South Wales (NSW):*
 - MiniVerde™, followed by 'MS-Supreme' was the most affected by disease
 - Bermagui GC – 'TifEagle' was not as badly effected by disease

In terms of managing the occurrence of disease, the incidence of disease is less where there is a higher fertility rate (about 3 kgN/100m²/year), but with higher Nitrogen comes added growth and thatch. Thatch levels must remain in check, which will also assist in lowering the occurrence and severity of disease. If finances permit, a preventative fungicide program should be implemented to negate mild to severe infestations of disease including Spring Dead Spot (*Leptosphaeria namari*), Dollar Spot (*Sclerotinia homeocarpa*), Brown Patch (*Rhizoctonia solani*), and Ring-Spot (*Gaeumannomyces incrustans*).

All cultivars appear to recover from disease relatively quickly with the onset of warmer temperatures and increasing day length, providing that the level of fertility is adequate.

Key points:

- All cultivars are susceptible to disease depending on location
- Disease control is dependent on good thatch control, adequate fertility and the use of preventative fungicides
- If finances permit, a preventative fungicide program should be implemented to negate mild to severe infestations of disease

Thatch and Thatch Control

All of the new second generation "ultradwarf" couchgrasses tend to produce a large amount of thatch with MiniVerde™ being the greatest thatch producer, particularly compared to 'Tifdwarf' and 'Tifgreen'. The maintenance of the new *Cynodon* hybrids will require a program of regular dethatching/grooming as well as regular light dustings of sand.

It was noted that the tendency towards high thatch accumulation resulted in greater formation of dry patch.

A general thatch control and dusting program would be as follows:

Thatch:

- Thatch prevention should begin 3 to 4 weeks after planting a new ultradwarf couchgrass green, with an emphasis on prevention rather than control.
- Biomass of “ultradwarf” couchgrass greens must be managed differently from that of ‘Tifdwarf’.
- Injuries from aggressive vertical mowing shock “ultradwarf” cultivars, slowing growth and possibly increasing the chance for “couchgrass decline” disease.

Topdressing:

- Topdressing material should be fine enough (e.g., 0.25 mm to 0.75 mm in diameter) to filter into the turf canopy.
- Light topdressing for example, 0.03 to 0.043 cubic meters/100 square meters every 7 to 14 days.
- MiniVerde™, ‘MS-Supreme’, Novotek™, ‘TifEagle’ and ‘Tifgreen’ take up the sand in topdressing quickly. ‘Tifdwarf’, ‘Champion Dwarf’ and FloraDwarf™ have the sand remain on the surface longer than the former cultivars
- It has been noted that regular dusting can be difficult because the density of the turf is such that it is very difficult to brush the sand into the thatch layer. An alternative means of thatch control has been suggested where the turf is groomed in two directions every week during the growing season.

Surface Grooming:

- The stolons of actively growing couchgrass lie flat, and the growing point escapes the mower bedknife, causing thatch and grain.
- Vertical mowing, grooming and brushing helps to overcome or reduce this horizontal stolon growth.
- Brushing improves the putting quality of “ultradwarf” greens and helps reduce grain.
- Brushing raises the tips of juvenile stolons to create a smoother, more complete clipping.
- In conjunction with light topdressing, brushing keeps the raised stolons and shoots vertical to produce a more consistent putting surface.
- It is less harmful to the plant than vertical mowing or grooming.
- Daily brushing should take place during periods of active growth.

Renovations:

- In addition to the regular grooming and dusting the “ultradwarfs” require hollow core aerification and topdressing twice a year. Solid tyning should be used more frequently.

Mowing Height and Rolling

All of the regional sites were maintained at a cutting height of 3.0 mm to 5.0 mm and all of the *Cynodon* hybrids produced a satisfactory surface at these cutting heights. As a general observation these grasses do not respond well to prolonged low cutting.

As a general recommendation on mowing, cutting height and rolling the following is noted:

- Cutting heights best at 3.0 mm to 4.5 mm
- During peak growth cut daily using walk-behind mowers with groomers
- Regular double cutting during periods of strong growth
- Rolling of the greens should be carried out once per week and should be undertaken within 48 hours of when the clubs formal competition is held. This will achieve optimum green speed.

At the DEEDI Redlands test facility two mowing heights were imposed, 3.5 mm and 2.7 mm. The results indicated the *Cynodon* cultivars accepted the lower cutting height (i.e. 2.7 mm) and produced a good surface and was second fastest to being cut (at 3.5 mm) and rolled. However, greens being maintained at this height would have to be cut daily for best results.

Under optimal growing conditions, “ultradwarf” couchgrasses can tolerate mowing heights as low as 3.2 mm for extended periods and 2.5 mm for short periods. At these mowing heights, the turf maintains acceptable density, but the plant is under considerable stress.

Recovery from Damage

MiniVerde™ was vigorous and recovered well following vertical mowing. ‘Tifdwarf’ was slow to recover from disease scars and showed these for considerable time during the winter months. In general, turf recovery from disease on the other *Cynodon* hybrids was relatively quick under good growing conditions (in particular temperature).

