

Evaluation the use of *fytofoam* on the water management, turfgrass germination and reestablishment in golf courses

C. Guerrero; C. Antunes; and M. Pereira

Abstract— To evaluate the *fytofoam* turfgrass application on the effect on the water management and in turfgrass germination and reestablishment some experiments had been carried out in two golf courses in the Algarve region [Herdade dos Salgados (Albufeira) and Pinhal Golf (Vilamoura)].

In the Salgados golf course it was done an evaluation of the *fytofoam* application on *Agrostis stolonifera* ("Pennncross") obtained by seed and transplantation. Soil moisture, turfgrass germination and soil bulk density were compared where *fytofoam* was and was not applied. It was also evaluated the turfgrass germination and reestablishment on lawns obtained by seed and transplantation, respectively. In the Pinhal Golf course it was done a comparative evaluation on the turfgrass establishment speed in the following situations: with *fytofoam*; with turf + sand and only with sand, on *Cynodon dactylon* ("Bermuda Tifton 419") lawn obtained by transplantation. According to the results (visual and laboratorial), it was observed that the application of *fytofoam* sped up the germination of the two tested turfgrass species and the root development was higher both in *Cynodon dactylon* and in *Agrostis stolonifera* lawns; the soil moisture had been higher at 5, 15 and 25 cm depth when *fytofoam* was used and the soil bulk density was smaller where *fytofoam* was incorporated.

Keywords — Golf courses, irrigation management, turfgrass germination, turfgrass reestablishment.

I. INTRODUCTION

Portugal, and particularly the Algarve, is a privileged golf turistic destination in the Europe. The success of golf in the Algarve results, further than the climate, from the high quality standards of most of its golf courses.

In golf courses the water consumption has been a constant concern for greenkeepers. Strategies for the reduction of water consumption in golf courses are an important issue for them and especially in regions where water scarcity may be a

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reality. Nevertheless the quality of a turfgrass is a very important factor in any golf course. High standards of quality with a substantial reduction in the maintenance costs and labour operations (irrigation and aerifications, for example), are permanent goals of the golf course greenkeeper. According to water consumption, this is an aspect to be considered.

Studies on water content have been done in substrate media with and without soil using hydrophilic polymers alone or mixed with wetting agents [1]-[2]-[4]-[5]. Hydrophilic polymers or hydrogels have a potential to increase water retention on substrate media or soil and to reduce irrigation frequency and water consumption [5]. In sandy soils, the use of this type of compounds, hydrophilic polymers, hydrogels, or wetting agents may decrease water percolation rates and increase water availability to crops [1].

In this experimental work it was intended to evaluate the effect of *fytofoam* in the management of water irrigation in a golf course. *Fytofoam* is a substance which may reduce the water consumptions up to 7 to 8 L.day⁻¹.m⁻² (www.fytogreen.us). It also may promote a fast recovery of turfgrass, healthful plants and a faster and bigger development of the roots, thus increasing the turfgrass resistance to drought (Hubel Group, Center of Hidropony).

II. MATERIAL AND METHODS

A. *Fytofoam*

The *fytofoam* is a product resulting from a resin (urea melamine formaldehyde) with a coagulant, under a pressure of 5 bars. It is a spongy and light substance with a density of 22 - 30 kg.m⁻³, able to hold 60% of its total volume in water (Hubel Group, Center of Hidroponia). It is harmless for the environment and bio-degradable (useful life of 10 the 15 years); it possesses a homogeneous texture, being able to be used alone or in a mixture with other materials, as soil. It has an acid pH (2.8 - 4.5) but, according to *fytofoam* specifications, this can be modified (pH>4.5). *Fytofoam* possesses a long durability in extreme climatic conditions and is sufficiently resistant to high pressures. It also may be used as a product able to reduce the soil compactation, especially in golf courses with high numbers of players and with frequently turfgrass stresses.

