Wear Tolerant Grasses for Use on Sports Fields in a Cold Climate

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Summary

This trial was initiated to examine the effects of traffic on various grasses for sports fields in a cold climate. Two locations were seeded in 2003 one in Calgary and one in Edmonton. The Calgary site was seeded in late June, and under irrigated conditions, established normally. The Edmonton site was seeded in early September on an unirrigated site. Due to drought stress in 2004 and physical damage from construction equipment working in the area, this site was abandoned in the spring of 2005.

At the Calgary site, athletic events were initiated in the fall of 2004. The plots endured moderate to heavy traffic from mid August through to and the end of October. Cleat injury was visible throughout the site. Damage ranged from moderate shearing of the above ground plant portion (verdure) to the more severe physical up rooting of the plants.

The tall fescue plots exhibited more physical uprooting than the other grasses and the bare patches created in the fall of 2004 required most of the season to fill-in. The perennial ryegrass, Kentucky bluegrass and the sports field mix plots successfully recovered from traffic damage and were rated as acceptable in overall turf quality. The *Poa supina* mix showed the greatest improvement over the course of the season and scored the highest in overall turf quality.

Introduction

During the summer of 2001, the Prairie Turfgrass Research Centre conducted a site visit to the County of Strathcona (Sherwood Park, Alberta) to examine the condition of their sports fields and to assist in the development of a long-term plan for their improvement. Many of the high use fields were characterized by bare areas and thin turf that was a result of extremely high levels of traffic and was exacerbated by drought conditions that were prevalent throughout much of Alberta.

Sports participation, and in particular soccer, has increased dramatically in the last few years. These high participation levels have resulted in sports fields receiving far more traffic than the existing grasses are capable of withstanding. In addition, highly organized leagues in football, softball and baseball have also served to increase traffic on sports fields, particularly in urban areas.

Sports fields grasses in this climate are predominately Kentucky bluegrass and creeping red fescue. These grasses are considered to have only a moderate tolerance to traffic and wear (the effects of abrasive activity from foot traffic). These grasses are, however, quite cold tolerant and as a result survive Canadian Prairie winters quite well. In areas with a moderate climate i.e. the lower mainland of British Columbia, perennial ryegrass and tall fescue are frequently used in high traffic areas due to their good wear tolerance. However, in Alberta, their lack of cold tolerance has made them unsuitable for use on sports fields or other high traffic areas.

In recent years many new varieties of perennial ryegrass and tall fescue have been developed, but have never been tested for their cold tolerance. As there are often differences in cold tolerance between varieties, some of these new wear tolerant perennial ryegrasses or tall fescues may have better cold tolerance. In addition, other grasses, such as *Poa supina*, have been successfully used in sports fields in other parts of North America due to their good recovery from traffic but have not been adequately tested for their cold tolerance.

The objective of this trial is to develop additional information regarding wear and cold tolerant grasses that can be used on sports fields.

Specific Objectives of this Trial

- Screen new species and varieties of grasses for improved cold tolerance
- Evaluate the most promising cold tolerant species and varieties for their wear tolerance and turfgrass quality under field conditions
- Evaluate these cold tolerant grasses in different climate zones throughout the province
- Evaluate mixtures of the best cold and wear tolerant grasses from the field study

Methodology – Initial Screening

A preliminary screening of forty-eight grass cultivars for cold tolerance was conducted in order to identify the most suitable cultivars for field-testing. Grasses were grown on in the greenhouse and then were subjected to a standard freeze test to determine their relative hardiness levels (Table 1). Twenty-one grasses were chosen for the field study component of this trial. In addition, *Poa supina*, a *Poa supina* and Touchdown Kentucky bluegrass mix, and the City of Calgary standard sports field mix were added.

Methodology – Field Study

Plots that measured 1.5 by 2 meters were arranged in a randomized complete block design (RCBD) and replicated four times. The Calgary site was seeded June 30, 2003, and the Edmonton site was seeded September 3, 2003. Seeding rates were 0.5 kg/100m^2 for Kentucky bluegrass, and 3.2 kg/100m^2 for the tall fescue and perennial ryegrasses. The plots were seeded by hand using a shaker bottle and were then lightly raked to ensure good seed to soil contact. Irrigation was available at the Calgary site, while the Edmonton site relied solely on natural precipitation.

