

STRI

# FINAL REPORT:

*In situ* evaluation of Palau Turf Hybrid system



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## Introduction

The objective of the visit was to test the area of Palau Hybrid turf installed at Palau Turf’s offices in Badalona, to evaluate how this new system compared to a typical stadium pitch. The tests involved both surface performance and turf quality assessments. The testing was carried out on the afternoon of 16 April and the morning of 17 April. On both test dates the weather conditions were the same and characterised by warm, sunny and dry conditions.

## Testing protocol

The turf was divided into two areas, with one area tending to more shaded than the other. Each area was tested separately, with multiple readings made in the shaded and sunny area. A schematic diagram of the layout of the sunny and shaded areas is given in Figure 1.

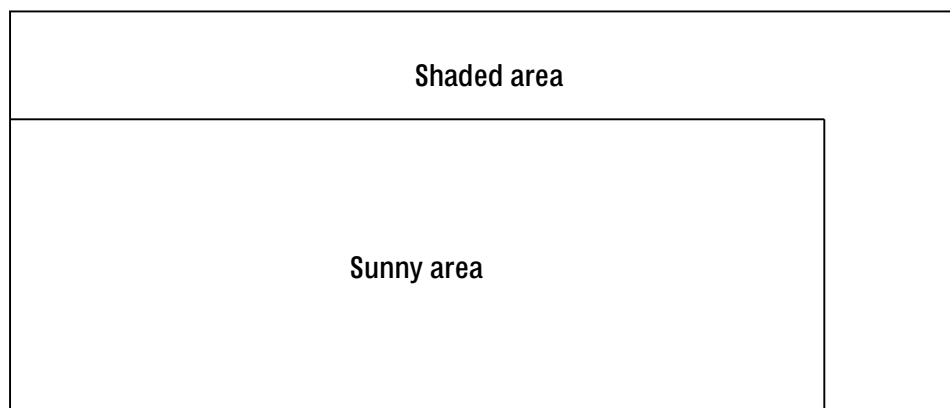


FIGURE 1. Schematic diagram of the areas tested during the visit.

The testing focussed on the agronomic quality and playing performance of the surface and included the following tests:

### Live grass cover

Grass cover was assessed visually and expressed as a percentage.

### Turf NDVI

Normalised Difference Vegetation Index (NDVI) measures the reflectance ratio of red to near infrared light. NDVI was measured with a Fieldscout TCM500 NDVI turf colour meter. Values range between -1 to +1 with healthy turf usually giving readings between 0.65 – 0.85.

### Surface hardness

Surface hardness was measured with the 2.25 kg Clegg Impact Soil Tester dropped from 0.45 m.

### Surface traction

Surface traction was measured as the torque required to initial movement of a studded disk.

### Volumetric soil water content

Soil water content was measured in the top 60 mm of the profile using a Theta Probe.

### Surface and soil temperature

Measured using a calibrated digital thermometer.

## Results

The results of the testing over both days are presented in Table 1. Each characteristic is discussed individually later in this section of the report.

TABLE 1. Results from the surface performance and agronomic assessments

Characteristic		Sunny	Shaded	Overall
Surface hardness (gravities) @ 26 mm HOC	Mean	69	73	71
	Range	62-77	67-80	-
Surface hardness (gravities) @ 24 mm HOC	Mean	69	75	72
	Range	61-78	66-87	-
Surface traction ( N m)	Mean	53	56	54
	Range	45-60	46-65	-
Volumetric soil water content (%) on 16 April	Mean	24.7	25.2	24.9
	Range	20.7-28.5	22.4-30.1	-
Volumetric soil water content (%) on 17 April	Mean	-	-	24.4
	Range	-	-	22.6-28.0
Grass cover (%)	Mean	95-100	95-100	95-100
NDVI	Mean	0.759	0.763	0.760
	Range	0.712-0.813	0.671-0.821	-

HOC = height of cut

### Surface hardness

Typical surface hardness values on a professional football pitches would range from 65-100 gravities (Baker *et al* 2007). From practical experience, optimal hardness values would typically range from 75 to 95 gravities for most stadia pitches. Average values from each area tested were within, but towards the lower end of the normal range for professional football (65-100 gravities).

On 16 April, when the turf was cut at 26 mm, average surface hardness of whole area was 71 gravities. There small differences in hardness values between the shaded and sunny area of the test area, with the shaded area having a slightly harder surface (73 gravities) as compared to the sunny area of the turf (69 gravities). This same pattern was observed the following morning, when the surface was re-tested following mowing the turf at a height of cut of 24 mm, the intention being to see if a reduction in the height of cut would result in a firmer surface.

A number of extra surface hardness readings were made from an area of the Hybrid system that had no grass cover. Values from this area averaged 91 gravities, indicating that the grass canopy layer was providing extra cushioning in the order of 20 gravities.

