Influence of Humic Acid on Kentucky Bluegrass Establishment

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Objective

This study tested a humic acid material at two application rates and two application schedules applied in combination with a starter fertilizer. The purpose of this study was to:

1. Evaluate the effectiveness of humic acid on Kentucky bluegrass (*Poa pratensis* L.) establishment in native soil.

Explanation

Anectodal evidence suggests that humic acid may improve germination and establishment of turf grasses such as Kentucky bluegrass. The root mass and root strength of Kentucky bluegrass sod was improved after humic acid was applied to the foliage at planting in sand, but the humic acid did not imporve shoot growth or visual quality (Ervin et al., 2008). Although humic acid may benefit the grown-in of sod, information regarding Kentucky bluegrass establishment from seed with humic acid is limited, including the effects in native soil environments.

Plot Design and Treatments

The experiment was conducted on a driving range at Saratoga Springs Golf Course in Saratoga Springs, UT. The driving range consisted of a calcareous native-soil with a pH of 7.67, ECe of 3.99 dS/m, and phosphorus (P) and potassium (K) soil levels of 31 mg/kg and 599 mg/kg respectively. Humic acid treatments were evaluated on the establishment of ‘Impact’ Kentucky bluegrass at different rates and with multiple application timings – in combination with a starter fertilizer – and compared to a starter fertilizer only control. The experiment was located at the back of the driving range. The driving range was routinely used as a source of sod for the golf course, and this particular area was harvested earlier in the year and was fallow upon beginning the experiment. Only a few weeds and pieces of sod remained in the area before planting seed for the experiment.

Planting occurred on 26 September, 2008. The soil was scratched with a steel rake several times in different directions to loosen the soil and prep the seed bed. Any large pieces of old sod or weeds were cut out or pulled by hand to provide a clean planting area. The plot was strung out to identify individual treatment blocks and seed was applied to the entire area with a calibrated drop-spreader that applied 2 pounds of seed per 1000 ft^2. The seed was then lightly raked in each block. Soil nutrition was equalized with a starter fertilizer (7-7-7 Seven Iron™, Grigg Bros., Albion, ID) and applied by hand to all plots at a rate of 1 pound of nitrogen (N) per 1000ft^2 and incorporated into the soil with a light-raking. Humic acid (Black Earth Humates Ltd., Edmonton - Alberta, Canada) was applied as a liquid at 5 gallons/acre or 10 gallons/acre to the soil with a pressurized CO_2 backpack sprayer operating at 40 psi, and applied in approximately 100 GPA of water (Figure 1). Immediately after planting and applying the treatments, a light irrigation with over-head Toro 670 rotors was done to settle the soil and water in the treatments (Figure 2). Light, frequent irrigations were done to keep the soil moist until germination occurred on 9 October, 2008. Repeat applications of humic acid at both rates were applied to specific plots after germination, on 23 October, 2008. Treatments in the experiment were arranged in a randomized complete block design, with four replications and a plot size of 5 feet by 5 feet (Figures 3, 4).

Figure 1. Experiment layout after planting seed and applying humic acid to the soil. The humic acid treatments are dark in color compared to the controls which received no liquid humic acid.

Figure 2. The seed, fertilizer and humic acid were watered in at planting and irrigation was done to keep the soil moist to encourage germination.

N▼

Rep 1

Control	HA 5gal/acre 1 app
HA 5gal/acre 2 apps	Control
HA 10gal/acre 1 app	HA 10gal/acre 2 apps
HA 10gal/acre 1 app	HA 5gal/acre 2 apps
HA 5gal/acre 1 app	Control
HA 10gal/acre 2 apps	Control

Rep 3

2' isle way

Rep 2

Control	HA 5gal/acre 1 app
Control	HA 10gal/acre 2 apps
HA 10gal/acre 1 app	HA 5gal/acre 2 apps
HA 5gal/acre 2 apps	Control
HA 10gal/acre 2 apps	Control
HA 10gal/acre 1 app	HA 5gal/acre 1 app

Rep 4

Figure 3. Experimental plot layout with randomization of humic acid treatments (HA) in 5 feet by 5 feet individual plots in each replication. An extra control treatment was used as filler plot.