In the state of Victoria at Chisholm TAFE, ‘Tifgreen’ was very slow to recover from summer drought stress and disease scars remained prominent for an extended period. All other cultivars were severely affected but did recover to form a complete turf cover.

Nutritional Requirements

As a general observation the new second generation *Cynodon* hybrids require a relatively high nitrogen input to provide the best quality surface and in particular to minimise the incidence of disease. At this point in time the optimum rate of nitrogen is at 3 kg/100m²/year.

Dormancy

Dormancy occurs on all cultivars at all sites. In Victoria and South Australia dormancy is very strong and “spring greenup” does not occur until at least mid-September (South Australia) to October (Victoria). In Victoria ‘MS-Supreme’ and *MiniVerde™* are the earliest cultivars to go into dormancy in winter.

‘Tifdwarf’ was observed as having greater winter dormancy based on colour. This is due to the purplish colour observed on the leaves and stolon growth which is incurred during the onset of cooler temperatures.

In studies conducted by DEEDI staff results showed that the critical threshold levels for active growth by first- and second-generation *Cynodon* hybrid cultivars occurs at air temperatures of about 9 - 10°C or at soil temperatures (10cm below ground) of 15 - 16°C. Below these levels, very little or no growth takes place and either freezing or chilling stress can occur. At temperatures above the threshold levels, active growth will inevitably increase, but a cut off will follow with temperatures being too extreme causing heat stress to the turf.

Pesticide Tolerance

Across all of the trial sites there has been various pesticides applied, of which can be seen in Table 3.

Table 3. Pesticides applied to *Cynodon* hybrid cultivars at regional facilities and or the DEEDI centralised test facility.

PESTICIDE*	COMMENT
Herbicide	
Ronstar®	Applied post planting and during initial grow in (Feb., Jun., Aug.) – no adverse effect
Dimension™	Applied late Nov. - no adverse effect Applied in July – shortened root systems compared to untreated area. TifEagle was the most sensitive and resulted in high incidence of disease.
Spearhead™	Applied in summer - no adverse effect
Pendimethalin	Applied in July – shortened root systems in all cultivars compared to untreated area. FloraDwarf™ was the most sensitive and resulted in a high incidence of disease.
Fluroxypyr	Some discolouration at 5ml/L when applied in January. 3ml/L showed no adverse effect when applied in April, September and December
Metsulfuron-methyl	Applied in January – no adverse effect
Propyzamide	Applied in April – no adverse effect
Monument™	Applied in July – no adverse effect
Endothal	Applied in July – no adverse effect
Trinoc™	Applied in July – some minor discolouration
Mecoprop/MCPA/Dicamba	Applied in August – no adverse effect
DSMA	Applied in December at a lower rate – no adverse effect
Fungicide	
Ipridione	Applied in late Nov. – no adverse effect
Chlorothalonil	Applied in late Nov. – no adverse effect
Signature™	Applied in late Nov. – no adverse effect
Tilt®	Applied in March – no adverse effect
Penncozeb™	Applied in late Nov. – no adverse effect
Baycor™	Applied in July – no adverse effect
Insecticide	
Acelepryn™	Applied summer – no adverse effect
Gremlin™	Applied in October – no adverse effect
Baythroid®	Applied in spring, summer and autumn – no adverse effect
Bravo®	Applied in May – no adverse effect
Heritage®	Applied in August – no adverse effect
Growth retardant	
Primo™	Applied in summer – all cultivars suffered leaf burn. All except 'Tifgreen' recovered in 2 weeks. 'Tifgreen' recovered in 3 weeks.

* Note: Not all pesticides have been trialled on all cultivars at all locations and under all climatic conditions. Always read and follow the label instructions. Fluroxypyr and metsulfuron-methyl are to be registered for turfgrass use as a generic pesticide in 2010 by the Australian Pesticides and Veterinary Medicines Authority (APVMA) following earlier studies undertaken at DEEDI Redlands Research Station.

Seashore paspalum

Sward Characteristics (turf density, growth characteristics etc.)

All of the seashore paspalums can be characterised as follows:

- High turfgrass density
- Seashore paspalums appear finer in winter than summer
- Forms a moderately tight surface and is harder under foot
- Stolons and leaves are low growing and prostrate, however, some cultivars will produce stolons that will grow upwards and then bend back towards the surface. This is often referred to as "porpoising".
- Velvetene™ has the more open growth habit.
- All cultivars produce a moderately dense and even putting surface particularly when cut lower.
- Sea Isle Supreme™ was consistently faster (green speed) than Velvetene™ and Sea Isle 2000. However, in comparison to the *Cynodon* hybrids they were considerably slower under trial conditions. The paspalums recorded approximately 5% higher soil moisture readings than the *Cynodon* hybrids
- The putting surface is described as being "sticky" and will not necessarily provide an ideal putting surface.
- Dew does not form on the leaves of the seashore paspalums because of this waxy leaf coating (which make it "sticky"). This is a potential advantage in terms of disease management and playability at certain times of the year
- The seashore paspalums stripe up well compared to the *Cynodon* hybrids.

