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# Fine fescues and colonial bentgrasses for fairways

With proper fertility treatments, some fine fescues show promise for fairway use.



Regardless of the agronomic practices being implemented to reduce inputs, superintendents today are faced with an interesting paradox: Golfers want perfection, but environmental and budget constraints limit perfection. With this in mind that researchers are attempting to identify management strategies for low-input turfgrass systems without sacrificing overall quality.

Fine fescues (*Festuca* species) and colonial bentgrasses (*Agrostis tenuis* Sibth.) have been used for years on fairways and roughs in the United Kingdom, but these grasses have not been as popular in the United States. Recently, however, fine fescues have been used as unmowed rough and, in a few cases, on fairways in the U.S. (1,10) as improvements in fine fescue and colonial bentgrass cultivars during the last decade have provided better turf quality.

Fine fescues have significantly lower water and fertility requirements than most other turfgrasses (3,7). Both fine fescues and colonial bentgrass are superior to creeping bentgrass (*A. palustris*) in terms of resistance to snow molds and tolerance to dollar spot (5,6,9), and colonial bentgrass at fairway height has greater wear tolerance than creeping bentgrass (2). Chewings fescue (*F. rubra* subspecies *commutata* Gaud.) and hard fescue (*F. trachyphylla*) are also more wear-tolerant than other fine fescues (2,11).

Research data for cultivar selection for fine fescues and/or colonial bentgrass for fairways are limited to monostands of each species. Other

data have shown that the positive attributes of single cultivars are not necessarily expressed when blended or mixed (4).

Information on the ideal type of fertilizer is also lacking. Superintendents from the U.K. routinely use organic nitrogen sources and believe synthetic, water-soluble nitrogen sources are not suitable for fine fescue or colonial bentgrass fairways (10). Furthermore, some cultivars that perform well at fairway height may have higher nitrogen requirements than cultivars that are not mowed low and not subjected to traffic.

## Objectives

The objectives of this research were to determine the best cultivars and combination(s) of fine fescues and colonial bentgrasses for use as a fairway turf by evaluating wear tolerance and the effect of organic versus water-soluble fertilizer on turf quality, fine fescue-colonial bentgrass competition and divot recovery.

## Materials and methods

Two identical research studies were conducted at the University of Minnesota Turfgrass Research Center in St. Paul on a loam soil and at the O.J. Noer Turfgrass Research and Education Facility in Verona, Wis., on a silt loam soil. Because of space constraints, this article will discuss the Minnesota location in detail and will summarize the Wisconsin location.

Plots were seeded in September 2003 with two

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**Brian Horgan, Ph.D.  
Andrew Hollman  
Eric Koeritz  
John Stier, Ph.D.**



colonial bentgrasses (Tiger II and SR 7100), two chewings fescues (SR 5100 and Longfellow II), one hard fescue (SR 3100) and one strong creeping red fescue (Jasper II) as monostands, blends and mixtures. Fine fescue and colonial bentgrass mixtures were composed of 80% fine fescue and 20% colonial bentgrass (by weight). Equal parts of each cultivar of a given species were used in blends. The cultivars were selected based on top performance in National Turfgrass Evaluation Program trials (8). One creeping bentgrass (Penncross) and a Kentucky bluegrass blend (Blue Carpet) were used for comparisons. The cultivars, blends and mixtures tested are listed in Table 1.

#### Fertilizer treatments

Fertilizer rate and source treatments were initiated in May 2004. The following fertilizer treatments were applied to all the species treatments.

- *Low-rate organic*: 1 pound nitrogen/1,000 square feet (4.9 grams/square meter) split into two 0.5-pound (2.45 grams/square meter) nitrogen applications in May and October
- *Low-rate water-soluble*: 1 pound nitrogen/1,000 square feet (4.9 grams/square meter) split into two 0.5-pound nitrogen (2.45 grams/square meter) applications in May and October
- *High-rate organic*: 3 pounds nitrogen/1,000 square feet (14.6 grams/square meter) applied monthly at 0.5-pound nitrogen (2.45 grams/square meter) from May through October
- *High-rate water-soluble*: 3 pounds nitrogen/1,000 square feet (14.6 grams/square meter) applied monthly at 0.5-pound nitrogen (2.45 grams/square meter) from May through October

The water-soluble nitrogen source was urea combined with triple superphosphate to achieve 2%  $P_2O_5$ , which is equivalent to the rate in Milorganite, the organic nitrogen source.

