

Choosing a Green Couch Cultivar: Factors to Consider

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Introduction

There is no such thing as a perfect turfgrass. All have their strengths and specific uses for which they are inherently best suited. How well turf managers deal with the negative issues of the cultivar chosen for a particular use and site is what separates good from mediocre turfgrass performance.

Developing information

A good turfgrass area begins with a well adapted, if not the best adapted, cultivar for that area. It is much cheaper to manage a well adapted grass and much easier to produce a high quality playing surface or park with good genetic material. However, to develop best management practices, there needs to be a good understanding of the strengths and weaknesses of the particular cultivar. Even within a group like the green couches (*Cynodon dactylon* and its hybrids with *C. transvaalensis*), some cultivars require higher fertility than others for optimal growth; produce greater or lesser amounts of thatch; show differences in their tolerance of wear, shade, salinity, chemicals and disease; suit different mowing heights; and differ in their degree of drought tolerance and capacity for winter growth.

Much of the research undertaken by the Queensland Department of Primary Industries and Fisheries (DPI&F) turf team at Redlands Research Station since its inauguration in 2000 is directed towards this end. When the DPI&F's turf research programme was developed, one of the first steps was to develop a comprehensive collection of warm-season turfgrass cultivars, including many new varieties not previously seen or used commercially in Australia. The introduction of new varieties is essential to keep up with new developments elsewhere in the world, and assists the Australian turf production industry to retain its competitive edge.

The in-ground turfgrass collection developed at Redlands Research Station numbers 137 different vegetative and seeded warm-season turfgrass varieties from 21 species. The collection includes more than 50 seeded and vegetative *Cynodon* varieties. Because the different varieties are grown in single (unreplicated) plots, this collection provides clues rather than definitive information on their adaptation and management requirements. Instead, these plots often feed into the rest of the Redlands turf research programme, enabling the turf team to familiarise themselves with the range of grasses being grown, while also providing a source of planting material for fully replicated experiments in which definitive information on the different varieties can be generated.

Some of the research projects that have contributed to a better understanding of the strengths and weaknesses of the different *Cynodon* varieties include:

- Performance of six new hybrid *Cynodon* greens cultivars relative to the two current industry standards (Horticulture Australia Ltd project TU05001);
- Performance of new *Cynodon* cultivars relative to standard varieties in Victoria (Victorian Golf Association project);
- Response of six turfgrasses (including two *Cynodon* cultivars) to nitrogen fertiliser (TU02005);
- Screening of 37 *Cynodon* cultivars to determine their salt tolerance relative to other turfgrass species and cultivars (TU02005, TU06006);
- On-going screening of 27 warm-season turfgrasses (including 9 *Cynodon* cultivars) for their tolerance of chemicals, mainly pesticides and herbicides (TU00011, TU04006, TU06008);
- Wear tolerance of eight *Cynodon* cultivars for elite stadia (contract research project);
- Wear tolerance of warm-season turfgrasses (including 7 *Cynodon* cultivars) under community sports field conditions (TU08018) and
- On-going trials to describe new cultivars for Plant Breeder's Rights (PBR) registration based on differences in plant morphology and development (contract research projects).

DPI&F is also collaborating with University of Queensland (UQ) researchers in a major new turf breeding project to develop more water- and nutrient-efficient *Cynodon* turfgrasses. This project has been funded through the Australian Research Council, and will involve in-depth physiological studies in these areas.

Climatic adaptation

There are environmental limits to the adaptation of any turfgrass cultivar and no one cultivar will perform optimally throughout the length and breadth of a country the size of Australia.

In trials undertaken in Melbourne (annual average daily temperature = 13.4°C), most *Cynodon* cultivars from Queensland and NSW did not perform as well as locally-developed grasses (Ford *et al.* 2006). In Brisbane (annual average daily temperature = 20.5°C), the reverse applies, with grasses such as 'Santa Ana' (well adapted to southern Australian climates) performing better once temperatures start to decline around April.

Cold tolerance is strongly associated with winter dormancy to ensure plant survival. In a wear study that was undertaken at Redlands between 2006 and 2008, it was noted that the two cultivars from Queensland maintained less winter dormancy than the two from NSW, which in turn showed less winter dormancy than the two from Victoria.

