# EFFECT OF FERTILIZER AND IRRIGATION TREATMENTS ON NECROTIC RING SPOT OF KENTUCKY BLUEGRASS

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Bio-organic amendments and slow release fertilizers were evaluated for necrotic ring spot management and thatch reduction under three irrigation regimes in a field study on six year old Kentucky bluegrass (Poa pratensis), cultivars Baron, Bristol and Victa, muck sod. The study was carried out at the Hancock Turfgrass Research Center at Michigan State University.

Bio-organic amendments were provided by the following companies: Sustane Corporation (Sustane, 5-2-4); Ringer Corporation (Lawn Restore, 9-4-4); KLM Biosystems (Biogroundskeeper) and Bio-Agronomics Corporation (Bio-Agronomics, 20-20-20). Controlled release fertilizers were provided by Nor-Am Chemical Corporation (Nitroform, 38-0-0); Growth Products (G.P. 27-2-3); and Vigoro Industries Incorporated (IBDU, 18-3-24).

Incidence of necrotic ring spot may be effected by shifts in soil and thatch microbe populations. The mode of action of irrigation and fertilizer treatments may be through their ability to increase specific microbe populations. Microbe populations may be stimulated through addition of organic matter and/or irrigation. Part of this study was designed to evaluate the influence of irrigation treatments combined with bio-organic and slow release fertilizers on soil and thatch bacteria, fungi and actinomycete populations.

## Methods.

The experiment was conducted as a randomized complete block design with bio-organic amendments and fertilizers applied in combination with three irrigation treatments. Bio-organic amendments and fertilizers were applied to 6 x 6' plots in each of nine 36 x 36' irrigation blocks. Three irrigation blocks received 2.5mm (0.1 inch) supplemental irrigation per day, applied at noon. Due to increased rainfall this summer no supplemental irrigation was applied when plots became saturated (graph A). Three blocks received a twice per week 80% open pan evaporation (OPE) irrigation treatment (80% of the water lost from an open evaporation pan was applied on mondays and fridays, ex: 1" lost = .8" applied). The remaining three blocks received no supplemental irrigation (rain only). The study area was mowed to 2.5 inches twice per week and received infrequent foot traffic.

Treatment application began on 25 May 1989 with subsequent applications on 29 June, 28 July, 4 September, 28 September and 26 October. All nitrogen carrying treatments were applied at 1#N per 1000 sq.ft., other products were applied at the recommended label rate. Granular treatments were preweighed and applied by hand. Liquid treatments were applied as drenches with two gallons water. After each application all plots were irrigated for fifteen minutes to promote treatment infiltration.

On 21 October three 43mm diameter plugs were taken from each test plot. The thatch layer was removed and washed in a root washer for 15 minutes, dried at 60$^{o}$C for 24 hr., desiccated for 24 hr. then weighed. To remove organic matter, each sample was then burned at 600$^{o}$C for 6 hr. Dried thatch weight minus the ash weight provides us with a corrected thatch weight, table 1.

Disease incidence was determined on 28 September 1989, (table 2). Percent area infected was determined by visual ratings on a 0 to 100% scale. <u>Leptosphaeria</u> <u>korrae</u> was isolated from roots exhibiting signs of necrotic ring spot. On 11 October the irrigation system was cleared and no further irrigation treatments were applied for the remainder on the year. To examine treatment carry-over effects on necrotic ring spot a second disease rating was taken on 11 November, 1989 (table 3). At this time irrigation treatments had been discontinued for thirty days.

Using the plate count technique, bactreria, fungi and actinomycete populations were measured in soil and thatch samples taken from test plots within each irrigation block. The following amendments were evaluated for effect on microbe populations; Sustane, Lawn Restore, Nitroform, urea (9-4-4) and FB-3 (10-3-4). FB-3 is an experimental bacteria-fungi composite on an organic carrier formulated by the primary author.

Inoculum was prepared from three 19mm diameter samples removed from each test plot with a soil probe. A composite one gram sample each of soil and thatch was diluted to 1 x $10^{-4}$ in 8.5% saline solution. One ml of inoculum preparation from each soil and thatch dilution was added to molten agar held at 45$^{o}$C. Nutrient agar was used for bacteria counts, potato dextrose agar amended with penicillin and streptomycin was used for fungi, and starch-casein agar amended with penicillin, polymixyin B sulfate, cycloheximide and nystatin was used for actinomycetes. Plates were incubated at room temperature (21$^{o}$C). Bacteria were counted after three days, fungi after five days and actinomycetes after eight days incubation. To measure effects of turf products on microbial populations the plate count experiment was performed before and after treatment application. Enumeration of microbes was performed on 24 May; 28 June; 6 & 11 July; 2, 18 & 28 August; 15 & 27 September; and 20 October.

At the time of each plate count experiment the percent moisture of soil and thatch of each irrigation block were measured (Graph B). Stimulation of microbes, especially bacteria, is largely dependent on available moisture and organic matter. Daily irrigation treatment promoted higher moisture levels than the 80% OPE or rain only treatments in both soil and thatch on most dates. Graph A shows the amount of supplemental irrigation applied each week during the season. More irrigation was applied in the early season with 80% OPE irrigation treatment than the daily irrigation treatment, but near equal amounts were applied thereafter. Higher moisture levels were maintained in the daily irrigated blocks even though less water was applied.

Thatch Study Results.

Factorial analysis indicates that differences in thatch between irrigation treatments was highly significant, F=13.7 (table 1). Differences in thatch between turf amendments was also found to be highly significant, F=3.98. Within each irrigation regime several products were found to have significantly less thatch than the untreated control. Duncan's multiple range was used to test for significant differences between turf amendments within each irrigation regime.

When used without supplemental irrigation, Lawn Restore, Sustane, and Biogroundskeeper + 9-4-4 (urea) had significantly less thatch than the untreated control.

IBDU and 9-4-4 (urea) when combined with 80% OPE irrigation treatment had significantly less disease than the control which received only 80% OPE irrigation treatment.

Although no product when combined with daily irrigation treatment was significantly different than the control, the average of all treatments when combined with daily irrigation was less than the 80% OPE and no supplemental treatment averages, (.762, .860 and .948g respectively).

Irrigation treatments and turf amendments were found to have significant influence on thatch accumulation of Kentucky bluegrass muck sod. Most products when used with daily irrigation had less thatch than when combined with the other irrigation treatments.

Disease Study Results.

Factorial analysis indicates a highly significant difference of disease incidence between irrigation treatments, F=8.6 (table 2). The average percent disease for all treatments combined with daily irrigation was only 2.5, as compared to 5.0 percent disease for all treatments combined with 80% O.P.E. and 6.5 percent disease for treatments without supplemental irrigation. Factorial analysis also indicates a highly significant (F=12.99) difference between bio-organic and fertilizer treatments. Duncan's multiple range was used to test for significant differences in disease incidence between turf amendments within each irrigation regime.

