

Turf Screen Solar protectant tests on creeping bentgrass *Agrostis stolonifera* L. plant quality under stress conditions.

E.J Nangle, D.P. Petrella, J.R. Street, D. Holdren

Introduction:

This project investigates the potential of using a synthetic pigment in applications ranging from reducing irrigation input, to reducing fungicide applications, to measuring stress levels on turfgrass treated with 'Turf Screen'. The product is part of a new range of colorants which have recently been introduced into the turfgrass industry. Being relatively new, data on positive and negative aspects of its use are necessary to ensure best practices and product optimization. 'Turf Screen' offers potential for further testing under various environmental conditions, and this trial may serve to increase focus for future testing. This study has three distinct objectives:

- 1. Investigate potential for reducing irrigation and fungicide applications through use of Turf Screen under stressful conditions.**
- 2. Investigate turfgrass quality and health during the period of the trial and response to repeated applications of Turf Screen under stressful conditions.**
- 3. Investigate if the results were reproducible at different heights of cut.**

Materials and Methods:

Replicated creeping bentgrass (*Agrostis stolonifera* L.) plots with two different heights of cut (0.170 inches and 0.5 inches) were used. Plots were mowed 3-4 times weekly and irrigation was scheduled daily. Fertility treatments were carried out weekly using Anderson's 14-7-14, and a total of 1.5 lbs. N was added through the season. Four treatments were sprayed from June 20th to September 13th 2012 at the Ohio State Turfgrass Research Center, Columbus Ohio. Treatments were set up in a split block design, with fungicide and no fungicide providing the split. The treatments were applied bi-weekly with a CO₂ back pack sprayer. Fungicide treatments included applications of Daconil ultra at 3.25 oz/M, where applications were made every 14 days; however, this was later extended to a 30 day interval. Irrigation was turned off August 5th and was returned to a two day cycle August 28th in order to evaluate drought stress and associated recovery. Treatments were set up as follows:

1. Untreated Check
2. Turf Screen at label rate (26.7 ml/2 Liter)
3. Daconil Ultrex 3.25 oz/M
4. Turf Screen (26.7ml/ 2 Liter) + Daconil Ultrex (3.25 oz/M)



Fresh tissue was harvested twice, and weighed to 1 gram (once prior to dry down and second in the middle of the dry down). Tissue was oven dried at 105 °C for 24 hours to remove moisture; differences between fresh weight and dry weight were then calculated and values were reported as percent moisture in tissue.

Fresh leaf tissue samples were used to measure chlorophyll content with 0.01g added to 10 ml of *N,N* dimethyl-formamide for 24 hours prior to taking absorbance values using a Shimadzu UV-vis spectrophotometer. Absorbance was measured for 664, 647, 625 and 603 nm. Chlorophyll A, B and total chlorophyll content was calculated based on calculations from Moran (1982).

Rankings for turfgrass color were carried using the NTEP ranking system where 1=brown/dead 9 = green/highest quality 6= acceptable. Stress ratings were developed with 1= brown dead turf 9 = highest quality / no visible stress. Dollar spot ratings were carried out on a percentage cover rating with 100 = complete cover of plot with dollar spot and 0 = clean plot with no dollar spot visible. Stress ratings were carried out based on wilt with 9 = no wilt excellent turf quality and 1 = complete wilt and brown turf.

The data were analyzed as a split plot treatment using SAS 9.2. The treatments analyzed within each fungicide treatment and also compared when fungicide was included. Significant differences between treatments were assigned at $P=0.05$.

Dollar Spot Results:

Dollar spot analysis indicated that Turf Screen alone and in combination with fungicide treatments offered, on average, better turfgrass rankings than the check plot on fairway height turfgrass. After week 7 of the treatments (Table 1.1) Turf Screen applied alone, had significantly lower dollar spot ratings compared to the check (Table 1.1). Dollar spot at week 7 was 0% for fungicide combined with Turf Screen; there was an average of 5% dollar spot cover for Turf Screen alone on that date. Recovery meant that treatments ranked better in week 8 (Table 1.1), and fungicide treatments were successfully spread out to 30 days.

