TURFGRASS RESEARCH FOR HIGH TRAFFICKED AREAS

J.N Rogers, III, J.C. Sorochan, J.J. Henderson, and L.M. Lundberg
Department of Crop and Soil Sciences
Michigan State University

1999 was another busy year for turfgrass research for high trafficked areas. This year we concentrated our research on finishing up some existing research projects as well as beginning a number of new studies. Copies or extended versions of these reports are also available via the World Wide Web at www.css.msu.edu.

Major areas of research include:

1) EFFECTS OF TRNEXAPAC-ETHYL AND WETTING AGENT ON ESTABLISHMENT RATE OF *POA PRATENSIS* IN A SAND-BASED ROOT ZONE.
2) MANAGING *POA SUPINA* SCHRAD.
3) AMMENDMENTS FOR LOW BUDGET ATHLETIC FIELDS.
4) QUEST FOR TRACTION IN THE ALTERNATIVE SPIKE WORLD.
5) ENGINEERING AND AGRONOMIC PROPERTIES OF SOIL MIXES.

Each of these areas will be reviewed in this paper and/or in subsequent papers within these proceedings.

EFFECTS OF TRINEXAPAC-ETHYL AND WETTING AGENT ON ESTABLISHMENT RATE OF *POA PRATENSIS* IN A SAND-BASED ROOT ZONE.

J.J. Henderson, J.C. Sorochan, J.R. Crum and J.N. Rogers, III
Department of Crop and Soil Sciences
Michigan State University

Objective

The objective of this research was to investigate the use of a plant growth regulator and wetting agent to aid in establishment and subsequent development of Kentucky bluegrass (*Poa pratensis*) in a sand-based root zone. Our hypothesis was that one or both of these chemicals could enhance establishment, leading to a more rapidly established turfgrass stand.

Introduction

The challenge for the sports turf manager is to sustain a dense turf stand throughout the competitive season. However, often times, regardless of proper management practices, areas of the field or entire fields can be worn very thin or even bare due to their intense use. Consequently, when the turf wear resistance reaches its breaking point, the perennial focus of athletic field management is the establishment of a new turf stand, often as quickly as possible. The objectives of these studies were to evaluate the effects and interactions of both Trinexapac-ethyl and soil surfactant applied during the establishment process. Plant growth regulators have been researched for a number of uses. Plant growth regulators use on mature sod has been investigated for a variety reasons, including installation and management (Hall and Bingham, 1993). Trinexapac-ethyl has also been investigated for its potential in aiding in establishment of mature sod (Wynne *et al*.,1998, Bingaman and Christians, 1998). Trinexapac-ethyl applied to established turf has been shown to enhance the lateral growth (Watschke and Dipaola, 1995). This study was designed to evaluate various Trinexapac-ethyl rates applied at different times during the establishment process to determine effects on the establishment rate of *Poa pratensis*. If density can be increased early during the establishment process, then wear tolerance could be increased (or the establishment process shortened) from this perennial activity.

Today's top athletic fields have an additional characteristic other than intense use that can make the establishment of turf difficult: high sand content root zones. High sand content root zone mixes are desirable because they drain very well and resist compaction, but these mixes can present some problems, particularly during establishment. Sand particles tend to have high surface tension causing them to be hydrophobic, making moisture retention for seed germination difficult. One way to reduce the surface tension of the sand particles and increase the moisture retention of the sand is through the application of a soil surfactant, Aqueduct™, incorrectly sited as Primer™ 604 in the proposal. This increased moisture retention could enhance the germination process.