When combined with daily irrigation the commercially available bio-organic fertilizers Lawn Restore and Sustane, and the slow release fertilizers IBDU and Nitroform had significantly less disease than the untreated control. Of the experimental treatments examined Biogroundskeeper + G.P., FB-3, and FB-3 w/o had significantly less disease than the untreated control. Biogroundskeeper amended with the fertilizer make-up 9-4-4 also had significantly less disease than the untreated control in the daily irrigation regime.

The products which significantly reduced the amount of disease under the daily irrigation regime were again significantly different than the untreated control when combined with 80% O.P.E. irrigation treatment. In addition, Biogroundskeeper was found significantly different than the untreated control when combined with 80% O.P.E. irrigation only treatment.

Without supplemental irrigation all turf amendments had significantly less disease when compared to the untreated control.

Most bio-organic and fertilizer treatments when combined with daily irrigation had lower disease ratings than when combined with 80% O.P.E. irrigation or no supplemental irrigation treatments.

Disease ratings taken on 11/9/89, thirty days after irrigation treatments were discontinued, indicate no significant difference between irrigation blocks (table 3). The average for all treatments in the daily irrigation regime increased from 2.5 percent area diseased on 9/28/89 to 6.4 percent area diseased on 11/9/89. After irrigation treatments were discontinued there was an increase of disease in most test plots which had previously been combined with daily irrigation. Apparently there was no carry-over effect of irrigation treatment on disease management. For maximum disease management daily irrigation treatment should be maintained throughout the period of disease activity.

Microbe Study Results.

Graphs 1-A and 1-B show total bacteria per gram of <u>soil</u> from each fertilized test plot receiving daily irrigation. Plate counts taken in June and July indicate the bio-organic fertilizer Lawn Restore increased bacteria populations after two applications. Counts taken after treatment application in June, early September and October indicate Sustane, Lawn Restore, FB-3 and 9-4-4 increased soil bacteria populations after each application as compared to the control which received only 1/10" irrigation per day.

When combined with 80% OPE irrigation treatment Sustane and Nitroform stimulated soil bacteria populations after application in June, July and September as compared to the control which received only 80% OPE irrigation treatment. Lawn Restore and FB-3 treated plots increased total bacteria populations after the 6/29 application but gave varied results therafter, (Graphs 2-A,B).

Without supplemental irrigation Sustane, Lawn Restore and 9-4-4 increased total soil bacteria populations after June, July and September application, (Graphs 3-A,B).

Similiar findings were observed in thatch bacteria plate counts. Irrigation and fertilizer treatments had little effect on fungi and actinomycete total populations (data not shown).

Conclusion.

Most products when combined with daily irrigation had less thatch and disease development than when combined with 80% OPE irrigation treatment or no supplemental irrigation. Results from the plate count experiment indicate various fertilizers increased total bacteria populations in soil and thatch in Kentucky bluegrass. Treatments which stimulated bacteria populations also had less thatch and reduced necrotic ring spot activity.

References.

1. Martin, Alexander. Soil Microbiogy, 2$^{nd}$ Ed. John Wiley & Sons, Inc. New York, N.Y. p 21, 1977.

Table 1. Analysis of variance and treatment means. Effect of fertilizer and bio-organic amendments combined with irrigation treatments on thatch of Kentucky bluegrass.

TREATMENT MEANS

Grams of thatch per 43mm diameter sample, 10/21/89.

| | Irrigation regime | | | | | |
|---|---|---|---|---|---|---|
| TREATMENT | DAILY | dmr | 80% | dmr | RAIN ONLY | dmr |
| 1. Nitroform | .64 | B* | .76 | ABC | .89 | ABC |
| 2. Lawn Restore | .66 | B | .95 | AB | .87 | BC |
| 3. Sustane | .67 | B | .75 | ABC | .88 | BC |
| 4. Biogroundskeeper + 9-4-4 | .70 | B | .82 | ABC | .80 | C |
| 5. IBDU | .72 | AB | .71 | BC | .92 | ABC |
| 6. 9-4-4 | .73 | AB | .67 | C | .89 | ABC |
| 7. Biogroundskeeper | .78 | AB | .99 | AB | 1.10 | AB |
| 8. FB-3 | .78 | AB | .86 | ABC | .98 | ABC |
| 9. Control | .85 | AB | 1.02 | A | 1.16 | A |
| 10. Biogroundskeeper + G. P. | .88 | AB | .89 | ABC | .98 | ABC |
| 11. Bio Agronomics | .98 | A | 1.02 | A | .96 | ABC |
| ave | .762 | | .860 | | .948 | |

* Treatment means followed by the same letter are not significantly different from each other at the 5% level using Duncan's Multiple Range test.
All turf amendments were applied on a monthly basis.
Nitrogen carrying amendments were applied at 1#N/M.

ANALYSIS OF VARIANCE SUMMARY.

| Source of variation. | df | mean square | F value |
|---|---|---|---|
| Irrigation | 2 | .282 | 13.70** |
| Turf amendments | 10 | 0.083 | 3.98** |
| T x I | 20 | 0.015 | .72NS |
| Error | 64 | 0.021 | |

*,** F significant at P=.05 and .01, respectively.
NS = not significant.

Table 2. Analysis of Variance and Treatment Means. Effect of Fertilizer and Bio-organic Amendments Combined with Irrigation Treatments on Necrotic Ring Spot of Kentucky Bluegrass.

TREATMENT MEANS

(Percent area diseased, 9/28/89.

| | | Irrigation regime | | | | | |
|---|---|---|---|---|---|---|---|
| TREATMENT | RATE | DAILY | dmr | 80% | dmr | RAIN ONLY | dmr |
| 1. FB-3,w/o(10-3-4) | 1#N/M | 0 | C* | 0 | D | 0 | D |
| 2. Lawn Rst (9-4-4) | 1#N/M | 0 | C | 1.7 | CD | 1.7 | D |
| 3. Biogroundskeeper + GP(27-2-3) | 2oz 1#N/M | 0 | C | 3.3 | CD | 4.3 | CD |
| 4. Nitrofrm(37-0-0) | 1#N/M | 0 | C | 0 | D | 6.7 | CD |
| 5. 9-4-4 | 1#N/M | 1.7 | BC | 1.7 | CD | 6.7 | CD |
| 6. Biogroundskeeper + 9-4-4 | 2oz 1#N/M | 1 | BC | 4.3 | CD | 3.3 | CD |
| 7. IBDU (18-3-24) | 1#N/M | 1.7 | BC | 3.3 | CD | 1.7 | D |
| 8. Sustane (5-2-4) | 1#N/M | 1.7 | BC | 6.7 | BCD | 3.3 | CD |
| 9. FB-3 (10-3-4) | 1#N/M | 1.7 | BC | 2.7 | CD | 0 | D |
| 10. Bio Agronomics | 1#N/M | 5 | ABC | 11.7 | AB | 10 | BC |
| 11. Biogroundskper | 2oz | 8.3 | AB | 8.3 | BC | 15 | B |
| 12. Control | | 9 | A | 16.7 | A | 25 | A |
| | ave | 2.5 | | 5.0 | | 6.5 | |

* Treatments followed by the same letter are not significantly different from each other at .05, Duncan's Multiple Range.
All treatments were applied at thirty day intervals from May to September.