While temperature appears to be the main factor determining climatic adaptation, humidity and changes in the seasonal pattern of rainfall can also affect this. In a PBR description trial in Brisbane, for example, 'Riley's Evergreen' (marketed as Conquest™) was badly affected by couch rust disease (*Puccinia cynodontis*) compared with the other four cultivars used as morphological comparators (data not shown). This accounts for the greater amount of dead leaf normally seen on that variety in southern Queensland. In the UQ-DPI&F turf breeding project, high levels of leaf disease occurred in Brisbane on accessions collected from drier climates in western Queensland. Furthermore, the new ultradwarf or second generation cultivars

'MS-Supreme' and 'TifEagle' proved susceptible to spring dead spot (*Leptosphaeria narmari*) in trials at Kerang, Victoria (Ford *et al.* 2006). It would seem timely for turf breeders to place greater emphasis in the future on disease resistance in the plants they release.

Stress tolerance

Drought. The green couches are among the most drought-tolerant of the warm-season grasses, though there appear to be relatively small differences among cultivars, perhaps related to the particular water-conserving mechanisms involved and/or differences in their depth of rooting. These aspects will be investigated in detail in the UQ-DPI&F turf breeding project. The project will look for the ability of accessions to survive for longer while losing water through evapotranspiration, rather than for lower water use *per se*. The latter strategy is more applicable to a desert climate where the chances of rainfall are very low. In more humid climates, where the chances of useful rainfall in the near future are higher, a better approach is to maximise the time between irrigations (by which time rain may have fallen and reduced or negated the need for watering). However, to achieve best results, it is essential to construct a good soil profile, rather than relying on the plant alone (Loch 2007).

Low fertility. In terms of its optimum nitrogen requirements, green couch is a high fertility species relative to most other turfgrasses (Loch *et al.* 2006). Nevertheless, anecdotal evidence suggests that some genotypes may be less fertility demanding than others. This possibility will also be studied in more detail as part of the UQ-DPI&F turf breeding project.

Shade. In general, green couch is poorly adapted to shade levels below about 70% of photosynthetically active radiation. A few cultivars do show moderate shade tolerance (essentially, a little better than average), but nothing like the 90% shade levels experienced in seasonally-shaded areas in elite stadiums.

In humid tropical areas, most green couch varieties turn upwards seeking light and reduce their shoot density during the prolonged periods of cloudy overcast weather during the wet season. The range of suitable varieties to choose from in such climates is extremely limited.

Salinity. The available green couches vary in their tolerance of salinity, though only from low to medium tolerance (Loch *et al.* 2006). At higher levels of salinity, different (halophytic) species such as seashore paspalum (*Paspalum vaginatum*) should be used, while also being mindful of their limitations in other respects such as drought tolerance.

Chemicals. The green couches show some variation in their tolerance of different broadleaf herbicides, though generally only at levels well above normal commercial rates. However, in the wear trial at Redlands, we did note strong varietal differences in the effect of trinexapac-ethyl (Primo Maxx[®]) used as recommended at 1.0L of product per hectare per month to tighten up the growth habit of the sward. In 'C1' (marketed as Legend[®]), this rate resulted in badly distorted shoots, while at the other extreme the likes of Conquest[™] and 'Hatfield' showed little or no shoot distortion.

Wear tolerance

At Redlands, a series of wear trials were undertaken between 2006 and 2008 on eight *Cynodon* cultivars, which were laid as washed sod in early April 2006. The

basic experiment was a randomised block design, with individual plots (6 x 2m) allocated at random to the eight different cultivars within each of four blocks (replications). The turfgrass was situated on a 15-cm deep sand profile with pop-up irrigation and internal drainage to remove excess water. The whole experimental area was well-fertilised and had been mown regularly to simulate sportsfield management conditions.