#### Mowing and irrigation

The plot area was mowed with a rotary mower two to three times per week at 1 inch (2.5 centimeters) during the 2005 season. The rotary mower could not mow the plots at the desired height of 0.75 inch because of numerous undulations that resulted in scalped areas. In 2006, a walking reel mower was used successfully to mow the plots at 0.75 inch (1.9 centimeters) without scalping. Irrigation was provided only to prevent significant stand loss during drought.

#### Traffic

Starting in May 2005, all plots were subjected to traffic three times a week with two passes of

a custom-built golf-car traffic simulator towed behind a turf utility vehicle. The traffic simulator consisted of two 1,000-pound traffic units on an axle containing five golf car tires. Traffic continued weekly through September.

#### Divots

Divot recovery trials were initiated in May 2005 using a custom-built divot maker. After divots were made, they were removed and filled with topdressing sand up to the level of the surrounding soil.

#### Measurements

Plots were rated for percent living ground cover (0%-100%), monthly turfgrass quality (on a scale of 1 to 9, where 9 is ideal turf and 1 is dead turf), and weed and disease infestation (as needed). Divot recovery was measured twice a month by counting the number of plants within a template that was identical in size to the original divot created. This allowed a divot recovery rate to be calculated. Species composition was measured each growing season in May and September with a 100-point grid on plots with mixtures of colonial bentgrass and fine fescues. The grass species beneath each intersection within the grid was identified and counted.

### Ground cover and turf quality

Treatment No./cultivar name/species	% living ground cover		Turf quality
	Oct. 2005	May 2006	2005-06 avg.
1. SR 7100 colonial bentgrass	92	91.6	4.3
2. Tiger II colonial bentgrass	92.3	88.8	4.44
3. SR 5100 chewings fescue	89.9	92.2	4.89
4. Longfellow II chewings fescue	91.3	93.4	4.93
5. Jasper II strong creeping red fescue	90.7	91.3	4.38
6. SR 3100 hard fescue	92.1	91.6	4.74
7. Penncross creeping bentgrass	85.8	92.2	4.43
8. Blue Carpet Kentucky bluegrass blend	92.1	77.2	4.30
9. SR 7100 colonial bentgrass + Tiger II colonial bentgrass	86	89.7	4.38
10. Jasper II strong creeping red fescue + SR 5100 chewings fescue	89.6	91.3	4.85
11. Tiger II colonial bentgrass + SR 7100 colonial bentgrass + Jasper II strong creeping red fescue + SR 5100 chewings fescue	90.2	89.1	4.46
12. SR 5100 chewings fescue + Longfellow II chewings fescue	86.9	89.1	4.60
13. Tiger II colonial bentgrass + SR 7100 colonial bentgrass + Jasper II strong creeping red fescue + SR 5100 chewings fescue + Longfellow II chewings fescue + SR 3100 hard fescue	91.8	90	4.52
14. Tiger II colonial bentgrass + SR 7100 colonial bentgrass + Jasper II strong creeping red fescue + SR 5100 chewings fescue + Longfellow II chewings fescue	90.6	91.6	4.44
15. Jasper II strong creeping red fescue + SR 5100 chewings fescue + SR 3100 hard fescue	91.3	94.1	4.60

**Table 1.** Treatment % living ground cover and turf quality averaged over fertilizer source and fertilizer rate in 2005 and 2006.