ANALYSIS OF VARIANCE SUMMARY.

| Source of variation. | df | mean square | F value |
|---|---|---|---|
| Irrigation | 2 | 145.528 | 8.60** |
| Turf amendments | 11 | 219.798 | 12.99** |
| T x I | 22 | 22.841 | 1.35NS |
| Error | 66 | 15.200 | |

*,** F significant at P=.05 and .01, respectively.
NS = not significant.

Table 3. Analysis of Variance and Treatment Means. Effect of Fertilizer and Bio-organic Amendments Combined with Irrigation Treatments on Necrotic Ring Spot of Kentucky Bluegrass after Irrigation Regimes were Discontinued.

TREATMENT MEANS

Percent area diseased 11/9/89.

| | | Irrigation regime | | | | | |
|---|---|---|---|---|---|---|---|
| TREATMENT | RATE | DAILY | dmr | 80% | dmr | RAIN ONLY | dmr |
| 1. FB-3,w/o(10-3-4) | 1#N/M | 0 | C* | 0 | B | 0 | C |
| 2. Lawn Rst (9-4-4) | 1#N/M | 3 | C | 2 | B | 0 | C |
| 3. Biogroundskeeper | 2oz | 0 | C | 2.3 | B | 4 | BC |
| + GP(27-2-3) | 1#N/M | | | | | | |
| 4. 9-4-4 | 1#N/M | 2.3 | C | 1 | B | 5 | BC |
| 5. Biogroundskeeper | 2oz | 2.7 | C | 5 | AB | 1 | C |
| + 9-4-4 | 1#N/M | | | | | | |
| 6. IBDU (18-3-24) | 1#N/M | 3.3 | C | 3.3 | B | 1.7 | C |
| 7. Nitrofrm(37-0-0) | 1#N/M | 4 | C | 0 | B | 6.7 | BC |
| 8. Sustane (5-2-4) | 1#N/M | 4.7 | C | 6 | AB | 2.7 | BC |
| 9. FB-3 (10-3-4) | 1#N/M | 5 | C | 2.7 | B | 0 | C |
| 10. B.A. | 1#N/M | 13.3 | B | 9 | AB | 9 | BC |
| 11. Biogroundskper | 2oz | 15 | B | 8.3 | AB | 11.7 | B |
| 12. Control | | 24 | A | 14 | A | 21.7 | A |
| | ave | 6.4 | | 4.5 | | 5.3 | |

* Treatments followed by the same letter are not significantly different from each other at .05, Duncan's Multiple Range.
All treatments were applied at thirty day intervals from May to September.

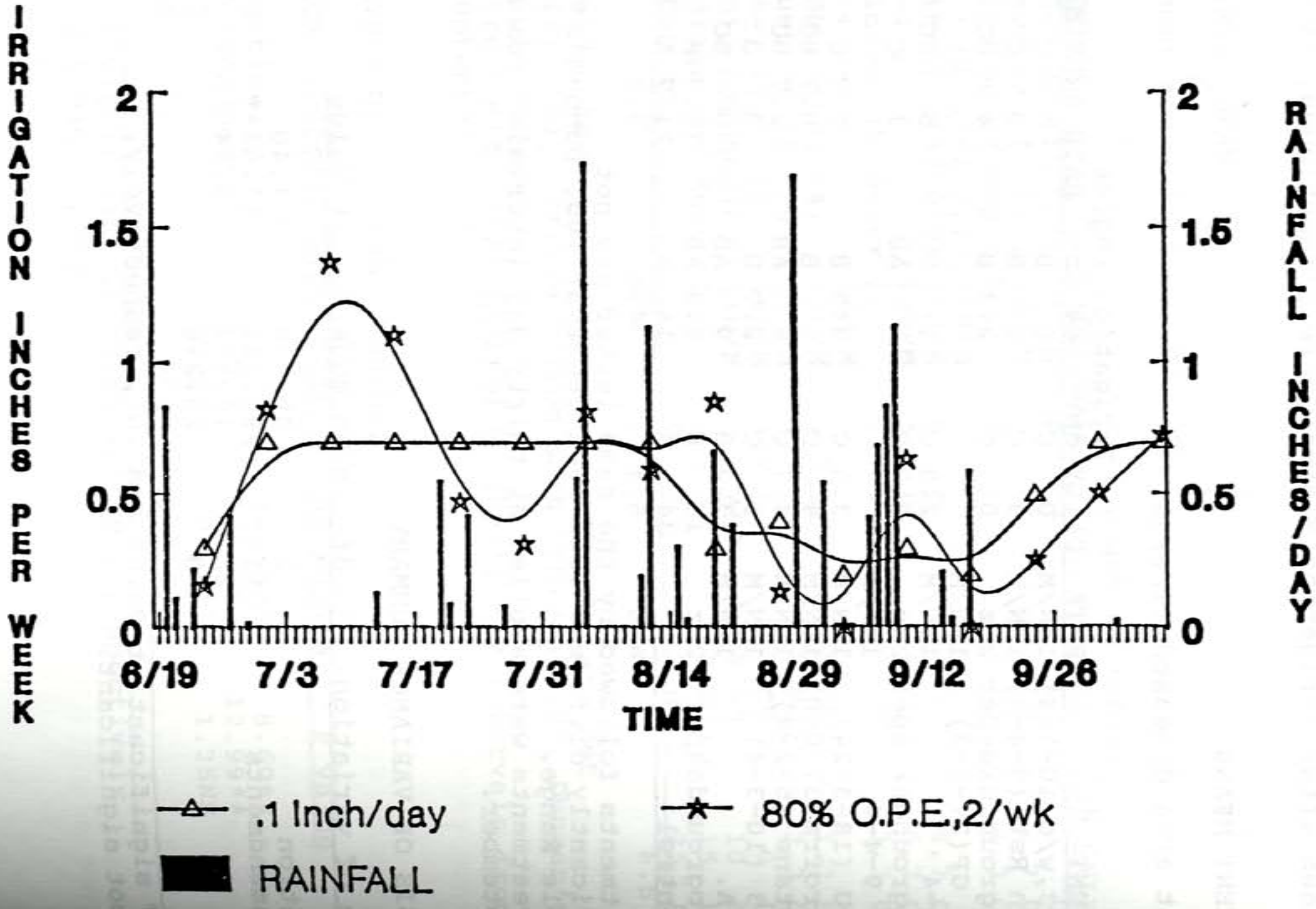
ANALYSIS OF VARIANCE SUMMARY.

| Source of variation. | df | mean square | F value |
|---|---|---|---|
| Irrigation | 2 | 35.398 | 1.40 |
| Turf amendments | 11 | 295.383 | 11.68** |
| T x I | 22 | 18.572 | 0.74 |
| Error | 70 | 25.298 | |

*,** F significant at P=.05 and .01, respectively.
NS = not significant.

