ANNUAL BLUEGRASS SUPPRESSION WITH HERBICIDES

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Attempts to control annual bluegrass with herbicides are hindered by limited crop tolerance to available herbicides and increasing resistance in this weed species. Low rates of Rely (glufosinate) have the potential to suppress annual bluegrass in crops such as perennial ryegrass and tall fescue. However, because Rely is a relatively non-selective herbicide, similar to Roundup (glyphosate) and Gramoxone (paraquat), crop tolerance is a major concern. Research in the 1996-97 growing season showed that perennial ryegrass seed yield was reduced by mid-May applications of Rely at all rates beyond 0.175 lb/a, while annual bluegrass control improved with Rely rate up to 0.3 lb/a. Tall fescue seed yield in 1997 was reduced by some, but not all, treatments in which Rely was applied in early March. Two approaches were adopted in the 1997-98 growing season to further evaluate the effects of Rely on crop yield and annual bluegrass suppression.

In the first approach, Rely was applied in mid-March to plots that had received a variety of herbicide treatments during the previous fall, creating a series of paired treatments between which the major difference was whether or not Rely was applied in mid-March. The treatments with and without Rely could then be averaged, providing the equivalent of 22 replications at each site to test the effects of Rely (Table 1). At the Tangent perennial ryegrass site, where there was a high population of diuron-resistant annual bluegrass, the average effect of mid-March Rely was to increase crop yield by 175 lb/a, or 14%. There was no significant effect on perennial ryegrass yield at the other two sites. Since there was virtually no annual bluegrass needing to be controlled at these other two sites, the absence of any effects on yield suggests that mid-March application of 0.3 lb/a Rely is safe on perennial ryegrass. Results in tall fescue are less clear cut. Because there was also a high population of annual bluegrass at the tall fescue site, crop yield should have increased as annual bluegrass was controlled with Rely. Since Rely treatment didn't increase yield despite reducing annual bluegrass growth, there must have been enough crop injury to counteract any weed control benefit. Tall fescue took far longer to recover from damage by Rely than did perennial ryegrass. Indeed, some stunting was present through harvest, and it would be much harder to justify the use of Rely on tall fescue than on perennial ryegrass. Application of Rely in mid-March reduced annual bluegrass seed yield an average of 47% (Table 2). Rely treatment in mid-March "burned back" the annual bluegrass, but failed to kill most of the plants. Annual bluegrass ground cover in mid-April in Rely-treated plots was nearly the same as it had been three weeks earlier, whereas annual bluegrass ground cover had more than doubled in plots not treated with Rely. Rely treatment also greatly reduced the proportion of annual bluegrass plants that were flowering in mid-April. A tank-mix of 1 lb/a Avenge plus 0.25 lb/a Rely was about as effective as 0.3 lb/a Rely.

In the second approach to evaluate this herbicide, Rely was applied in mid-April at a range of rates to a perennial ryegrass stand that was nearly free of annual bluegrass (Table 3). Nine replications were used to improve the ability to detect any perennial ryegrass yield losses caused by Rely. The ability of an additional 60 lb/a of spring-applied nitrogen to overcome the damage by Rely was also tested. This additional nitrogen had no significant effect on perennial ryegrass seed yield. The most damaging treatment was 0.5 lb/a Rely, reducing yield an average of 52%. However, damage from 0.375 lb/a Rely (44% yield loss) was statistically similar to that from 0.5 lb/a. Ryegrass yield for the two lower rates of Rely (0.25 and 0.3 lb/a) was significantly better than for 0.375 lb/a. However, even the 0.25 lb/a rate caused a 16% yield loss, while the 0.3 lb/a rate reduced yield by 22%. Mid-April timing of Rely in 1998 caused less damage than mid-May timing had in 1997. However, since yield losses from mid-April Rely in the absence of annual bluegrass were larger than the benefits from mid-March Rely in the presence of annual bluegrass, there is a clear need for further research into the optimum timing and rate of spring-applied Rely. Studies underway in 1999 are focusing on the mid-March to mid-April time period. This is the same period that was found to be critical as a cut-off date for application of Horizon (fenoxaprop), and corresponds to the beginning of rapid tiller elongation and elevation of the growing point.