Materials and Methods

This two-year study was initiated in May 1998 on a sand-based root zone research area (97.4% sand, 0.9% silt, 1.7% clay) at the Hancock Turfgrass Research Center located on the Michigan State University campus, East Lansing, MI. In May 1999 the plots were stripped and tilled and the entire experiment was repeated. The experiment was a 5 x 2 (plant growth regulator x wetting agent) factorial in a randomized complete block, strip plot design with three replications. Traffic was applied as a strip treatment. The plots measured 3.0 m (10 ft) by 3.6 m (12 ft). *Poa pratensis* 'Touchdown' was seeded over the entire area at 12.2 g m^{-2} (2.5 lb 1000 ft^{-2}) on 20 May 1998 and 27 May 1999. Four plant growth regulator (PGR) treatments (Primo™, Novarits, Greensboro, NC) and a control were used: (1) 0.1 ml m^{-2} (0.3 fl oz 1000 ft^{-2}) 7 days after seedling emergence; (2) 0.2 ml m^{-2} (0.6 fl oz 1000 ft^{-2}) 7 days after seedling emergence; (3) 0.1 ml m^{-2} (0.3 fl oz 1000 ft^{-2}) applied after the first mowing; and (4) 0.2 ml m^{-2} (0.6 fl oz 1000 ft^{-2}) applied after the first mowing. Control plots received no PGR. In 1998, treatments 1 and 2 were applied 28 days after seeding and treatments 3 and 4 were applied 52 days after seeding. In 1999, treatments 1 and 2 were applied 24 days after seeding and treatments 3 and 4 were applied 49 days after seeding.

A wetting agent (Aqueduct™, Aquatrols, Cherry Hill, NJ) was applied every 10-14 days throughout the growing season to half the plots in each replication at the rate of 2.0 ml m^{-2} (6.0 fl oz 1000 ft^{-2}). Following turf establishment, all PGR treated plots received two supplemental PGR applications 30 and 60 days after the initial application. In 1998, for treatments 1 and 2 these dates were 20 July and 21 August, for treatments 3 and 4 they were 12 August and 11 September. In 1999, for treatments 1 and 2 these dates were 26 July and 19 August, for treatments 3 and 4 they were 19 August and 18 September. In both 1998 and 1999 the plots received 9.8 g P m^{-2} (2.0 lb P 1000 ft^{-2}) using 13-25-12 (Lebanon Country Club, Lebanon, PA) at seeding and 4.9 g P m^{-2} (1.0 lb P 1000 ft^{-2}) in early June. Beginning the first week in July, the plots received 2.5 g N m^{-2} (0.5 lb N 1000 ft^{-2}) every week throughout the growing season using 26-0-26 (Northern Star Mineral, East Lansing, MI). The plots were mowed three times per week at 3.2 cm (1.25 in) using a John Deere 2653A triplex reel mower (Moline, Ill).

Plots were evaluated weekly or as needed from late June through November using color and density ratings. The color ratings were done visually using a 1-9 scale where 1=brown-yellow, 5=acceptable, and 9=dark green. Density ratings were assessed visually by estimating percent cover. A cup cutter with a diameter of 8.9 cm (3.5 in) was used to take three random cores from each plot to quantify differences in density on 4 September and 20 November in 1998. In 1999 samples were taken on 25 September. The cores were trimmed by hand to remove all green tissue present. Verdure samples were combined to make a composite sample for each plot. Composite samples were then oven dried for 48 h at 50° C and weighed. In 1998, from 11 September to mid-November 1998 traffic was applied twice per week as a strip application to a portion of each plot using the Brinkman Traffic Simulator (Cockerham and Brinkman 1989). In 1999 traffic was applied from 21 September to mid-November. The objective was to simulate the traffic between the hashmarks of 2-3 football games per week. Post-traffic density ratings were taken to determine wear tolerance differences between treatments. In 1998, the sod strength of only the untrafficked turf was quantified on 22 October using the Calrochan Sod Puller (Sorochan, *et al.*, 1999) (Pictures 1& 2), a device developed at Michigan State University. The device measures the peak force necessary to completely tear a piece of sod. The sod strength was tested again on 25 November after the turfgrass had hardened off for the season. In 1999, sod strength measurements were taken on 22 October and 23 November. Data were analyzed by analysis of variance (ANOVA, alpha = 0.1).

