Coating Warm-Season Turfgrass Seed To Improve Establishment Under Saline Conditions

Warm-season turfgrass species and seed coatings were evaluated for seedling establishment under saline irrigation ranging from 2 to 7 dS/m. Plots were seeded on 2 July 2014. Picture taken on 16 Sep 2014. Riverside, CA.

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The Bottom Line: Effects of seed coating were evaluated on seedling establishment of bermudagrass 'Princess 77' and seashore paspalum 'Sea Spray' irrigated with saline water ranging from 2 to 7 dS/m. Establishment of uncoated seed of buffalograss 'Sundancer' and kikuyugrass 'Whittet' was also evaluated under saline irrigation. By the end of the experiment (three months after seeding), the only seed coating treatment that had a positive effect on bermudagrass establishment was ASET 4000 6%, which increased turf cover in comparison to uncoated seed at 3 and 7 dS/m. In particular, ASET 4000 6% coating on Princess 77 achieved the highest overall turf cover (63%) when irrigated with saline water at 7 dS/m. Seashore paspalum coated with ASET 4000 1% reached the highest overall cover (97%) when irrigated at 2 dS/m, and showed higher turf cover in comparison to the uncoated treatment (76% vs. 67%) when irrigated at 5.5 dS/m. Since coating treatment adds approximately twice the weight to the seeds, coated plots were seeded at roughly half the rate of uncoated seed; regardless, establishment of coated treatments was never lower than the uncoated. Kikuyugrass was slower to establish under saline conditions compared to bermudagrass and seashore paspalum, reaching only 79% cover at 2 dS/m and 0% at 7 dS/m. Of all turfgrass species evaluated, buffalograss seedling establishment was slowest and most impacted by irrigation salinity.

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Introduction:

Saline irrigation has been proposed as a water conservation strategy to irrigate turfgrass areas. It is estimated that approximately 15% of U.S. golf courses and close to 35% of courses in the southwestern states use recycled water for irrigation. Warm-season turfgrasses are more tolerant to salinity than cool-season species; however, salinity can hinder the germination process and be detrimental for turfgrass seedling establishment. The objectives of this research were to determine: 1) effects of five experimental seed coatings and Zeba coating on the establishment of 'Princess 77' bermudagrass and 'Sea Spray' seashore paspalum when irrigated with increasing levels of saline water; and 2) how irrigation salinity affects seedling establishment of 'NuMex Sahara' bermudagrass, 'Whittet' kikuyugrass, and 'Sundancer' buffalograss.

Methods:

The study was conducted during the summer of 2014 at the UC Riverside turfgrass research facility in Riverside, CA. Soil was a Hanford fine sandy loam. Environmental data for the site are provided in Table 1. Plots were seeded using a vertical drop spreader on 2 July 2014 at the following rates: 2 lb/M (bermudagrass and buffalograss); 1 lb/M (seashore paspalum and kikuyugrass). Since coating treatment adds approximately twice the weight to the seeds, coated plots were seeded at roughly half the rate of uncoated seed. A list of treatments is provided in Table 2. Plots received 0.5 lb N/M/2 wks (Gro-Power; 5-3-1) from seeding to establishment for a total of 2 lb N/M. When and if necessary plots were mowed at 0.75 inches.

Turf was irrigated with Toro 300 series pop-up stream sprinklers (Toro Company, Bloomington, MN) on 30-ft spacing. A line-source gradient experiment was designed to alternate distribution of potable and saline water to establish an irrigation salinity gradient, identifying 5 different electrical conductivity (EC) levels (2, 3, 4.5, 5.5, and 7 dS/m). Seeding treatment plots were randomized in between the potable and the saline lines for a total of three replications per treatment. Irrigation was set to 100% Et_o.

Percent ground cover was assessed weekly throughout the experiment using Digital Image Analysis. At the beginning and the end of the study a total of three soil samples per plot was collected and analyzed for salinity and nutrients (Ag Source Labs, Lincoln, NE). Data were subjected to analysis of variance (ANOVA). When necessary, multiple comparisons of means were assessed using Fisher's protected least significant difference test at the 0.05 probability level.