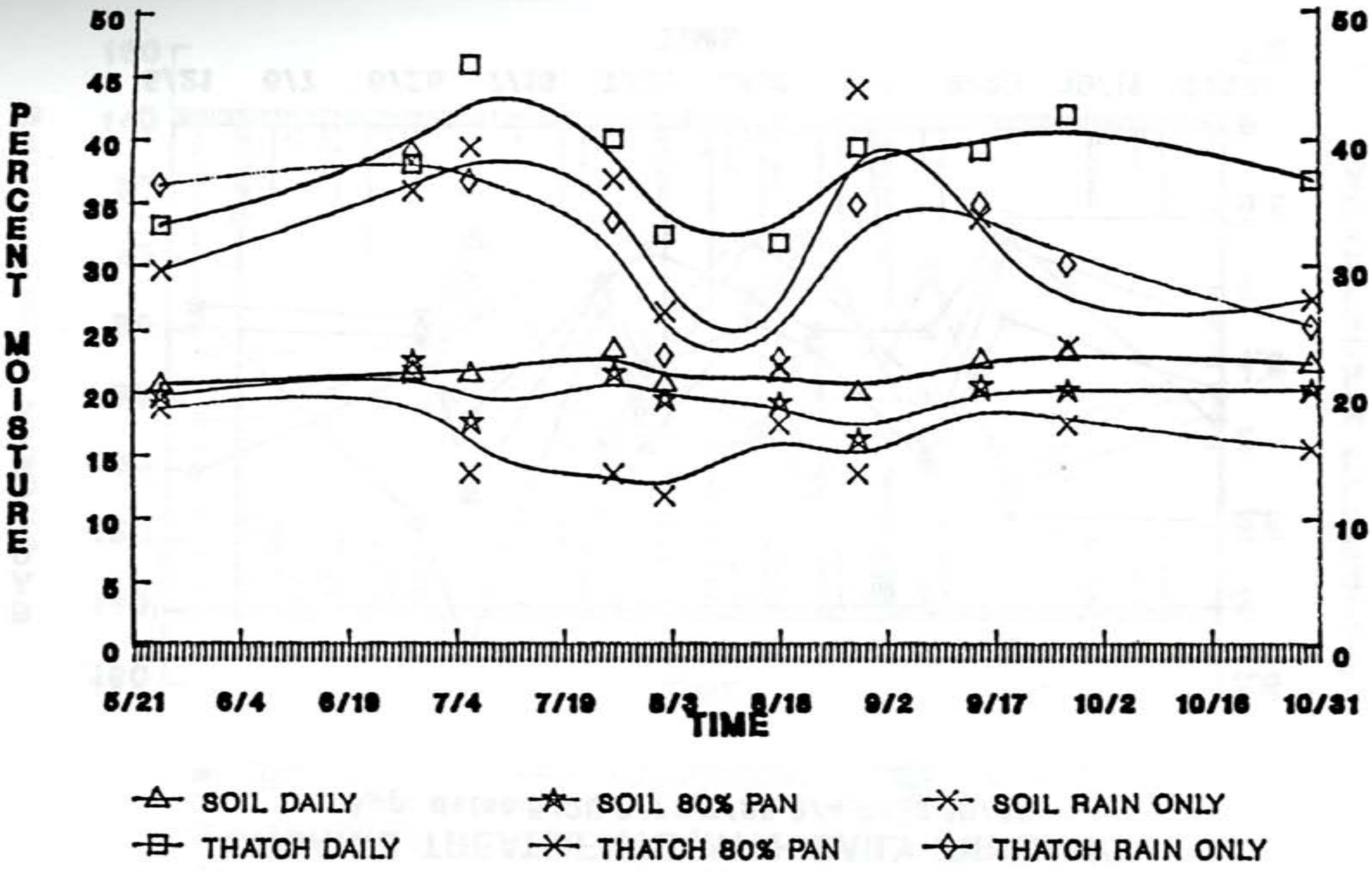
# Graph A. SUPPLEMENTAL IRRIGATION RATES