Results and Discussion

The results from the 1998 study are presented in Figures 1 and 2. While there was some increase in density in 1998 due to the use of Trinexapac-ethyl and wetting agent separately (Figure 1), it became apparent that the combination of these two products was detrimental to turf establishment. This is further exhibited from the sod strength measurements (Figure 2). Although these measurements were recorded in late November the positive effects of Trinexapac-ethyl and the negative effects of the wetting agent + PGR were still apparent. The high rate of PGR 7 days after seeding emergence had significantly higher sod strength than the control (Figure 2). It appeared that Trinexapac-ethyl had potential to accelerate Kentucky bluegrass establishment. However, in 1999 the results did not match those of 1998. There were no positive effects of the Trinexapac-ethyl and wetting agent applied separately. The wetting agent applications resulted in significantly weaker sod strength and the increase in density attributed to Trinexapac-ethyl was not observed (Table 1). Rust (*Puccinia sp.*) outbreaks were observed in 1998 and 1999. The plots that had the highest incidence of the disease were those that received Trinexapac-ethyl in late August or later (Table 1). The conflicting results between 1998 and 1999 are difficult to explain, but emphasizes the importance of repeating a study before recommendations are made. More research must be completed before the use of a wetting agent and/or plant growth regulator is recommended to increase the establishment rate of Kentucky bluegrass on sand.

Figure 1. Effects of Wetting Agent (WA) and Plant Growth Regulator (PGR) on Density of Kentucky Bluegrass (21 July 1998)

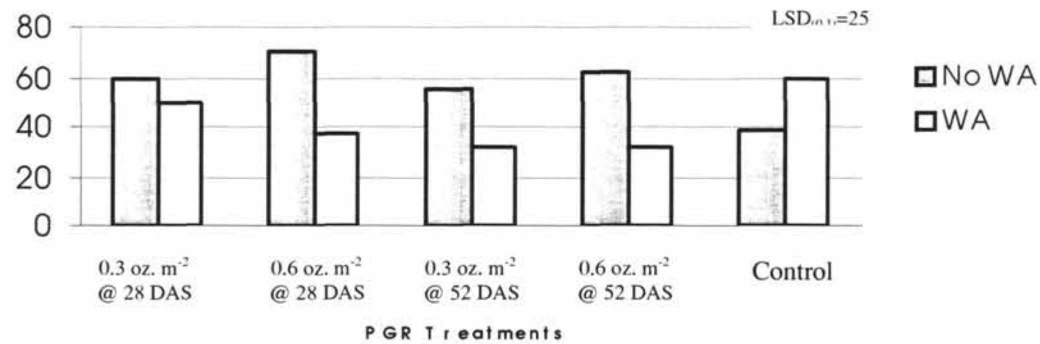

Figure 2. Effects of Wetting Agent (WA) and Plant Growth Regulator (PGR) on Sod Strength of Kentucky Bluegrass (25 November 1998)

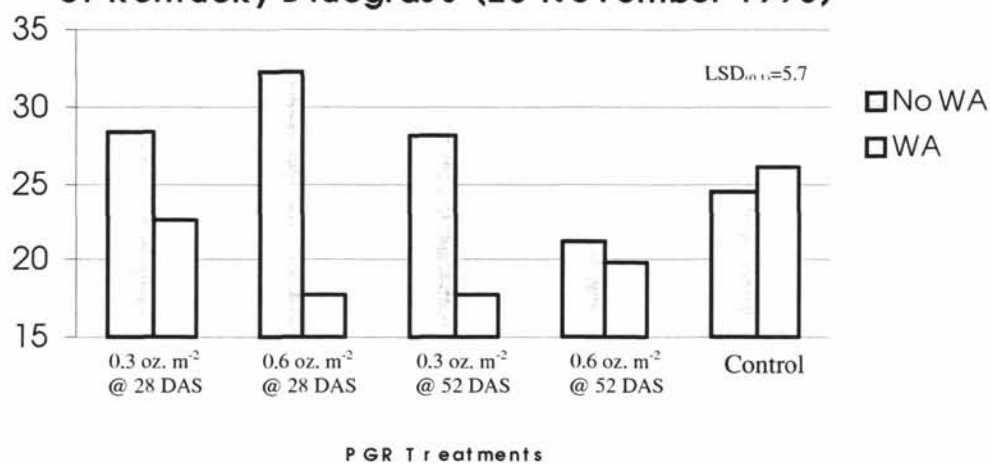

Table 1. Main effects and interaction effects of wetting agent and Trinexapac-ethyl on establishment of Kentucky bluegrass in a high sand-based root zone (selected dates) 1999.