Fifteen species treatments received four different fertilizer treatments over two seasons at the University of Minnesota Turfgrass Research Center in St. Paul. Photos by B. Horgan

Data were analyzed as a split-split-plot design, where whole plots were species and subplots were fertilizer source (organic and synthetic) and fertility rate (high and low). The 15 whole plots (with four replications) were 10 feet × 10 feet, yielding a total of 60 whole plots. Each whole plot contained four subplots that were 5 feet × 5 feet, yielding a total of 240 discrete rating plots.

## Results and discussion

What makes a higher-quality low-input turfgrass fairway: creeping bentgrass or fine fescue/colonial bentgrass? U.S. golfers often define qual-

ity as turf with dark green color and high density, firm soil and a consistent playing surface. In general, Scottish golf course conditions do not satisfy today's American golfer, which is unfortunate, because courses in Scotland receive fewer pesticides and less fertilizer and water — the ultimate in low-input turfgrass management.

Although our turfgrass quality ratings may seem low on the traditional 1 to 9 scale (where 9 is ideal turf, and 1 is dead turf), recall that a management program was implemented to evaluate these grasses as low-input. Irrigation was applied only when we risked losing the entire turf stand; fertilizer rates were 1 to 3 pounds/1,000 square feet (4.9-14.6 grams/square meter) applied as either urea or Milorganite. No pesticides were applied, and plots were mowed between 0.75 and 1.0 inch (1.9-2.5 centimeters).

### Percent living ground cover

In spring 2006, plots were rated for percent living ground cover, which differed significantly among species. Among the single-species plots, Longfellow II (93.4%) and SR 5100 (92.2%) chewings fescues had the highest percent living ground cover, and Tiger II colonial bentgrass (88.8%) and Blue Carpet Kentucky bluegrass blend (77.2%) had the lowest (Table 1). In both years there were significant differences between fertilizer source and fertilizer rate for percent living ground cover. Plots receiving water-soluble fer-

## Turf quality vs. fertilizers and rates

Treatment	2005-2006 average			
	High-rate		Low-rate	
	Water-soluble	Organic	Water-soluble	Organic
1. SR 7100	5.58	4.75	3.84	3.43
2. Tiger II	5.67	4.70	3.83	3.42
3. SR 5100	6.10	5.07	4.28	4.10
4. Longfellow II	5.82	5.54	4.30	4.07
5. Jasper II	5.24	4.44	4.0	3.85
6. SR 3100	5.71	4.93	4.30	4.05
7. Pennncross	5.60	4.32	3.49	3.12
8. Blue Carpet	5.61	4.23	3.69	3.42
9. SR 7100 + Tiger II	5.65	4.39	3.76	3.58
10. Jasper II + SR 5100	5.88	4.97	4.19	4.07
11. Tiger II + SR 7100 + Jasper II + SR 5100	6.04	4.50	3.96	3.35
12. SR 5100 + Longfellow II	6.12	4.82	3.96	3.41
13. Tiger II + SR 7100 + Jasper II + SR 5100 + Longfellow II + SR 3100	6.00	4.95	4.03	3.59
14. Tiger II + SR 7100 + Jasper II + SR 5100 + Longfellow II	5.92	4.65	4.11	3.52
15. Jasper II + SR 5100 + SR 3100	5.66	5.11	4.48	3.98
LSD (0.05)	0.67	0.49	0.56	0.50

**Table 2.** Turf quality for plots receiving high and low rates of water-soluble fertilizer (urea and triple super phosphate) and for plots receiving high and low rates of organic fertilizer (Milorganite). Quality was rated visually on a 1-9 scale, where 1 = totally dead, 9 = optimal turf quality, and 6 = acceptable fairway turf quality.





In the fertility treatments, Penncross creeping bentgrass did not fare well in comparison to most of the other species treatments in study.

tilizer had 91.5% living ground cover in 2005 and 92.9% in 2006, whereas plots receiving organic fertilizers had 88.8% living ground cover in 2005 and 87.5% in 2006. Plots receiving high rates of fertilizer had 95.6% living ground cover in 2005 and 95.4% in 2006, whereas plots receiving the low rate of fertilizer had 84.7% living ground cover in 2005 and 85.0% in 2006.

