Effect of Bioorganic Turf Amendments on Microbe Populations, Necrotic Ring Spot and Thatch

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Bioorganic turf amendments were examined for their influence on microbe populations, management of Necrotic Ring Spot (Leptosphaeria korrae) and thatch control in each of three different irrigation regimes. The study was performed at the Hancock Turfgrass Research Center on the campus of Michigan State University on a five year old Kentucky bluegrass (Poa pratensis, cultivars bristol and victa) muck sod. The turfstand was inoculated on 5/6/86 with L. korrae. At present the stand is severely diseased.

Treatments were applied to muck sod in a Randomized Complete Block design. The turf amendments Biogroundskeeper, Greenspeed, Nitroform, Sustane, Turf Restore and urea were applied to 6x6' plots in each of nine irrigation blocks. Three turf blocks received 0.1"/day irrigation, three received an 80% evapo-pan irrigation twice per week (80% of the water lost from an open evaporation pan was applied to these blocks on mondays and fridays, ex. 1" lost = .80" applied), and three blocks received no supplemental irrigation, (rain only). Treatment application began on May 15 with subsequent applications indicated in table 1. Granular treatments were preweighed and applied by hand. Liquid treatment were applied as drenches with two gallons water. After each application all plots were irrigated for fifteen minutes. The area was mowed to 2.5" twice per week and received infrequent foot traffic.

Disease incidence was evaluated on September 28, 1988, (table 1). Disease ratings were taken by counting the number of active ring spots in each plot.

On October 21 three 43 mm diameter plugs from each plot were removed for thatch measurement. Thatch layers were removed, washed for fifteen minutes each in a root washer, dried at 60°C for 24hr., desiccated for 24hr., then weighed. Ash weights were determined and subtracted from thatch weight to correct for mineral matter. The corrected thatch weights are presented in table 2.

Microbe counts in soil and thatch were determined for each treated plot under each irrigation regime during the 1988 growing season. Experiments for microbe enumeration were performed on May 5, June 17, July 8, 19, 29, August 9, 25, September 15, October 3, and November 2. Bacteria, fungi and actinomycete total populations were measured in soil and thatch of each test plot using the plate count technique. Inoculum was prepared from three 19mm samples removed from each replicated plot with a soil probe. Samples from each plot were combined and one gram each of soil and thatch were diluted to 10^{-4} in .85% saline. One ml inoculum preparation from each soil and thatch dilution was added to molten agar held at 45°C. Selective agar was used to enumerate each microbe population. Nutrient agar was used for bacteria, potato dextrose agar amended with penicillin and streptomycin was used for fungi, and starch-caesin agar amended with nystatin, cycloheximide, polymyxin B sulfate, and penicillin was used for actinomycetes. Plates were incubated at room temperature (21°C). Bacteria were counted after three days, fungi after five days and actinomycetes after eight days incubation.

At the time of each plate count experiment the percent moisture content of soil and thatch from each irrigation block was determined. The results were averaged and are presented in graph 1. In most cases higher moisture levels were reported in the thatch. With daily irrigation treatment moisture levels were generally higher than either 80% pan or rain only treated plots in both soil and thatch. Stimulation of microbes, especially bacteria, in the soil and thatch is largely dependent on organic matter and moisture. Microbe utilization of organic matter is limited by available moisture.

Disease Study Results.

Irrigation treatments had the greatest impact on disease incidence. All test plots receiving 1/10 inch daily irrigation had less number of active ring spots than those plots receiving 80% evapo-pan or rain only treatment. Irrigation treatments were the most significant factor in management of necrotic ring spot, as shown in table 1 (analysis of variance).

Table 1 also indicates several bioorganic treatments had significantly less ring spots than the untreated control at the 5% level using Duncan's Multiple Range test. When combined with daily irrigation Turf Restore (10#/month), Greenspeed (8oz./month), and Sustane (10#/month) were significantly different from the control. Sustane and Turf Restore when used with an 80% evapo-pan irrigation had significantly less ring spots than the untreated control. Due to drought conditions disease in the rain only plots remained inactive and could not be evaluated. On the average only 50% of the muck sod was left in these plots at the end of the season.