## HANCOCK TURFGRASS RESEARCH CENTER




**KENTUCKY BLUEGRASS MUCK SOD, 1989.**

# Graph B. SOIL & THATCH PERCENT MOISTURE
## EFFECT OF IRRIGATION TREATMENTS

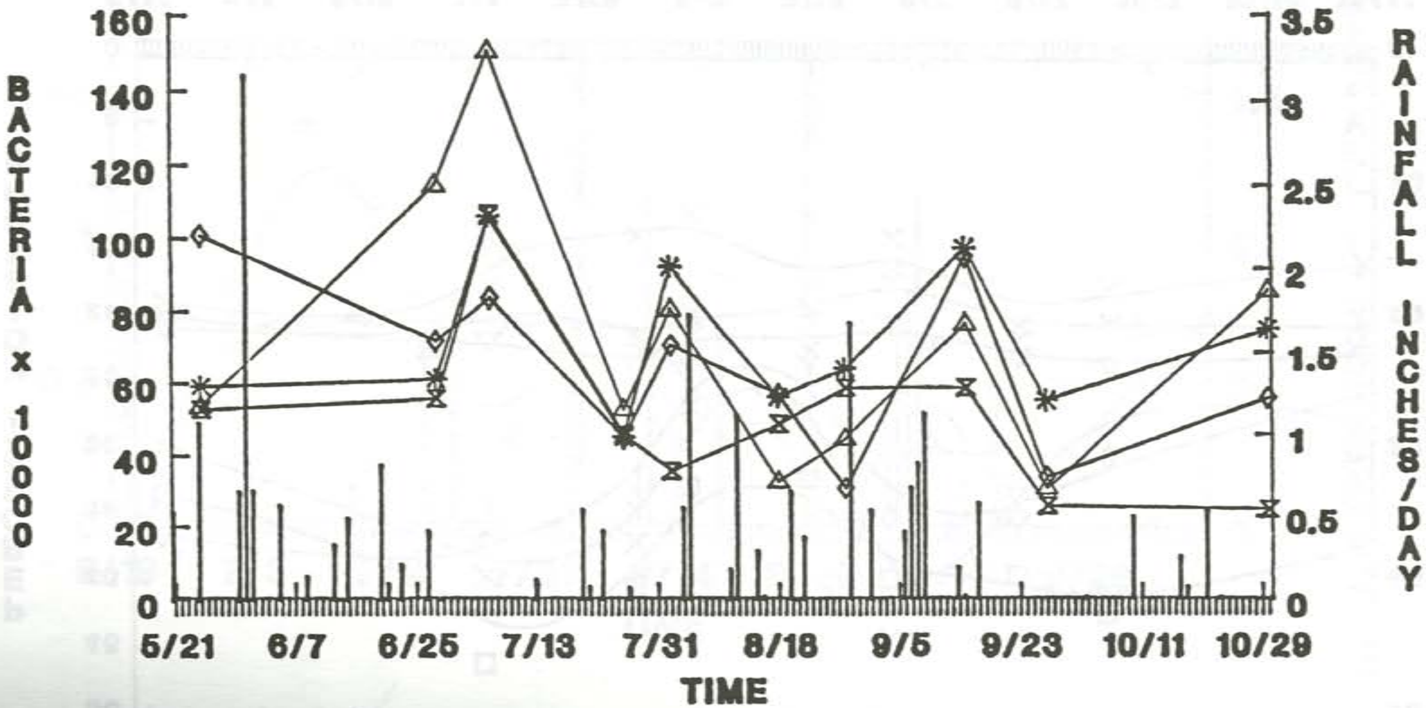



KENTUCKY BLUEGRASS MUCK SOD, 1989.