	Color†	Pre-traffic turf cover‡ (%)		Post-traffic turf cover§ (%)		Verdure¶ (g)	Sodpull# (kg)		Rust††
Treatments	21/07	21/07	02/09	22/10	11/11	25/09	22/10	23/11	26/10
Wetting agent (WA)									
No WA	4.4	62.3	90.7	68.7	55.7	10.2	30.1*	27.9*	6.1
WA	4.1	58.0	87.9	67.7	52.3	9.7	23.7	23.3	5.5
Trinexapac-ethyl (PGR)									
0.1 ml m^{-2} 24 DAS‡‡	4.0	57.5	86.0	72.5	59.2	10.3	23.9	27.3	4.2
0.2 ml m^{-2} 24 DAS	4.0	67.5	87.2	70.0	53.3	10.7	25.5	24.5	5.3
0.1 ml m^{-2} 49 DAS	4.5	54.1	88.3	60.8	52.5	9.7	26.9	24.5	7.2
0.2 ml m^{-2} 49 DAS	4.8	49.2	88.0	60.0	46.7	9.7	27.7	22.5	8.7
No PGR	4.0	72.5	97.5	77.5	58.3	9.3	30.5	29.4	3.7
$LSD_{(0.1)}$	0.2	NS	6.0	12.2	9.7	NS	NS	NS	1.1
WA x PGR									
No WA 0.1 ml m^{-2} 24 DAS	4.0	63.3	91.0	80.0	65.0				
No WA 0.2 ml m^{-2} 24 DAS	4.0	51.7	85.0	65.0	60.0				
No WA 0.1 ml m^{-2} 49 DAS	5.0	70.0	95.0	68.3	50.0				
No WA 0.2 ml m^{-2} 49 DAS	5.0	48.3	88.7	50.0	36.7				
No WA x No PGR	4.0	78.3	96.7	80.0	66.7				
WA x 0.1 ml m^{-2} 24 DAS	4.0	51.7	81.0	65.0	53.3				
WA x 0.2 ml m^{-2} 24 DAS	4.0	83.3	89.3	75.0	46.7				
WA x 0.1 ml m^{-2} 49 DAS	4.0	38.3	81.7	53.3	55.0				
WA x 0.2 ml m^{-2} 49 DAS	4.7	50.0	89.3	70.0	56.7				
WA x No PGR	4.0	66.7	98.3	75.0	50.0				
$LSD_{(0.1)}$	0.3	24.1	8.5	17.3	13.6				

* Significant at the 0.1 probability level.
† Color was rated visually on a 1-9 scale where 1 = dead or brown turf, and 9 = dark green turf.
‡ Turf cover was estimated visually as a percentage (0-100%).
§ Traffic began 21 September 1999.
¶ Verdure based on 186.6 cm^2 sample.
# Sod strength was measured with the Calrochan Sod Puller.
†† Rust severity was rated visually on a 1-9 scale where 1 = no rust and 9 = desiccation due to rust.
‡‡ DAS, days after seeding (seeded on 27 May 1999).

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MANAGING *POA SUPINA* SCHRAD.(SUPINA BLUEGRASS) IN MICHIGAN 1996-1998

John C. Sorochan, and John N. Rogers, III.

Introduction

Due to the need to develop better turf systems for high wear areas on golf courses and athletic fields a research program was started at Michigan State University in 1994 to develop management practices for supina bluegrass in Michigan. A preliminary report has been published on the comparison of supina bluegrass, Kentucky bluegrass (*Poa pratensis* L.), and perennial ryegrass (*Lolium perenne* L.) sods for sand based athletic fields (Rogers et al., 1996). Although supina bluegrass has been used extensively in certain areas of Europe, little published research exists to recommend specific management practices. This is the fourth and final year for data collection from the following three experiments. Results from 1996 and 1997 data can be found in last years Annual Michigan Turfgrass Conference proceedings. In 1995, three plot areas were established to satisfy the following research objectives: 1) Determine the appropriate mowing height range, 2) Determine the fertility requirements on sandy loam soil, and 3) Determine the effect of seeding ratios of supina bluegrass : Kentucky bluegrass on turf characteristics, with a long term objective to determine the changes in stand composition over time.

