TURFGRASS RESEARCH FOR HIGH TRAFFICKED AREAS

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1998 was another busy year for turfgrass research for high trafficked areas. This year we focused our research in three major areas:

1) MANAGING POA SUPINA SCHRAD. (SUPINA BLUEGRASS) IN MICHIGAN

2) THE EFFECTS OF DIFFERENT SOCCER SHOE SOLES ON TURFGRASS

3) THE 1998 TRAVELING GOLF SPIKE STUDY

Each of these areas will be reviewed in some detail in this paper. Copies or extended versions of these reports are also available via the world wide web @ www.css.msu.edu

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

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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 third 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 addition to the internet at www.css.msu.edu. 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.

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 (1995-1998).

A factorial experiment was developed to test individual fertility treatments beginning spring 1996, and was repeated beginning spring 1997 and 1998. 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 - 1998.

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 79 simulated football games have been applied during the fall of each year (26, 25, and 28 games, respectively).

Turf color, density, and quality were 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 again in 1997 and 1998. 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 79 simulated football games have been applied during the fall of each year (26, 25, and 28 games, respectively).

Plots were fertilized with 5 lb. N/1000 ft^2 and 3.5 lb. K/1000 ft^2 from 1996 - 1998. 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, 97, and 98) 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 were 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 - 98 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 lb. 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 79 simulated football games have been applied during the fall of each year (26, 25, and 28 games, respectively).

Turf color, density, and quality were 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 and 1998, 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 1999.

Results and Discussion

Experiment 1: Fertility requirements of supina bluegrass

Analysis of variance for all three years of testing are included. However, results and discussion will concentrate primarily on 1998 data, or a combination of 1996-1998 data when comparisons are warranted.

Supina bluegrass responded positively to nitrogen fertilization (Table 3 and 5). Turf color and quality were consistently greater at 4, and 6 lbs. N $1000ft^{-2}$ yr^{-1} compared to the 2 lb. N $1000ft^{-2}$ yr^{-1}. The ratio of nitrogen to potassium had no significant effect on turf color, density, quality, or shear strength. Traffic treatments significantly enhanced turf color, but decreased turf density, quality, and shear strength.

Color interactions occurred in May and November of 1997, and June and November of 1998 (Table 7). No significant differences between 4, and 6 lbs. N $1000ft^{-2}$ yr^{-1} occurred regardless of the nitrogen to potassium level. However, the non trafficked plots had significantly greater color than the trafficked plots during May and November of 1997. Results from 1998 had no significant differences between traffic treatments for the 4, and 6 lbs. N $1000ft^{-2}$ yr^{-1} treatments.

Table 3. Analysis of variance for color† on supina bluegrass at different fertility‡ and traffic§ levels, East Lansing, MI. 1996-98.

1996	June	July	August	September	October	November
Fertility (F)	Ns	*	*	*	*	*
Traffic (T)	*	*	Ns	*	*	*
F * T	Ns	Ns	Ns	Ns	Ns	Ns

1997	May	June	July	September	October	November
Fertility (F)	*	Ns	*	*	*	*
Traffic (T)	*	*	*	Ns	Ns	*
F * T	*	Ns	Ns	Ns	Ns	*

1998	May	June	July	August	September	November
Fertility (F)	Ns	*	*	*	*	*
Traffic (T)	*	*	Ns	Ns	Ns	Ns
F * T	Ns	*	Ns	Ns	Ns	*

† Color was rated visually on a 1-9 scale where 1=dead or brown turf, and 9=dark green turf.
‡ Fertility consisted of 2, 4, and 6 lbs. N 1000 ft^{-2} yr^{-1} at both a 1:1 and 2:1 ratio of N:K.
§ Traffic was simulated using the Brinkman Traffic Simulator.
* Significant at the 0.05 probability level.
Ns Not significant at the 0.05 probability level.

Table 4. Analysis of variance for density† on supina bluegrass at different fertility‡ and traffic§ levels, East Lansing, MI. 1996-98.