B. Experimental fields

Fytofoam experimental fields had been installed at the Herdade dos Salgados (Albufeira) and Pinhal Golf (Vilamoura), both golf courses located in the Algarve, Portugal.

At the Herdade dos Salgados, *fytofoam* was incorporated in a *Penncross* (*Agrostis stolonifera*) nursery with an area of 32m². This parcel was divided in eight plots with an area of 4m² each. In four plots *fytofoam* was incorporated to a soil depth of 20cm in a proportion of 20/80% (*fytofoam*/sand) (v/v). In two plots, turfgrass was seeded and in the other two it was transplanted. In the other four plots, it was done the same turfgrass implantation procedure; however no *fytofoam* was applied (Fig. 1).

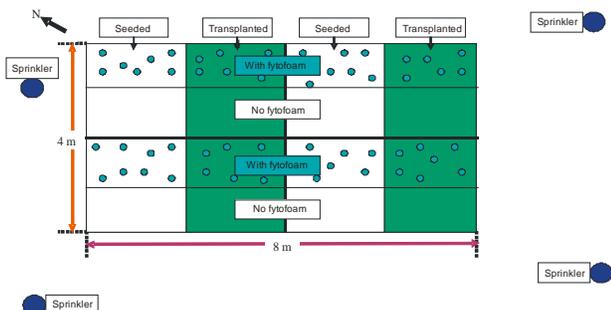


Fig. 1. Experimental field at the Herdade dos Salgados (*Penncross* nursery)

At the Pinhal Golf, *fytofoam* was experimented in a 168m² area of the 11th tee. This tee was divided in three parts: a 60m² plot, where *fytofoam* was incorporated to a soil depth of 20 cm at a 30/70% ratio (*fytofoam*/sand) (v/v), a 99m² plot, where it was used a mixture of turf and soil of 30/70%, to a same depth, and a 9m² plot only with sand. After soil preparation, the 11th tee was transplanted with *Bermuda Tifton 419* (Fig. 2).

The water irrigation distribution was analyzed using udometers (plastic cups) distributed by the areas where the experimental fields had been carried through.

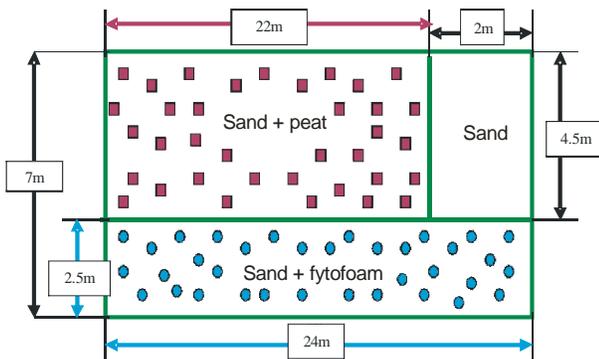


Fig. 2. Experimental field at the Pinhal Golf (11th tee)

C. Field measurements

At the **Herdade dos Salgados**, it was measured the following parameters:

- a) soil moisture content at 5, 15 and 25 cm depth, using a multi-sensor capacitance probes connected to a customized data logging facility (Fig. 3, 4 and 5). At each turfgrass surface implantation (seeded or transplanted);
- b) soil moisture comparisons were made between where *fytofoam* was (WF) and was not (NF) applied. To estimate the soil moisture increment (SMI) it was used the following equation:

$$SMI = [(SMIWF - SMINF)/SMINF] \times 100 (\%) \quad (1);$$

- c) the speed of germination (days) on the seeded plots,
- d) the speed of turfgrass reestablishment (days) on the transplanted plots, with and without *fytofoam*;
- e) soil bulk density.



Fig. 3. *Penncross* experimental field



Fig. 4. Capacitance probe

At the **Pinhal Golf** course, it was measured the good visual appearance (green colour), root depth and density.