Results:

On 30 September 2014, and consistent with previous rating dates, the only seed coating treatment that had a positive effect on bermudagrass establishment was ASET 4000 6%, which increased turf cover in comparison to uncoated seed at 3 dS/m, and 7 dS/m (Figure 1). In particular, ASET 4000 6% coating on Princess 77 achieved the highest turf cover (63%) when irrigated with saline water at 7 dS/m. Seashore paspalum coated with ASET 4000 1% reached the highest overall cover (97%) when irrigated at 2 dS/m, and showed higher cover in comparison to the uncoated treatment (76% vs. 67%) when irrigated at 5.5 dS/m. Although coated treatments were seeded at approximately half the rate of the uncoated, both coated bermudagrass and seashore paspalum were able to reach the same percentage of green cover as the uncoated by the end of the study period. Kikuyugrass was slower to establish in comparison to bermudagrass and seashore paspalum, covering only 79% of the ground at 2 dS/m and 0% at 7 dS/m, revealing poorer adaptability to establish from seed under high salinity levels of irrigation water. Buffalograss was the slowest to establish and most impacted by irrigation salinity of all turfgrass species (Figure 1).

Three months of saline irrigation were extremely detrimental for soil conditions. In fact, plots that received saline water with EC_w equal to 7 dS/m showed EC and SAR levels equal to 18 and 27, respectively (Table 3). Visual inspection of the plots confirmed deleterious effects on soil structure, with puddles arising from saline plots. Unfortunately, soil sample analysis also revealed the limits and flaws of the line-source gradient set-up. In fact, although visual inspection of the sprinklers and catch can test were run on the plots, ANOVA detected differences among treatments. Such differences were due to poor water distribution uniformity, which failed to deliver water homogeneously on plots, and therefore created areas that deviated from average salinity level zones. Nevertheless, salinity measured on plots seeded with coating treatments that appeared to have a beneficial effect on establishment (bermudagrass ASET 4000 6%, and seashore paspalum ASET 4000 1%) was never lower than that of the control (Table 4). Therefore, these results suggest that aforementioned beneficial effects on seedling establishment were a result of the seed coating treatments and not from differences caused by irrigation distribution uniformity.

Table 1. Environmental data collected and reported by the California Irrigation Management System (CIMIS) for Station 44 (Riverside) during the salinity alleviation study. Riverside, CA. Weather station located ≈ 100 ft away from study area.

Month Year	Total ETo (in)	Total Precip (in)	Avg Sol Rad (Ly/day)	Avg Vap Pres (mBars)	Avg Max Air Temp (F)	Avg Min Air Temp (F)	Avg Air Temp (F)	Avg Max Rel Hum (%)	Avg Min Rel Hum (%)	Avg Rel Hum (%)	Avg Dew Point (F)	Avg Wind Speed (mph)	Avg Soil Temp (F)
Jul-14	7.76	0.00	630	14.8	91.2	65.5	77.8	71	28	47	54.8	4.3	74.6
Aug-14	7.29	0.28	605	14.9	91	63.6	76.1	75	27	49	54.9	4.1	73.4
Sep-14	6.19	1.45	538	14.7	91.6	64.6	76.7	72	27	48	54.6	3.8	73.4
Oct-14	4.40	0.00	419	11.6	84.9	57.7	69.8	71	27	49	47.5	3.3	67.4

Table 2. Turfgrass species, cultivars, and seed coatings evaluated in the study.

Treatment	Species/Cultivar/Coating
1	Seashore Paspalum ‘Sea Spray’ uncoated
2	Seashore Paspalum ‘Sea Spray’ ASET 4000 1%
3	Seashore Paspalum ‘Sea Spray’ ASET 4000 6%
4	Seashore Paspalum ‘Sea Spray’ ASET 4000 20%
5	Seashore Paspalum ‘Sea Spray’ ASET 4001 10%
6	Seashore Paspalum ‘Sea Spray’ ASET 4002 10%
7	Bermudagrass ‘Princess 77’ uncoated
8	Bermudagrass ‘Princess 77’ ASET 4000 1%
9	Bermudagrass ‘Princess 77’ ASET 4000 6%
10	Bermudagrass ‘Princess 77’ ASET 4000 20%
11	Bermudagrass ‘Princess 77’ 4001 10%
12	Bermudagrass ‘Princess 77’ ASET 4002 10%
13	Seashore Paspalum ‘Sea Spray’ Zeba
14	Bermudagrass ‘Princess 77’ Zeba
15	Bermudagrass ‘NuMex Sahara’ uncoated
16	Kikuyugrass ‘Whittet’ uncoated
17	Buffalograss ‘Sundancer’ uncoated