1996	June	July	August	September	October	November
Fertility (F)	Ns	Ns	*	*	Ns	Ns
Traffic (T)	Ns	*	Ns	Ns	Ns	*
F * T	Ns	Ns	Ns	*	Ns	*

1997	May	June	July	September	October	November
Fertility (F)	Ns	Ns	*	Ns	Ns	*
Traffic (T)	*	Ns	*	Ns	*	*
F * T	*	Ns	Ns	Ns	Ns	Ns

1998	May	June	July	August	September	November
Fertility (F)	Ns	Ns	Ns	Ns	Ns	Ns
Traffic (T)	Ns	Ns	Ns	Ns	Ns	*
F * T	Ns	Ns	Ns	Ns	Ns	Ns

† Density was rated visually on a percent turfgrass cover (0-100%).
‡ Fertility consisted of 2, 4, and 6 lbs. N 1000 ft^{-2} yr^{-1} at both a 1:1 and 2:1 ratio of N:K.
§ Traffic was simulated using the Brinkman Traffic Simulator.
* Significant at the 0.05 probability level.
Ns Not significant at the 0.05 probability level.

Table 5. Analysis of variance for quality† on supina bluegrass at different fertility‡ and traffic§ levels, East Lansing, MI. 1996-98.

1996	June	July	August	September	October	November
Fertility (F)	Ns	*	Ns	*	*	*
Traffic (T)	Ns	*	*	Ns	*	*
F * T	Ns	Ns	Ns	Ns	Ns	Ns

1997	May	June	July	September	October	November
Fertility (F)	Ns	Ns	*	*	*	*
Traffic (T)	*	*	*	*	*	*
F * T	Ns	Ns	Ns	*	Ns	*

1998	May	June	July	August	September	November
Fertility (F)	Ns	*	*	*	*	*
Traffic (T)	*	*	*	Ns	Ns	*
F * T	Ns	Ns	Ns	Ns	Ns	Ns

† Quality was rated visually on a 1-9 scale where 1=dead and/or bare turf, and 9=uniform dark green turf.
‡ Fertility consisted of 2, 4, and 6 lbs. N 1000 ft^{-2} yr^{-1} at both a 1:1 and 2:1 ratio of N:K.
§ Traffic was simulated using the Brinkman Traffic Simulator.
* Significant at the 0.05 probability level.
Ns Not significant at the 0.05 probability level.

Table 6. Analysis of variance for shear vane† on supina bluegrass at different fertility‡ and traffic§ levels, East Lansing, MI. 1996-98.

	September 1996	November 1996	November 1997	August 1998	December 1998
Fertility (F)	*	Ns	Ns	*	Ns
Traffic (T)	*	*	*	Ns	*
F * T	Ns	Ns	Ns	Ns	Ns

† Shear strength was collected using the Eijelkamp Shear Vane in Newton meters.
‡ Fertility consisted of 2, 4, and 6 lbs. N 1000 ft^{-2} yr^{-1} at both a 1:1 and 2:1 ratio of N:K.
§ Traffic was simulated using the Brinkman Traffic Simulator.
* Significant at the 0.05 probability level.
Ns Not significant at the 0.05 probability level.

Table 7. Interaction of fertility and traffic† for color‡ on supina bluegrass, East Lansing, MI. 1997-98.

	May 1997		November 1997		June 1998		November 1998	
	None	26 games	None	25 games	None	25 games	None	28 games
Fertility rate	---------- Color ----------							
2:1	6.8	6.0	5.1	5.0	7.0	7.4	6.0	5.9
4:2	7.3	6.0	6.0	4.9	8.5	8.5	6.4	6.0
6:3	7.4	5.9	6.0	5.0	8.5	8.5	6.5	6.1
2:2	6.6	6.0	4.8	4.6	7.1	7.6	5.5	5.5
4:4	6.8	6.0	5.9	4.6	8.5	8.5	6.5	6.5
6:6	7.5	5.9	6.0	5.0	8.5	8.5	6.4	6.0
LSD§ (0.05)	0.5		1.7		0.5		0.3	
LSD¶ (0.05)	0.6		0.9		0.8		0.5	

† Traffic was simulated using the Brinkman Traffic Simulator.
‡ Color was rated visually on a 1-9 scale where 1=dead or brown turf, and 9=dark green turf.
§ Between traffic treatments at same fertility level.
¶ Between fertility levels at same or different traffic.

Experiment 2: Mowing height study

Analysis of variance for all three years of testing are included. However, results and discussion will concentrate primarily on 1998 data, or a combination of 1996-1998 data when comparisons are warranted.

Mowing height and traffic interactions occurred for color at the end of each season after traffic treatments were applied (Table 12). Color ratings differed greatly for each year regardless of mowing height or traffic. The vast differences between each rating date and treatments, may be a result of the different temperatures during the late fall of each season. The fall of 1996 was much cooler than the fall of 1997, and especially 1998. This is noticeable by the low turf color for the 2.25" mowing height in December 1996.