This is the final year for these studies and final drafts are currently being drawn up for refereed publications. Therefore, results and conclusions will be available on the aforementioned web site in early February when final drafts are completed.

Materials and Methods

Experiment 1: Fertility requirements of supina bluegrass

Supina bluegrass 'Supra' was established on a sandy loam soil at the Hancock Turfgrass Research Center, Michigan State University, MI., during summer 1995. The plot area (40 ft x 40 ft) was seeded with 1.5 lb/1000 ft^2 seed on 21 June 1995 using a drop spreader. Starter fertilizer (13-25-12) was applied at time of seeding to supply approximately 1 lb. N and 1 lb. P/1000 ft^2. The area was hydromulched and an automated irrigation system used to maintain sufficient moisture levels for germination, establishment, and subsequent maintenance. All plots were fertilized equally during 1995 with approximately 2.75 lb. additional N/1000 ft^2 with approximately 1 lb/1000 ft^2 additional P and 1.5 lb/1000 ft^2 additional K. On 17 Nov. 1995 a dormant application of 1 lb/1000 ft^2 N was applied using SCU (40-0-0). Beginning July 1995 all plots were mowed with a triplex riding mower at approximately 1.25" cutting height. Clippings were returned in each year (1995-1999).

A factorial experiment was developed to test individual fertility treatments beginning spring 1996, and was continued through 1999. Both total N (2, 4, and 6 lb/1000 ft^2/year) and N to K ratios (2:1 and 1:1) were investigated. The experimental design was a strip-plot, randomized complete block with three replications. Main plots were fertility treatments which were stripped for traffic (no traffic and simulated athletic traffic). Fertility treatment dates were as follows (Table 1), with 1 lb. N/1000 ft^2 and ½ (treatments 1-3) or 1 lb. K/1000 ft^2 (treatments 4-6) applied on each date. Urea (46-0-0) was used as the N source and sulfate of potash (0-0-50) was used as the potassium source.

Table 1. Treatment dates and rates on supina bluegrass fertility study, East Lansing, MI, 1996 - 1999.

Treatment (N:K)	Application dates
2:1	10 May, 16 Sept.
4:2	10 May, 3 June, 16 Aug., 16 Sept.
6:3	10 May, 3 June, 28 June, 16 Aug., 16 Sept., 11 Nov.
2:2	10 May, 16 Sept.
4:4	10 May, 3 June, 16 Aug., 16 Sept.
6:6	10 May, 3 June, 28 June, 16 Aug., 16 Sept., 11 Nov.

Simulated athletic traffic was applied using a Brinkman Traffic Simulator (BTS). Since 1996 a total of 104 simulated football games have been applied during the fall of each year (26, 25, 28, and 25 games, respectively).

Turf color, density, and quality was evaluated on a regular basis. An Eijelkamp shear vane apparatus was used to determine turf shear resistance.

Experiment II: Mowing height study

Supina bluegrass 'Supra' was established on a sandy loam soil at the Hancock Turfgrass Research Center, Michigan State University, MI, during summer 1995. The plot area (40 ft x 40 ft) was seeded with 1.5 lb/1000 ft^2 seed on 21 June 1995 using a drop spreader. Starter fertilizer (13-25-12) was applied at time of seeding to supply approximately 1 lb. N and 1 lb. P/1000 ft^2. The area was hydromulched, and an automated irrigation system was used to maintain sufficient moisture levels for germination, establishment, and subsequent maintenance. All plots were fertilized equally during 1995 with approximately 2.75 lb. additional N/1000 ft^2 with approximately 1 lb/1000 ft^2 additional P and 1.5 lb/1000 ft^2 additional K. Fertilizer was applied on six dates between June through October with no more than 0.6 lb. N/1000 ft^2 applied at any date. On 17 November 1995 a dormant application of 1 lb/1000 ft^2 N was applied using SCU (40-0-0). During 1995 and early spring 1996 all plots were mowed with a triplex riding mower set at approximately 1.25" cutting height. Clippings were returned when mowed.