Table 3. Soil EC_e (dS/m), sodium absorption ratio (SAR), calcium (Ca), magnesium (Mg), potassium (K), and sodium (Na) content (meq/L) at the end of the establishment period of the 5 saline irrigation water zones in October 2014 following 3 months of saline irrigation. No significant differences were found for these parameters prior to irrigation with saline water at the beginning of the experiment (data not shown).

Salinity Level (dS/m)	EC_e	SAR	Ca	Mg	K	Na
2	5.64 D	9.27 E	14.84 C	6.97 C	1.97 D	30.33 E
3	7.12 D	13.31 D	14.66 C	8.00 C	2.92 C	43.74 D
4.5	9.51 C	16.04 C	19.07 B	11.63 B	4.58 B	63.46 C
5.5	11.53 B	19.66 B	20.17 B	13.43 B	5.17 B	80.14 B
7	18.16 A	27.38 A	29.67 A	22.16 A	8.22 A	136.03 A

Means followed by the same letter in a column are not significantly different ($\propto$ = 0.05).

Table 4. Soil EC_e (dS/m), sodium absorption ratio (SAR), calcium (Ca), magnesium (Mg), potassium (K), and sodium (Na) content (meq/L) at the end of the establishment period of each coated or uncoated treatment in October 2014 following 3 months of saline irrigation.

Treatment	EC_e	SAR	Ca	Mg	K	Na
1	7.31 EF	13.66 E	15.29 EF	8.84 D	3.61 E	48.16 F
2	8.50 D-F	15.67 DE	15.06 EF	8.57 D	3.63 E	55.84 D-F
3	12.11 AB	18.65 A-D	21.48 A-E	15.37 A-C	5.76 A-C	87.87 A-C
4	13.77 A	21.47 A	26.73 A	17.85 A	6.20 A	99.18 A
5	11.26 A-D	17.34 B-E	23.19 A-D	15.00 A-C	5.49 A-D	78.18 A-D
6	13.41 A	20.05 A-C	24.97 AB	16.42 AB	6.07 AB	96.18 AB
7	9.34 C-F	17.27 B-E	16.40 D-F	10.99 CD	4.58 B-E	66.48 C-F
8	11.15 A-D	16.61 C-E	23.56 A-C	14.77 A-C	5.12 A-D	76.33 A-D
9	9.19 C-F	15.18 DE	18.73 B-F	11.89 B-D	4.23 C-E	61.21 D-F
10	9.69 B-F	16.00 DE	17.21 C-F	12.35 B-D	3.99 DE	63.48 D-F
11	10.00 B-F	16.63 C-E	18.69 B-F	12.35 B-D	4.89 E	71.11 C-F
12	7.29 F	14.49 E	14.27 F	8.43 D	3.55 B-E	49.94 EF
13	9.94 B-F	16.66 C-E	20.55 A-F	11.99 B-D	4.65 A-D	69.21 C-F
14	10.06 B-E	16.60 C-E	19.45 B-F	10.66 CD	3.90 E	65.54 C-F
15	10.20 B-D	14.50 E	22.02 A-E	14.75 A-C	4.54 B-E	66.90 C-F
16	11.69 A-C	19.94 A-C	17.63 C-F	10.72 CD	3.81 E	73.50 B-E
17	11.74 A-C	20.54 AB	19.39 B-F	10.46 CD	3.70 E	73.49 B-E

Means followed by the same letter in a column are not significantly different ($\propto = 0.05$).