#### Turf quality

Turf quality was significantly different among species for all rating dates in 2005 and all dates for 2006 except for September. Turf-quality data were analyzed for the 2005 and 2006 seasons and the average of the two seasons combined (Table 2). When averaged over the 2005 season, the turf quality of the chewings fescues Longfellow II (4.90) and SR 5100 (4.88) and the hard fescue SR 3100 (4.87) was significantly better than that of the colonial bentgrass SR 7100 (4.19). In 2005 the three mixtures containing colonial bentgrass had turf quality scores of 4.54 (treatment 13), 4.55 (treatment 11) and 4.38 (treatment 14). Average turf quality ratings for 2006 again show that the chewings fescues Longfellow II (4.96) and SR 5100 (4.89) had significantly better turf quality than the colonial bentgrasses SR 7100 (4.41) and Tiger II (4.2). All three mixtures containing colonial bentgrass had turf quality scores of 4.5, 4.49 and 4.36. When turf quality was averaged over the 2005 and 2006 seasons, the chewings fescues Longfellow II (4.93) and SR 5100 (4.89) had significantly better quality than the colonial bentgrasses Tiger II (4.44) and SR 7100 (4.30).

#### Water-soluble and organic fertilizers

Turf quality was significantly better for plots receiving water-soluble fertilizer (4.87 in 2005 and 4.92 in 2006) than for plots receiving organic

fertilizer (4.46 in 2005 and 3.96 in 2006). Turf quality was also significantly better for plots receiving high rates of fertilizer (5.21 in 2005 and 5.30 in 2006) rather than low rates (4.12 in 2005 and 3.58 in 2006).

#### Species analysis for fertilizer source and rate

Because of the interaction between fertilizer source and rate, the species were analyzed for each combination of fertilizer source and rate. The analysis was based on average turf quality for 2005, 2006 and the average over both seasons (Table 2).

Longfellow II chewings fescue received high ratings for turf quality at high and low rates of organic fertilizer (5.54 and 4.07, respectively) and at the low rate of water-soluble fertilizer (4.30). Treatment 15 (Jasper II, SR 5100 and SR 3100) had the highest turf quality at the low rate of water-soluble fertilizer

### Wisconsin turf quality

Turf group	Low nitrogen	High nitrogen
	Turf quality <sup>†</sup>	
Colonial bentgrass	5.1 b	6.1 d
Creeping bentgrass	4.2 e	5.4 f
Chewings fescue	5.3 a	6.9 a
Strong creeping red fescue	5.0 b	6.2 d
Hard fescue	4.9 c	6.4 c
Fine fescue species mixtures	5.4 a	6.8 ab
Fine fescue/colonial bentgrass mixtures <sup>‡</sup>	5.4 a	6.7 b
Elite Kentucky bluegrass blend	4.5 d	5.9 e

<sup>†</sup>Turf quality was rated visually on a 1-9 scale, where 1 = totally dead turf, 9 = optimal turf quality and 6 = acceptable fairway turf quality. Means within the same column followed by the same letter are not significantly different from each other.

<sup>‡</sup>Mixture contains 80% fine fescue and 20% colonial bentgrass by seed weight.

**Table 3.** Data for the Wisconsin research location. Mean annual turf quality in 2004 at two different nitrogen rates. The low nitrogen rate was 1 pound/1,000 square feet (4.9 grams/square meter) annually and the high nitrogen rate was 3 pounds/1,000 square feet (14.6 grams/square meter) annually.





The fine fescue fairways on courses in Scotland are maintained with fewer inputs and less intensive cultural practices. The ideal is not a blemish-free, dark green turf.

(4.48) and the second-highest rating at the high rate of organic fertilizer (5.11). SR 5100 chewings fescue had the highest quality rating at the low rate of organic fertilizer (4.10), and SR 3100 hard fescue had the second-highest rating at the low rate of water-soluble fertilizer (4.30).

