MANAGING POA SUPINA SCHRAD. (SUPINA BLUEGERASS) IN MICHIGAN

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Introduction

Supina bluegrass (*Poa supina* Schrad.) is a stoloniferous bluegrass native to Europe where it has been cultivated as a golf course, lawn, and athletic field turf for over twenty years (Berner, 1984; Nonn, 1994). Supina bluegrass is well adapted to cold temperatures and is found commonly in the sub-alpine regions of the German and Austrian Alps (Berner, 1984; Köck and Walch, 1977, Skirde, 1971). In Germany, the common name is Lägerrispe, which means, "where the cows lay". The name is a reflection of the ability of Supina bluegrass to persist and even thrive on cattle trails, even in shaded woodland areas (Berner, 1984; Pietsch, 1989). Another attractive asset is the apparent resistance of Supina bluegrass to many diseases which results in fewer fungicide applications (Nonn, 1994). Unfortunately, the cost of Supina bluegrass seed is quite high, approximately ($25/lb) therefore, the practicality of seeding monostands of the grass is often economically unfeasible. Evidence from Germany suggests relatively low rates (e.g., less than 10%) of Supina bluegrass seed can be mixed with other cool season grasses and after several years of heavy traffic the stand will be predominantly Supina bluegrass, providing superior cover compared to stands without Supina bluegrass.

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 practice 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 second year for data collection from the following three experiment. Results from 1996 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 appropriate mowing height range 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 of the three years (1995-1997).

A factorial experiment was developed to test individual fertility treatments beginning spring 1996, and was repeated beginning spring 1997. 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 split-plot, randomized complete block with three replications. Main plots were fertility treatments which were split for traffic (no traffic and simulated athletic

traffic). Fertility treatment dates were as follows (Table 1), with 1 lb N/1000 ft² and ½ (treatments 1-3) or 1 lb K/1000 ft² (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 and 1997.

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.

Lightweight athletic traffic (i.e., soccer-type) was applied as a split-plot treatment using a Brinkman Traffic Simulator (BTS) with empty rollers from 28 May 1996 to 9 July 1996 for a total of an estimated 11 games. Beginning 9 August 1996, the rollers on the BTS were filled with water and used to simulate one to three football games per week ending 18 November 1996. Football Traffic was repeated beginning 28 August 1997 to 18 November 1997 for a total of 26 games. No simulated soccer games were applied during the June 1997.

Turf color, density, and quality were evaluated on a regular basis. An Eijkelkamp shear vane apparatus was used to determine turf shear resistance. Dollar spot disease ratings were collected on 17 September.

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 ft² 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 ft². 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 ft² with approximately 1 lb/1000 ft² additional P and 1.5 lb/1000 ft² additional K. Fertilizer was applied on six dates between June through October with no more than 0.6 lb N/1000 ft² applied at any date. On 17 Nov. 1995 a dormant application of 1 lb/1000 ft² 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. The experimental design was a randomized complete block, split-plot, with three replications. All plots (each 10 x 10 ft²) were split into trafficked and non-trafficked areas. Simulated athletic traffic was applied using a Brinkman Traffic Simulator (BTS). Lightweight athletic traffic (i.e., soccer-type) was applied as a split-plot treatment using a Brinkman Traffic Simulator (BTS) with empty rollers from 28 May 1996 to 9 July 1996 for a total of an estimated 11 games. Beginning 9 August 1996, the rollers on the BTS were filled with water and used to simulate one to three football games per week ending 18 November 1996. The football traffic was again applied in fall 1997 from 28 August to 18 November.

Plots were fertilized with 5 lb N/1000 ft² and 3.5 lb K/1000 ft² in 1996 and 1997. Fertilizer (18-3-18) was applied at 0.5 lb N/1000 ft² on 10 May, 24 May, 14 June, 12 Aug., 3 Sept., and 24 September for both 1996 and 1997. On 28 June (1996 and 1997), 1 lb N/1000 ft² using sulfur coated urea (40-0-0) was applied plus 1 lb K/1000 ft² using sulfate of potash (0-0-50). On 16 November (1996 and 1997) 1 lb N/1000 ft² 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 Eijkelkamp shear vane apparatus was used to determine turf shear resistance. Dollar spot disease ratings were collected on 17 September.