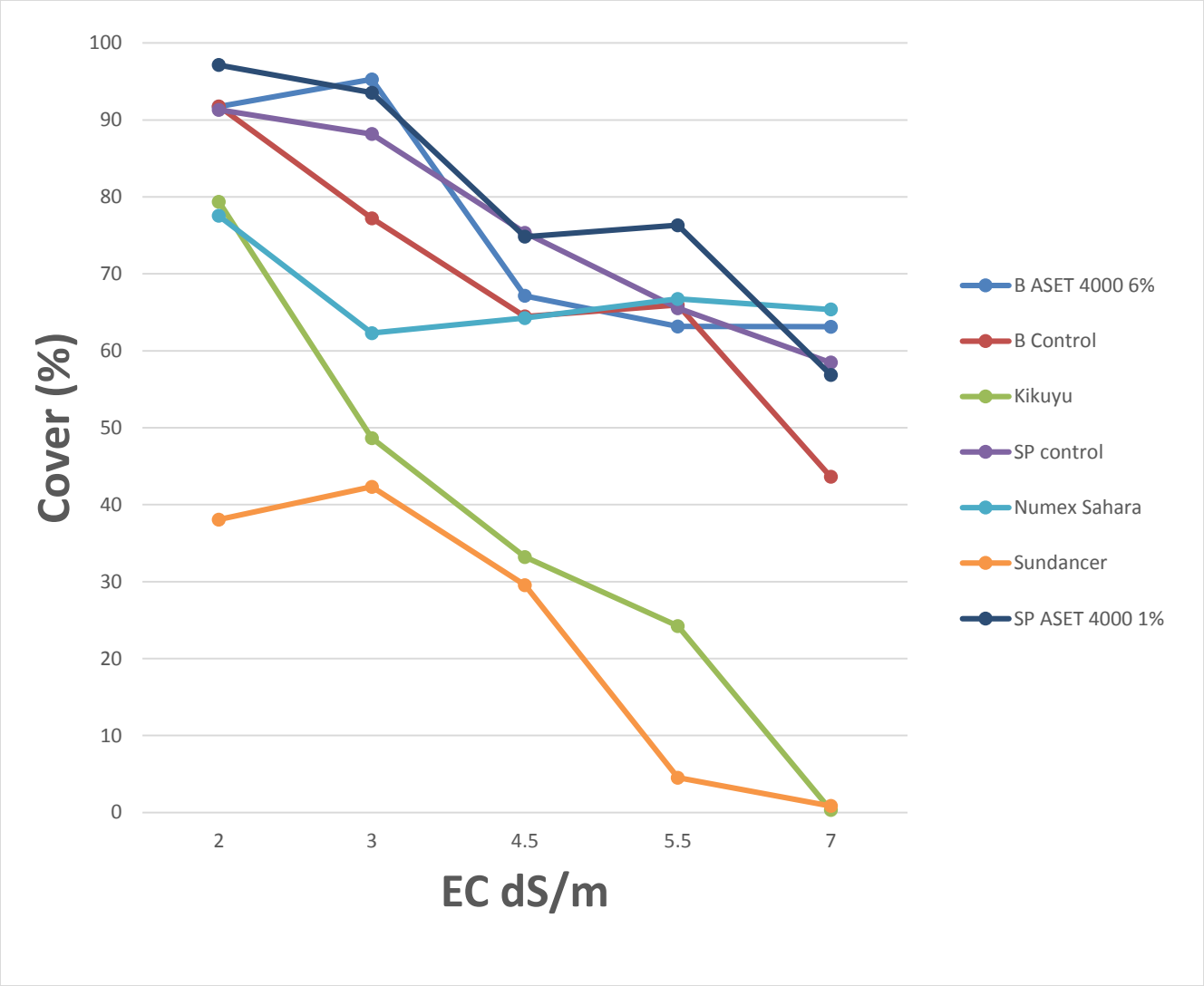

Figure 1. Percent turf groundcover on 30 September 2014 of coating treatments that were significantly different in comparison to uncoated bermudagrass (B), seashore paspalum (SP), buffalograss, and kikuyugrass.