At the high rate of water-soluble fertilizer, only Jasper II strong creeping red fescue, with a turf quality rating of 5.24, was statistically lower than the five top-performing species treatments (Table 2). For the low rates of both water-soluble and organic fertilizer, Pennncross had the lowest quality ratings, and it had the second-lowest ranking, just above Blue Carpet, for the high rate of organic fertilizer.

When the fertilizer source and rate combinations were visually observed in the field, it was evident that the fine fescues, but more specifically the chewings fescues (Longfellow II and SR 5100), consistently outperformed creeping bentgrass or Kentucky bluegrass if the fertilizer rate was low or if the fertilizer was organic (slowly available). When water-soluble fertilizer was applied monthly, both the fine fescues and the colonial bentgrasses performed adequately.

#### *Percent colonial bentgrass*

A separate analysis of percent colonial bentgrass was performed for plots with a mixture of colonial bentgrasses and fine fescues (treatments 11, 13 and 14) for 2005 and 2006. This prevented plots composed entirely of either colonial bentgrass or fine fescues from skewing the results. There were no significant differences among the three species treatments (11, 13 and 14) or between the effects of water-soluble and organic fertilizers on the turf quality of the three mixtures, but plots receiving

high rates of fertilizer had a significantly higher percentage of colonial bentgrass than plots receiving low rates of fertilizer.

In 2005, the percentage of colonial bentgrass dropped from 28% for the July rating date to 9% for the September rating date. Because this was the first season of traffic, this drop was expected as plants died out that did not tolerate traffic or suffered from the lack of moisture.

In 2006, an increase in colonial bentgrass to 56% in May and 62% in September was attributed to the application of fertilizer treatments and to adequate moisture from rainfall received in fall 2005 and spring 2006.

#### *Divot recovery*

Divots created in May 2005 and 2006 had significantly better recovery when treated with water-soluble fertilizers and when receiving the high rate of fertilizer, regardless of fertilizer source (data for divot recovery are not shown). In 2006, there was a significant difference among species in their rate of recovery. Overall, the plots containing chewings fescue (Longfellow II or SR 5100) recovered more quickly than the other plots.

#### *Weeds*

The percentage of weeds in plots differed significantly among species and among fertilizer rates, but not between fertilizer sources in 2005 (data not shown). The plots of Jasper II strong creeping red fescue and Blue Carpet Kentucky bluegrass blend had significantly more weeds than other plots. The plots receiving high rates of fertilizer had significantly fewer weeds than the plots receiving low rates of fertilizer.

In 2006, plots were rated for clover, which was the predominant weed (data not shown). Clover percentages differed significantly among species, among fertilizer sources and among fertilizer rates. Again, Jasper II and Blue Carpet had the highest percentage of clover. The plots receiving water-soluble fertilizer had significantly less clover than those receiving organic fertilizer, and the plots receiving high rates of fertilizer had less clover than those receiving low rates of fertilizer.

#### *Wisconsin results*

Mean quality for eight different turf classifications representing 15 different monostands, blends and mixtures is presented in Table 3. All turf groups provided better turf quality when fertilized with 3 pounds nitrogen/1,000 square feet (14.6 grams/square meter) annually. Regardless of the amount of nitrogen applied, the chewings fescues and the fine fescue species mixtures



consistently provided the best turf quality. Mixtures of fine fescue and colonial bentgrass also provided good overall turf quality, but they did not consistently provide acceptable turf quality throughout the growing season as they were stressed by dollar spot and drought in summer. Creeping bentgrass, which was in the study for comparison, provided the worst turf quality due to severe drought stress and dollar spot outbreaks. Results from Wisconsin suggest that chewings fescue is responsible for the high turf quality of the fine fescue species mixture.

