BY MATT ROCHE

Matt Roche details research work on thatch undertaken by the Queensland Department of Primary Industries and Fisheries Turf Research Group and asks whether thatch is a real or perceived threat when it comes to sporting injuries.

Thatch or fiction?

The QDPI&F's Turf Research Group has been undertaking trials, using its specially designed automated traction tester, to determine the influence of thatch on traction. Plots containing a thatch layer (left) and no thatch (within the pink highlighted area) were subjected to traction testing at four to five week intervals during the winter-early spring period in 2006 and 2007

In recent years, sporting professionals, medical experts, stadium managers and turf scientists have disagreed over the influence of thatch on traction and injury occurrence to athletes participating on natural turf sporting surfaces.

Thatch generally varies in depth depending on species selection, field usage (wear patterns) and regular or scheduled management activities such as mowing and scarification.

In their recent work, Orchard et al. (2005) and Chivers et al. (2005) have expressed concern claiming that a heavier thatch layer leads to higher traction and trapping of players' boots thereby contributing to anterior cruciate ligament (ACL) injuries.

These authors have also suggested that a perennial ryegrass (*Lolium perenne*) sward, has less thatch and therefore less risk of obtaining an ACL injury then a pure green couch (*Cynodon dactylon*), or a mixed sward of couch and ryegrass.

Orchard (2004) also added that perennial ryegrass in the vast majority of circumstances leads to conditions with reduced shoe-surface traction due to ryegrass producing fewer rhizomes or stolons which may create excess friction between the players' footwear and the turf.

Orchard et al. (2005) grouped the risk factors associated with ACL injuries into two categories – intrinsic (personal) and extrinsic (environmental). Cochrane et al. (2007) evaluated the importance of intrinsic characteristics associated with ACL damage in Australian Rules football, which included the type of manoeuvre the player was attempting, direction of the knee when it 'gave way', running speed, knee angle, cutting angle and if the player was accelerating or decelerating when the injury occurred.

They studied available videos of 34 ACL injuries incurred in Australian Rules football during 1992 and 1998, in an attempt to depict the factors involved in each injury. Of the 34 ACL injuries studied, 56 per cent of the athletes were injured in a non-contact situation, with sidestepping accounting for 37 per cent of that total, landing (32 per cent), landing and stepping (16 per cent), decelerating (10 per cent) and undertaking crossover cut manoeuvres (5 per cent).

MEASURING TRACTION

Rotational and transitional (linear) traction are the two types of forces encountered when a player's footwear with studs, blades or spikes comes in contact with the playing surface following a change in footing.

For players, the higher the rotational traction the greater the tendency is for a foot to become fixed in its original position during changes of direction. Being able to take an accurate and meaningful measurement of rotational traction is therefore important in terms of minimising the risk of knee and ankle injuries to players with studded shoes.

A device enabling Australian researchers to acquire such reliable and repeatable traction measurements is the Automated Traction Tester (Australian patent number PAT/AU/2004270767) which has been developed for use by the Queensland Department of Primary Industry and Fisheries' (QDPI&F) Turf Research Group.

The portable testing unit measures the maximum torque reached during rotation of the studded disc, while generating a profile of torque (traction) showing changes over time and calculates the angle through which the studded disc moved before reaching maximum torque. Further information about the automated tester can be found in Volume 8.5 (Oct-Nov 2006) of Australian Turfgrass Management.

THATCH VS TRACTION

To investigate in more detail the influence of thatch on traction, the QDPI&F turf research team used an ongoing wear trial, which involves eight *Cynodon* cultivars in a randomised block design located at Redlands Research Station in Cleveland, Queensland. The experimental site was constructed in March 2006 on an irrigated 15cm sand carpet profile with internal drainage to remove excess water. Individual plots (6m x 2m) of the eight cultivars were allocated at random within each of the four blocks.

Superimposed over the basic experiment was a two-level strip-plot design to accommodate wear treatments, which of necessity must be applied in straight lines. Strips within each level were again allocated at random.

The first level involved oversowing perennial ryegrass into two of the five sub-plots per cultivar to simulate standard winter management of elite fields, leaving the remaining three as a pure green couch sward.

The second level (wear frequency) involved imposing two wear treatments (weekly and fortnightly wear applications at equivalent overall intensity to simulate a home-and-away schedule) within each of the couch strips and a fortnightly wear treatment only within each of the oversown ryegrass strips. In both situations, the worn treatments were compared with an unworn control treatment.

Traction testing has been conducted at four to five week intervals during the winter-early spring period in 2006 and 2007. This has involved taking a total of 160 measurements from each sub-plot over the trial area (i.e.: five wear treatments per cultivar x eight cultivars x four replications = 160).

In winter 2006, bare ground increased rapidly before reaching relatively stable levels of residual cover after about five to six weeks of wear. By the end of the 10-and-a-half week trial period, sub-plots ranged from 100 per cent bare ground through to complete ground cover.

At this stage, the dry matter yield of above-ground material on the control couch plots across all cultivars averaged $660g/m^{-2}$. Covariance analysis of the data taken at the end of the wear trial showed a significant linear relationship between bare ground and torque (Roche et al., 2007). Across the three sub-treatments receiving weekly or fortnightly wear, traction declined by 2.18 (± standard error of 0.702) Newton metres for every 10 per cent increase in bare ground.