Thatch Study Results.

When results of the daily irrigation plots were analyzed at the 5% level of significance using Duncan's Multiple Range test no treatment was significantly different from the untreated control. In the 80% pan irrigation regime Nitroform, Urea, Sustane, Turf Restore and Biogroundskeeper had significantly less thatch than the untreated control. No treatment resulted in significantly less thatch than the untreated control in the rain only irrigation block. A factorial analysis of variance of results from all irrigation regimes revealed differences in thatch levels were highly significant among daily, 80% evapo-pan, and the rain only irrigation blocks.

Microbe Study Results.

In the untreated control plots, comparison of total bacteria plate counts in soil and thatch of each irrigation regime reveal thatch supported greater bacteria populations than soil on most dates (Graphs 2 and 3). Comparison of plate counts of total thatch bacteria in the untreated control plots of each irrigation regime revealed daily irrigation treatments supported twice the bacteria populations as 80% pan irrigation and three times the bacteria populations of rain only treatments from early to mid summer, which is the time of year infection by the necrotic ring spot pathogen, L. korrae, takes place (Graph 3). The increase in thatch bacteria populations at the time of fungal infection may have lead to a decrease of disease activity. Plate counts performed in late summer and fall reveal thatch bacteria populations in the rain only plots were similar to daily and 80% pan populations in the untreated control plots . Increases of bacteria in rain only plots in late season may be associated with increased rainfall and unused organic matter which was not consumed during drought conditions (Graph 3).

Sustane in the daily irrigation treatment had higher populations of thatch bacteria than the untreated control for most of the season (Graph 4). The Nitroform treated plots in the daily irrigation had higher total thatch bacteria populations than the untreated control in late season plate counts (Graph 4). In the daily irrigation treatment the Turf Restore treated plots had higher soil and thatch bacteria populations for most of the season as compared to the untreated control. The Turf Restore treated plots showed increased total bacteria populations following each monthly application. Stepwise increases in total bacteria populations with Turf Restore over the course of the season is evident in both soil and thatch although more pronounced in thatch (Graphs 5 and 6).

Discussion.

Daily irrigation treatment increased percent moisture in the soil and thatch. Comparison of control plots in each irrigation regime reveal the increase in percent moisture through daily irrigation treatment favored total bacteria populations, especially in the thatch. Total soil and thatch actinomycete populations did not change significantly in any of the irrigation treatments. Total fungi populations also showed little variation between treatments.

Disease expression is significantly different between irrigation regimes (Table 1, Analysis of variance summary). Daily irrigation test plots had the least number of active ring spots. Three treatments Turf Restore, Sustane, and Greenspeed were found to have significantly less ring spots than the control in the daily irrigation treatment. When combined with 80% pan irrigation Turf Restore and Sustane had significantly less disease than the untreated control (Table 1). All treatments had less ring spots in the daily irrigation treatment compared to 80% evapo-pan irrigation treatment. The daily irrigation regime was found to significantly decrease disease incidence compared to 80% evapo-pan irrigation regime.

Thatch levels were lower for all treatments that received supplemental irrigation compared to the rain only regime. This indicates moisture may have an effect on thatch decomposition. The amount of thatch in the control plots receiving daily irrigation was lower than the untreated control plots in the other irrigation regimes. The daily irrigated plots averaged the highest percent moisture and the highest total bacteria populations during early summer. Nitroform, urea, Turf Restore, Sustane and Biogroundskeeper had significantly less thatch than the untreated control in the 80% pan irrigation regime.

Conclusion.

Stimulation of total bacteria populations by maintaining high soil and thatch moisture levels was accomplished through daily irrigation. Several bioorganic treatments were able to stimulate bacteria populations, as compared to the untreated control, in the daily and 80% pan irrigation regimes. Those test plots which averaged higher bacteria populations demonstrated reduced disease incidence as well as reduced levels of thatch.

Table 1. Analysis of Variance and **Treatment Means** Regarding the Effect of Bioorganic Treatments and Irrigation on Necrotic Ring Spot in Kentucky Bluegrass for 9/28/88.

