Evaluating Effects of Salicylic Acid (SA) and Pigment of Harrell's sources for Improving Bentgrass Putting Green Quality and Physiological Fitness during Summer Stress

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Introduction and Objective

Salicylic acid (SA), a hormone, has been shown to improve turfgrass stress tolerance (Zhang et al., 2001). Various pigment products have also been used to improve turf visual quality. In a recent growth chamber study at Virginia Tech, we found that SA at 0.25 mM, 0.5 mM, and 0.1 mM plus pigment improved visual color of creeping bentgrass under heat and mild drought stress at 42 and 56 d after initial treatment. SA at 0.5mM had relatively better effects and low-rate SA (0.1 mM) plus pigment at 0.22 fl oz/1000 ft2 had better effects on creeping bentgrass visual color than SA at 0.1mM alone. The results indicated a synergy between SA and the pigment for turf quality improvement under heat and mild drought stress conditions.

We also found that SA at 0.25 mM and 0.5 mM provided better turf visual quality than SA at 0.1 mM. It is possible that SA at 0.25 mM and 0.5 mM plus pigments may have better effects on turf quality than SA alone in creeping bentgrass putting green under summer stress. The objective of this study was to evaluate SA and pigment interactions under field conditions and evaluate effects of SA and the pigment for improving turf quality and physiological fitness during summer stress.

Research procedures

The study was conducted on the bentgrass putting green at Virginia Tech Turfgrass Research Centre, Blacksburg, VA. There were 6 treatments with 4 replications in a randomized block design with 6 ft x 6 ft plots.

Regular mowing and irrigation maintenance practices for a putting green were performed. The SA and pigment products received from Harrell's were used in this study.

The 6 treatments were as follows:

1. Fertilized control (0.15 lb (68.1 g) N per 1000 sq ft every 14 days from 28-8-18 complete fertilizer).
2. SA at 0.25 mM (0.26 g or 0.009 oz/1000 ft2) every 14 days
3. SA at 0.5 mM (0.52 g or 0.017oz/1000 ft2) every 14 days
4. SA at 0.25 mM + Pigment at 0.22 fl oz/1000 ft2 every 14 days
5. SA at 0.5 mM + Pigment at 0.22 fl oz/1000 ft2 every 14 days
6. Pigment at 0.22 fl oz/1000 ft2 every 14 days.

All treatments received the same amount of fertilizers as treatment #1 (control) during the experiment to ensure all nutrient levels were the same. The trial lasted for 84 days from June 5 through August 27, 2018.

The following measurements took place at day (s) 0, 14, 28, 42, 56, 70, and 84 after initial treatments. Leaf color was rated on a visual scale of 1-9 with 9 indicating the dark green color, and 1 indicating brown color. Photochemical efficiency was measured base on the Fvm, which is the ratio of variable chlorophyll fluorescence (Fv) to maximum chlorophyll fluorescence (Fm). Leaf samples were collected and chlorophyll content was determined using spectrophotometer method (Zhang et al., 2005).

In late August, irrigation was withheld to induce mild drought stress and resumed after drought symptom appeared. The data were collected on August 27. At the end of the trial, 3 root samples (1-inch diameter and 6-inch deep cores) were collected from each plot, cores washed and root dry weight was determined after the samples were dried at 70° C for 72 h. The root length density were analyzed using WinRhizo technology. Briefly, after fine cleaning of wash root sample, the root samples from each plot were divided into multiple subsamples. Each subsample was scanned using WinRhizo and all root morphological parameters were generated and analyzed. In addition, root viability was analyzed using TTC method (Zhang et al., 2007)

Results and Discussion

We observed that SA and pigment, alone or in combination, improved leaf color (Table 1). The pigment had better effects than SA for improving leaf color. SA at 0.5 mM alone, SA with pigment and pigment alone improved PE as measured from July 2 through July 27 (Table2). On August 27, all treatments increased leaf chlorophyll content (Table 2). However, the SA and pigment, alone or in combination, did not impact root characteristics and viability (Table 3). In summary, SA at both rates and pigment, alone or in combination, improved leaf color from July through August 27 which was associated with increased PE and Chlorophyll content. The results of this study suggest that SA and pigment may block UV-B radiation and present/reduce oxidative stress and protect plant photosynthetic function from UV-B injury but may not impact root growth.