Table 1.1 Fairway height dollar spot rankings

Dollar spot rating (% cover -0=no dollar spot/100 = complete cover)								
Treatment	Wk1	Wk2	Wk3	Wk4	Wk5	Wk6	Wk7	Wk 8
Check	0.0a [†]	2.0a	2.7a	4.2a	3.5a	5.8a	8.3a	4.2a
Turf Screen	0.0a	0.3a	0.5a	1.7a	1.7a	4.3a	5.0b	0.0b
LSD	0.0	4.0	3.3	4.0	4.4	2.1	2.3	2.3
Turf Screen	0.0a	2.3a	3.2a	5.8a	5.2a	10.2a	13.3a	4.2a
Turf Screen + Fungicide	0.0a	0.0a	0.0a	0.0a	0.0a	0.0a	0.0b	0.0b
LSD	0.0	6.8	6.2	9.5	11.8	15.7	12.9	3.6

[†] Mean values followed by different letters are significantly different at ($P=0.05$)

Dollar spot ratings for greens height turfgrass indicated that Turf Screen in combination with fungicide control of dollar spot was significantly better than Turf Screen alone. There was no significant difference in dollar spot incidence between Turf Screen and non-fungicide treated plots throughout the trial (Table 1.2).

Table 1.2 Greens height dollar spot rankings

Treatment	% Dollar spot			
	Wk 1	Wk 2	Wk 3	Wk 4
Turf Screen	2.0 a [†]	1.7 a	5.0 a	0.0 a
Control	2.8 a	4.2 a	8.3 a	4.2 a
LSD	2.0	5.2	6.4	5.2
Turf Screen	4.3 b	5.8 b	13.3 b	4.2 a
Turf Screen+ Fungicide	0.5 a	0.0 a	0.0 a	0.0 a
LSD	2.0	5.2	6.4	5.2

[†] Mean values followed by different letters are significantly different at ($P=0.05$)

Turfgrass Quality and Color Rating Results:

Color rankings are subjective; however, it was agreed that the Turf Screen treated turf quality and color rankings compared to the check for fairway height turfgrass were significantly higher ($P=0.05$) at all times during the trial period (Table 2.1). There was no difference when Turf Screen was applied on its own or when mixed with fungicide which could be expected as none of the fungicides used had added pigment. The main advantage noted in our testing was that Turf Screen treated turf had better turf quality and higher color rankings through the testing period compared to the check plots.

Turf quality and color rankings for greens height turfgrass were also significantly higher ($P=0.05$) for Turf Screen treated plots on greens height bentgrass compared to control plots. There was no difference noted between treatments of Turf Screen and Turf Screen combined with fungicides (Table 2.2).

Table 2.1 Fairway height color rankings

Treatment	Color (1-9 scale 1=brown 6 = acceptable 9 = best turf)							
	Wk1	Wk2	Wk3	Wk4	Wk5	Wk6	Wk7	Wk8
Check	6.0b [†]	6.0b	6.0b	6.0b	6.1b	6.0b	5.8b	6.0b
Turf Screen	8.0a	7.5a	8.0a	7.9a	7.1a	8.0a	7.8a	6.5a
LSD	0.0	0.0	0.0	0.2	0.0	0.0	0.6	0.0
Turf Screen	7.0a	6.7a	7.0a	6.9a	6.5a	7.0a	6.7a	6.3a
Turf Screen + Fungicide	7.0a	6.7a	7.0a	7.0a	6.7a	7.0a	6.9a	6.3a
LSD	0.0	0.0	0.0	0.4	0.7	0.0	0.7	0.0

[†] Mean values followed by different letters are significantly different at ($P=0.05$)

Table 2.2 Greens height color rankings

Treatment	Color			
	Wk 1	Wk 2	Wk 3	Wk 4
Turf Screen	7.5 a [†]	8.0 b	7.8 a	6.5 a
Control	5.0 b	6.0 a	5.8 b	6.0 a
LSD	0.0	0.0	0.4	0.0
Turf Screen	6.3 a	7.0 a	6.9 a	6.2 a
Turf Screen+ Fungicide	6.3 a	7.0 a	6.7 a	6.2 a
LSD	0.0	0.0	0.4	0.0