Over the course of 2004 season, poor seed germination combined with some physical damage to the plots as a result of further construction at the Edmonton site left most of the turf plots sparse and patchy. After the initial spring rating of 2005, the stands of turf were deemed as not acceptable and the collection of data for this site was discontinued.

At the Calgary site, athletic events were conducted on the turf in the fall of 2004. The plots endured moderate to heavy traffic from mid August through to the end of October. The site was routinely mowed at a height of 6.25cm (2½") and regularly fertilized at a rate of 0.5kg N/100m^2 (1b N/1000ft^2) per growing month. Irrigation was carried out to prevent moisture stress.

Following National Turfgrass Evaluation Program (NTEP) protocols, the overall appearance of the turf plots was assessed. Three turf quality factors: colour, density and area coverage was evaluated on a monthly basis from early May through to mid October.

The colour factor subjectively evaluated the uniformity and intensity of the colour displayed by the turf. To ensure that the turf colour was representative of the cultivar's genetic potential and not as a result of an environmental stress on the turf, only actively growing turf was rated. A 1 to 9 scale was used to rate the spring green-up and seasonal colour of each plot. Cultivars with a uniform dark green colour received scores ranging from 6 for an acceptable colour to 9 for turf with outstanding colour. Cultivars displaying weak or chlorotic turf colour were scored lower.

Density, the second quality factor, subjectively evaluated shoot and tiller production. The 1 to 9 scale was used to rate each plot. Cultivars which developed a thick tight knit turf surface received scores ranging from 6 for an acceptable density to 9 for a superior turf. Cultivars associated with a weak or thin turf stand were scored lower.

The final quality factor area cover subjectively evaluated the vigor of turf. Again the 1 to 9 scale was used to rate each plot. Cultivars with a thick competitive turf cover received scores ranging from 6 for an acceptable area cover to 9 for superior area coverage. Cultivars affected by weed encroachment and/or the presence of bare patches were scored lower.

To compare the overall turf quality of the cultivars, the average of the combined colour, density and area cover scores for each plot was calculated and statistically analyzed.

Results and Discussion

Initial Screening for Winter Hardiness

All of the Kentucky bluegrasses selected for this study had winter hardiness levels >-26^{o}C, which is considered good (Table 1). Winter hardiness levels for the perennial ryegrasses were -17^{o}C, while the tall fescues had winter hardiness levels of -22^{o}C. These values would be considered moderate to poor winter hardiness levels. *Poa supina* values were not determined.

Table 1. List of grasses seeded and their relative winter hardiness level.

Grass Species	Cultivar	Relative Hardiness (LT_{50} Values)
Kentucky Bluegrass	SR 2284	>-26°C
Kentucky Bluegrass	Showcase	>-26°C
Kentucky Bluegrass	Award	>-26°C
Kentucky Bluegrass	Total Eclipse	>-26°C
Kentucky Bluegrass	Tsunami	>-26°C
Kentucky Bluegrass	America	>-26°C
Kentucky Bluegrass	Langara	-26°C
Kentucky Bluegrass	Moon Shadow	-26°C
Kentucky Bluegrass	Touchdown	>-26°C
Kentucky Bluegrass	Rambo	>-26°C
Kentucky Bluegrass	Argyle	>-26°C
Perennial Ryegrass	Fiesta 3	-17°C
Perennial Ryegrass	Pennfine	-17°C
Perennial Ryegrass	Pick RC2	-17°C
Perennial Ryegrass	PR A-97	-16°C
Tall Fescue	Grande	>-22°C
Tall Fescue	SR 8600	>-22°C
Tall Fescue	Arid 3	>-22°C
Tall Fescue	Pixie	>-22°C
Tall Fescue	Mustang II	>-22°C
Tall Fescue	Watchdog	>-22°C
Poa supina	Supranova	Unknown
Poa supina Mix	10% Poa supina	Unknown
	90% Touchdown (KentuckyBluegrass)	>-26°C
Sport Field Mix	25% Award (Kentucky Bluegrass)	>-26°C
	25% Liberator (Kentucky Bluegrass)	Unknown
	25% Odyssey (Kentucky Bluegrass)	>-26°C
	25% Champion (Perennial Ryegrass)	Unknown

Overall Traffic Injury

Injury from football cleats was visible throughout the site in the fall of 2004. Damage ranged from moderate shearing of the verdure (above ground plant portion) to more severe physical up rooting of the plants. The turf overwintered in this worn condition as the turf damage was not repaired. With no athletic events played on the turf surface in 2005, the turf was allowed to recover. The turf damage within each plot was left for the entire season in order to evaluate the recovery rate of the grasses.