Figure 4. Experiment design with humic acid treatments in bottles in individual blocks after Kentucky bluegrass seed was planted at 2 lbs/1000ft^2.

Plot Management

After germination, irrigation of the seedlings was reduced to encourage rooting and aid in establishment. Weeds were not a major problem during the experiment and were periodically removed by hand. No pesticides or additional fertilizers were applied to the turf during the experiment. Also, the turf was not mowed during establishment.

Evaluations of Germination and Establishment

Germination and establishment effects of humic acid were measured by visual inspection and digital image analysis of the plots. The plots were evaluated one week after treatment applications, but no germination had occurred (2 October, 2008). Germination was observed two weeks after planting on 9 October, 2008, and individual seedlings were counted using two methods. The first involved dropping a 0.5 inch-thick piece of a 2 inch diameter PVC pipe from a height of approx. 2 feet at six random locations in each plot (Figure 5a). Individual seedlings inside the pipe were counted and the six values were averaged to get the plot mean. The second method involved counting plants that intersected a 14-gauge wire that was pulled at 3 random transects in each plot (Figure 5b) and the three values were averaged to get the plot mean. Plant

counts were also done on 23 October, 2008 but not done after this date as counting the seedlings became difficult once they began to mature. Once germinated, establishment was visually evaluated on a density scale of 1-9, with 9 having the most dense turf cover and 1 having the least cover. Digital images of the plots were taken the same days as density ratings and analyzed for percent green cover using SigmaScan Pro software (v 5.0, SPSS, Chicago, IL). This has been an effective method of determining the percentage of turf cover in the field (Richardson et al., 2001). The software measures green pixels in each image and divides them by the total pixels for a percent green cover scale of 0-100, with 100 having complete green cover and 0 having no green cover – or bare soil. Small weeds present in the plots were removed by hand on each evaluation date before images were taken to improve the accuracy.

Figure 5a (left), 5b (right). A piece of PVC pipe (left) and a line-intersect (right) were used to count individual plants in each plot to determine germination effects from the humic acid.

Statistical Analysis

Plant counts, density, and digital image analysis of cover were analyzed for differences using the PROC MIXED analysis (SAS Institute, 2003) and means compared using Fisher's protected LSD. Two statistical methods were used. Analysis of means on individual rating dates was done as a randomized complete block design with humic acid treatment as a fixed variable, and replication was considered random. Additionally, a repeated analysis of all dates for density and digital image analysis of cover means was done as a split-plot design with humic acid treatment as whole-plots and date as sub-plots, and replication was considered random.

Results on Germination

Germination of Kentucky bluegrass was not enhanced with the addition of humic acid to the soil. No humic acid treatment provided quicker germination than the control as all plots germinated on 9 Oct., 2008 (~ 2 weeks after planting), and plant counts after germination had no overall differences. However, means comparisons of plants counted with the PVC pipe on 23 October, 2008 had some differences, but the trends were not logical – and not consistent with density and digital image analysis of cover data on the same date (Table 1). These differences were probably due to experimental error.

Results on Establishment

No overall differences for visual density or digital image analysis of cover were observed for any treatment on any date, but means comparisons of density ratings did have some differences on two rating dates (Table 1). However, like differences observed with the plant counts, the trends for the density means were not logical. Date was a significant effect for both density and digital image evaluations (Tables 2, 3), but this was expected as the turf became more established over time. Although differences in density rating means did occur on two of the three rating dates, average density ratings of all dates was not different (Table 2) – and the results were not consistent with means from the digital analysis of cover on the same dates (Table 1; Figure 6).