Superimposed over the basic experiment was a two-level strip-plot design to accommodate the wear treatments, which of necessity had to be applied in straight lines. Strips within each level were again allocated at random. The first level involved oversowing a 2.4m wide strip with perennial ryegrass to simulate standard winter management of elite fields, leaving the remaining 3.6m strip as a pure *Cynodon* sward. In summer, treatment with trinexapac-ethyl (Primo Maxx[®]) was substituted for ryegrass oversowing. The second level (wear frequency) then involved imposing two simulated wear treatments within each of the ryegrass/Primo strips and three wear treatments within each of the pure *Cynodon* strips.

Among the pure *Cynodon* treatments, this provided a simulated comparison of weekly play versus a fortnightly home-and-away schedule. With the fortnightly wear treatments, this also provided a direct comparison of the effect of ryegrass oversowing (winter) or Primo (summer).

After the first few weeks in the first wear trial, the same total amount of wear was applied over each two-week period to both the weekly and the fortnightly wear treatments. The machine used to apply these simulated wear treatments is a modified Brinkman design based on the self-propelled GA-SCW Traffic Simulator (Carrow *et al.* 2001). In the studies described below, it was drawn by a small Kubota tractor (Plate 1) much like the original Brinkman Traffic Simulator (Cockerham and Brinkman 1989). The major difference is that the Redlands Traffic Simulator uses smooth rubber galvanised rollers (1m wide), rather than studded rollers, rotating at different speeds to cause scuffing of the turf surface.



Plate 1. Former operation of the Redlands Traffic Simulator

Wear tolerance consists of two main components: resistance to wear followed by recovery from wear. In earlier experiments with hybrid *Cynodon* cultivars grown at

Redlands, Roche and Loch (2005) determined that the minimum threshold night temperatures for active growth was approximately 9–10°C (air temperature) and 15–16°C at 10-cm soil depth. Typically, night temperatures at Redlands (27°32'S latitude, 153°15'E longitude, 25 metres above sea level) decline below these levels around the end of May or early June, and are exceeded consistently again around the third week in August. The two winter-spring wear trials described below therefore commenced in periods of very slow (almost no) growth when the response was dominated by resistance to wear. However, by the end of each trial, recovery from wear had also become an important component of wear tolerance.

Winter-Spring 2006. Wear treatment commenced on 14 July (three months after laying the turf) and ended on 27 September 2006. On the first three wear occasions, both weekly and fortnightly wear treatments received 30 passes with the Redlands Traffic Simulator. Subsequently, wear was reduced to 20 passes per week on the weekly treatment, but increased to 40 passes per fortnight on the fortnightly treatment.

Substantial differences in wear tolerance among cultivars quickly became apparent and persisted through to the end of the trial (Plate 2). The four best cultivars—TifSport™, 'Grand Prix', Legend® and Conquest™—continued to produce new leafy growth following each wear event; but after 4–6 weeks, the other four grasses had either stopped producing new leafy growth (especially under the weekly wear regime) or in the case of some 'Wintergreen' plots were producing new shoots at greatly reduced rates.

Turf quality under fortnightly wear did not decline to the same extent as under weekly wear. The recovery potential between fortnightly wear events was also much greater than where there was only a week between wear events, particularly for the top four grasses.

The percentage of bare ground was visually assessed. This increased rapidly in the worn treatments before stabilising after about 3–4 weeks of treatment. Up until mid-August, recovery from wear was very slow and the results largely reflected differences among the cultivars in their resistance to wear. However, once growth rates started to increase with the return of warmer temperatures from about mid-August onwards, recovery from wear became an increasingly important component of wear tolerance. The percentages of bare ground in the different treatments at the end of the trial are shown in Table 1.

Winter-Spring 2007. Wear treatment commenced on 5 July and ended on 4 October 2007. Wear was applied at 20 passes per week (40 passes per fortnight) for the first six weeks, but caused much less damage to the turf than in the previous year. Wear was then increased to 30 passes per week (60 passes per fortnight) for the remaining eight weeks to show up cultivar differences more clearly.

As in 2006, once growth rates started to increase with the return of warmer temperatures from about mid-August onwards, recovery from wear became an increasingly important component of wear tolerance. The percentages of bare ground in the different treatments (taken four days after applying the final fortnightly wear) are shown in Table 1.