Kentucky Bluegrass Ratings - 2005

Spring Greenup

Two separate rating dates, May 5 and 19, were conducted in order to determine the transition from winter dormancy to active spring growth. An analysis of the turf colour data for the first sampling date revealed no significant difference in early spring greenup between the cultivars (Table 2).

By the second sampling date there was a statistical difference in spring colour between the cultivars (Table 2). Cultivar SR228 scored the highest for spring greenup, while the cultivar, Rambo, scored the lowest (Table 2).

Summer Colour

The summer rating revealed a statistical difference between the highest scoring cultivars: Showcase, Tsunami and SR228 and the lighter coloured cultivars: Langara, America, Total Eclipse and Rambo (Table 2).

Fall Colour

The Kentucky bluegrass cultivars showed good colour retention under the cooler and frost-prone conditions of October. The cultivars, Showcase, Tsunami and Moon Shadow scored the highest for fall colour, while the turf colour of the cultivars: Total Eclipse and Rambo were the lowest (Table 2).

Table 2 Kentucky bluegrass turf colour, Calgary 2005.

Cultivar	Rating Period				
	Early Spring	Spring	Summer	Fall	Seasonal Average
	1-9 scale				
Showcase	4.3a	5.3ab	6.5a	6.5a	6.1
Tsunami	4.5a	5.0ab	6.5a	6.0ab	5.8
SR228	4.0a	5.5a	6.5a	5.3bc	5.8
Moon Shadow	4.3a	5.0ab	6.0ab	5.8abc	5.6
Award	4.0a	5.3ab	6.0ab	5.5bc	5.6
Touchdown	4.5a	5.0ab	6.0ab	5.5bc	5.5
Argyle	4.0a	4.8bc	6.0ab	5.3bc	5.4
Langara	4.3a	5.0ab	5.8bc	5.5bc	5.4
America	4.0a	4.8bc	5.8bc	5.3bc	5.3
Total Eclipse	4.0a	4.8bc	5.5bc	5.0c	5.1
Rambo	3.5a	4.3c	5.3c	5.0c	4.9
$LSD_{0.05}$ =	n/s	0.6	0.5	0.8	

* Values that have the same letter as a suffix are not significant from each other.

Turf Density

Shoot density can vary greatly over the course of the growing season. While the scores improved from the spring to the summer rating period, no significant difference in turf density was detected between the cultivars over the entire season (Table 3).

Area Cover

With damage sustained by the turf in the fall of 2004, the spring area cover rating was generally lower and considered unacceptable. By the summer rating period, plots had recovered and the bluegrass rated higher. There were no statistical differences between the cultivars for area cover at any time during the growing season (Table 3).

Turf Quality

A seasonal mean combining the three quality factors was calculated for each of the cultivars. The cultivars were ranked from highest to lowest based on overall turf quality (Table 3).

Table 3 Kentucky bluegrass turf density and area cover (AC), Calgary 2005.

Cultivar	Rating Period						Turf Quality
	Spring		Summer		Fall		
	Density	AC	Density	A C	Density	AC	Mean of the 3 Factors for the Season
	1-9 scale						
Showcase	4.5a	4.0a	6.0a	5.5a	5.8a	5.5a	5.3
Moon Shadow	4.3a	4.5a	6.0a	6.0a	5.8a	5.3a	5.2
Tsunami	3.8a	3.8a	6.3a	5.3a	5.8a	5.5a	5.2
Touchdown	4.5a	4.3a	6.0a	5.0a	5.3a	5.5a	5.1
Langara	4.3a	4.0a	6.3a	5.5a	5.8a	5.8a	5.1
Award	4.8a	4.3a	5.3a	5.3a	5.3a	5.8a	4.9
Argyle	3.8a	3.5a	5.5a	5.3a	5.0a	5.5a	4.9
Total Eclipse	3.8a	4.0a	5.5a	4.8a	5.3a	5.0a	4.8
America	4.0a	4.0a	5.8a	5.0a	5.5a	4.8a	4.8
SR228	3.5a	3.5a	5.5a	4.5a	4.8a	5.0a	4.7
Rambo	4.0a	4.0a	5.8a	4.8a	5.3a	5.0a	4.7
$LSD_{0.05}$ =	n/s	n/s	n/s	n/s	n/s	n/s	

* Values that have the same letter as a suffix are not significant from each other.