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; 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. On 17 November 1995-1997 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 split-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 (3 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 1. 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). Lightweight athletic traffic (i.e., soccer-type) was applied as a split-plot treatment using a Brinkman Traffic Simulator (BTS) with empty rollers from 28 May to 9 July for a total of an estimated 11 games. Beginning 9 Aug., the rollers on the BTS were filled with water and used to simulate one to three football games per week ending 18 November 1996. Beginning 28 August 1997 football traffic was again applied twice per week until 18 November 1997.

Turf color, density, and quality were evaluated on a regular basis. An Eijkelkamp shear vane apparatus was used to determine turf shear resistance. Dollar spot disease ratings were collected on 17 September. Changes in stand composition were determined March 1997 by collecting plants at random from each plot using a point quadrant and determining the percentages of Supina bluegrass and Kentucky bluegrass via destructive identification techniques. Plant counts will be collected again in March 1998.

Results and Discussion

Results and discussion will concentrate primarily on 1997 data, or a combination of 1996 and 1997 data when

comparisons are warranted. Refer to the Michigan Turfgrass Conference Proceedings, 1997 for all 1996 data and results.

Experiment 1: Fertility requirements of Supina bluegrass

Supina bluegrass responded positively to nitrogen fertilization (Table 2). Turf color and quality were consistently significantly greater at 4 and 6 lb N/1000 ft^2/year compared to 2 lb N/1000 ft^2/year. The ratio of N:K had little or no effect on turf color, density, or quality. Traffic treatments significantly enhanced turf color (darker green) but decreased turf density and quality (Table 2). There were interactions between traffic and fertility rate on turf color and quality in 1997. On two dates (10 May and 8 Nov.) there were interactions between traffic and fertility rate on turf color (Table 3). The 10 May data shows interactions approximately after one month of growing conditions, and after receiving 26 simulated football games from fall 1996. 8 Nov. data shows interactions between fertility and traffic after 26 fall 1996 and 25 fall 1997 simulated football games. In both instances, trafficked plots had significantly lower color ratings, but did not vary much between fertility rates. None trafficked plots had greater color ratings than non trafficked plots, and color rating increased as fertility increased. The low color ratings on the medium and high fertility plots for the 9 July data was a result of fertilizer burn from human error. After the urea application, the fertilizer was not sufficiently watered in.

Additionally, 8 Sept. 1997 and 8 Nov. 1997 showed interactions between fertility levels and traffic on turf quality (Table 4). After only 3 simulated football games in 1997 and 26 from fall 1996, 8 Sept. interactions showed higher fertility levels regardless of Potassium ratio had significantly greater turf quality on trafficked plots. This is likely a result of decreased thatch, promoting healthier growing turf, as a result of the fall 1996 simulated football games. Non trafficked plots had significantly higher results on both medium and high fertility treatments when the N:K ratio was 1:1 in 8 Sept. and regardless of ratio on 8 Nov. Conversely, the 8 Nov. interactions had greater turf quality on non trafficked plots. This is a direct result on the fall 1997 simulated football games wearing the turf during periods of low growing conditions (Oct. to Nov.). There were no significant interactions on turfgrass density prior to or after fall 1997 simulated football games.

Shear resistance values were generally lower at the high fertility rates compared to low fertility treatments although the results were significant only on one of four dates tested (Table 5). The medium fertility rates (4 lb N/1000 ft^2/year) resulted in intermediate shear resistance values. As with turf color, density, and quality, there were no interactions between traffic and fertility rate.

Table 2. Effects of fertility rate and traffic on Supina bluegrass, East Lansing, MI, 1997.