# Graph 1-A. SOIL BACTERIA PLATE COUNTS

## ORGANIC TREATMENTS WITH DAILY IRRIGATION

**App. dates:5/25;6/29;7/28;9/4;9/29;10/26**

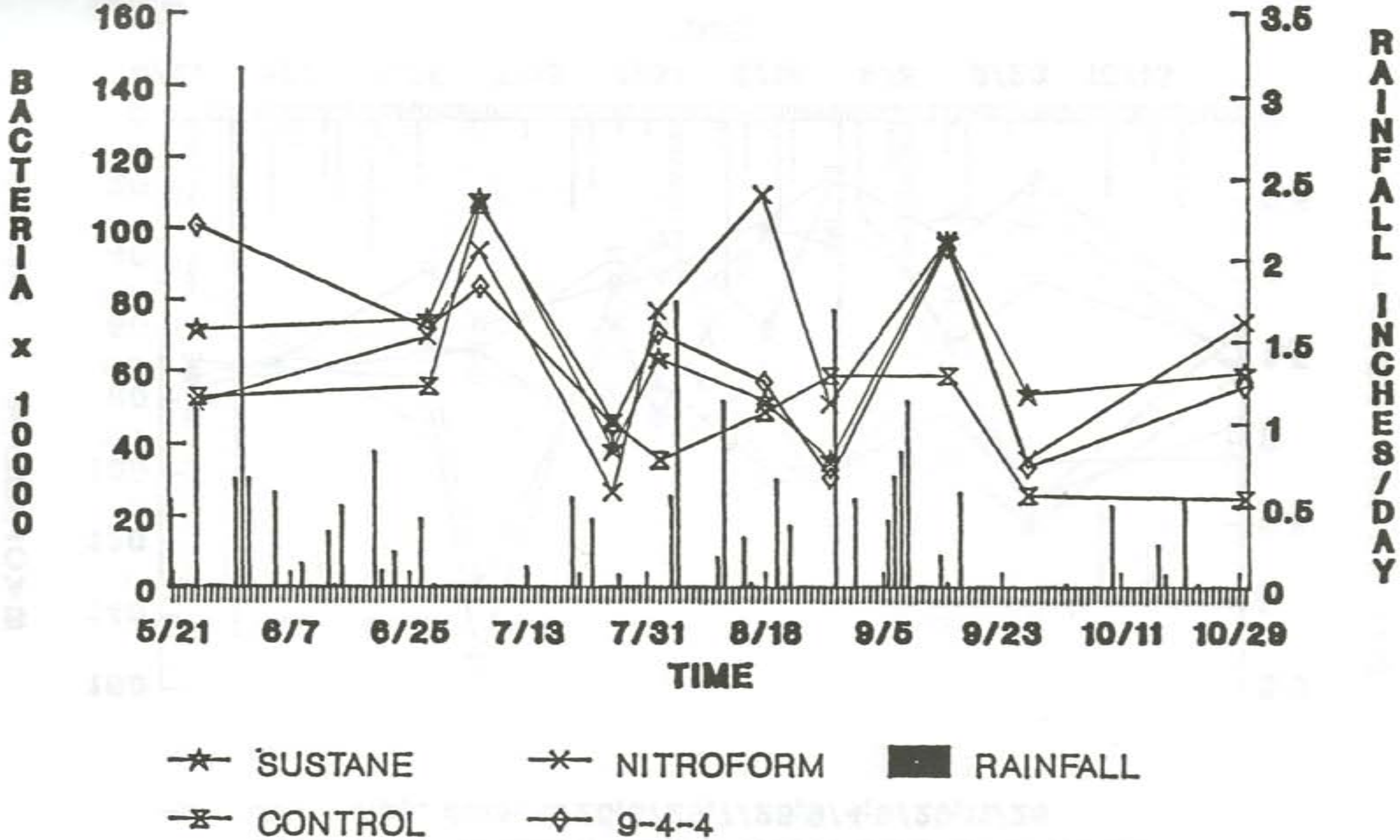



**KENTUCKY BLUEGRASS MUCK SOD, 1989.**

## Graph 1-B. SOIL BACTERIA PLATE COUNTS

**ORGANIC TREATMENTS WITH DAILY IRRIGATION**

**App. dates:5/25;6/29;7/28;9/4;9/29;10/26**

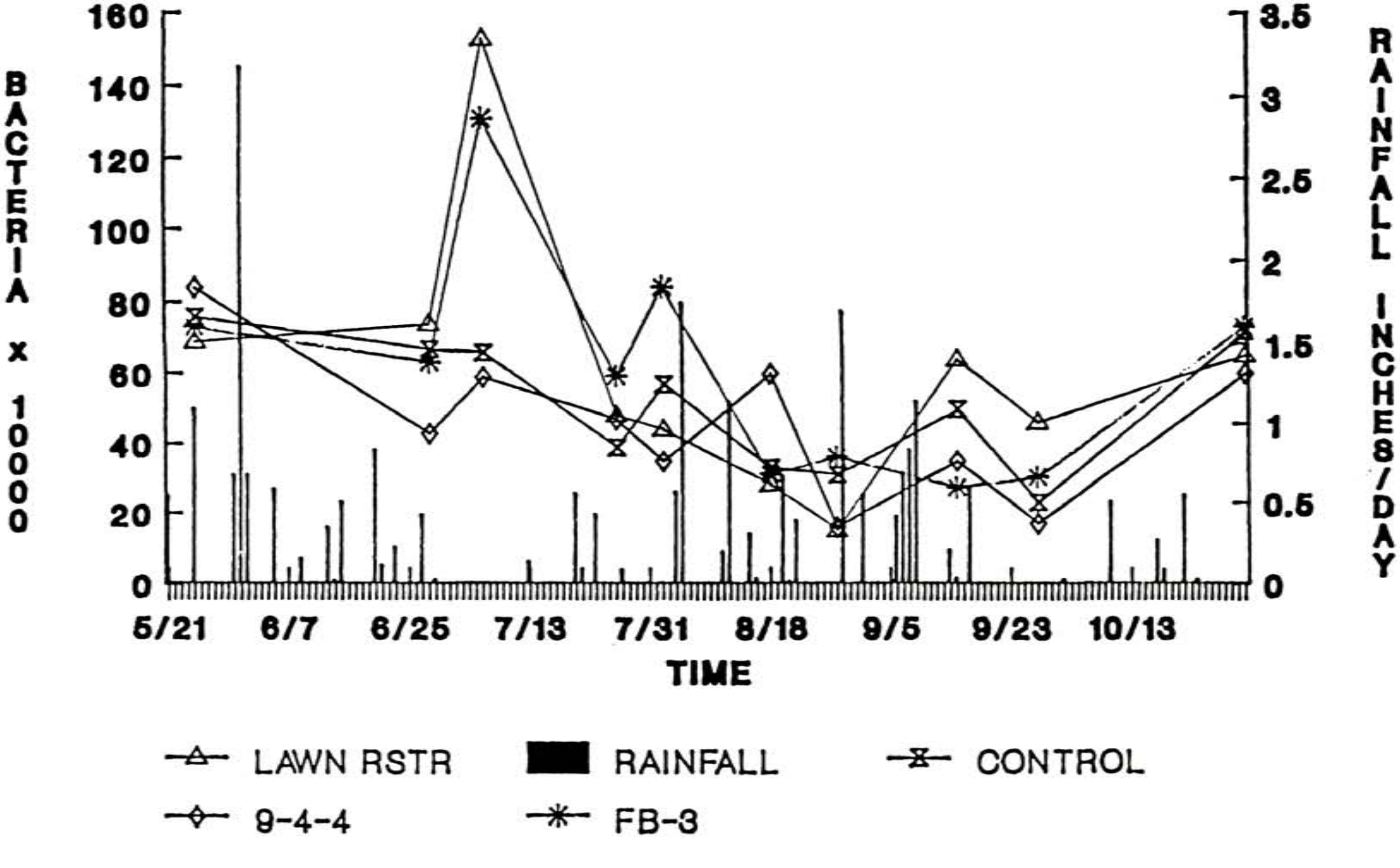



**KENTUCKY BLUEGRASS MUCK SOD, 1989.**

# Graph 2-A. SOIL BACTERIA PLATE COUNTS

**ORGANIC TREATMENTS WITH 80% OPE IRRIG**

**App. date: 5/25;6/29;7/28;9/4;9/29;11/26**

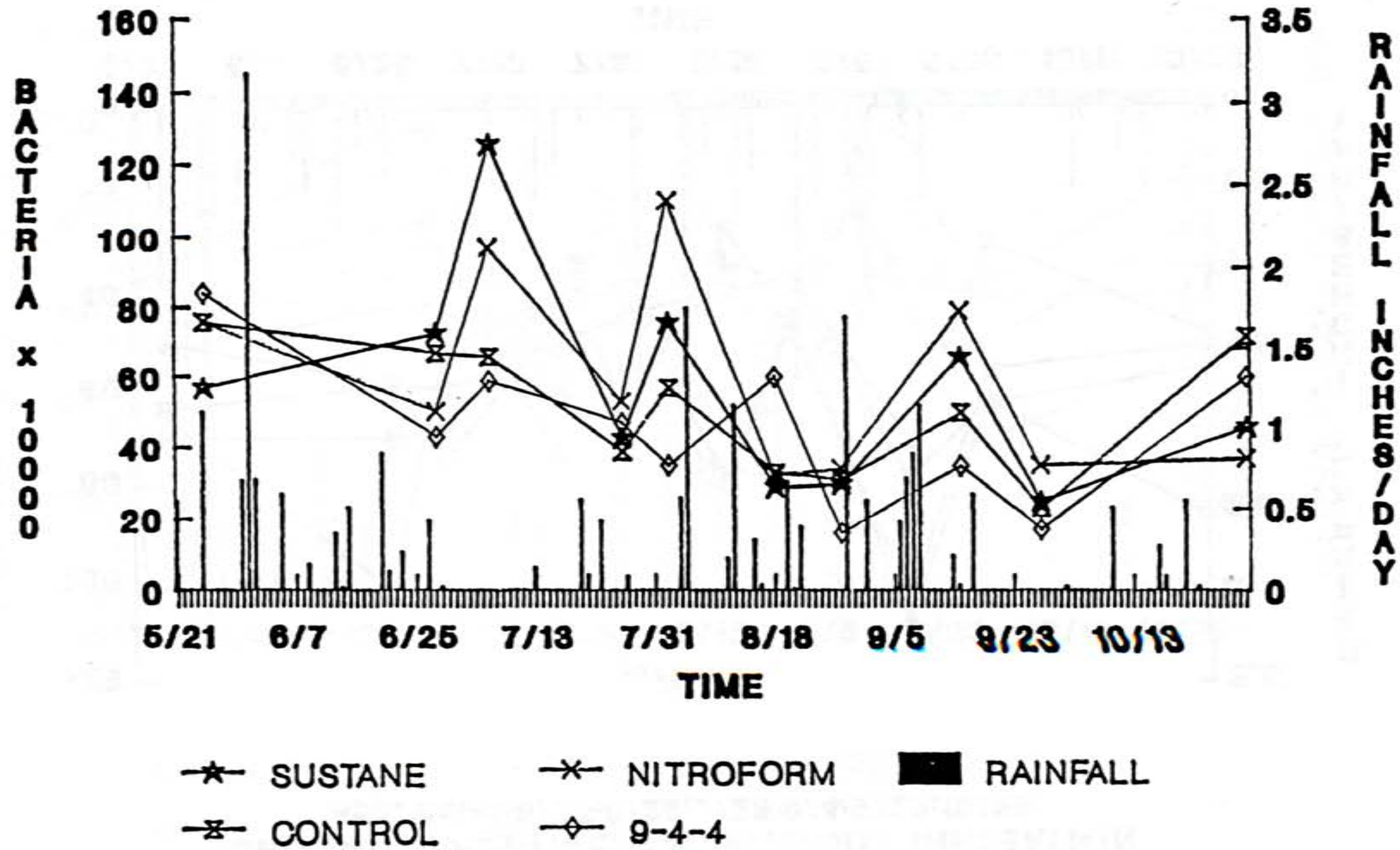



**KENTUCKY BLUEGRASS MUCK SOD, 1989.**

# Graph 2-B. SOIL BACTERIA PLATE COUNTS

**ORGANIC TREATMENTS WITH 80% OPE IRRIG**

**App. dates:5/25;6/29;7/28;9/4;9/29;10/26**

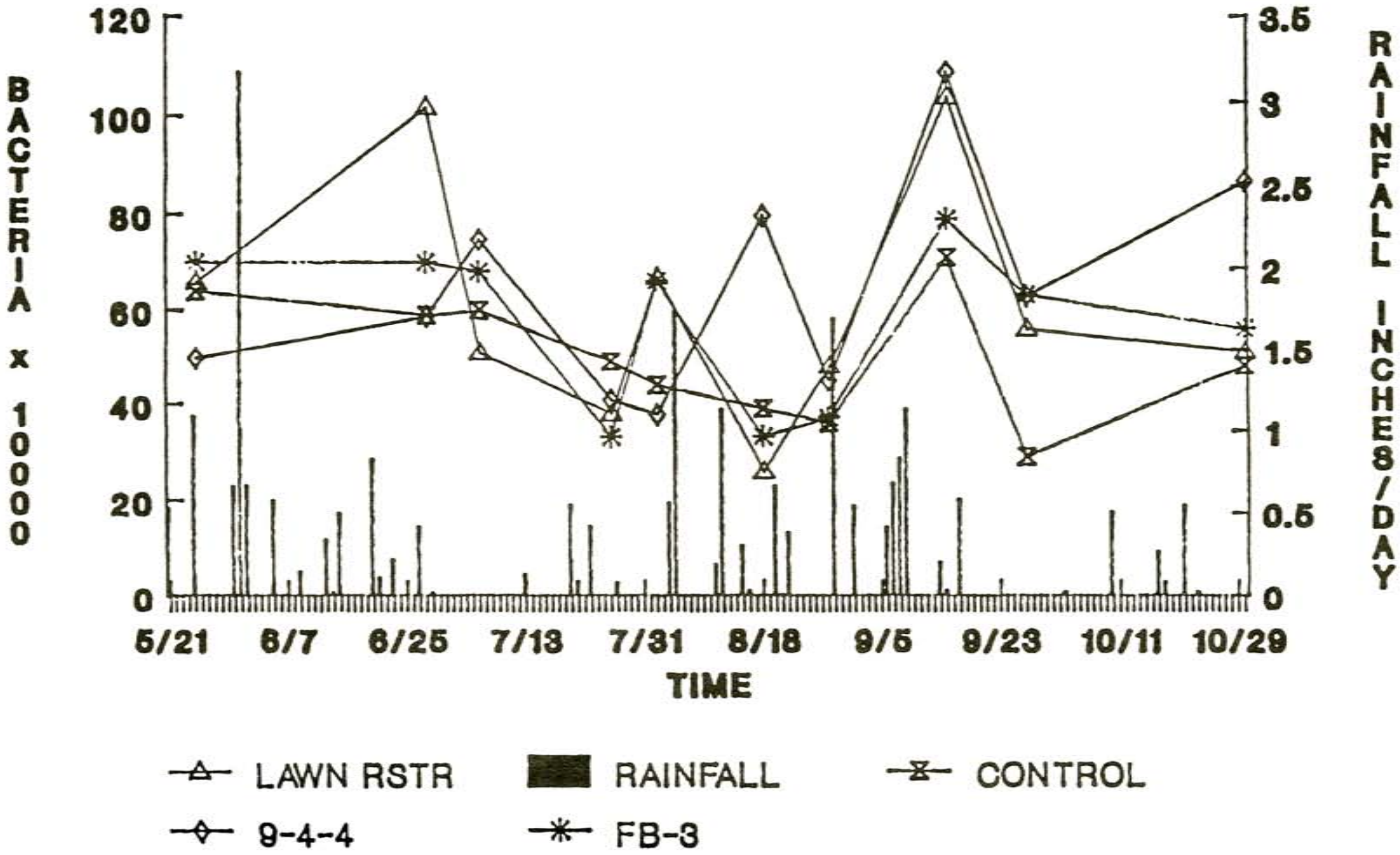



**KENTUCKY BLUEGRASS MUCK SOD, 1989.**

# Graph 3-A. SOIL BACTERIA PLATE COUNTS

## ORGANIC TREATMENTS WITHOUT IRRIGATION

App. dates:5/25;6/29;7/28;9/4;9/29;10/26

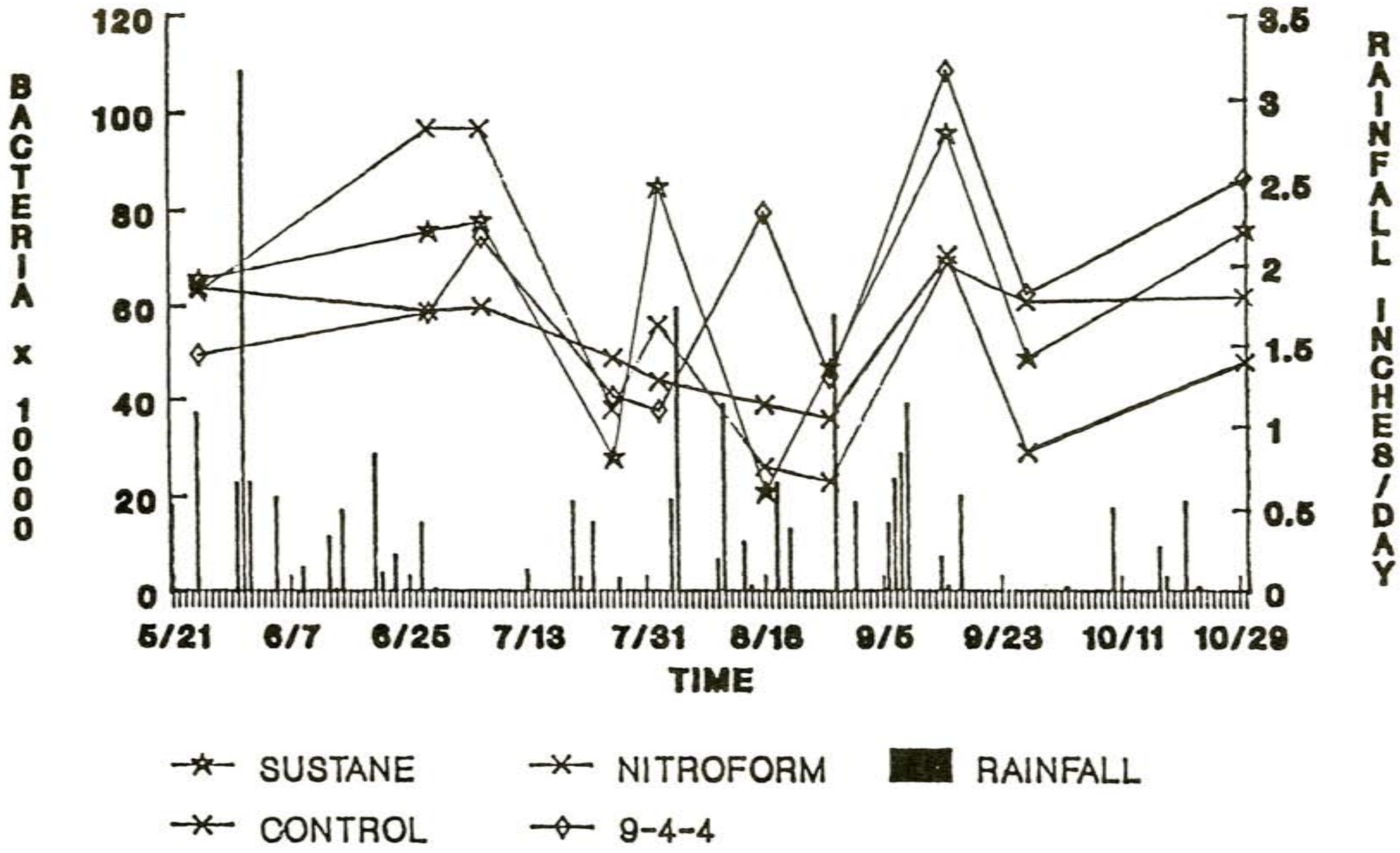



KENTUCKY BLUEGRASS MUCK SOD, 1989.

# Graph 3-B. SOIL BACTERIA PLATE COUNTS

## ORGANIC TREATMENTS WITHOUT IRRIGATION

App. dates:5/25;6/29;7/28;9/4;9/29;10/26




**KENTUCKY BLUEGRASS MUCK SOD, 1989.**

Table 1. Analysis of variance and treatment means. Effect of fertilizer and bio-organic amendments combined with irrigation treatments on thatch of Kentucky bluegrass.

TREATMENT MEANS

Grams of thatch per 43mm diameter sample, 10/21/89.

| TREATMENT | Irrigation regime DAILY | dmr | 80% | dmr | RAIN ONLY | dmr |