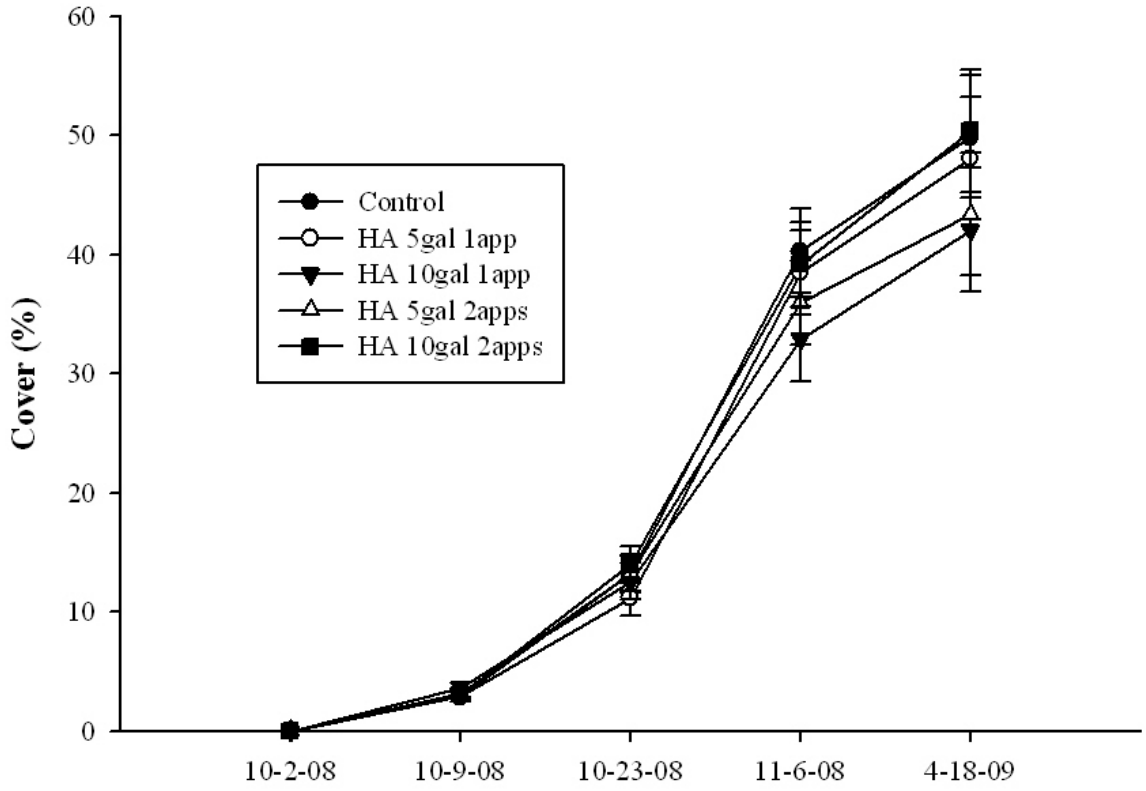


Figure 6. Digital image analysis of cover for Kentucky bluegrass plots treated with humic acid as determined by SigmaScan software. Bars indicate LSDs (*P*=0.05) for treatment comparisons at a given day. HA=humic acid.

Conclusion

The humic acid treatments did not improve the establishment of Kentucky bluegrass seed in native soil during the experiment. Humic acid treatments did not encourage quicker germination, nor enhance greater spread of the turf after germination – as no treatment at any rate, or number of applications provided better establishment than the control plots throughout the experiment (Figures 7a, 7b; Appendix A). Although a few statistical differences existed on a few dates, no logical trends existed between the treatments – and the averages of all dates did not show any differences. These data suggest there is no benefit from humic acid in the establishment of Kentucky bluegrass seed in native soil compared to only using a starter fertilizer.

Soil tested at the beginning of the study revealed salt levels (ECe = 3.99 dS/m) higher than what is recommended for growing bluegrass turf (ECe < 3.0 dS/m). This may or may not have negatively affected the growth of the Kentucky bluegrass in this study. However the grass was not visually affected by these saline conditions during establishment – and it was interesting to note that the humic acid treatments provided no growth benefit to the turf in these conditions compared to the control. Further investigation into the influence of humic acid on turf establishment in saline soils is warranted.

Figure 7a (left), 7b (right). Once the seed was germinated, visual observation of the plots showed no differences in the rate of establishment throughout the experiment as indicated by pictures taken on 11 November, 2008 (left) and 18 April, 2009 (right).