	Treatment Means Irrigation regime					
Treatment,[a] Rate/1000sq.ft.	DAILY	DMR	80%	DMR	RAIN ONLY[b]	DMR
Sustane 1#N	0.33	A*	2.7	AB	45	-
Greenspeed 8 oz.	0.33	A	5.0	C	57	-
Turf Restore 1#N	0.33	A	1.3	A	53	-
Biogroundskeeper 2oz.ea. A,B & C	1.33	AB	4.3	BC	52	-
Urea 0.5#N	1.7	AB	4.7	BC	50	-
Nitroform 1.5#N	2.0	AB	4.7	BC	37	-
Control	3.0	B	6.3	C	37	-

*Treatments followed by the same letter are not significantly different from each other at the 5% level. Duncans Multiple Range test.

a. All treatments were applied monthly (5/25, 6/27, 7/26, 8/26 and 9/27). Sustane treatment not applied on 5/25. Nitroform was applied after aerification on 6/27 and 9/27.

b. Data in this column represents average percent of green grass remaining after drought, no disease reading were taken.

Analysis of variance summary.

Source of variation.	df	mean square	F value
Replication	2	9.929	6.89 **
Treatments	6	9.429	6.54 **
Irrigation	1	85.714	59.47 **
T x I	6	1.825	1.27 NS
Error	26	1.441	

*,** Significantly different at the 0.05 and 0.01 probability levels, respectively. NS = not significant.

Table 2. Analysis of Variance and Treatment Means Regarding the Effect of Bioorganic Treatments and Irrigation on Thatch$_a$ in Kentucky Bluegrass for 10/21/88.

Treatment Means
Irrigation regime

Treatment$_b$	Daily DMR		80% Pan DMR		Rain only DMR	
Sustane 1#N	.62g	A*	.70g	AB	1.0	A
Biogroundskeeper 2 oz.ea. A,B & C	.73	A	.86	AB	.98	A
Urea 0.5#N	.74	A	.69	AB	1.11	AB
Greenspeed 8oz.	.83	A	1.00	BC	1.69	C
Turf Restore 1#N	.84	A	.70	AB	1.15	AB
Nitroform	.84	A	.63	A	1.37	AB
Control	1.04	A	1.17	C	1.34	AB

*Treatments followed by the same letter are not significantly different from each other at the 5% level of significance using Duncans Multiple Range test.

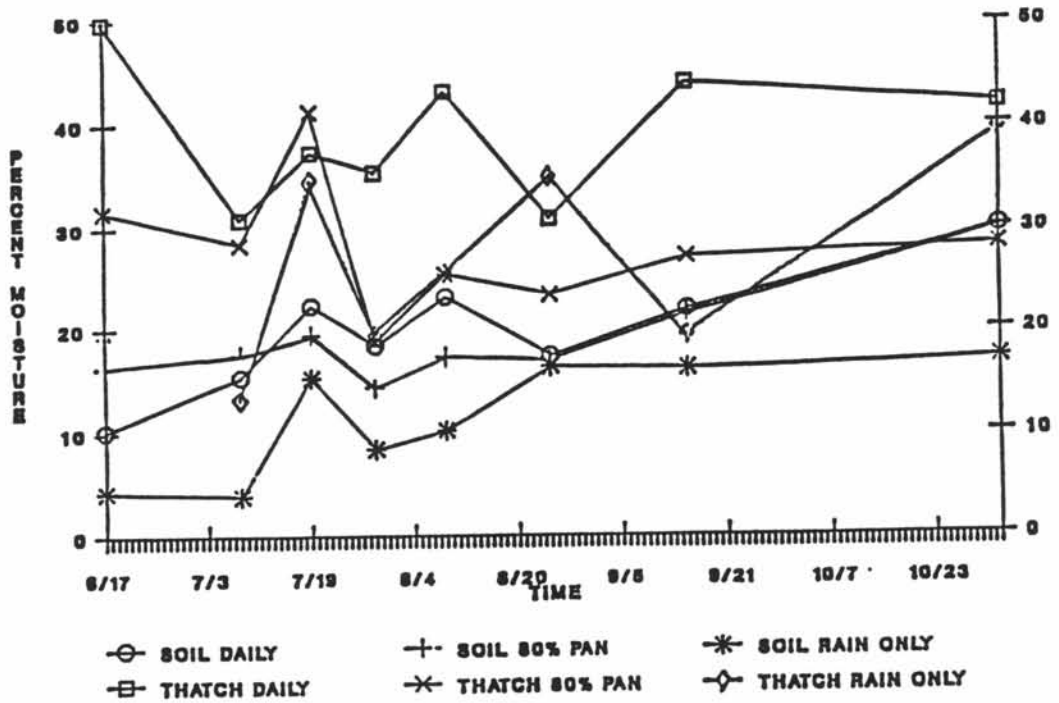
a. Plug sample size = 42 mm diameter.
b. All treatments were applied monthly (5/25, 6/27, 7/26, 8/26 and 9/27). Sustane treatment not applied on 5/25. Nitroform was applied after aerification on 6/27 and 9/27.