Perennial Ryegrass Ratings

Spring Greenup

An analysis of the turf colour for spring greenup revealed no significant difference between the cultivars. The cultivar, Fiesta 3, scored the highest for spring greenup but was not significantly better than the other ryegrasses (Table 4).

Summer Colour

The cultivar, PR A-97, recovered from a slow spring start to receive the highest colour score for the summer rating period (Table 4). Again the analysis of the turf colour data revealed that the summer colour of the cultivars was not significantly different from each other (Table 4).

Fall Colour

The Perennial Ryegrass cultivars showed excellent colour retention under the cooler conditions of the fall. Cultivars: Fiesta 3 and Pick RC2 scored the highest for fall colour (Table 4). An analysis of the fall turf colour data revealed that there was no statistical different between the ryegrass cultivars.

Table 4 Perennial Ryegrass turf colour, Calgary 2005

Cultivar	Rating Period				Seasonal Average
	Early Spring	Spring	Summer	Fall	
	1-9 scale				
Fiesta 3	4.3a	5.0a	6.0a	6.3a	5.8
PR A-97	3.5a	5.0a	6.3a	6.0a	5.8
Pick RC2	4.0a	4.8a	6.0a	6.3a	5.7
Pennfine	4.0a	4.8a	6.0a	5.8a	5.5
$LSD_{0.05}$ =	n/s	n/s	n/s	n/s	

* Values that have the same letter as a suffix are not significant from each other.

Turf Density
The density of the ryegrasses was very similar to each other. An analysis of the turf density data revealed that the cultivars were not statistically different from each other (Table 5).

Area Cover
The spring area cover of the ryegrasses was open and not tightly knit. The bare patches created by the traffic in the fall of 2004 required most of the season to fill-in. The cultivar, Pennfine, generated the best area coverage for both the summer and fall rating dates. An analysis of the turf area cover data revealed that the cultivars were not significantly different from each other (Table 5).

Table 5 Perennial Ryegrass turf density and area cover (AC), Calgary 2005

Cultivar	Rating Period						Turf Quality
	Spring		Summer		Fall		
	Density	AC	Density	A C	Density	AC	Mean of the 3 Factors for the Season
	1-9 scale						
Fiesta 3	4.5a	4.3a	6.0a	5.0a	6.0a	5.0a	5.4
Pennfine	3.5a	3.8a	5.8a	5.8a	5.5a	5.8a	5.2
Pick RC2	4.0a	3.8a	5.8a	5.0a	5.8a	5.0a	5.2
PR A-97	4.0a	4.0a	5.8a	5.3a	5.3a	5.3a	5.2
$LSD_{0.05}$ =	n/s	n/s	n/s	n/s	n/s	n/s	

* Values that have the same letter as a suffix are not significant from each other.

Turf Quality
A seasonal mean combining the three quality factors was calculated for each of the cultivars. The cultivars were ranked from highest to lowest based on overall turf quality (Table 5).

Tall Fescue Ratings
Spring Greenup
An analysis of the turf colour data for spring greenup revealed no significant colour difference between the cultivars. By the second sampling date there was a statistical difference in spring greenup between the cultivars. Cultivars, Grande and SR8600 scored the highest for spring greenup, while the cultivar, Watchdog, scored the lowest (Table 6).

Summer Colour
The cultivar, SR8600, scored the highest for turf colour at the summer rating period. An analysis of the summer turf colour data revealed that the cultivars were not statistically different from each other (Table 6).

Fall Colour
The Tall Fescues cultivars also showed good colour retention under the cooler conditions of the fall. Once again the analysis of the fall turf colour data revealed that the cultivars were not statistically different from each other (Table 6).