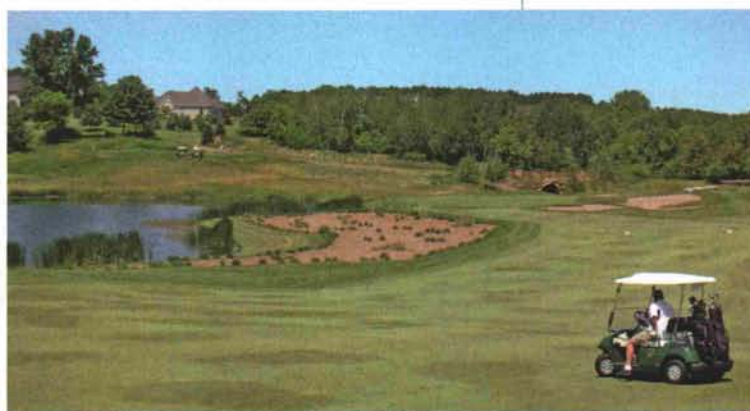
## Conclusions

It is often thought that combining fine fescue and colonial bentgrass could bring out the positive characteristics of both species. For example, fine fescues use less water and require less fertilizer and less mowing than colonial bentgrass. Unlike fine fescues, colonial bentgrasses can tolerate low mowing heights and have good recuperative ability because they spread by rhizomes and stolons. Combining the two could provide the low-input benefits of the fescues and the ability to recover from divot damage and traffic stress. In addition, mixing the two species may be advantageous because fine fescues often green up faster in the spring and remain green late into the fall when colonial bentgrass tends to lose color, whereas colonial bentgrass remains green in summer when some fine fescues may thin out and lose color. When the two species are planted together, there is the potential to have good-quality turf for the entire growing season.

The results of this study suggest that fine fescue and colonial bentgrass mixtures will provide good turf quality under proper environmental conditions. If reducing irrigation, fertilizer and pesticide inputs is the goal, however, a monostand of chewings fescue may be a better option where rainfall is inadequate and fungicides are not applied. In this study, the fine fescues, especially the chewings fescues, maintained better turf quality than the fine fescue and colonial bentgrass mixtures when subjected to water stress and disease pressure. Observations of plots seeded with fine fescue and colonial bentgrass mixtures indicated that the colonial bentgrass in the sward seemed to use water in the soil to the point where the fine fescue in the sward began to undergo drought stress.

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**GCM**

Brian Horgan (bphorgan@umn.edu) is an assistant professor and Andrew Hollman is a turfgrass scientist in the department of horticultural science at the Twin Cities campus of the University of Minnesota. Eric Koeritz is a graduate student and John Stier is an associate professor in the department of horticulture at the University of Wisconsin-Madison.

Creeping bentgrass turfgrass on courses in the United States requires more inputs, including more irrigation and more turf-care products than the fine fescue courses in Scotland.



## The research says

→ There were no significant differences among mixtures containing colonial bentgrass and fine fescues regardless of the fertility source or rate.

→ Water-soluble fertilizer provided better turf quality, higher percent living ground cover, fewer weeds, higher colonial bentgrass percentages and quicker divot recovery.

→ Because plots were irrigated only to prevent turf death, the lack of moisture in summer may have limited mineralization of organic fertilizers and thus led to lower turf quality.

→ Overall, monostands of chewings fescues SR 5100 and Longfellow II provided the best turf quality in sites receiving traffic and limited supplemental irrigation.





# Cold influences overseeded perennial ryegrass control

Cold temperatures have a direct impact on the effectiveness of some sulfonylurea herbicides used for overseeded perennial ryegrass control in the transition zone.



Many superintendents must overseed bermudagrass (*Cynodon* species) with perennial ryegrass (*Lolium perenne*) in order to improve winter playability and aesthetics. However, overseeding is detrimental to the underlying bermudagrass base because perennial ryegrass actively competes with bermudagrass for space, light, water and nutrients. The process of removing perennial ryegrass is known by many as transition. In the Deep South, climate and cultural practices are often effective tools for transitioning to bermudagrass. In the transition zone and the upper South, however, herbicides are needed to control perennial ryegrass in the spring and release bermudagrass from competition with perennial ryegrass.