Disease

All trial sites reported the occurrence of disease in the seashore paspalums with the main incidence of disease occurring following rainfall and under cloud cover. The main disease reported was Dollar Spot (*Sclerotinia homoeocarpa*) with some "patch disease" (mainly *Rhizoctonia* sp.) and Leaf Spot (*Drechslera* and *Curvularia* spp.) recorded. A higher fertility rate (about 3 kgN/100m²/year) has shown to limit the occurrence and severity of disease. However, like that of the *Cynodon* hybrids, with added nitrogen comes supplementary thatch development.

There was little difference in the severity of the disease between cultivars. All cultivars appear to recover from Dollar Spot relatively quickly with the onset of clear and dry weather. Disease scars can persist with the onset of dormancy.

Thatch and Thatch Control

All of the seashore paspalums tend to produce a large amount of thatch and as a consequence are easily scalped during mowing. Scalping appears to be more pronounced during the winter. The seashore paspalums are slow to recover from scalping and require considerable vigilance to ensure that they are not scalped. Extra care should be taken during the winter when the paspalums are more prone to scalping.

Topdressing:

- A general thatch control and dusting program would be similar to the "ultradwarf" couchgrasses. However, paspalums take up more sand than the majority of the couches

Surface Grooming:

- The maintenance of the seashore paspalums will require a program of regular light dethatching/grooming as well as regular light dustings of sand.
- The paspalums did not respond well to heavy vertical mowing

Renovations:

- In addition to the regular grooming and dusting the seashore paspalums require hollow core aerification and topdressing twice a year.

Mowing Height and Rolling

All of the regional sites are maintained at a cutting height of 3.0 mm to 5.0 mm and all of the seashore paspalums are producing a satisfactory surface at these cutting heights. The general observation is that they respond better to the lower height of cut (i.e. 3 mm) and require the lower cutting height in order to produce an acceptable putting surface.

At the DEEDI Redlands test facility two mowing heights were imposed, 3.5 mm and 2.7 mm. The results indicated that the paspalum varieties produced a good quality surface at both heights, but was marginally better at the higher cut. If a lower cutting height (e.g. 2.7 mm – 3.0 mm) was desired, regular and repeated mowings are necessary to reduce scalping and produce a smooth surface.

Rolling of the greens should be carried out once per week and should be undertaken within 48 hours of when the clubs formal competition is held. Greens being cut higher (e.g. 3.5 mm) and rolled produced a faster surface than not being rolled or cut at 2.7 mm.

Recovery from Damage

Turf recovery following disease is relatively quick under good growing conditions (in particular temperature). Paspalums are slow to recover from scalping and requires constant vigilance of thatch development which hightens the opportunity for scalping to occur.

Drought Stress Tolerance

At two of the regional sites located in Victoria (Chisholm TAFE) and Queensland (Horton Park) an irrigation failure placed the seashore paspalums under moisture deficit. Whereas the hybrid couchgrasses were severely affected, the seashore paspalums suffered considerably less from moisture deficit and were quick to recover. This is likely to be a result of the dense rhizome and thatch layer present in comparsion to the *Cynodon* hybrids.

Nutritional Requirements

As a general observation the seashore paspalums require a relatively high nitrogen input to provide the best quality surface and in particular as a guard against the incidence of disease. At this point in time the optimum rate of nitrogen is at 3 kg/100m².

Dormancy

Dormancy occurs on all cultivars at all sites. However, the level of dormancy and reduction in colour was far greater in the *Cynodon* hybrids. In Victoria 'Sea Isle 2000' produced a darker colour in the winter.

Pesticide Tolerance

Across all of the trial sites there has been various pesticides applied, of which can be seen listed in Table 4.

Table 4. Pesticides applied to seashore paspalum cultivars at regional facilities and or the DEEDI centralised test facility.

PESTICIDE*	COMMENT
Herbicide	
Ronstar®	Applied post planting and during initial growth (Feb., Jun., Aug.) – no adverse effect
Spearhead™	Applied in summer - no adverse effect
Fluroxypyr	Applied in Jan., Apr., Sep., and Dec. – no adverse effect
Metsulfuron-methyl	Applied in January – no adverse effect
DSMA	Applied in December – prone to leaf burn or loss of turf at low rates
Fungicide	
Triadimenol	No adverse effect
Chlorothalonil	Applied in late November – no adverse effect
Baycor™	Applied in July – no adverse effect
Bravo®	Applied in May – no adverse effect
Tilt®	Applied in March – no adverse effect
Heritage®	Applied in August – no adverse effect
Insecticide	
Gremlin™	Applied in October – no adverse effect
Baythroid®	Applied in spring, summer and autumn – no adverse effect

***Note: Not all pesticides have been trialled on all cultivars at all locations and under all climatic conditions. Always read and follow the label instructions. Fluroxypyr and metsulfuron-methyl are to be registered for turfgrass use as a generic pesticide in 2010 by the Australian Pesticides and Veterinary Medicines Authority (APVMA) following earlier studies undertaken at DEEDI Redlands Research Station.**

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FINAL REPORT

The Final Horticulture Australia (HAL) Report is available in its entirety from the HAL web site http://www.horticulture.com.au/reports/search_final_reports.asp.

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