Mowing height and traffic interactions also occurred for turfgrass density at the end of each season (Table 13). As mowing height decreased from, 2.25" to 1.25" to 9/16" respectively, turf density also decreased proportionally. However, unlike the December 1996 and November 1997 ratings, there was no significant difference between the 1.25" and 2.25" mowing heights plus traffic for the November 1998 rating. This is likely a result of the turf having three full seasons of growth to mature. During the winter of 1997-98 the ground never froze, and in turn the growing season was lengthened. As a result, all grasses were able to grow longer enabling thatch to accumulate, and possibly providing more wear resistance.

Finally, mowing height and traffic interactions occurred for turfgrass quality at the end of each season (Table 14). Without traffic, the 1.25" mowing height typically had the greatest turfgrass quality. At the 2.25" mowing height, particularly without traffic, the overall appearance of the turf was not uniform giving it a lower quality rating. The appearance of the 9/16" mowing height without traffic was very dense and uniform in texture; however, quality was decreased as a result of creeping bentgrass encroachment. The lower quality ratings for the trafficked plots is mostly attributed to the level of decline in turfgrass density.

Table 8. Analysis of variance for color† on supina bluegrass at different mowing heights‡ and traffic§ levels, East Lansing, MI. 1996-98.

1996	**June**	**July**	**August**	**September**	**October**	**November**
Height (H)	*	Ns	Ns	*	-	*
Traffic (T)	Ns	Ns	Ns	Ns	-	Ns
H * T	Ns	Ns	Ns	Ns	-	*
1997	**May**	**June**	**July**	**September**	**October**	**November**
Height (H)	*	Ns	*	Ns	Ns	Ns
Traffic (T)	Ns	Ns	Ns	Ns	Ns	*
H * T	*	Ns	Ns	Ns	Ns	*
1998	**May**	**June**	**July**	**August**	**September**	**November**
Height (H)	*	*	Ns	*	*	Ns
Traffic (T)	*	Ns	Ns	Ns	Ns	*
H * T	*	Ns	Ns	Ns	Ns	*

† Color was rated visually on a 1-9 scale where 1=dead or brown turf, and 9=dark green turf.
‡ Mowing was done three times a week using reel mowers returning clippings.
§ Traffic was simulated using the Brinkman Traffic Simulator.
* Significant at the 0.05 probability level.
Ns Not significant at the 0.05 probability level.
- Data was not collected during this period.

Table 9. Analysis of variance for density† on supina bluegrass at different mowing heights‡ and traffic§ levels, East Lansing, MI. 1996-98.

1996	June	July	August	September	October	November
Height (H)	*	Ns	Ns	Ns	-	Ns
Traffic (T)	Ns	Ns	Ns	Ns	-	*
H * T	Ns	Ns	Ns	Ns	-	*
1997	**May**	**June**	**July**	**September**	**October**	**November**
Height (H)	*	*	Ns	Ns	*	*
Traffic (T)	*	*	Ns	Ns	*	*
H * T	*	*	Ns	Ns	*	*
1998	**May**	**June**	**July**	**August**	**September**	**November**
Height (H)	*	*	Ns	*	*	Ns
Traffic (T)	*	Ns	Ns	Ns	Ns	*
H * T	*	Ns	Ns	Ns	Ns	*

† Density was rated visually on a percent turfgrass cover (0-100%).
‡ Mowing was done three times a week using reel mowers returning clippings.
§ Traffic was simulated using the Brinkman Traffic Simulator.
* Significant at the 0.05 probability level.
Ns Not significant at the 0.05 probability level.

Table 10. Analysis of variance for quality† on supina bluegrass at different mowing heights‡ and traffic§ levels, East Lansing, MI. 1996-98.