Soil moisture values, had been submitted to a variance analysis (ANOVA); differences were considered significant when p<0.05. Normality of sample distribution and homogeneity of variances were verified before ANOVA [10]. The comparative analysis of the treatment averages was realized through the New Multiple-Range Test [3]. For the

statistical analysis it was used the SPSS ver. 14.0 (SPSS Incorporation, 1989-2005, Chicago, Illinois, U.S.A.) and the Microsoft Excel (Office 2003).



Fig. 5. Logging facility

III. RESULTS

At the **Herdade dos Salgados**, along all the experimental period, soil moisture at 5, 15 and 25 cm depth was highest where *fytofoam* was incorporated to soil either in seeded plots (Fig. 6 and 7) or in transplantation plots.

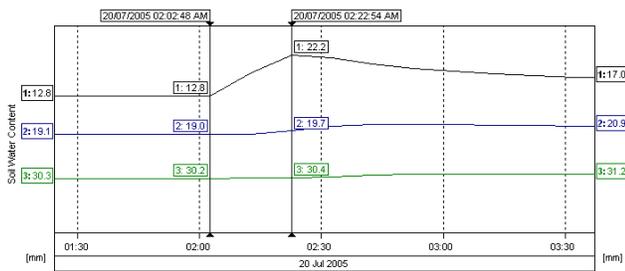


Fig. 6. Soil moisture values (mm) on seeded turfgrass plot (*Penncross*) with *fytofoam* application, at **1:** 5cm, **2:** 15cm and **3:** 25cm depth

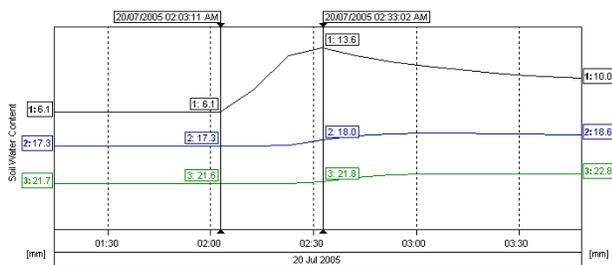


Fig. 7. Soil moisture values (mm) on seeded turfgrass plot (*Penncross*) without *fytofoam* application, at **1:** 5cm and **3:** 25cm depth

On the *Agrostis stolonifera* plots, the use of *fytofoam* promoted significant increments ($p < 0.01$) of soil moisture in the first three months. At the superficial soil layer (5 cm depth), where turfgrass was seeded and *fytofoam* was incorporated, it was observed the highest monthly average increments in soil moisture (52.1 – 141.4 %) compared with the similar plot without any *fytofoam* application. At 25 cm depth it was also verified a reasonable increase in soil moisture, compared to where no *fytofoam* was applied. In the intermediate layer (15 cm), it was observed a smaller increment of soil moisture compared with the other soil layers.

Table 1. *Penncross* nursery seedling plots. Comparison of soil moisture monthly average between where *fytofoam* was and was not applied. Averages with the same letter do not present significant differences at 95% (multi average comparison - Duncan test)

cm	Soil moisture increments (%)					
	Irrigation period: 02h30			Irrigation period: 12h00		
	June	July	August	June	July	August
5	141.4 a	52.1 a	71.1 a	117.6 a	74.1 a	99.0 a
15	14.2 b	9.2 c	13.3 c	9.6 c	9.2 c	13.0 c
25	41.4 b	38.7 b	44.6 b	37.1 b	37.6 b	40.4 b

In the experimental field carried through in the *Penncross* nursery, germination was significantly faster ($p < 0.05$) in the seeded plots where *fytofoam* was incorporated. Where *fytofoam* was applied it was observed that after 12 days the soil surface was totally covered (Fig. 8 and 9). Where *fytofoam* was not applied the soil surface was covered after 22 days.