On 24 May 1996 a factorial experiment was started to test the effects of three mowing heights (9/16", 1.25", and 2.25") on supina bluegrass characteristics, and was continued through 1999. The experimental design was a randomized complete block, strip-plot, with three replications. All plots (each 10 x 10 ft^2) were divided into trafficked and non-trafficked areas. Simulated athletic traffic was applied using a Brinkman Traffic Simulator (BTS). Since 1996 a total of 104 simulated football games have been applied during the fall of each year (26, 25, 28, and 25 games, respectively).

Plots were fertilized with 5 lb. N/1000 ft^2 and 3.5 lb. K/1000 ft^2 from 1996 - 1999. Fertilizer (18-3-18) was applied at 0.5 lb. N/1000 ft^2 on 10 May, 24 May, 14 June, 12 Aug., 3 Sept., and 24 September for 1996 - 1998. On 28 June (1996, 97, and 98), 1 lb. N/1000 ft^2 using sulfur coated urea (40-0-0) was applied plus 1 lb. K/1000 ft^2 using sulfate of potash (0-0-50). In late November of each year (1996-1999) 1 lb. N/1000 ft^2 was applied as a dormant application using urea (46-0-0). Plots were irrigated as needed to prevent moisture stress.

Turf color, density, and quality was evaluated on a regular basis. An Eijelkamp shear vane apparatus was used to determine turf shear resistance. Dollar spot disease ratings were collected when the disease appeared.

Experiment 3: Competition Study

Plots were established June 1995 on a sand based root zone (80:10:10, sand:peat:soil). Individual plots (10 x 18 ft) were seeded by hand (1.25 lb. seed/1000 ft^2) and the seed was raked lightly into the surface. Plots were covered with hydromulch and kept moist during the germination and establishment processes. Following establishment all plots were mowed at 1.25" height with a riding triplex mower, and clippings were returned. Plots were irrigated daily, or as needed in the spring and fall, using an automated irrigation system to prevent moisture stress. All plots were fertilized equally during 1995 with approximately 2.75 lb. additional N/1000 ft^2, approximately 1 lb/1000 ft^2 additional P, and 1.5 lb/1000 ft^2 additional K. Fertilizer was applied on six dates between June through October with no more than 0.6 lb. N/1000 ft^2 applied at any date. In late November 1995 - 1999 a dormant application of 1 lb/1000 ft^2 N was applied using SCU (40-0-0).

A factorial experiment was used to evaluate the effect of seeding mixtures and monostands of supina bluegrass (SB) 'Supra' and Kentucky bluegrass (KB) 'Touchdown' on turf characteristics and eventually, changes in stand composition over time. The experimental design was a strip-plot, randomized complete block with three replications. Main plots were the six seeding treatments: Trt 1=100% SB, Trt 2=50%SB:50% KB, Trt 3=75% SB:25%KB, Trt 4=10% SB:90%KB, Trt 5=5% SB:95% KB, and Trt 6=100% KB. Plots were split to evaluate the effects of low (4 lbs. N/1000 ft^2/year) and high (6 lb. N/1000 ft^2/year) fertility levels. Nitrogen was applied at approximately a 1:1 ratio with potassium on most dates (unless noted) using an 18-3-18 fertilizer (Table 1).

Table 2. Fertility schedule and rates for supina bluegrass:Kentucky bluegrass seeding ratio study.