Table 6 Tall Fescue turf colour, Calgary 2005

Cultivar	Rating Period				
	Early Spring	Spring	Summer	Fall	Seasonal Average
	1-9 scale				
SR8600	3.8a	5.5a	6.5a	5.5a	5.8
Grande	3.8a	5.5a	6.0a	5.5a	5.7
Mustang II	3.5a	5.3a	5.8a	5.0a	5.4
Pixie	3.0a	5.0ab	5.5a	5.0a	5.2
Watchdog	3.8a	4.3b	6.0a	5.3a	5.2
Arid 3	3.5a	4.8ab	5.5a	5.0a	5.1
$LSD_{0.05}$ =	n/s	0.7	n/s	n/s	

* Values that have the same letter as a suffix are not significant from each other.

Turf Density

The density of the tall fescue was very similar to each other. An analysis of the turf density data revealed that the cultivars were not significantly different from each other (Table 7).

Area Cover

The tall fescue plots exhibited more physical uprooting than the other grasses and the bare patches created in the fall of 2004 required most of the season to fill-in. An analysis of the turf area cover data revealed that the cultivars were not significantly different from each other (Table 7).

Turf Quality

A seasonal mean combining the three quality factors was calculated for each of the cultivars. The cultivars were ranked from highest to lowest based on overall turf quality (Table 7).

Table 7 Tall Fescue turf density and area cover (AC), Calgary 2005

Cultivar	Rating Period						
	Spring		Summer		Fall		Turf Quality
	Density	AC	Density	A C	Density	AC	Mean of the 3 Factors for the Season
	1-9 scale						
SR8600	3.5a	3.5a	5.8a	5.0a	5.0a	5.0a	5.1
Grande	3.8a	3.8a	5.3a	4.8a	5.0a	5.0a	5.0
Watchdog	3.5a	3.5a	5.5a	5.0a	5.3a	4.8a	4.8
Arid 3	3.5a	3.0a	5.3a	4.8a	4.5a	4.8a	4.6
Pixie	3.0a	2.5a	5.5a	5.0a	4.8a	5.3a	4.6
Mustang II	3.3a	3.5a	5.0a	4.5a	4.5a	4.5a	4.6
$LSD_{0.05}$ =	n/s	n/s	n/s	n/s	n/s	n/s	

* Values that have the same letter as a suffix are not significant from each other.

Comparing the Grass Species

When it comes to evaluating turf solely based on turf quality the general rule is that comparing ratings within species is relative, while comparing ratings between species and blends is not. Hopefully, the strengths of each of the species and the blended mixes will become more apparent after a head to head comparison is made for each of the three turf quality factors.

While the cultivars within each grass species tended to be very similar to each other during the 2005 season, some interesting trends were seen when the species and turf mixes were compared with each other.

Spring Greenup
The initial spring greenup of the *Poa supina* and the *Poa supina* mix scored significantly lower than the Sports Field Mix and the other turf species (Table 8). An analysis of spring turf colour data for the second sampling date revealed no significant difference in spring colour between the turf treatments.

Summer Colour
The summer colour data indicates that there was a significant difference in turf colour between the species. The genetically lighter green displayed by the *Poa supina* was significantly lower when compared with the darker green colour of the other grasses (Table 8).

Fall Colour
All the turf species showed good colour retention under the fall conditions. The perennial ryegrasses scored the highest and were statistically better for fall colour than the other grasses (Table 8).

Table 8 Comparison of species for turf colour, Calgary 2005

Cultivar	Rating Period				
	Early Spring	Spring	Summer	Fall	Seasonal Average
	1-9 scale				
Perennial Ryegrass	4.3a	5.0a	6.0ab	6.3a	5.8
Sports Field Mix	4.0a	5.3a	6.5a	5.5b	5.8
Kentucky Bluegrasses	4.3a	5.0a	6.0ab	5.5b	5.5
Tall Fescue	3.8a	5.3a	6.0ab	5.0bc	5.4
Poa supina Mix	3.0b	4.8a	5.5bc	5.0bc	5.1
Poa supina	3.0b	4.3a	5.3c	4.8c	4.8
$LSD_{0.05}$=	0.6	n/s	0.5	0.5	

* Values that have the same letter as a suffix are not significant from each other.

Turf Density
An analysis of the spring turf density data revealed no significant difference in turf density between the treatments (Table 9).

After recovering from a slow start in the spring, the *Poa supina* mix with 90% Kentucky bluegrass (cultivar Touchdown), produced the best density for the summer rating (Table 9).