	10 May	13 June	9 July	8 Sept.	8 Oct.	8 Nov.
Treatment	Color †					
Fertility (#N:#K yr^{-1}) ‡						
2:1	6.4	6.8	6.9	5.9	5.8	5.1
4:2	6.6	6.8	5.9	6.8	7.8	5.4
6:3	6.6	6.5	4.9	7.5	7.4	5.5
2:2	6.3	6.9	7.1	6.3	5.5	4.7
4:4	6.4	6.6	7.4	7.4	7.6	5.3
6:6	6.7	6.7	5.3	7.4	7.5	5.5
LSD (0.05)	0.3	Ns	1.5	0.7	0.6	0.6
Traffic						
No	7.0	6.6	5.9	6.9	6.9	5.6
Yes	5.6**	6.8**	6.5**	6.9	7.0	4.9**
Fertility (#N:#K yr^{-1})	Density (% turf cover)					
2:1	87.5	99.6	97.8	99.8	94.0	84.4
4:2	89.4	99.6	94.4	99.4	94.9	85.0

6:3	86.9	99.5	75.3	99.5	95.1	85.6
2:2	91.8	99.6	100.0	99.9	94.6	82.5
4:4	87.1	99.0	100.0	999.9	95.3	82.5
6:6	85.6	99.6	88.6	99.5	95.9	85.6
LSD (0.05)	Ns	Ns	16.4	Ns	Ns	Ns
Traffic						
No	100.0	100.0	91.8	99.6	100.0	100.0
Yes	76.1**	99.0	94.2*	99.7	89.9**	68.5**
Fertility (#N:#K yr^{-1})	Quality §					
2:1	5.9	8.3	8.0	7.2	6.2	5.7
4:2	6.2	8.3	6.5	7.8	7.9	5.9
6:3	6.1	7.7	4.8	9.0	7.9	5.8
2:2	6.0	8.1	8.9	7.2	6.1	5.3
4:4	5.9	7.8	8.8	8.9	7.7	5.8
6:6	6.1	7.9	5.3	9.0	7.7	5.8
LSD (0.05)	Ns	Ns	1.3	1.4	0.7	0.3
Traffic						
No	8.0	8.5	6.7	8.1	7.8	6.7
Yes	4.1**	7.5**	7.4**	8.3*	6.6**	4.7**
No. games simulated ¶	26	26	26	26 + 3	26 + 11	26 + 20

*,** Significant at the 0.05 and 0.01 probability levels, respectively; ns = not significant at p=0.05.

† Color was rated visually on a 1-9 scale; 1=100% brown, 9=dark green.

‡ Nitrogen was supplied as urea (46-0-0) and potassium was supplied as sulfate of potash (0-0-50). 1 lb N and ½ lb K per 1000 ft^2 were applied to the following treatments (**bold**) on the following 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 November. 1 lb N, 1 lb K per 1000 ft^2 were applied to the following treatments on the following dates: **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.

§ Quality was rated visually on a 1-9 scale; 1=100% necrotic turf/bare soil, 9=dense, uniform turf; 5=minimum value for acceptable quality.

¶ A Brinkman Traffic Simulator (BTS) with empty rollers was used to simulate soccer traffic from 28 May 1996 - 9 July 1996. Beginning 9 Aug. 1996, a BTS with rollers filled with water was used to simulate football traffic, approximately 3 games per week, until 18 Nov. 1996 (26 games); two passes with the BTS was equivalent to the amount of traffic between the hashmarks at the 40 yd line of a football field. The values following the + sign are the amount of trafficked games for 1997.

Table 3. Interaction of traffic and fertility rates on color of Supina bluegrass on a sandy loam soil, East Lansing, MI, 1997.

	10 May 1997		8 Nov. 1997	
	Traffic†			
Fertility rate (lb N:K/1000 ft^2/yr)	None	26 games	None	51 games
	Color (1 – 9)			
2:1	6.8	6.0	5.1	5.0
4:2	7.3	6.0	6.0	4.9
6:3	7.4	5.9	6.0	5.0
2:2	6.6	6.0	4.8	4.6
4:4	6.8	6.0	5.9	4.6
6:6	7.5	5.9	6.0	5.0
LSD (0.05)				
between traffic treatments	0.5		0.7	
between fertility rates	0.6		0.9	

† A Brinkman Traffic Simulator (BTS) was used to simulate the amount of traffic in football games between the hashmarks at the 40 yd line.

Table 4. Interaction of traffic and fertility rates on quality of Supina bluegrass on a sandy loam soil, East Lansing, MI, 1997.