Analysis of variance summary.

Source of variation	df	mean square	F value
Replication	2	0.076	1.13 NS
Treatments	6	0.284	4.21 *
Irrigation	2	1.291	19.12 **
T x I	12	0.059	0.88 NS
Error	40	0.068	

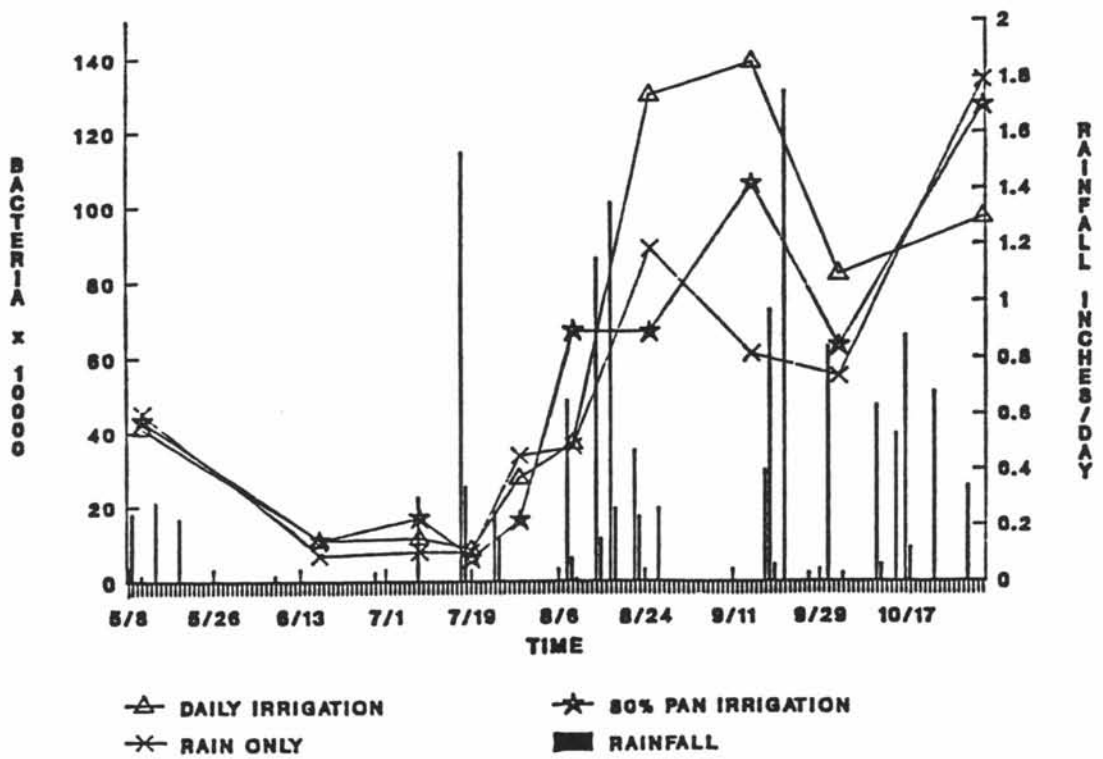
*,** Significantly different at the 0.05 and 0.01 probability levels, respectively. NS = not significant.