|---|---|---|---|---|---|---|
| 1. Nitroform | .64 | B* | .76 | ABC | .89 | ABC |
| 2. Lawn Restore | .66 | B | .95 | AB | .87 | BC |
| 3. Sustane | .67 | B | .75 | ABC | .88 | BC |
| 4. Biogroundskeeper + 9-4-4 | .70 | B | .82 | ABC | .80 | C |
| 5. IBDU | .72 | AB | .71 | BC | .92 | ABC |
| 6. 9-4-4 | .73 | AB | .67 | C | .89 | ABC |
| 7. Biogroundskeeper | .78 | AB | .99 | AB | 1.10 | AB |
| 8. FB-3 | .78 | AB | .86 | ABC | .98 | ABC |
| 9. Control | .85 | AB | 1.02 | A | 1.16 | A |
| 10. Biogroundskeeper + G. P. | .88 | AB | .89 | ABC | .98 | ABC |
| 11. Bio Agronomics | .98 | A | 1.02 | A | .96 | ABC |
| ave | .762 | | .860 | | .948 | |

* Treatment means followed by the same letter are not significantly different from each other at the 5% level using Duncan's Multiple Range test.
All turf amendments were applied on a monthly basis.
Nitrogen carrying amendments were applied at 1#N/M.

ANALYSIS OF VARIANCE SUMMARY.

| Source of variation. | df | mean square | F value |
|---|---|---|---|
| Irrigation | 2 | .282 | 13.70** |
| Turf amendments | 10 | 0.083 | 3.98** |
| T x I | 20 | 0.015 | .72NS |
| Error | 64 | 0.021 | |

*,** F significant at P=.05 and .01, respectively.
NS = not significant.

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(Percent area diseased, 9/28/89.

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| 3. Biogroundskeeper + GP(27-2-3) | 2oz 1#N/M | 0 | C | 3.3 | CD | 4.3 | CD |
| 4. Nitrofrm(37-0-0) | 1#N/M | 0 | C | 0 | D | 6.7 | CD |