	8 Sept. 1997		8 Nov. 1997	
	Traffic†			
Fertility rate (lb N:K/1000 ft²/yr)	None	29 games	None	51 games
	Quality (1 - 9)			
2:1	6.9	7.5	6.4	5.0
4:2	7.5	8.1	7.0	4.8
6:3	9.0	9.0	7.0	4.6
2:2	7.0	7.4	6.0	4.5
4:4	9.0	8.9	7.0	4.5
6:6	9.0	9.0	7.0	4.6
LSD (0.05)				
between traffic treatments	0.6		0.3	
between fertility rates	1.5		0.5	

† A Brinkman Traffic Simulator (BTS) was used to simulate the amount of traffic in football games between the hashmarks at the 40 yd line. 8 Sept. were trafficked 26 games from 1996 and 3 from fall 1997. 8 Nov. were trafficked 26 games from 1996 and 25 from 1997.

Table 5. Effects of fertility and traffic on the shear resistance of Supina bluegrass maintained at 1.25" height, East Lansing, MI, 1996 and 1997

	Shear resistance (N m) †			
Treatment	23 July	17 Sept.	8 Nov.	10 Nov.
Fertility (#N:#K per 1000 ft²/year)‡				
2:1	19.2	16.6	13.6	15.4
4:2	17.8	14.6	12.4	13.9
6:3	19.1	14.4	11.6	14.2
2:2	19.8	16.6	13.4	16.5
4:4	19.7	16.5	12.3	14.7
6:6	16.9	14.4	12.2	13.6
LSD (0.05)	Ns	1.7	Ns	Ns
Traffic				
no	19.6	16.8	17.9	17.2
yes	17.8*	14.3**	7.3**	12.2**

*,** Significant at the 0.05 and 0.01 probability levels; Ns = not significant at p=0.05.

† An average of two shear resistance values per plot were used for analysis.

‡ Nitrogen was supplied as urea (46-0-0) and potassium was supplied as sulfate of potash (0-0-50). Plots were fertilized (1996 and 1997) according to the following schedule:

#N:#K	Application dates
2:1	1 lb N, 1/2 lb K/1000 ft²: 10 May, 16 Sept.
4:2	1 lb N, 1/2 lb K/1000 ft²: 10 May, 3 June, 16 Aug., 16 Sept., 11 Nov.
6:3	1 lb N, 1/2 lb K/1000 ft²: 10 May, 3 June, 28 June, 16 Aug., 16 Sept., 11 Nov.
2:2	1 lb N, 1 lb K/1000 ft²: 10 May, 16 Sept.
4:4	1 lb N, 1 lb K/1000 ft²: 10 May, 3 June, 16 Aug., 16 Sept., 11 Nov.
6:6	1 lb N, 1 lb K/1000 ft²: 10 May, 3 June, 28 June, 16 Aug., 16 Sept., 11 Nov.

Experiment II: Mowing height study

Turfgrass color was greatly decreased on the 2.25" mowing height during the late fall in both 1996 and 1997 (Table 1). Turfgrass color was also decreased on the 2.25" mowing height during the spring (May 1997. This is likely a result of the increased susceptibility to snow mold by the higher mowing height.

Traffic greatly reduced density as mowing heights decreased (Table 2). The 9/16" mowing height has proven to be an unacceptable mowing height for athletic field conditions in Michigan. However, it did maintain acceptable characteristics under non athletic traffic conditions, indicating its potential as a suitable fairway trufgrass for golf courses in Michigan. At the 1.25" and 2.25" mowing heights, Supina bluegrass performed well as an athletic turfgrass.

Turfgrass quality was typically the greatest with the 1.25" and 2.25" mowing heights (Table 3). Under trafficked conditions, the 2.25" mowing height had the highest turfgrass quality. However, under non trafficked conditions the 1.25" mowing height had the highest quality. This was a result of the lack of uniformity in growth when mowed at 2.25".

Dollar spot severity was highest in September of 1997 (Table 4). Non trafficked plots had significantly more dollar spot diseased area than trafficked plots. This is likely a result of the increased thatch layer on the non trafficked plots providing a more favorable host environment for the dollar spot to inoculate. Conversely, dollar spot severity increased as mowing height decreased. This is likely a result of the increased stress at the lower mowing heights, and the symptoms being easier to identify.

Table 1. Interaction of cutting height and traffic on color† of *Poa supina*, East Lansing, MI., 1997.