Plate 2. Aerial view of wear damage (6 October 2006)

Table 1. Percentages of bare ground at the end of the winter-spring wear period in 2006 and 2007, shown with plant analysis data from 2006.

Cultivar	2006			2007	
	Bare Ground (%)		TCW % (Total Cell Wall Constituents)	Bare Ground (%)	
	Weekly	Fortnightly		Weekly	Fortnightly
Conquest™	48	31	37.0	13	19
Grand Prix	40	23	38.6	15	16
Hatfield	95	78	34.8	19	5
JT1	98	93	33.6	75	33
Legend®	43	26	37.0	44	36
Princess	95	84	35.2	70	30
TifSport®	35	16	40.2	40	29
Wintergreen	89	65	36.0	35	14
<i>Least Significant Difference (P=0.05)</i>	10	20	2.9	21	19

At the end of the 14-week period of winter wear in the second year (2007), 20 visiting sportsfield curators were asked to visually rank the eight *Cynodon* cultivars according to their observable tolerance to wear based on the weekly treatment. Within each of the four replications, the varieties were ranked 1 (= worst) to 8 (= best). For comparative purposes, rankings of the same plots were also made by three DPI&F

scientists from Redlands. Overall, both groups placed the eight *Cynodon* cultivars in the same order of tolerance to wear as shown in Table 2.

Table 2. Mean ranking scores (8 = best; 1 = worst) for wear tolerance of *Cynodon* varieties as rated by twenty curators and three DPIF scientists.

<i>Cynodon</i> Variety	Curators ¹	DPIF Scientists ¹
Conquest TM	5.6 ^c	6.3 ^{bc}
Grand Prix	7.2 ^a	7.3 ^a
Hatfield	6.3 ^b	6.8 ^{ab}
JT1	1.7 ^g	1.4 ^e
Legend [®]	4.0 ^{ef}	4.1 ^d
Princess	2.1 ^g	2.0 ^e
TifSport [®]	5.2 ^{cd}	4.8 ^d
Wintergreen	4.2 ^e	4.0 ^d
Least Significant Difference (P=0.05)	0.5	1.0

¹Ranking scores followed by the same superscript letter are not significantly different.

Attributes Contributing to Wear Tolerance. At the end of the trial period in 2006, samples of above-ground material (leaf and thatch) were cut for fibre, lignin and ash analysis. Differences in wear tolerance were not associated with shoot moisture content as suggested by Trenholm *et al.* (1999, 2000) and Brosnan *et al.* (2005) for other species, nor were they associated with the levels of minerals (ash), silica (acid insoluble ash) or acid detergent fibre (ADF) present. However, wear tolerance was strongly and positively associated with levels of total cell wall constituents (TCW—see Table 1), lignin and neutral detergent fibre (NDF). Essentially, this confirms the importance of cell wall strength in determining the wear tolerance of different *Cynodon* cultivars, as shown by Trenholm *et al.* (2000) and Brosnan *et al.* (2005) with other warm- and cool-season grasses, though both highlighted other contributing factors as well.

In 2007, the order of the varieties in terms of wear tolerance changed, possibly due to changes in growth habit as the swards matured. High shoot density and a dense mat of stolons strongly rooted onto the ground surface (i.e. growth habit) appear to have contributed to the high wear tolerance shown by ‘Grand Prix’ and ‘Hatfield’, with the latter greatly improving its ranking between establishment (in 2006) and the second year of the trial (2007). Similarly, ‘Wintergreen’ improved its wear tolerance ranking in the second year (2007). TifSportTM and Legend[®], however, ranked lower in terms of wear tolerance in the second year, suggesting that they may benefit from aggressive management (as on elite sportsfields) to rejuvenate them regularly. In contrast, ‘Hatfield’ and ‘Wintergreen’ would appear to be best left to mature as much as possible, and may therefore be better suited to community sportsfields.

In 2008, during our final wear trial the turf group were able to compare the effect of turf age (newly planted vs. two-year old turf) on wear tolerance. This information (data not shown) will be made available at a later date.

In the future the Redlands Traffic Simulator will be made available for further wear studies, such as the community sportsfield wear trial (TU08018) and research on other aspects of turf wear (for example, the effect of shade on wear tolerance).