Graph 1. PERCENT MOISTURE.
SOIL AND THATCH WITH IRRIGATION.



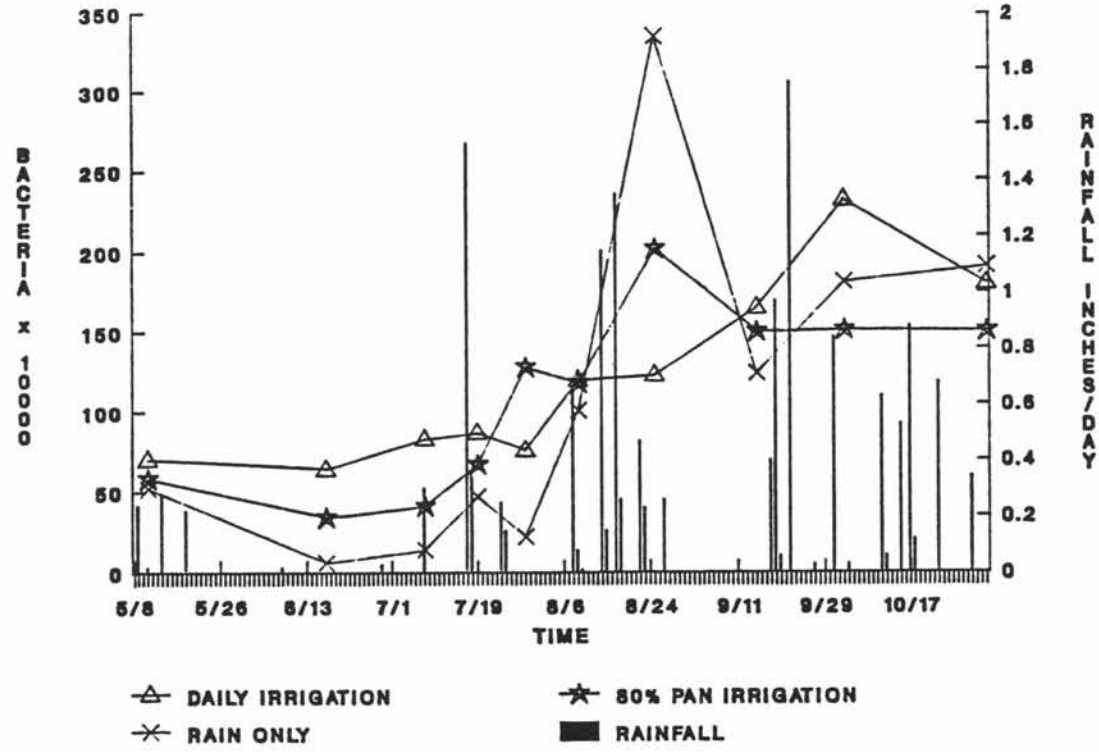
KENTUCKY BLUEGRASS MUCK SOD, 1988.