1996	June	July	August	September	October	November
Height (H)	*	*	*	Ns	-	Ns
Traffic (T)	Ns	Ns	Ns	Ns	-	*
H * T	Ns	Ns	Ns	Ns	-	*
1997	**May**	**June**	**July**	**September**	**October**	**November**
Height (H)	*	*	Ns	Ns	*	*
Traffic (T)	*	*	*	*	*	*
H * T	*	*	*	*	*	*
1998	**May**	**June**	**July**	**August**	**September**	**November**
Height (H)	*	Ns	Ns	Ns	*	Ns
Traffic (T)	Ns	Ns	Ns	Ns	Ns	*
H * T	Ns	Ns	Ns	Ns	Ns	*

† Quality was rated visually on a 1-9 scale where 1=dead and/or bare turf, and 9=uniform dark green turf.
‡ Mowing was done three times a week using reel mowers returning clippings.
§ Traffic was simulated using the Brinkman Traffic Simulator.
* Significant at the 0.05 probability level.
Ns Not significant at the 0.05 probability level.

Table 11. Analysis of variance for shear vane† on supina bluegrass at different mowing heights‡ and traffic§ levels, East Lansing, MI. 1996-98.

	November 1996	November 1997	December 1998
Height (H)	*	*	Ns
Traffic (T)	*	*	*
H * T	Ns	*	Ns

† Shear strength was collected using the Eijelkamp Shear Vane in Newton meters.
‡ Mowing was done three times a week using reel mowers returning clippings.
§ Traffic was simulated using the Brinkman Traffic Simulator.
* Significant at the 0.05 probability level.
Ns Not significant at the 0.05 probability level.

Table 12. Interaction of mowing and traffic† for color‡ on supina bluegrass, East Lansing, MI. 1997-98.

	December 1996		November 1997		November 1998	
	None	26 games	None	25 games	None	28 games
9/16	5.3	5.8	3.8	4.0	3.8	4.0
1.25	3.0	5.3	4.0	3.2	4.0	3.2
2.25	1.0	3.8	3.0	2.3	3.0	2.3
LSD(0.05)	0.8		1.0		0.6	
	0.7		0.8		0.6	

† Traffic was simulated using the Brinkman Traffic Simulator.
‡ Color was rated visually on a 1-9 scale where 1=dead or brown turf, and 9=dark green turf.
§ Between traffic treatments at same mowing height.
¶ Between mowing heights at same or different traffic.

Table 13. Interaction of mowing and traffic† for density‡ on supina bluegrass, East Lansing, MI. 1997-98.

	December 1996		November 1997		November 1998	
	None	26 games	None	25 games	None	28 games
9/16	99.0	60.0	96.3	41.7	100	46.7
1.25	99.0	78.3	100	65.0	100	86.7
2.25	99.0	94.0	100	97.7	100	91.7
LSD(0.05)	2.6		14.8		7.0	
	2.3		15.0		7.5	

† Traffic was simulated using the Brinkman Traffic Simulator.
‡ Density was rated visually on a percent turfgrass cover (0-100%).
§ Between traffic treatments at same mowing height.
¶ Between mowing heights at same or different traffic.

Table 14. Interaction of mowing and traffic† for quality‡ on supina bluegrass, East Lansing, MI. 1997-98.

	December 1996		November 1997		November 19-98	
	None	26 games	None	25 games	None	28 games
9/16	7.3	2.2	4.2	2.0	6.8	3.7
1.25	6.3	2.7	5.7	3.7	7.0	5.5
2.25	5.0	5.5	4.5	3.8	7.0	6.2
LSD(0.05)	0.7		0.6		0.6	
	0.7		0.6		1.3	

† Traffic was simulated using the Brinkman Traffic Simulator.
‡ Quality was rated visually on a 1-9 scale where 1=dead and/or bare turf, and 9=uniform dark green turf.
§ Between traffic treatments at same mowing height.
¶ Between mowing heights at same or different traffic.

Experiment three: Competition study

For the purpose of this study, color and quality ratings will not be presented, because of the vast differences in normal physiological characteristics (i.e. color), the color and quality ratings would be somewhat skewed as a result of the mixing of the two turf species.

No significant differences occurred between the different seeding ratios in turfgrass density since the first fall of traffic (Table 15). However, significant differences occurred during the spring and fall ratings for turfgrass density, as a result of fertility treatments. With the exception of the fall 1996 rating, the November 1997 and 1998 density ratings were greater for the 6 lbs. N $1000ft^{-2}$ $yr.^{-1}$ than the 4 lbs. N $1000ft^{-2}$ yr^{-1} treatment. The drastic improvement in turfgrass density at the end of the 1997 and 1998 season compared to the 1996 season, for the high fertility treatments, may be a result of

increased turfgrass maturity. It is interesting to note that the May 1998 density ratings reversed from the previous fall even though no more traffic had been applied. For the high fertility treatment, the percent turfgrass cover declined from the previous fall; while, the low fertility treatment increased in density. These results may be a result of pink snow mold that occurs on the supina bluegrass every winter, particularly on the high fertility treatments.