Winter overseeding

Overseeding green couch sportsfields with ryegrass for winter use leads to deterioration of the root system (and eventually the above ground growth) on the couch, so that once the ryegrass is taken out in the spring the depleted stand of couch needs time to recover. While traction (grip) on the field is maintained during the winter by the progressive replacement of the deteriorating couch root system by ryegrass, this is followed by a reduction in traction in spring when the ryegrass is removed (Roche *et al.* 2008). The extent to which traction is reduced depends on how rapidly and completely the ryegrass component is removed. American research suggests a minimum of around 100 days of good growing conditions in summer is needed for *Cynodon* to recover fully in time for the next winter overseeding, and this appears consistent with our measurements in Brisbane.

Seeded vs. Vegetative Cultivars

Laying full vegetative turf is expensive, and can put considerable strain on budgets when large areas are to be planted. A cheaper alternative in such circumstances is to break up the sod into sprigs, which can then be planted over a much larger area. Another alternative for large areas is to sow a seeded variety. So how do the available seeded *Cynodon* varieties compare with vegetatively-propagated varieties?

Firstly, turf quality is generally better in the vegetative couches. We have grown plots of all but the very latest seeded varieties, and only ‘Princess’ and ‘Riviera’—both produced as one-shot F₁ hybrids by planting alternating rows of the parent clones—can match the vegetative couches in terms of turf quality. Other seeded varieties go through at least three generations of multiplication to produce the final seed that is sold commercially, and some genetic drift and deterioration away from the variety as originally constituted can occur. With such varieties, different genotypes (denser, finer-textured, etc) eventually dominate in different sections of a plot, which reduces their overall uniformity.

By definition, seeded couches need to produce a lot of seed heads, and these also need to be tall enough for seed to be harvested effectively. Speedy couch comes from “brown bag” (inexpensive no name) seed, which these days is usually ‘NuMex Sahara’ because of the heavy seed yield it produces.

The seeded couches generally produce weaker rhizome systems than the vegetative couches. In our turf collection, we have observed several examples of seeded couch plots being invaded and taken over by a neighbouring vegetative couch variety.

In choosing a green couch, whether it is a seeded or vegetative form, all of the previously outlined factors (climatic adaptation, stress and wear tolerance, etc) still apply.

Genetic purity

Historically, the Australian turf industry has been commodity driven, supplying and using planting material largely on the basis of price. Neither turf producers nor the end users “win” in this situation: producers must accept (and work to) a low profit margin, while the buyers of that turf may end up with planting material of dubious pedigree.

The alternative is to protect new cultivars under PBR and/or trademarks. Provided sound supporting information is developed behind proprietary cultivars, licensed producers then have the opportunity to promote and market these more actively and effectively than is possible for the older public varieties.

With repeated uncontrolled propagation from commercial stocks, variations arise within forms of green couch. The two most common varietal names used to market commodity green couch material are 'Wintergreen' and 'Greenlees Park'. Morphological observations and DNA testing reveal that commodity cultivars with the same moniker can vary considerably among producers—sometimes closely resembling the original cultivar in appearance and at the other extreme looking nothing like the original.

For the Australian turf industry to develop and prosper, producers must be encouraged to grow up to a quality, not down to a price. While markets for “cheap and green” will always be there (and buyers will get what they pay for), quality assurance based on certification principles will, in time, be applied formally or informally to the production of the higher-priced proprietary cultivars to protect their genetic integrity. Without such protection to ensure that it is multiplied carefully, I would expect that any new *Cynodon* cultivar could become contaminated within 10–15 years of release.

Acknowledgements

The original version of this paper was presented by the author on 2 July 2008 at the Turf Grass Association of Australia Conference “Turf Management with Less Water: is Couch the Answer?”, Woden ACT.

Many of the trials described in this paper were made possible with funding from numerous voluntary industry contributors, which was then matched by Horticulture Australia Ltd. I also freely and gratefully acknowledge the vast amount of work by my colleagues in the DPI&F Redlands turf team and from other organisations, including the Australian Golf Course Superintendents Association and the North Melbourne Institute of TAFE, in generating the data presented.

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