Graph 2. SOIL BACTERIA PLATE COUNTS.
EFFECT OF IRRIGATION



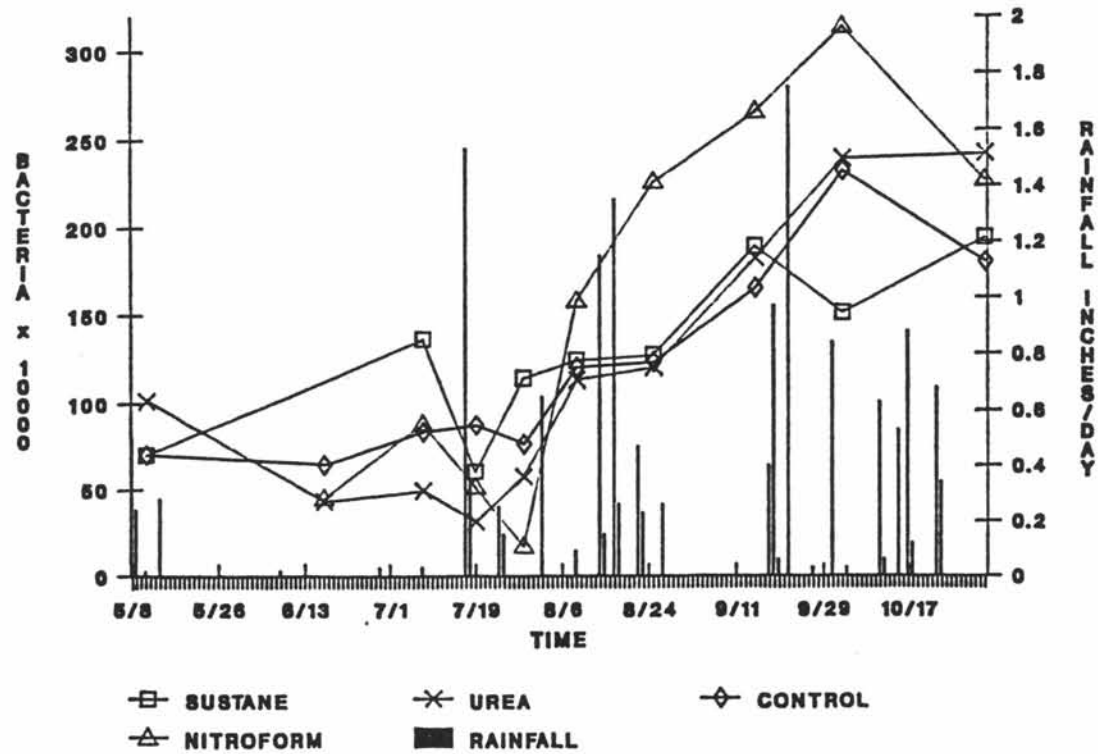
KENTUCKY BLUEGRASS MUCK SOD, 1988.

Graph 3. THATCH BACTERIA PLATE COUNTS.
EFFECT OF IRRIGAITON



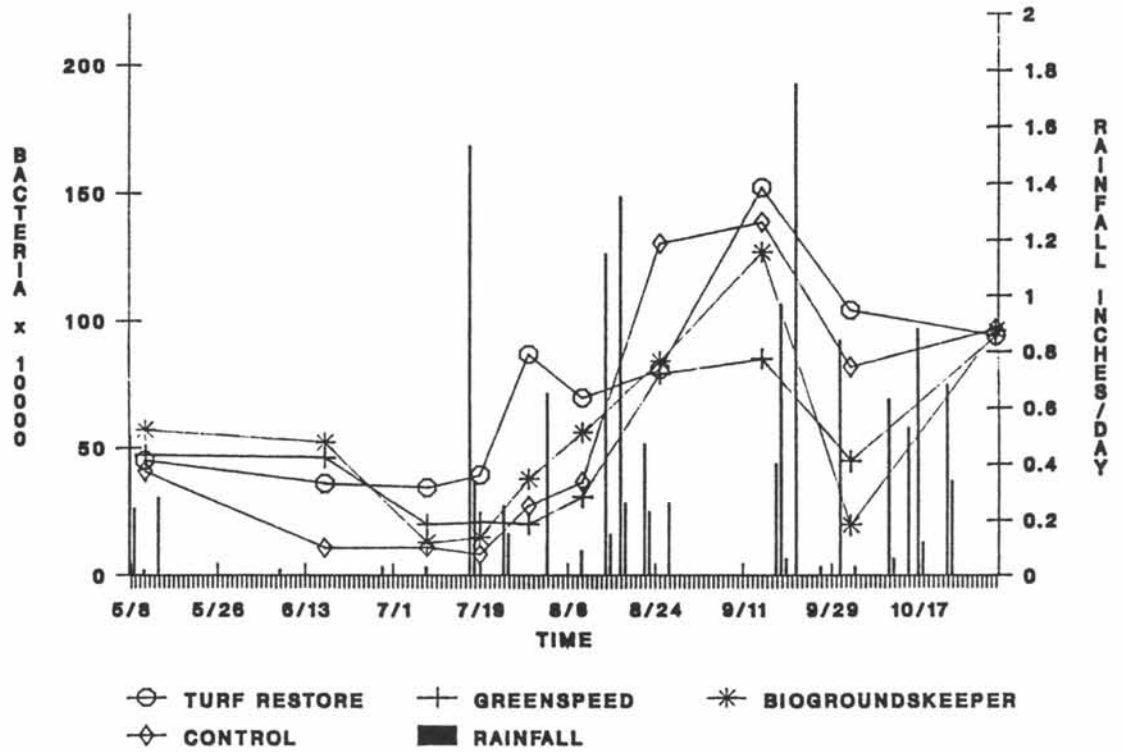
KENTUCKY BLUEGRASS MUCK SOD, 1988.