[†] Mean values followed by different letters are significantly different at ($P=0.05$)

Canopy Temperature Results:

On one date (Week 1) turfgrass treated with Turf Screen had significantly lower temperatures compared to the check plots. On the same date Turf Screen combined with fungicide also had significantly lower temperatures ($P=0.05$) compared to Turf Screen only (Table 3.1). There were no other differences in temperatures noted through the trial period for fairway height turfgrass.

Table 3.1 Fairway canopy temperatures

Treatment	Temp °F				
	Wk1	Wk2	Wk3	Wk4	Wk5
Check	92.8a [†]	84.7a	99.0a	99.2a	115.5a
Turf Screen	91.1b	86.1a	100.5a	102.2a	115.3a
LSD	1.7	2.4	4.0	4.7	3.0
Turf Screen	92.3a	85.6a	100.5a	101.9a	116.5a
Turf Screen + Fungicide	91.6b	85.2a	99.1a	99.5a	114.3a
LSD	0.6	0.7	3.8	9.1	4.4

[†] Mean values followed by different letters are significantly different at ($P=0.05$)

Analysis of greens height turfgrass temperatures indicated regardless of treatment there were no differences in canopy temperature throughout the trial. There was some extreme canopy temperatures noted particularly at week 3 where temperatures were above 110 °F for all treatments (Table 3.2)

Table 3.2 Greens height canopy temperatures.

Treatment	Temp °F		
	Wk 1	Wk 2	Wk 3
Turf Screen	101.6 a [†]	87.5 a	113.8 a
Control	101.4 a	89.6 a	114.2 a
LSD	1.5	2.2	6.2
Turf Screen	101.5 a	88.7 a	115.5 a
Turf Screen+ Fungicide	101.4 a	88.4 a	112.5 a
LSD	1.5	2.2	6.2

Turfgrass Quality and Stress Level Results:

Measuring stress was subjective; however, three of the four investigators evaluated the surfaces and gave their interpretations which were then merged into stress data. It can be seen that on the first three dates Turf Screen plots ranked significantly higher in turf quality compared to the check plot. These dates coincided with the period when water stress was implemented and for the first two weeks it is evident that Turf Screen treated turf was of satisfactory quality or higher and had significantly better ratings and turf quality compared to the check plot. By week 3 all treatments had lost quality and wilt was noticeable and browning of tissue was apparent. Once irrigation was returned, all plots returned to high quality and there were no differences in week 4. It is important to note that under extremely stressful and droughty conditions, no turfgrass was lost over the trial period and the Turf Screen plots had higher quality and recovered well (Table 4.1).

Table 4.1 Stress values 1-brown wilted 9-lush dense upright green 6-satisfactory

Treatment	Stress ranking			
	Wk1	Wk2	Wk3	Wk4
Check	5.5b [†]	4.3b	4.0b	8.7a
Turf Screen	7.3a	6.0a	5.0a	8.7a
LSD	0.9	1.2	0.0	0.0
Turf Screen	6.2a	5.5a	4.5a	8.7a
Turf Screen + Fungicide	6.7a	4.8a	4.5a	8.7a
LSD	0.7	1.2	0.0	0.0