Applying 6 lbs. N $1000ft^{-2}$ $yr.^{-1}$ compared to 4 lbs. N $1000ft^{-2}$ $yr.^{-1}$ decreases turfgrass shear strength (Table 16). Even though the low fertility treatments had greater shear strength results, the average shear values for the high fertility treatments, for November 1997 and December 1998, are still at acceptable values for turfgrass shear strength. Since the first fall of treatments (October 1996), turfgrass shear strength greatly increased overall for both fertility levels, and different seeding ratios. This is a result of the turfgrass maturing, and developing more extensive stolons and rhizomes.

Results from Figure 1 show the increase in supina bluegrass competition as a result of traffic and increased fertility (spring 1997 sampling date). Applying traffic significantly increases the percent supina bluegrass. In addition, high fertility treatments further increase supina bluegrass encroachment. Simply seeding at 5 or 10% supina bluegrass, and applying traffic is enough to increase the percent supina bluegrass to about 50%. Seeding at 10 and 25% supina bluegrass, and applying high fertility and traffic is enough to increase their stand to almost 80%.

Figure 2 shows the same results for percent supina encroachment, but for spring the spring 1998 sampling date one year later. Unlike Figure 1 results from Figure 2 show the increase in percent supina bluegrass, for the 5 and 10% seeding rates, is not increased any further by a combination of high versus low fertility in addition to traffic, but only by traffic alone. After two seasons of traffic, seeding at 5 and 10% supina bluegrass the percent supina bluegrass increased to about 70%. This is the same for the 25% seeding rate for supina bluegrass with traffic and low fertility. With high fertility and traffic, seeding at 25% supina bluegrass the percent supina present after two years of testing is about 85%.

Finally, Figure 3 shows the number of actual seed stalks counted in a given area for each treatment. This figure simply reinforces the results from Figures 1 and 2. The aggressiveness of supina bluegrass is evident by the similar number of seed stalks recorded for the 5, 10, and 25% seeding rates with the 50 and 100% supina seeding rates.

Table 15. Effects of seeding ratios and fertility on supina bluegrass and Kentucky bluegrass mixes for turfgrass density†, East Lansing, MI. 1996-98.

% supina seeded	December 1996	May 1997	November 1997	May 1998	November 1998
0	84.8	95.8	91.8	95.8	100
5	84.8	95.6	93.8	95.6	94.0
10	81.2	96.0	94.0	96.0	98.4
25	80.3	95.1	92.3	95.2	98.7
50	79.8	94.9	94.8	94.9	96.9
100	65.0	89.8	93.6	89.8	94.5
LSD(0.05)	11.8	Ns	Ns	Ns	Ns
Fertility	**26 games**	**26 games**	**25 games**	**25 games**	**28 games**
3 lbs. N year-=1	92.4	96.8	90.2	96.8	95.8
6 lbs. N year-=1	76.3*	92.3*	96.6*	92.3*	98.4*

† Density was rated visually on a percent turfgrass cover (0-100%).

* Significant at the 0.05 probability level.

Table 15. Effects of seeding ratios and fertility on supina bluegrass and Kentucky bluegrass mixes for turfgrass shear vane†, East Lansing, MI. 1996-98.

% supina seeded	October 1996	November 1997	December 1998
0	9.9	23.0	19.5
5	11.6	20.3	20.4
10	12.0	18.9	20.3
25	13.3	19.1	19.1
50	13.7	18.5	20.9
100	14.9	16.5	21.0
LSD(0.05)	Ns	2.8	Ns
Fertility			
3 lbs. N year-=1	14.3	20.0	21.5
6 lbs. N year-=1	10.8*	18.8*	18.9*

†, Shear strength was collected using the Eijelkamp Shear Vane in Newton meters. * Significant at the 0.05 probability level.

Figure 1. The effects of supina bluegrass (SB) seeding (S) rate, fertility level (F), and traffic (T) on % SB in a supina / Kentucky bluegrass stand, East Lansing, MI. 1997.