In recent years, several sulfonylurea herbicides have been registered that effectively control perennial ryegrass without harming bermudagrass. Many university trials and golf courses have effectively used these products. However, in fluctuating transitional climates, several superintendents and researchers have observed perennial ryegrass control failures when using these products. Recalling the specifics of individual situations, most of the cases had one thing in common: cold weather after application.

Limited research has evaluated the effects of environmental conditions on effectiveness of these products. Our objectives are to evaluate the effects of temperature on perennial ryegrass control with Revolver (foramsulfuron), Monument (trifloxysulfuron) and flazasulfuron, and to provide rec-

ommendations for using these products for perennial ryegrass control when cold temperatures may occur after product application.

## Research methods

Our research was conducted in Blacksburg, Va., on pure stands of perennial ryegrass. Evaluating perennial ryegrass control in the absence of bermudagrass competition allowed the most accurate assessment of perennial ryegrass control. Typical overseeding removal rates of Revolver (17.5 fluid ounces/acre), Monument (0.33 ounce product/acre) and flazasulfuron (1.5 ounces product/acre) were applied to previously untreated plots on four random plots at each of two sites. Applications were made at weekly intervals on 21 dates from mid-February through mid-July. A weather station was placed at each location, with appropriate sensors to measure air and soil temperature, soil moisture, solar radiation and dew period through the duration of the trial. All plots were visually evaluated for perennial ryegrass control and green cover at two, four and nine weeks after treatment.

## Influence of cold temperatures

Of all the environmental factors measured, average soil temperatures collected hourly between treatments and one week after treatment correlated best with perennial ryegrass control. Soil temperature significantly reduced speed of control for all three herbicides; when soil temper-

John B. Willis  
Shawn D. Askew, Ph.D.  
Brent W. Compton





When herbicides were applied at soil temperatures below 65 F (18 C), photographs taken at nine weeks after application show that control of perennial ryegrass by Revolver (A) was reduced more than control by Monument (B) and by flazasulfuron (C). Photos by J. Willis

atures were below 65 F (18 C), control was significantly lower for each herbicide at two weeks after treatment (Figure 1). However, at nine weeks after treatment, Revolver was the only product affected by cold temperatures (Figure 2). Of the tested products, Revolver is most sensitive to cold temperatures, flazasulfuron is the least sensitive and Monument falls between the two.

Revolver is a predominately foliar-absorbed product, whereas Monument and flazasulfuron are absorbed by both foliage and roots, which may explain differential sensitivity to cold temperatures. However, the general physiological processes of plants that lead up to growth — including nutrient absorption, movement of sugars within the plant and photosynthesis — are all reduced in cold temperatures.

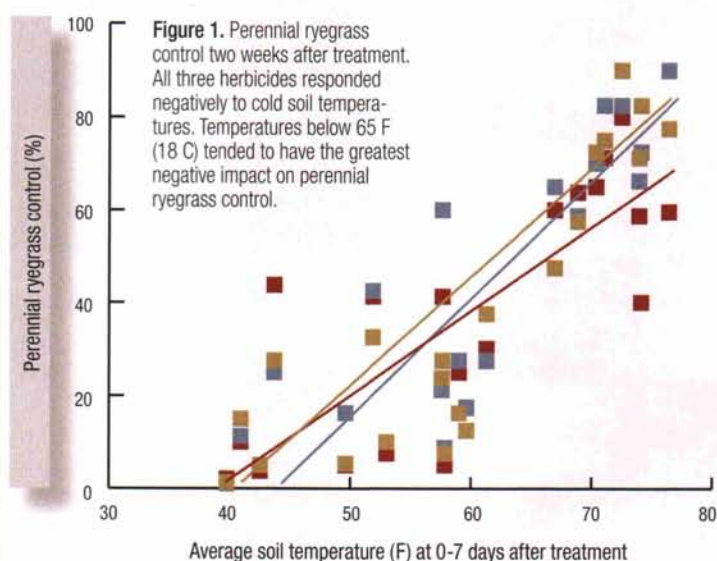
The sulfonylurea herbicide family kills susceptible plants through the process of enzyme inhibition, leading to the buildup of toxic precursors of amino acids. The process of amino acid production is slower in cold temperatures, hindering the buildup of toxic precursors. Generally, when plant processes slow down, herbicides are not as effective. All of these factors are likely influencing perennial ryegrass control at cold temperatures, complicating the explanation of why these products are not as effective at cold temperatures. Future research at Virginia Tech will focus on cold temperatures' effects on herbicide movement and activity in perennial ryegrass.