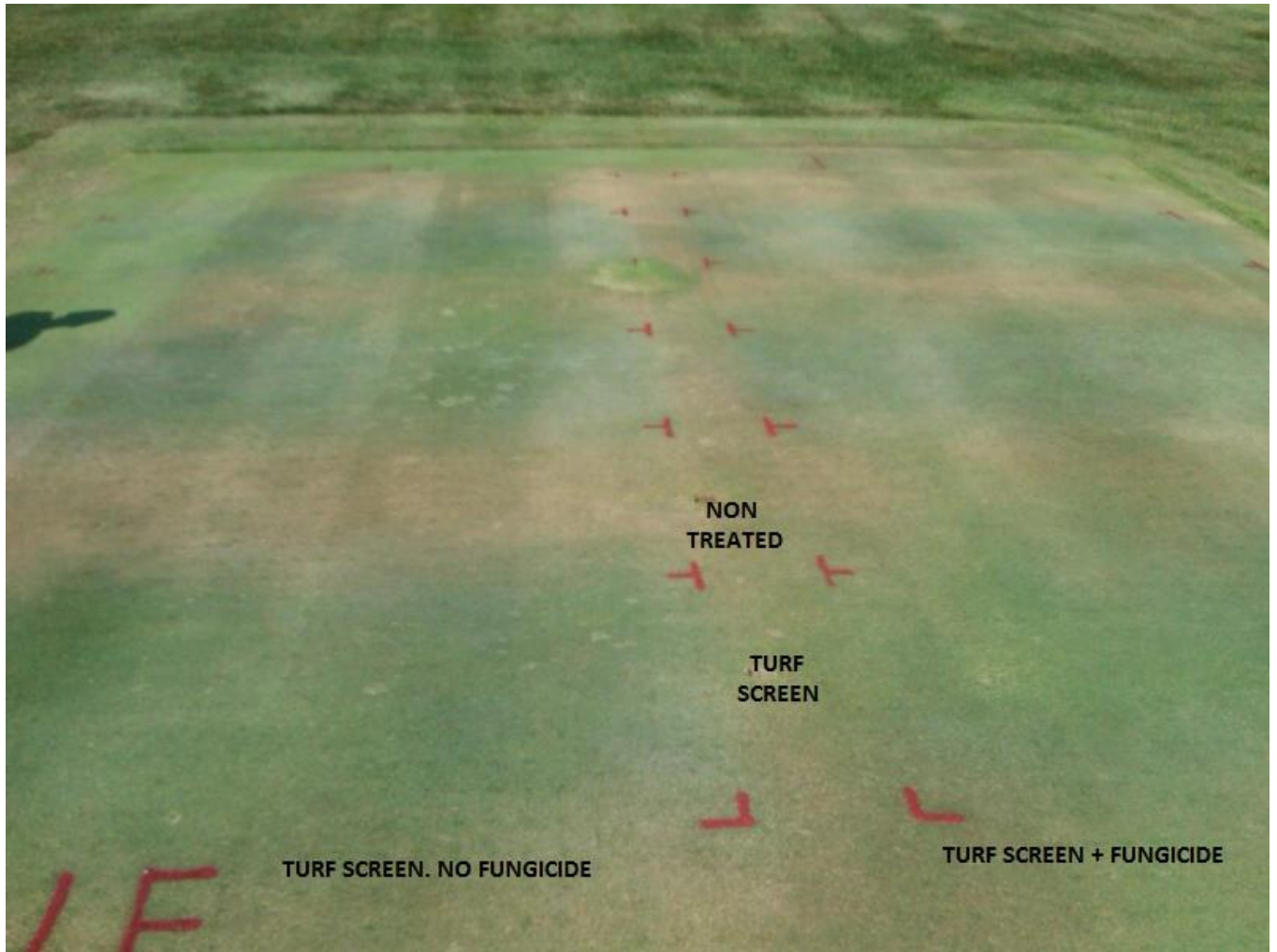
[†] Mean values followed by different letters are significantly different at ($P=0.05$)

Measuring stress levels on greens height creeping bentgrass was somewhat difficult, however there was still good agreement with the numbers between the investigators as to the ratings. During the dry down period (first 14 days) turf quality of the control plots declined on a much more significant level ($P=0.05$) as compared to the Turf Screen treated plots (See photo below Table 4.2 and on next page). By 14 days without irrigation both treatments were below satisfactory. There was no difference between the fungicide treated plots in combination with Turf Screen or Turf Screen alone (Table 4.2).