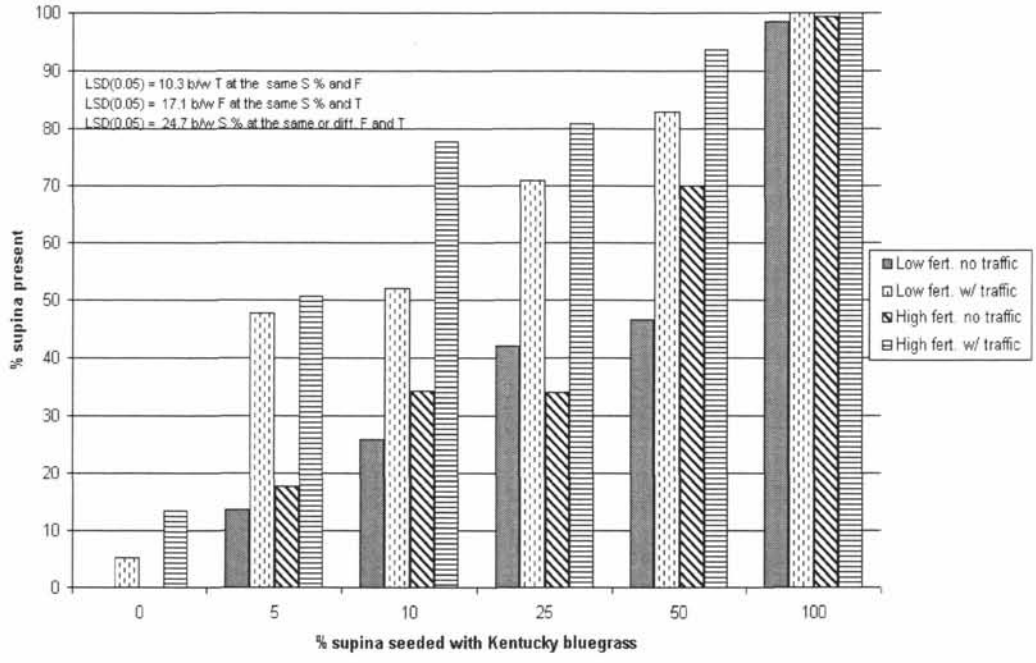


Figure 2. The effects of supina bluegrass (SB) seeding (S) rate, fertility level (F), and traffic (T) on % SB in a supina / Kentucky bluegrass stand, East Lansing, MI. 1998