The summer turf density score of the *Poa supina* mix was significantly better than the scores received by the Sports Field Mix, the monoculture stand of Tall Fescue and the monoculture stand of *Poa supina*. (Table 9)

By the fall rating date the turf density of *Poa supina* mix scored significantly higher than the Sports Field Mix, the monoculture stand of Kentucky bluegrass, the monoculture stand of Tall Fescue and the monoculture stand of *Poa supina* (Table 9).

Table 9 - Comparison of species for turf density, Calgary 2005

Cultivar	Rating Period			Seasonal Average
	Spring	Summer	Fall	
	1-9 scale			
Poa supina Mix	3.5a	6.5a	6.3a	5.4
Perennial Ryegrass	4.0a	6.0ab	5.8ab	5.3
Kentucky Bluegrasses	4.3a	6.0ab	5.3bc	5.2
Sport Field Mix	4.3a	5.8b	5.5bc	5.2
Poa supine	3.8a	5.5b	5.3bc	4.9
Tall Fescue	3.5a	5.5b	5.0c	4.7
$LSD_{0.05}$ =	n/s	0.6	0.6	

* Values that have the same letter as a suffix are not significant from each other.

Area Cover

The spring area cover ratings in 2005 were not statistically different between the grass species (Table 10). The turf damage, sustained in the fall of 2004, was still very evident within the plot area. The impact of the play was more evident on the tall fescue than any other species. Large bare patches in the fescue turf cover were present throughout the trial.

By the summer rating date, the area cover of the *Poa supina* mix significantly improved and was scored accordingly (Table 10). The fall rating found the area cover of the *Poa supina* mix to be significantly better than the remaining treatments (Table 10).

Table 10 - Comparison of species area cover, Calgary 2005

Cultivar	Rating Period			Seasonal Average
	Spring	Summer	Fall	
	1-9 scale			
Poa supina Mix	3.5a	6.3a	7.0a	5.6
Perennial Ryegrass	4.3a	5.3a	5.5b	5.0
Kentucky Bluegrasses	4.0a	5.0a	5.5b	4.8
Sports Field Mix	3.8a	5.3a	5.3b	4.8
Poa supina	3.8a	4.8a	5.2b	4.6
Tall Fescue	3.3a	5.0a	5.0b	4.4
$LSD_{0.05}$ =	n/s	n/s	0.8	

* Values that have the same letter as a suffix are not significant from each other.

Turf Quality

A mean for the three quality factors for each of the turf treatments was calculated for each rating period. The treatments were ranked from highest to lowest based on overall turf quality.

Despite the damage generated by the traffic over the turf surface in fall, all the grasses in trial successfully made the transition from winter dormancy to live active growing stands of turf in the spring. The spring turf quality rating between the species was not significantly different (Table 11).

All the turf plots showed signs of improvement over the course of the season. But it was the aggressive area cover ratings that were produced by the *Poa supina* mix over the summer and fall which was most impressive. The blend of *Poa supina* with the Kentucky Bluegrass

cultivar, Touchdown, overcame the low scores received for turf colour of the *Poa supina* to produced a turf stand which scored the highest in overall turf quality (Table 11).

Table 11 Comparison of species for overall turf quality, Calgary 2005.

Cultivar	Rating Period			
	Spring	Summer	Fall	Overall Turf Quality
	Mean of 3 quality factors			
Poa supina Mix	4.0a	6.1a	6.1a	5.4
Perennial Ryegrass	4.3a	5.7ab	5.7ab	5.2
Sports Field Mix	4.4a	5.8ab	5.4bc	5.2
Kentucky Bluegrasses	4.4a	5.7ab	5.4bc	5.2
Tall Fescue	3.9a	5.4bc	5.0c	4.8
Poa supina	3.9a	5.1c	5.2c	4.7
$LSD_{0.05}$ =	n/s	0.6	0.4	

* Values that have the same letter as a suffix are not significant

Discussion

The turf injury was visible throughout the site. Damage ranged from moderate shearing of the verdure to the more severe physical up rooting of the turf plants. While all the plots showed some effects form the traffic, the tall fescue plots exhibited more physical uprooting than the other grasses.

Despite overwintering in a stressed and worn condition, it appeared that the turf stands were not significantly affected by cold winter temperatures as all of the grasses showed good transition from winter dormancy to active spring growth.

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