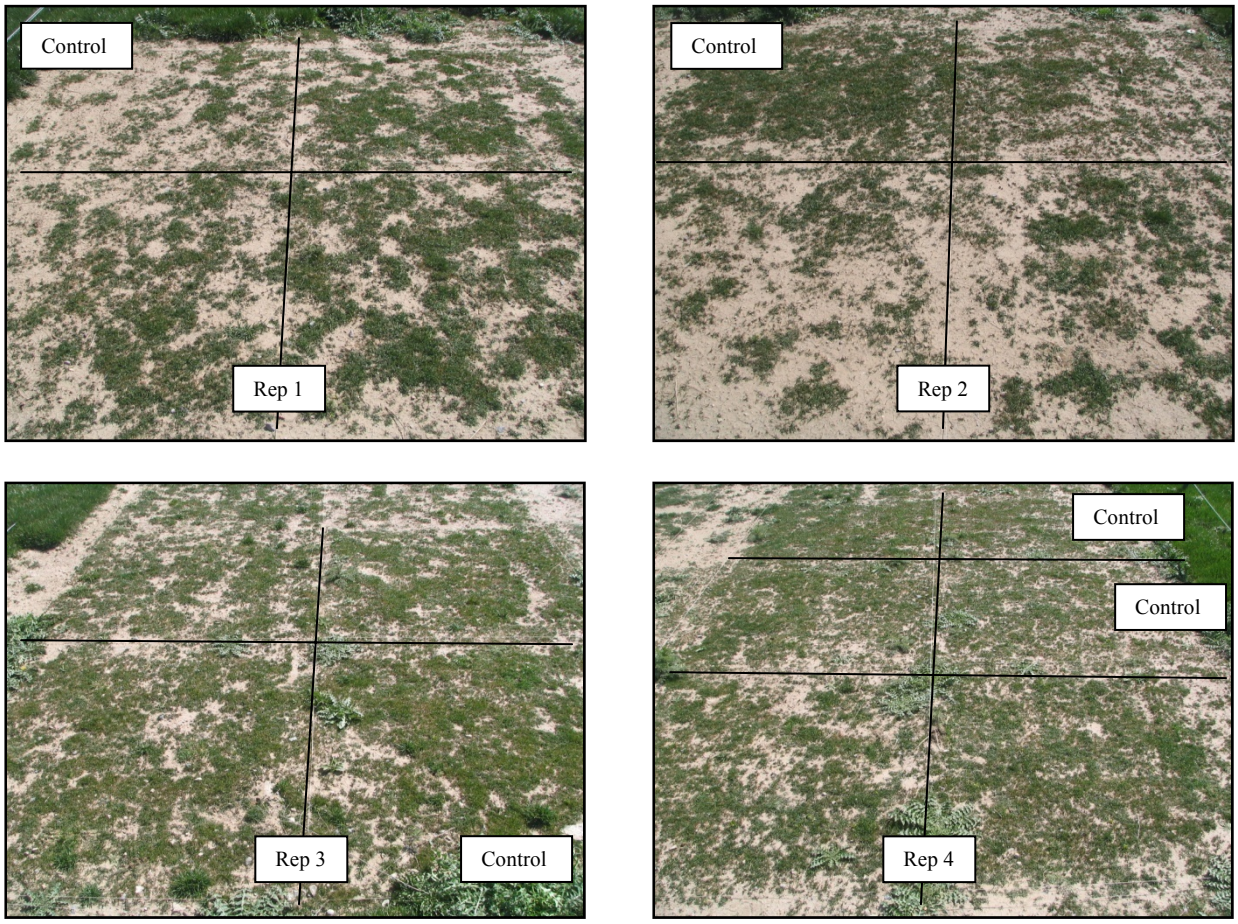
References

Ervin, E.H., X. Zhang, and J.C. Robets. 2008. Improving root development with foliar humic acid applications during Kentucky bluegrass sod establishment on sand. Acta Hort. (ISHS) 783:317-322. Available online at www.actahort.org/books/783/783_33.htm.

Richardson, M.D., D.E. Karcher, and L.C. Purcell. 2001. Quantifying turfgrass cover using digital image analysis. Crop Sci. 41:1884–1888.