### Surface traction

The normal range of traction values for professional football pitches ranges from 35 – 60 N m (Baker & Woollacott 2005). Average values from each area tested and from the surface as a whole were within this range. There were no consistent differences in average surface traction values between the sunny (53 N m) and shaded areas (56 N m).

Additional surface traction readings were made on an area of exposed Hybrid material without grass cover. Traction values averaged 40 N m in this area, indicating that the grass was, on average, contributing around 14 N m of rotational strength.

### Volumetric soil water content

The optimal soil water content of any professional football pitch is dependent on a number of factors, including grass species being grown, prevailing weather conditions and hardness of the pitch surface. Soil water content is often one of the main ways to adjust the hardness of the pitch surface, with wetter surfaces tending to be softer. For most stadia rootzones, optimal soil water content tends to vary between 22-30%. Soil water content values measured on both testing dates were within this range with no apparent differences between the sunny or shaded areas of the turf.

Since the soil moisture probe needs to be inserted into the ground to take a reading, the effect of the shock pad material on the moisture readings is an unknown. The lower density material used in the shock pad, in comparison to the surrounding sand, may have resulted in slightly lower readings than would be expected if the whole profile was derived of sand-based rootzone. Even if the readings were lowered slightly, the measurement provided a reflection of a) the soil water available to the plant and b) the evenness of soil water across the whole area.

### Grass cover

Grass cover across the whole area was very good with values ranging from 95-100% cover. The grass composition was made up of perennial ryegrass and tall fescue. Areas of the turf in the more sunny locations visually appeared to have a greater proportion of tall fescue in the sward than shaded areas.

### NDVI

NDVI readings were good across the whole area indicating healthy green grass (0.760). There were no differences in values between the sunny and shaded areas.

### Surface and soil temperatures

On the afternoon of 16 April, surface temperatures at the time of testing were 20.9°C in the shaded area and 25.5°C in the sunny area. Soil temperatures above the shock pad were 15.5°C in the shaded area and 18.4°C in the sunny area.

## Conclusions

- Grass cover across the whole area was good. The turf looked healthy both visually and when NDVI readings were taken across whole area. There were no apparent differences between the sunny and more shaded areas of the turf.
- Average surface hardness values from the turf were within the normal range of values for professional football surfaces (65-100 gravities). The shaded area tended to be slightly firmer than the sunny area, although the difference was only 4 gravities.
- The grass canopy contributed to a softening of the playing surface by on average 20 gravities.
- Average surface traction values were well within the optimum range for professional football pitches.
- Soil water content was within the normal range for professional football pitches. It should be noted that the shock pad layer may have affected the readings as it was of a different density to the sand layers above and below it, although the overall effect would likely to have been to reduce the overall reading slightly.
- Overall, the quality and performance of the turf was good and would have been comparable to a high quality football surface.

## Recommendations

The turf surface tested was representative of a high quality football surface, although surface hardness was towards the lower end of the normal range for professional football pitches and outside the optimal range for stadia pitches. This is likely to be the result of the shock pad providing extra cushioning, coupled with the dense grass cover at the time of testing. There are aspects of the Palau Hybrid system that could be investigated to further optimise surface hardness, such as using a finer sand as the infill material creating a denser and firmer surface layer, or looking at the effect of short heights of cut and a slightly thinner grass sward (as typically seen in stadia growing environments).

During the testing it was noticed that the stud penetration from the traction apparatus was not extending fully into the Hybrid fibres, as they had a tendency to lay across the sand surface. This may have meant that these fibre were not contributing as much as possible to surface traction. As discussed, the second generation of Hybrid reinforcement with the more upright fibres may prove better at increasing surface grip to the player, especially when grass cover is reduced through play.

The Palau Hybrid system looks like a very interesting concept, offering good levels of surface performance. It certainly merits further research work to look at the performance of the system under heavy wear situations and to quantify the differences between the relative performance of both the existing and second generation Hybrid materials. This would be best achieved by running trials at our test facility where we have the capability to carry out a full suite of tests and to apply simulated wear to the turf to fully study the reaction of the system to heavy wear damage. This could be coupled with onsite testing of the pitch to be installed in Tarragona this summer.

## References

Baker, S.W., Spring, C.A. & Wheeler, J.A. (2007). Performance requirements for surface hardness of winter pitches. *J. Turfgrass & Sports Surface Sci.*, 83, 91-97.

Baker, S.W. & Woollacott, A.R. (2005). Comparison of the playing performance of "third generation" artificial grass with natural turf used for professional soccer. *Int. Turfgrass Soc. Res. J.*, 10, 15-26.

## Photographs



Shaded area of turf



Close up of shaded turf



Sunny turf



Close up of sunny turf



Core through upper profile with root development evident through both geotextile and shock pad

Signed: Christian Spring

(Research Manager)

Date: 29 April 2014

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## QUALITY STATEMENT

We confirm that this report is a true representation of the original data collected and that the Standard Operating Procedures referred to in the STRI Manual of Standard Operating Procedures, and those relevant to data collection, data preparation, archiving of data and preparation of reports have been implemented in full.

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