	10 May		12 June		8 October	
	traffic‡					
	None	26 games§	None	26 + 1¶	None	26 + 11#
Mowing height						
14 mm	6.5	5.8	5.5	7.0	6.3	5.3
30 mm	7.5	6.5	7.2	7.5	6.3	5.5
57 mm	5.2	6.5	7.5	7.3	6.3	5.2
$LSD^{††}_{(0.05)}$	0.4*		ns		ns	
$LSD^{†††}_{(0.05)}$	0.4*		ns		ns	

* Significant to the 0.05 probability level; ns=not significant.
† Color was rated visually on a 1-9 scale; 1=100% brown, 9=dark green
‡ Football traffic was applied using the Brinkman Traffic Simulator.
§ Trafficked 26 games fall 1996.
¶ Trafficked 26 games fall 1996 and 1 game fall 1997.
# Trafficked 26 games fall 1996 and 11 games fall 1997.
†† Between traffic treatments at same height.
††† Between heights at same or different traffic.

Table 2. Interaction of cutting height and traffic on density† of *Poa supina*, East Lansing, MI., 1997.

	10 May traffic‡		12 June	8 October		
	None	26 games§	None	26 + 1¶	None	26 + 11#
Mowing height						
14 mm	99.7	71.7	100	95.7	100	75.0
30 mm	100	81.7	100	98.7	100	92.3
57 mm	100	94.7	100	100	100	99.7
$LSD^{††}_{(0.05)}$	5.7*		1.1*		3.7*	
$LSD^{†††}_{(0.05)}$	5.8*		1.1*		3.7*	

* Significant to the 0.05 probability level; ns=not significant.
† Density was rated visually on a 0-100% scale.
‡ Football traffic was applied using the Brinkman Traffic Simulator.
§ Trafficked 26 games fall 1996.
¶ Trafficked 26 games fall 1996 and 1 game fall 1997.
# Trafficked 26 games fall 1996 and 11 games fall 1997.
†† Between traffic treatments at same height.
††† Between heights at same or different traffic.

Table 3. Interaction of cutting height and traffic on quality† of *Poa supina*, East Lansing, MI., 1997.

	10 May traffic‡		12 June	8 October		
	None	26 games§	None	26 + 1¶	None	26 + 11#
Mowing height						
14 mm	8.0	3.3	9.0	7.2	7.7	3.7
30 mm	8.0	5.8	9.0	8.3	8.5	7.3
57 mm	5.8	6.0	9.0	8.0	8.0	7.5
$LSD^{††}_{(0.05)}$	0.8*		0.4*		0.5*	
$LSD^{†††}_{(0.05)}$	0.8*		0.4*		.06*	

* Significant to the 0.05 probability level; ns=not significant.

† Quality was rated visually on a 1-9 scale; 1=necrotic turf/bare soil, 9=dense, uniform turf with acceptable color (color $\geq$ 5).

‡ Football traffic was applied using the Brinkman Traffic Simulator.
§ Trafficked 26 games fall 1996.
¶ Trafficked 26 games fall 1996 and 1 game fall 1997.
# Trafficked 26 games fall 1996 and 11 games fall 1997.
†† Between traffic treatments at same height.

††† Between heights at same or different traffic.

Table 4. Interaction of cutting height and traffic on dollar spot† on *Poa supina*, East Lansing, MI., 1996-77.

	17 Sept. 1996 traffic‡		8 Aug. 1997		3 Sept. 1997	
	None	15 games§	None	26 games¶	None	26 + 1#
	%					
Mowing height						
14 mm	8.7	6.0	45.7	1.7	58.3	11.7
30 mm	5.2	3.0	0	0	31.0	15.7
57 mm	2.1	2.0	0	0	20.0	6.7
$LSD^{††}_{(0.05)}$	ns		8.4*		11.0*	
$LSD^{†††}_{(0.05)}$	ns		9.1*		17.2*	

* Significant to the 0.05 probability level; ns=not significant.

† Dollar Spot was rated visually on a percent area infested (0-100%).

‡ Football traffic was applied using the Brinkman Traffic Simulator.
§ Trafficked 15 games 1996.
¶ Trafficked 26 games 1996 and.
# Trafficked 26 games 1996 and 1 game fall 1997.
†† Between traffic treatments at same height.