Graph 4. THATCH BACTERIA PLATE COUNTS
ORGANIC TREATMENTS WITH DAILY IRRIGATION



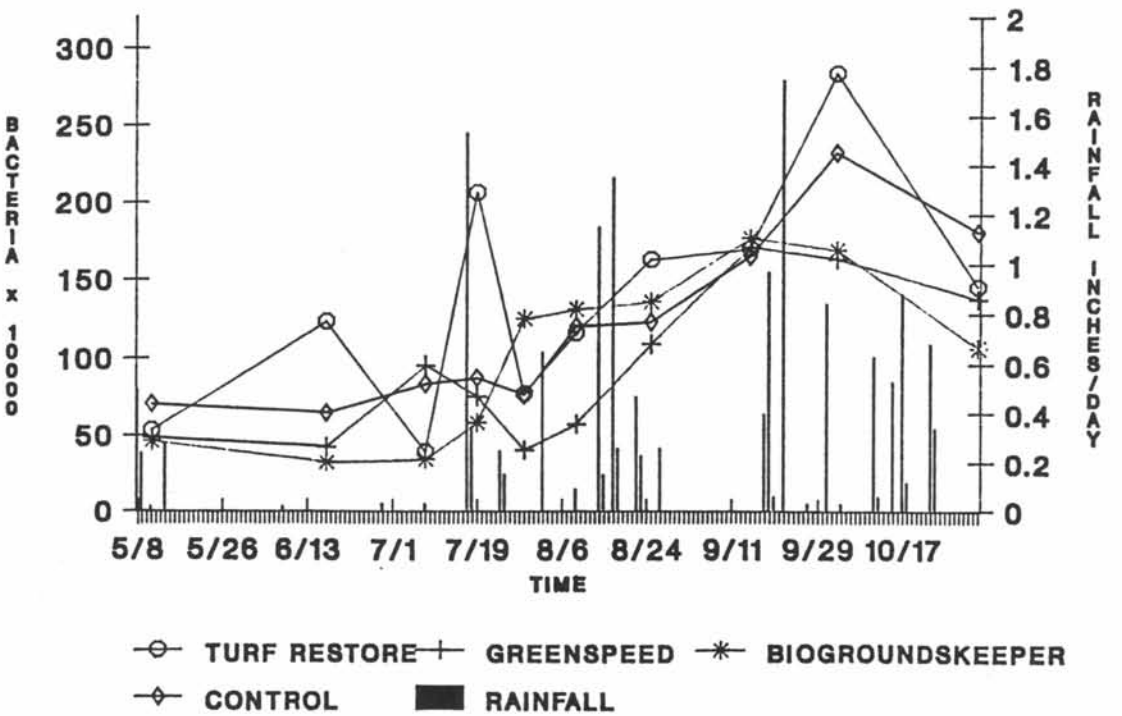
KENTUCKY BLUEGRASS MUCK SOD, 1988.

Graph 5. SOIL BACTERIA PLATE COUNTS
ORGANIC TREATMENTS WITH DAILY IRRIGATION



KENTUCKY BLUEGRASS MUCK SOD, 1988.

Graph 6. THATCH BACTERIA PLATE COUNTS.
ORGANIC TREATMENTS WITH DAILY IRRIGATION



KENTUCKY BLUEGRASS MUCK SOD, 1988.