| 5. 9-4-4 | 1#N/M | 1.7 | BC | 1.7 | CD | 6.7 | CD |
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| 8. Sustane (5-2-4) | 1#N/M | 1.7 | BC | 6.7 | BCD | 3.3 | CD |
| 9. FB-3 (10-3-4) | 1#N/M | 1.7 | BC | 2.7 | CD | 0 | D |
| 10. Bio Agronomics | 1#N/M | 5 | ABC | 11.7 | AB | 10 | BC |
| 11. Biogroundskper | 2oz | 8.3 | AB | 8.3 | BC | 15 | B |
| 12. Control | | 9 | A | 16.7 | A | 25 | A |
| | ave | 2.5 | | 5.0 | | 6.5 | |

* Treatments followed by the same letter are not significantly different from each other at .05, Duncan's Multiple Range.
All treatments were applied at thirty day intervals from May to September.

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| 2. Lawn Rst (9-4-4) | 1#N/M | 3 | C | 2 | B | 0 | C |
| 3. Biogroundskeeper + GP(27-2-3) | 2oz 1#N/M | 0 | C | 2.3 | B | 4 | BC |
| 4. 9-4-4 | 1#N/M | 2.3 | C | 1 | B | 5 | BC |
| 5. Biogroundskeeper + 9-4-4 | 2oz 1#N/M | 2.7 | C | 5 | AB | 1 | C |
| 6. IBDU (18-3-24) | 1#N/M | 3.3 | C | 3.3 | B | 1.7 | C |
| 7. Nitrofrm(37-0-0) | 1#N/M | 4 | C | 0 | B | 6.7 | BC |
| 8. Sustane (5-2-4) | 1#N/M | 4.7 | C | 6 | AB | 2.7 | BC |
| 9. FB-3 (10-3-4) | 1#N/M | 5 | C | 2.7 | B | 0 | C |
| 10. B.A. | 1#N/M | 13.3 | B | 9 | AB | 9 | BC |
| 11. Biogroundskper | 2oz | 15 | B | 8.3 | AB | 11.7 | B |
| 12. Control | | 24 | A | 14 | A | 21.7 | A |
| | ave | 6.4 | | 4.5 | | 5.3 | |

* Treatments followed by the same letter are not significantly different from each other at .05, Duncan's Multiple Range.
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