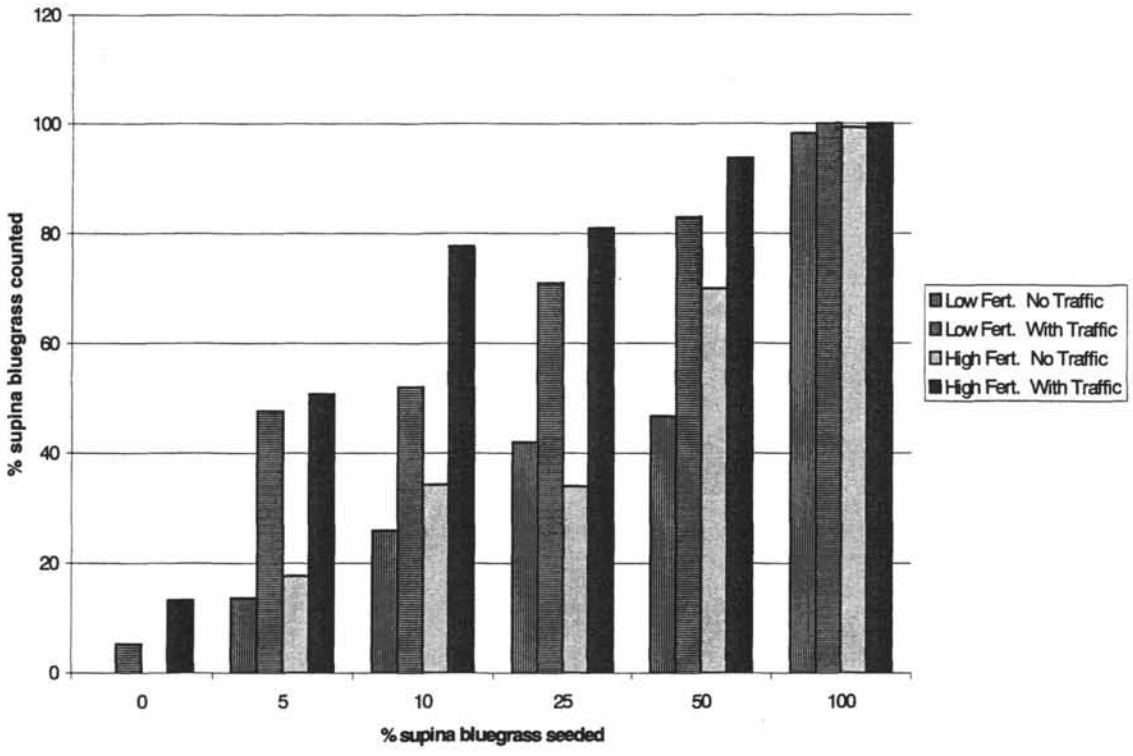
††† Between heights at same or different traffic.

Experiment 3: Competition Study

The results from Figure 1 detail that when supina bluegrass/Kentucky bluegrass stands are subjected to traffic that supina bluegrass percentages increase due to the stoloniferous and aggressive nature of supina bluegrass. When the fertility is high then the increase is more dramatic. While the amount of supina bluegrass increases as supina bluegrass seeding percentages increase, It appears that 10% supina bluegrass seeded under high fertility is the approximate amount to use from an economic standpoint.

Color ratings differed significantly among the six seeding mixtures, and two fertility levels (Table 1). Table 1 also indicates that density ratings are only significant between the seeding mixtures, and the two fertility levels. These significant differences only occur when, traffic applications are being applied (8 Oct. and 8 Nov.), or early in the growing season (10 May and 12 June) before the turf has the ability to recover from the previous fall traffic. After 25 simulated football games (plus 26 from the previous fall) turfgrass density increases significantly as the percent of seeded supina bluegrass also increases. This indicates that supina bluegrass has the ability to thrive more effectively than Kentucky bluegrass under high trafficked conditions. The fertility level only significantly influenced quality ratings; where, increased fertility meant increased quality ratings. The greater the percentage of Kentucky bluegrass, or the higher the fertility level the greater the shear strength of the turf (Table 2).

Fig. 1. The effects of supina bluegrass seeding rate, fertility level, and traffic on % supina bluegrass in a kentucky bluegrass/supina bluegrass stand, East Lansing, MI. 1997.