Low fertility (4 lb. N/1000 ft^2/year)	**High fertility (6 lb. N/1000 ft^2/year)**
10 May 0.5 lb. N, 18-3-18	10 May 0.5 lb. N, 18-3-18
	24 May 0.75 lb. N, 18-3-18
3 June 0.5 lb. N, 18-3-18	14 June 0.5 lb. N, 18-3-18
28 June 1.0 lb. N, 40-0-0 SCU	28 June 1.0 lb. N, 40-0-0 SCU
	2 Aug. 0.5 lb. N, 18-3-18
16 Aug. 0.5 lb. N, 18-3-18	16 Aug. 0.75 lb. N, 18-3-18
5 Sept. 0.5 lb. N, 18-3-18	5 Sept. 0.5 lb. N, 18-3-18
	1 Oct. 0.5 lb. N, 18-3-18
16 Nov. 1.0 lb. N, 46-0-0 urea	16 Nov. 1.0 lb. N, 46-0-0 urea
TOTAL ANNUAL N = 4 LB/1000 FT^2	TOTAL ANNUAL N = 6 LB/1000 FT^2

Simulated athletic traffic was applied using a Brinkman Traffic Simulator (BTS). Since 1996 a total of 104 simulated football games have been applied during the fall of each year (26, 25, 28, and 25 games, respectively).

Turf color, density, and quality was evaluated on a regular basis. The Eijelkamp shear vane apparatus was used to determine turf shear resistance. Changes in stand composition were determined March 1997, 1998, and 1999, by collecting plants at random from each plot using a point quadrant and determining the percentages of supina bluegrass and Kentucky bluegrass. Plant counts will be collected again in March 2000.

Results and Discussion

Experiment 1-3: Fertility, Mowing, and Competition studies

Again, this is the final year for these studies and final drafts are currently being drawn up for refereed publications. Therefore, results and conclusions will be available on the aforementioned web site in early February when final drafts are completed.

Experiment 3: Competition study

Preliminary results determined that supina bluegrass will encroach into or out compete Kentucky bluegrass when seeded as a mixture. Only 5 or 10% supina bluegrass is needed to aggressively compete with Kentucky bluegrass. When seeded at 5 or 10%, supina bluegrass will become the dominant species (about 70%) in the turf stand after two seasons of simulated football traffic (26, and 25 games, respectively). Ultimately, it would be optimal to achieve a turf stand that is predominantly supina bluegrass for its quick recuperative potential via stolons, while maintaining a lesser stand of Kentucky bluegrass to utilize its ability to increase stability and shear strength via rhizomes. A combination of a supina bluegrass and Kentucky bluegrass may in a sense mimic a cool season version of Bermudagrass; which, is a turfgrass that provides superior turf conditions for high wear athletic fields, as a result of its aggressive stoloniferous and rhizomatous growth habit.

AMENDMENTS FOR A LOW BUDGET ATHLETIC FIELD

L. M. Lundberg, J.C. Sorochan, J.R. Crum, J.N. Rogers III
Department of Crop and Soil Sciences
Michigan State University

A study has begun at the Hancock Turfgrass Research Center on the campus of Michigan State University to investigate cultural practices while operating within a low budget. The study is being conducted to provide information to budget decision makers as to how resources relate to improved athletic field quality. The motivation for this study comes from the number of athletic injuries induced by poor field conditions (Harper et al, 1984). High schools are often forced to operate within a fixed budget for athletic field maintenance. Because of this, it is thought that they can not afford the machinery, products, and staff required for a high maintenance field and it is questioned where to invest their resources. As a result, it is assumed that they are incapable of maintaining a high quality, safe athletic field. However, as we have seen so many times in the past, more is not always better. Therefore, Michigan State University is conducting a study to discover the potential of minimum inputs combined in such a way so as to maintain a quality athletic field while still operating within a low budget.

The objectives of this study are to demonstrate the differences in field quality based on cultural inputs and to relate the inputs to maximizing events. The study is a three-factor design with mowing, fertility, and cultivation as variables. It is being conducted on both a sand-based root zone and a native soil field. Fertilizer will be applied at levels of 4 lb N/1000 ft^2 four times per year, 4 lb N/1000 ft^2 eight times per year, or 6 lb N/1000ft^2 six times per year. Mowing will be done once or twice per week and cultivation will be done none or twice per year. Different combinations of each treatment will be applied. In addition, half of the treatments will receive a traffic application of approximately twenty-five games per year. Establishment of the plots was begun in the spring of 1999. Treatments were begun in the fall of 1999 and are expected to continue through the summer of 2001.