Table 4.2 Stress values 1-brown wilted 9-lush dense upright green 6-satisfactory

Treatment	Stress rating 9 – none 1 –wilt brown			
	Wk 1	Wk 2	Wk 3	Wk 4
Turf Screen	8.0 a [†]	5.7 a	5.0 a	8.2 a
Control	7.0 b	4.0 b	4.0 b	8.2 a
LSD	0.0	0.0	0.0	0.5
Turf Screen	7.5 a	4.8 a	4.5 a	8.3 a
Turf Screen+ Fungicide	7.5 a	4.8 a	4.5 a	8.3 a
LSD	0.0	0.0	0.0	0.5

[†] Mean values followed by different letters are significantly different at ($P=0.05$)



(Photograph of greens plots 18 days with no irrigation. August 23, 2012)

Chlorophyll Testing Results:

Chlorophyll degradation could be due to daily turnover or additionally oxidative stress on the turfgrass plant. A potential benefit through solar reflection could be a possible reduction in damage to chlorophyll pigments. In this trial there were high levels of variation within the data and so there was no differences noted between any of the treatments (Table 5.1).

Table 5.1 Chlorophyll content for turfgrass treated with Turf Screen and fungicides June 20th – September 30th 2012.

Treatment	Chlorophyll content $\mu\text{g/g}$					
	July 17			August 17		
	Chl A	Chl B	Chl Total	Chl A	Chl B	Chl Total
Check	1903.3a [†]	683.8a	2596.5a	1773.8a	631.2a	2399.5a
Turf Screen	1889.9a	679.6a	2533.8a	1765.8a	615.9a	2376.3a
LSD	187.9	79.0	248.9	409.1	140.9	548.5
Turf Screen	1832.0a	655.3a	2477.0a	1879.3a	651.4a	2250.7a
Turf Screen + Fungicide	1961.2a	708.1a	2653.4a	1660.3a	595.6a	2525.1a
LSD	187.9	79.0	248.9	409.1	140.9	548.5

[†] Mean values followed by different letters are significantly different at ($P=0.05$)

Tissue Moisture Results:

Tissue moisture values were of interest due to the possible anti-transpirant effect that Turf Screen may have. This would allow for a much larger potential use as superintendents generally try to decrease water consumption. The data pre dry down treatment initiation indicated that no differences in tissue moisture were found. However, when water was withdrawn in Week 2, Turf Screen treated plots had significantly lower ($P=0.05$) water content in the tissue compared to the check (Table 6.1). There was a similar result when using the Turf Screen combined with the fungicides. From our perspective the result could be important. Lower tissue moisture in the second week could mean that the plant may have slowed stomatal transpiration and water uptake has been decreased, potentially allowing more water available compared to the untreated. This may be important to the plant during stressful periods. This would need to be investigated in greenhouse conditions further, but it does fit with stress ratings and also color values that were rated.

Table 6.1 Tissue moisture content for turfgrass treated with Turf Screen and fungicides June 20th – September 30th 2012. (Wk1 7-17) (Wk2 8-17; 10 days into dry down).

Treatment	Moisture (%)	
	Wk1	Wk2
Check	75.4a	64.7a
Turf Screen	75.3a	61.7b
LSD	2.5	2.6
Turf Screen	75.5a	64.8a
Turf Screen + Fungicide	75.1a	61.6b
LSD	2.5	2.6

† Mean values followed by different letters are significantly different at ($P=0.05$).

Conclusions:

The data from the fairway trial in particular offered some benefits to the use of Turf Screen, and from our perspective there were no negative aspects to turfgrass in applying Turf Screen under stressful conditions. Overall turf quality and color rankings were higher where Turf Screen was applied. Additionally, other notable plant benefits were noted in the stress ratings and tissue moisture content. Another notable benefit was that fungicide treatments were stretched to 30 days without any negative impact on turf quality when Turf Screen was applied in conjunction with fungicides. This offers a cost cutting benefit for turfgrass managers going forward. From our perspective, decreasing water use is very interesting and is something that warrants further work. This was seen at both fairway and green height, indicating Turf Screen is usable and effective in different situations.

Reference:

Moran, R. 1982. 1982. Formulae for determination of chlorophyllous pigments extracted with *N,N*-dimethylformamide. *Plant Physiol.* 69:1376-1381.