1) $LSD_{(0.05)}$ = 10.3 Between traffic treatments at the same level of seeding % and fertility.
2) $LSD_{(0.05)}$ = 17.1 Between fertility levels at the same seeding % and traffic treatment.
3) $LSD_{(0.05)}$ = 24.7 Between Seeding % at the same or different rate levels of fertility and traffic.

Table 1. Effects of Supina bluegrass (SB) and Kentucky bluegrass (KB) seeding ratios and fertility rates on turf subjected to simulated sports traffic, East Lansing, MI, 1997.

	10 May	12 June	11 July	8 Sept.	8 Oct.	8 Nov.
Treatment			Color†			
Seeding mixture ‡						
100 % KB	7.5	7.7	8.3	7.7	6.9	4.4
5 SB:95% KB	6.8	7.0	7.4	7.1	6.5	4.0
10% SB:90% KB	6.8	6.5	7.5	6.9	6.4	4.2
25% SB:75% KB	6.3	6.7	7.4	7.0	6.4	4.0
50% SB:50% KB	6.1	6.3	7.3	7.1	6.3	4.0
100% SB	5.6	6.1	7.1	6.6	6.3	3.8
LSD (0.05)	0.4	0.5	0.3	0.4	0.4	0.2
Fertility §						
low	6.1	6.1	7.6	7.3	6.3	3.5
high	6.9**	7.3**	7.4ns	6.9**	6.6ns	4.7**

Table 1. cont.

Seeding mixture	Density (% turf cover)					
100 % KB	95.8	99.5	100.0	100.0	95.7	91.8
5 SB:95% KB	95.6	99.5	100.0	100.0	96.4	93.8
10% SB:90% KB	96.0	99.3	100.0	100.0	97.5	94.0
25% SB:75% KB	95.1	98.6	99.8	100.0	96.5	92.3
50% SB:50% KB	94.9	99.2	100.0	100.0	97.1	94.8
100% SB	89.8	96.5	99.6	100.0	97.4	93.6
LSD (0.05)	ns	1.5	ns	ns	0.9	ns
Fertility						
low	96.8	98.9	99.8	100.0	95.9	90.2
high	92.3**	98.6ns	100.0ns	100.0ns	97.6**	96.6**
Seeding mixture	Quality¶					
100 % KB	7.7	8.1	8.1	7.5	7.0	5.3
5 SB:95% KB	7.4	8.0	8.0	7.9	7.6	5.3
10% SB:90% KB	7.0	8.0	7.7	7.2	7.6	5.6
25% SB:75% KB	6.5	8.0	7.7	7.6	7.4	5.2
50% SB:50% KB	7.0	7.4	7.8	7.9	7.5	5.4
100% SB	6.1	7.2	8.1	8.0	7.7	5.2
LSD (0.05)	ns	ns	ns	ns	0.4	ns
Fertility						
low	7.0	7.3	7.4	8.1	7.3	4.2
high	7.0ns	8.2**	8.4**	7.2**	7.6*	6.4**
No. games simulated#	26	26	26	29	37	51

*,** Significant at the 0.05 and 0.01 probability levels, respectively; ns = not significant at p=0.05.

† Color was rated visually on a 1-9 scale; 1=100% brown, 9=dark green.

‡ Plots were seeded with Supina bluegrass 'Supra' and/or Kentucky bluegrass 'Touchdown' at 1.5 lb seed/1000 ft^2 in June 1995. Mixtures were on a weight:weight basis.

§ Low fertility: ½ lb N/1000 ft^2 using 18-3-18 on 10 May, 3 June, 16 Aug., and 5 Sept., plus 1 lb N/1000 ft^2 using sulfur coated urea (40-0-0) on 28 June and 1 lb N/1000 ft^2 using urea on 16 Nov. 1996. High fertility: ½ lb N/1000 ft^2 10 May, 14 June, 2 Aug., 5 Sept., 1 Oct.; ¾ lb N/1000 ft^2 24 May, 16 Aug., all using 18-3-18, plus 1 lb N/1000 ft^2 using sulfur coated urea (40-0-0) on 28 June, and 1 lb N/1000 ft^2 using urea on 16 Nov.