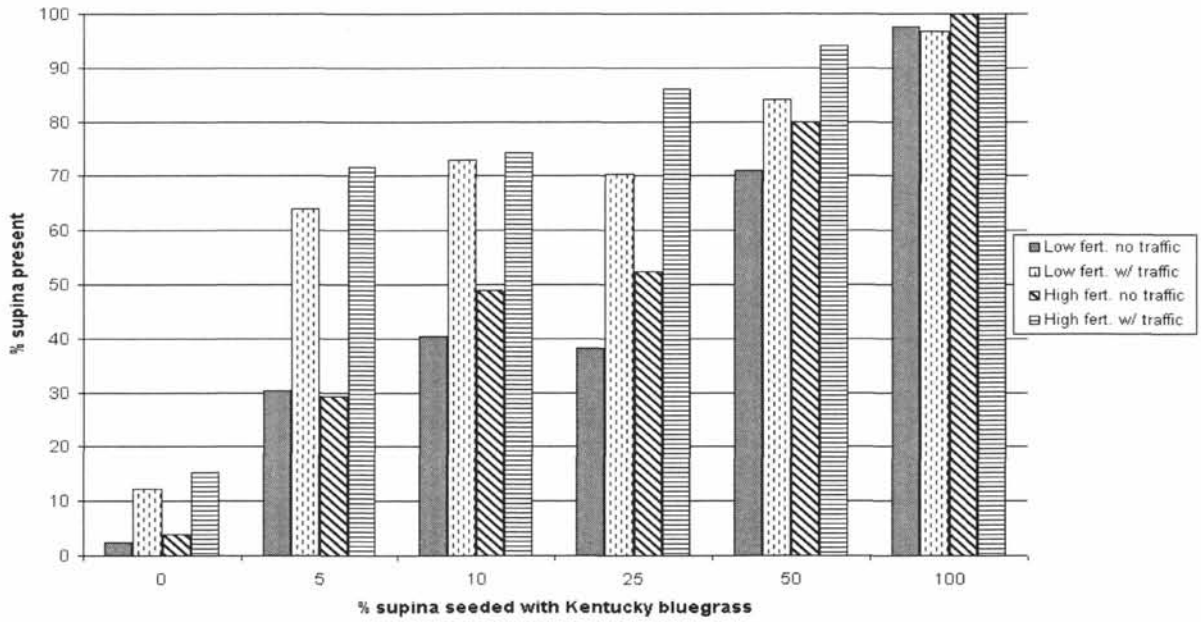
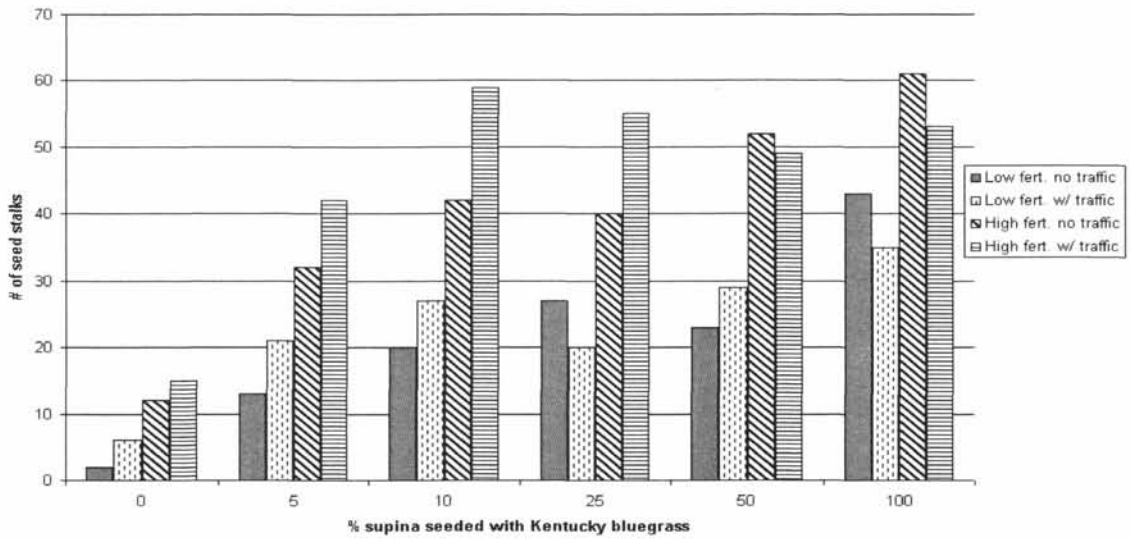


Figure 3. The effects of supina bluegrass (SB) seeding (S) rate, fertility level (F), and traffic (T) on the number of SB seed stalks in a supina / Kentucky bluegrass stand, East Lansing, MI. 1998



Conclusions

Experiment 1: Fertility requirements of supina bluegrass

Fertilizing at 4, or 6 lbs. N $1000ft^{-2}$ yr^{-1} compared to the 2 lb. N $1000ft^{-2}$ yr^{-1} resulted in superior turfgrass color, and to an extent density quality. The ratio of nitrogen to potassium, whether it was 1:1 or 2:1, had no significant effect on turf color, density, quality, or shear strength. Shear resistance, indicative of the degree of rooting and turf strength, was occasionally decreased by high N fertility. Traffic treatments significantly enhanced turf color, but decreased turf density, quality, and shear strength. Thus, one could conclude that fertilizing at 4 lbs. N $1000ft^{-2}$ yr^{-1} would provide the highest overall quality of turf at the most efficient cost.

Experiment 2: Mowing study

Supina bluegrass provided acceptable turfgrass stand for all three mowing heights tested (9/16", 1.25", and 2.25") on non trafficked plots. Supina bluegrass has demonstrated the ability to thrive at a fairway mowing height of 9/16". However, it would not provide a suitable turf surface at the 9/16" mowing height for athletic field conditions. One example of its ability to thrive at this mowing height is its ability to recover from as low as 50% cover to 100% cover within a few growing months after traffic has ceased. Mowing at 2.25", supina bluegrass is very tolerable to traffic, but it does exhibit a lack of uniformity in growth at this increased mowing height. The appearance of the supina appears to accumulate a lot of thatch causing the lack of uniformity at the 2.25" mowing height. Overall, mowing at 1.25" provided the greatest all around turf stand. Supina bluegrass, mowed at 1.25", is very tolerable to athletic field traffic, while maintaining a uniform, high quality appearance.

Experiment 3: Competition study

Supina bluegrass has demonstrated the ability to 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.