## Summary

Revolver is a useful product for perennial ryegrass control when soil temperatures are above 65 F (18 C). It also is very active on annual bluegrass (*Poa annua* L.) and goosegrass (*Eleusine indica* L.). If temperatures decrease after Revolver is applied

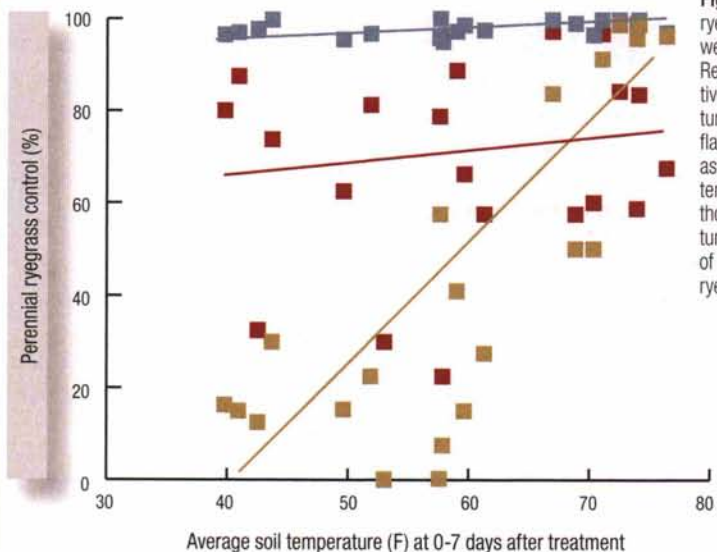
## Two weeks after treatment

■ Flazasulfuron ■ Monument (trifloxysulfuron) ■ Revolver (formasulfuron)



## Nine weeks after treatment

■ Flazasulfuron ■ Monument (trifloxysulfuron) ■ Revolver (formasulfuron)





Sulfonylurea herbicides have shown different levels of perennial ryegrass control when soil temperatures are cold. Photo by B. Compton



## The research says

- Failures of perennial ryegrass control with sulfonylurea herbicides seem to be related to cold temperatures one week after application.
- Soil temperatures below 65 F (18 C) significantly reduce the speed of perennial ryegrass control with Revolver, Monument and flazasulfuron, but at nine weeks after treatment, cold temperatures reduce the effectiveness of only Revolver.
- If temperatures decrease after Revolver is used to control perennial ryegrass, sequential applications or higher rates may be necessary to achieve desirable levels of control.
- Monument and flazasulfuron would be the obvious choices for perennial ryegrass control when cold temperatures are threatening.

for perennial ryegrass control, sequential applications or higher rates of Revolver will probably be necessary to obtain effective control.

Monument and flazasulfuron are less dependent on warmer temperatures and would be the obvious choices if cold temperatures are threatening. Flazasulfuron provides outstanding perennial ryegrass control with bermudagrass tolerance equivalent to Monument and Revolver. However, superintendents should be aware of its high speed of activity. Removing perennial ryegrass while bermudagrass is not aggressively growing can be detrimental to transition aesthetics.

Overall, superintendents using these products in cold temperatures should expect slower activity and reduced long-term control with Revolver.

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John B. Willis (jbwillis@vt.edu) is a research associate and Shawn D. Askew is an assistant professor at Virginia Tech, Blacksburg, Va. Brent W. Compton was a research assistant at Virginia Tech and is currently an assistant superintendent at Birkdale Golf Club in Chesterfield, Va.