¶ Quality was rated visually on a 1-9 scale: 1=100% necrotic turf/bare soil, 9=dense, uniform turf with acceptable color (color $\geq$ 5).

A Brinkman Traffic Simulator (BTS) with empty rollers was used to simulate soccer games from 14 May- 9 July 1996; afterwards, the rollers were filled with water and the BTS was used to simulate football games from 9 Aug. - 18 Nov. 1996. 28 Aug. 1997 simulated football traffic resumed.

Table 2. Effects of Supina bluegrass and Kentucky bluegrass seeding ratios on turf shear subjected to simulated sports traffic, East Lansing, MI, 1996-97.

	1996 Shear resistance (N m)		1997 Shear
Treatment	23 July	16 Oct.	9 Nov.
Seeding mixture †			
100 % SB	17.5	9.9	16.5
50% SB:50% KB	19.7	11.6	18.5
25% SB:75% KB	19.2	12.0	19.1
10% SB:90% KB	21.2	13.3	18.9
5% SB:95% KB	21.2	13.7	20.3
100% KB	20.3	14.9	23.0
LSD (0.05)	ns	ns	2.8
Fertility ‡			
low	20.4	14.3	20.0
high	19.3 ns	10.8*	18.8**
No. games simulated§	14	18	51

* Significant at the 0.05 probability level; ns = not significant.

† Plots were seeded with Supina bluegrass 'Supra' and/or Kentucky bluegrass 'Touchdown' at 1.5 lb seed/1000 ft² in June 1995. Mixtures were on a weight:weight basis.

‡ Low fertility: ½ lb N/1000 ft² using 18-3-18 on 10 May, 3 June, 16 Aug., and 5 Sept., plus 1 lb N/1000 ft² using sulfur coated urea (40-0-0) on 28 June and 1 lb N/1000 ft² using urea on 16 Nov. 1996. High fertility: ½ lb N/1000 ft² 10 May, 14 June, 2 Aug., 5 Sept., 1 Oct.; ¾ lb N/1000 ft² 24 May, 16 Aug., all using 18-3-18, plus 1 lb N/1000 ft² using sulfur coated urea (40-0-0) on 28 June, and 1 lb N/1000 ft² using urea on 16 Nov.

§ A Brinkman Traffic Simulator (BTS) with empty rollers was used to simulate soccer games from 14 May- 9 July; afterwards, the rollers were filled with water and the BTS was used to simulate football games from 9 Aug. - 18 Nov.

Conclusions

Experiment 1: Fertility requirements of Supina bluegrass

Four to six lbs N/1000 ft²/year resulted in significantly superior turf color, density, and quality compared to two lbs N/1000 ft²/year. The ratio of N:K, whether 2:1 or 1:1, did not affect the turf. Shear resistance, indicative of the degree of rooting and turf strength, was occasionally decreased by high N fertility. The four lb N/1000 ft²/year rate of fertilizer with either two or four lbs K/1000 ft²/year appeared to provide the best combination of turf color, density, quality, and shear resistance compared to either two or six lb N/1000 ft²/ year.

Experiment II: Mowing height study

Supina bluegrass maintained acceptable turf characteristics at 9/16" height to make it a viable candidate for further testing as fairway turfgrass for golf courses in Michigan. The 9/16" height was too short for it to be used for aggressive athletic traffic such as football. Supina bluegrass performed well at 1.25" height although more than 20 simulated football games caused excessive damage. At 1.25", Supina bluegrass would be expected to perform well in less aggressive traffic situations (e.g., soccer fields). At the 2.25" height, Supina bluegrass could perform well as a lawn turf although the foliage would become nearly totally necrotic by mid to late autumn. Spring green up is extremely quick making this a true cool season turfgrass. All three mowing heights recovered and showed no evidence of snow mold early in the growing season.

Experiment three: Competition study

Supina bluegrass has a demonstrated ability to out compete Kentucky bluegrass when seeded as a mixture. A seeding mixture containing only 10% supina bluegrass is enough to aggressively compete with the Kentucky bluegrass in only two seasons. Increasing the traffic and/or fertility levels will enhance the aggressiveness of the supina bluegrass as it encroaches on the Kentucky bluegrass. Also, during trafficked conditions supina bluegrass has shown to maintain higher densities than Kentucky bluegrass during these stressed periods.

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