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References

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TABLE 1: Effects of salicylic acid (SA) and pigment, alone or I combination, on leaf color quality in creeping bentgrass putting green.

Treatment	Leaf Color (1-9, 9 = best)						
	5-Jun	19-Jun	2-Jul	16-Jul	30-Jul	13-Aug	27-Aug
Control	6.9	6.9	5.8c	5.8c	6.1c	6.0d	6.1d
SA0.25mM	7.0a	7.0a	6.3b	6.3b	6.5b	6.5bc	6.6bc
SA0.5mM	7.0a	7.1a	6.3b	6.3b	6.8ab	6.4c	6.4cd
SA0.25+pigment	6.9a	7.0a	6.9a	6.8a	6.8ab	6.8ab	7.0a
SA0.5+pigment	7.0a	7.1a	6.9a	7.0a	6.9a	6.9a	6.9a
Pigment	7.0a	7.3a	6.8a	6.9a	6.8ab	7.0a	7.1a

Means followed by same letters within same column are not significantly different at P = 0.05.

TABLE 2: Effects of salicylic acid (SA) and pigment, alone or in combination, on photochemical efficiency (PE) and chlorophyll content in creeping bentgrass putting green.

Treatment	Date						
	5-Jun	19-Jun	2-Jul	16-Jul	30-Jul	13-Aug	27-Aug
	PE (Fv/Fm)						
Control	0.55a	0.52a	0.56b	0.53b	0.43c	0.64c	0.57c
SA0.25mM	0.62a	0.56a	0.63a	0.65a	0.54bc	0.65bc	0.58bc
SA0.5mM	0.61a	0.59a	0.67a	0.62ab	0.58ab	0.58a	0.61a
SA0.25+pigment	0.62a	0.57a	0.64a	0.66a	0.60ab	0.68a	0.61a
SA0.5+pigment	0.60a	0.56a	0.66a	0.63ab	0.68a	0.67ab	0.61a
Pigment	0.62a	0.59a	0.66a	0.63ab	0.59ab	0.67ab	0.60ab
Chorophyll (mg/g FW)							
Control	1.78a	1.78b	1.78b	2.17a	2.42c	1.80c	1.79b
SA0.25mM	1.79a	1.85b	1.90b	2.31a	2.97a	2.08a	1.99a
SA0.5mM	1.77a	1.83b	1.73b	2.23a	2.92a	1.88bc	1.93a
SA0.25+pigment	1.83a	1.98a	2.28a	2.29a	2.70abc	1.93b	1.95a
SA0.5+pigment	1.77a	1.87b	1.94b	2.32a	2.76ab	1.91bc	2.00a
Pigment	1.77a	1.85b	1.85b	2.46a	2.52bc	1.89bc	2.2a

Means followed by same letters within same column are not significantly different at P = 0.05.

TABLE 3: Effects of salicylic acid (SA) and pigment, alone or in combination, on root growth and viability in creeping bentgrass putting green.

Treatment	Root mass (mg)	Root length (cm/cm3)	Surface area (cm2/cm3)	Diameter (mm)	Root volume (cm3/dm3)	Root viability (A490/mg DW)
Control	42.9ab	1.25ab	0.075ab	0.193a	0.361a	4.64a
SA0.25mM	44.7a	0.83ab	0.052ab	0.200a	0.265a	4.77a
SA0.5mM	38.8abc	1.59a	0.086a	0.183a	0.382a	4.95a
SA0.25+pigment	31.9bc	0.94ab	0.057ab	0.195a	0.281a	5.14a
SA0.5+pigment	39.0abc	1.08ab	0.063ab	0.190a	0.297a	4.63a
Pigment	28.6c	0.56b	0.037b	0.223a	0.207a	4.97a

Means followed by same letters within same column are not significantly different at P = 0.05.