SAS Institute. 2003. SAS 9.1 for Windows. SAS Institute, Cary, IN.

Appendix A



Representative pictures of each replication on the last rating date (18 April, 2009) showed few differences in the establishment of Kentucky bluegrass treated with humic acid compared to the control (starter fertilizer only). Some differences could be seen in reps 1 and 2, but often the control plots had the densest stand of turf in these replications. In reps 3 and 4, no difference in the density of the turfgrass was evident.

Table 1. Effect of humic acid application[†] on the germination and establishment of Kentucky bluegrass in native soil.

Treatment	Germination				Establishment						
	Plant Counts				Density[††]			Percent Cover[‡‡]			
	------ Pipe[§] ------		----- Line[¶] -----		---------- # ----------			---------- % ----------			
	10-9	10-23	10-9	10-23	10-23	11-6	4-18-09	10-9	10-23	11-6	4-18-09
Humic acid 5 gal/acre 1 app	18.0 a[‡]	40.9 a	28.0 a	71.8 a	3.0 a	4.5 a	6.5 a	2.9 a	11.2 a	38.5 a	48.1 a
Control	15.1 a	34.0 ab	36.2 a	82.9 a	3.5 a	4.4 ab	6.3 ab	3.2 a	13.2 a	40.3 a	49.9 a
Humic acid 10 gal/acre 2 apps	14.1 a	33.0 a	37.3 a	86.2 a	3.8 a	4.3 ab	6.3 ab	3.1 a	14.0 a	39.2 a	50.4 a
Humic acid 5 gal/acre 2 apps	13.4 a	34.6 ab	33.1 a	97.4 a	4.0 a	4.0 a	5.8 ab	2.9 a	13.3 a	36.0 a	43.4 a
Humic acid 10 gal/acre 1 app	11.3 a	27.0 b	23.7 a	92.0 a	3.5 a	3.0 b	4.8 b	3.7 a	12.6 a	32.9 a	42.1 a

[†]Treatments were applied to the soil at planting on 26 September, 2008, and to the turf after germination on 23 October, 2008 (2 apps treatments only).

[‡]Means within same column with same letter are not different significantly (P=0.05) using Fisher's LSD mean separation method.

[§]Number of plants using a 2 inch diameter pipe method.

[¶]Number of plants using a line-intersect method.

[††]Turfgrass density rating scale 1-9, with 9=most dense, and 1=least dense.

[‡‡]Percent cover (0-100) of digital photographs using SigmaScan software (www.aspiresoftwareintl.com/html/sigmascan_pro).

Table 2. Average visual density ratings of three dates for humic acid treatments applied to Kentucky bluegrass during establishment.

Treatment		Density
		#
Humic acid 10 gal/acre 2 apps		4.8 a[†]
Control		4.7 a
Humic acid 5 gal/acre 1 app		4.7 a
Humic acid 5 gal/acre 2 apps		4.6 a
Humic acid 10 gal/acre 1 app		3.6 a
ANOVA		
Effect	**df**	
Treatment	4	ns
Date	2	***
Treatment × Date	8	ns

[*, **, ***, ns], significant at P≤0.05, 0.01, 0.001, or not significant respectively

[†]Means within same column with same letter are not different significantly (*P*=0.05) using Fisher's LSD mean separation method.

Table 3. Average digital image analysis of cover values of four dates for humic acid treatments applied to Kentucky bluegrass during establishment.

Treatment		Cover
		#
Humic acid 10 gal/acre 2 apps		26.7 a[†]
Control		26.6 a
Humic acid 5 gal/acre 1 app		25.2 a
Humic acid 5 gal/acre 2 apps		23.9 a
Humic acid 10 gal/acre 1 app		22.8 a
ANOVA		
Effect	**df**	
Treatment	4	ns
Date	3	***
Treatment × Date	12	ns

[*, **, ***, ns], significant at P≤0.05, 0.01, 0.001, or not significant respectively

[†]Means within same column with same letter are not different significantly (*P*=0.05) using Fisher's LSD mean separation method.