Once torsion was adjusted for the level of bare ground, there were no longer any significant differences between treatments for torsion. These data, however, in all probability reflected some deterioration in the root-rhizome system on badly denuded sub-plots, because subsequently they were slow to recover and in some cases had to be replaced by new sod.

Comparable analyses of data taken five-and-a-half weeks after initiating wear showed no significant interaction between traction and the level of bare ground. At this stage, the rhizome-root system would have been in much ▶

better condition than after a further five weeks of continued wear through to the end of the trial.

The above indirect inferences as to the effect of thatch on traction were subsequently confirmed by direct comparisons of peak traction values with or without above-ground material present in the control plots on 26 April and 5 July, 2007.

On both occasions, a small area in each of the 32 unworn (control) couch sub-plots was removed mechanically down to the stolons, so that the effect on traction could be determined by comparing traction measured in the cut area with a paired second reading taken among the intact thatch in the same sub-plot (see photo pg 44).

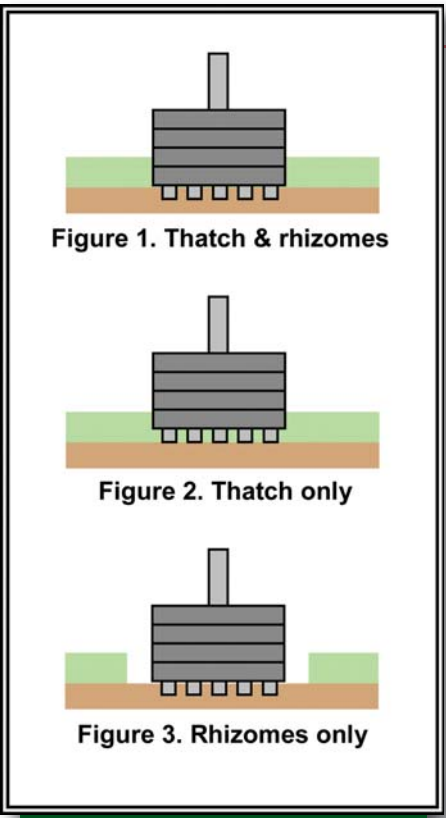
The dry matter yield of thatch was also determined on 5 July by cutting a 35cm x 35cm quadrat from each of the 32 control sub-plots and drying it at 60-70°C. On both occasions, we found no significant difference in traction, despite the removal of an average of 450g/m^{-2} of above-ground dry matter on the second occasion (Table 1).

CONCLUSIONS

Recent postulations by Orchard et al. (2005) and Chivers et al. (2005) that a heavier thatch layer leads to higher traction and trapping of players' boots, thereby contributing to ACL injuries, would therefore appear to over-estimate and over-emphasise the significance of the thatch layer.

Our findings indicate that the main plant factor determining traction is the stolon and/or rhizome and general root growth on and just within the ground surface. Provided the rhizomes of the established sod are still intact in areas where the top growth including thatch has been completely worn away, we have recorded almost no change in traction in these bare areas compared with nearby areas where the top growth is still intact (Roche et al., 2007).

Our experience elsewhere in sportsfield benchmarking activities is that, provided the rhizome-root layer is still intact and healthy, bare areas where the top growth has been completely worn away, can still record traction levels that are adequate for good playability (>30-35Nm – e.g. Bell and Holmes, 1988; Baker, 1999) and, in fact, tend to show little or no apparent reduction in traction compared with nearby areas with intact top growth.



A schematic of the various traction testing trials being undertaken

An obvious priority area for future studies is to define more accurately the critical level of rotational traction above which the playing surface could potentially lead to player injury. Previous assessments of playing quality versus traction (e.g. Baker, 1999) are based on ryegrass and other cool-season turfgrasses, which tend not to give traction readings above 50-60Nm.

Future research in this area must also include biomechanical studies, along with greater data on how such injuries might be affected by the angle of foot rotation up to this point. For example, Cochrane et al. (2007) showed that 17 of the 19 athletes injured in non-contact situations incurred ACL injury at extended knee angles of 30° or less.

Our work in relation to thatch highlights the need for greater research rigour in determining field performance criteria and setting standards for playability and player safety. The development of the QDPI&F Automated Traction Tester (to enable more accurate and repeatable measurements of traction to be taken quickly and efficiently) also illustrates how improving the equipment available to researchers can also contribute to achieving more accurate and relevant benchmarking of natural turf playing surfaces.

Further information on traction and other trials being undertaken by the Queensland Department of Primary Industries and Fisheries Turf Research Group can be found at www.dpi.qd.gov.au/turf.

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TABLE 1. MAXIMUM TRACTION VALUES (NM) FOR BERMUDAGRASS WITH OR WITHOUT THE ABOVE-GROUND MATERIAL REMOVED

Date	Traction profile	Peak torsion (Nm)	Above-ground dry matter (g/m^{-2})
April 26, 2007	+ above-ground material	69.4	ND[2]
	- above-ground material	71.5	
	Difference	NS[1]	
July 5, 2007	+ above-ground material	74.5	450
	- above-ground material	74.2	
	Difference	NS[1]	

[1] NS (not significant P>0.05) [2] ND (not determined)