Fig. 8. *Penncross* nursery with *fytofoam* application



Fig. 9. *Penncross* nursery without *fytofoam* application

In *Penncross* transplantation plots it wasn't observed significant visual differences, independently if *fytofoam* was or was not applied. Regarding to the turfgrass rootzone the establishment of *Penncross* was faster where *fytofoam* was applied. It was also observed higher density and longer roots (Fig. 10 and 11).



Fig. 10. Root development of *Penncross* transplantation plots with *fytofoam* application



Fig. 11. Root development of *Penncross* transplantation plots without *fytofoam* application

Comparing soil bulk density results, where turfgrass was transplanted and seeded, the average results were lower, but without statistically differences ($p>0.05$), in plots where *fytofoam* was incorporated to topsoil (Table 2).

Table 2. Soil bulk density of the *Penncross* nursery plots

Penncross plots	Soil bulk density
Transplantation without <i>fytofoam</i>	1.43
Transplantation with <i>fytofoam</i>	1.32
Seeded plots without <i>fytofoam</i>	1.43
Seeded plots with <i>fytofoam</i>	1.24

At the **Pinhal Golf course**, it wasn't observed any significant differences on the three analysed aspects: in the three treatments plots it was observed the similar greenish colour, showing the same visual appearance; root depth and density were also similar, however in the plot with sand +

fytofoam, roots were slightly longer and with higher density (Fig. 12, 13 and 14).



Fig. 12. Root development (sand + *fytofoam*)



Fig. 13. Root development (sand + peat)



Fig. 14. Root development (sand)

IV. DISCUSSION AND CONCLUSIONS

The results obtained in this experimental work were in accordance with other studies carried out in some golf courses in Europe (Portugal, Spain, Germany, Switzerland, United Kingdom, Ireland) and, also, in United States and South Africa (www.fytogreen.us). At the Herdade dos Salgados experiment, where it was used *fytofoam*, water retention increased between 9.2 and 14.2 % at 15 cm depth as it happened in investigations realized in Michigan and New Mexico Universities where water retention increased between 7 to 15% after incorporating 20% of *fytofoam*. According to

[6] such available water increases in the soil profile may allow a reduction of about 50% in the amount of water used in irrigation.

The observed effect on water retention using *fytofoam* may correspond to a reduction on water losses by percolation and thus in an increase on water content in the soil and on its availability to crops. In studies carried out using polyacrylamides alones and mixed with a sandy soil it was observed a water retention of 40 to 140 kg of water per kg of polyacrylamides mixed with sand [1]. In these studies were also observed water retention between 200 and 500 kg of water per kg of polyacrylamide alone.

Turfgrass germination and/or reestablishment were slightly faster using *fytofoam* at the *Pennncross* nursery (Herdade dos Salgados), allowing time saving after cultural operations, as turfgrass seeding or sodding. These facts may be associated to the referred increase on water content in the soil and probably to an increase on porosity due to the light density of *fytofoam*. Root growth and root development were faster in those areas where *fytofoam* was applied and thus where rootzone had lower bulk density. The Estoril Golf Club (Portugal) made the total restructuration of the 13th green, using a mixture of *fytofoam* with sand (20/80% - v/v) using *Pennncross*. Green entered in game after 2 months and 16 months later roots reach 15 cm depth, almost the double of what happens in greens where the used substratum is a mixture of sand and turf [9].

In a trial undertaken to evaluate the effectiveness of *Fytofoam* injection it was observed significantly higher turfgrass height, and density, and produced significantly greater amounts of grass clippings compared with the untreated control [8].

Two investigators [7] compared *fytofoam* with other substrata and it was verified that *fytofoam* improved the turfgrass germination and turfgrass growth, mainly when mixed only with sand. At Pinhal Golf, it was obtained similar results; the plot where it was applied *fytofoam* had higher density and root depth compared to the substrate with sand + peat.

According to the exposed results, *fytofoam* may confer an increase in soil water-holding capacity and less losses of water by percolation. These factors associated to an increase on air capacity, due to *fytofoams'* light density, may positive affect the germination process and faster turfgrass re/establishment.

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