Fall-applied herbicide treatments can have great impact on crop yield, volunteer seedlings, and annual bluegrass. Much effort has been expended over the past decade trying to find the "best" treatments for use in the fall. As indicated in an accompanying article, the problem is that the opportunistic nature of annual bluegrass allows it to fill in any space vacated by volunteer seedlings controlled by herbicides or vacated by crop itself when damaged by herbicides or other causes. Several fall-applied herbicides used in the current studies provided partial control of annual bluegrass, although none were perfect (Table 4). Prowl (pendimethalin) at 6 lb/a reduced annual bluegrass seed yield compared to that of the untreated checks or the lower rate (3 lb/a) of Prowl in both vacuum sweep and full straw load chop conditions. At 3 lb/a, Prowl reduced annual bluegrass seed yield compared to the vacuum sweep check but not the full straw load check. Sequential application of Prowl at 3 lb/a plus Goal (oxyfluorfen) followed by Diuron plus Goal reduced annual bluegrass seed yield compared to untreated checks in both residue management systems. Sequential application of Dual Magnum (s-metolachlor) at 0.94 lb/a plus Goal followed by Diuron reduced annual

bluegrass seed yield compared to the untreated check only in vacuum sweep. Axiom was the most effective fall-applied herbicide in these tests, reducing annual bluegrass seed yield by 64% in vacuum sweep. Although Axiom treatments caused serious injury to perennial ryegrass during late fall and early winter, even thinning the stands, yields were not reduced at any site. Indeed, the highest yielding treatment at Tangent was Axiom followed by Goal plus Diuron. Factors influencing the safety of Axiom will be a major focus of research efforts over the next few years. Fall and winter weather patterns, herbicide rate, application date, other herbicide treatments, and stand vigor will all interact in determining the extent of injury from Axiom. Combinations of Prowl plus Axiom may come close to providing adequate weed control without the need for any postemergence treatment.

Table 1. Perennial ryegrass and tall fescue seed yield response to early spring treatment with Rely.

Treatment comparison	Perennial ryegrass			Tall fescue
	Tangent	Amity	Hyslop	Shedd
	(lb/a clean seed)			
Six treatments with LPOST Rely	1399 a	850 a	579 a	1138 a
Comparable treatments without Rely	1224 b	846 a	541 a	1185 a

High populations of diuron-resistant annual bluegrass were present at Tangent perennial ryegrass and Shedd tall fescue. Moderate populations of diuron-resistant Italian ryegrass were present at Amity perennial ryegrass. Hyslop perennial ryegrass was virtually weed-free except for volunteer crop seedlings. LPOST Rely was applied March 13 at Hyslop and March 17 at the other sites.

Table 2. Annual bluegrass response to selected treatments at the Tangent perennial ryegrass site.

Herbicide Treatment (lb a.i./a)	Annual bluegrass		
	Seed yield July 7	Ground cover April 16	Proportion flowering April 16
	(lb/a)	(%)	(%)
Vacuum sweep treatments			
1-leaf: Prowl 3 + Goal 0.125	216 b	54 b	59 a
1-leaf: Prowl 3 + Goal 0.125 / 4-leaf: Rely 0.3 / LPOST: Rely 0.3	79 e	18 cd	22 d
1-leaf: Prowl 3 + Goal 0.125 / 4-leaf: Rely 0.25 + Avenge 1 / LPOST: Rely 0.25 + Avenge 1	99 de	26 c	27 cd
1-leaf: Prowl 3 + Goal 0.125 / 4-leaf: Goal 0.25 + Diuron 1.2	173 bc	44 b	55 a
1-leaf: Prowl 3 + Goal 0.125 / 4-leaf: Goal 0.25 + Diuron 1.2 / LPOST: Rely 0.3	110 de	21 cd	19 de
Untreated check	314 a	70 a	58 a
Full straw load chop treatments			
1-leaf: Prowl 3 + Goal 0.125	222 b	51 b	41 b
1-leaf: Prowl 3 + Goal 0.125 / 4-leaf: Rely 0.3 / LPOST: Rely 0.3	93 de	20 cd	10 e
1-leaf: Prowl 3 + Goal 0.125 / 4-leaf: Goal 0.25 + Diuron 1.2	141 cd	28 c	36 bc
1-leaf: Prowl 3 + Goal 0.125 / 4-leaf: Goal 0.25 + Diuron 1.2 / LPOST: Rely 0.3	113 de	11 d	9 e
Untreated check	211 b	54 b	41 b
4-leaf: Rely 0.3 / LPOST: Rely 0.3	144 cd	24 c	17 de
1-leaf: Milestone 0.15 / LPOST: Rely 0.3	110 de	29 c	16 de
Treatment contrasts			
Six treatments with LPOST Rely	106 A	20 A	17 A
Comparable treatments without Rely	196 B	48 B	49 B

Means followed by the same letter do not differ at the P=0.05 level.

Table 3. Perennial ryegrass seed yield response to rates of nitrogen and Rely applied in mid-spring in the absence of annual bluegrass.

Herbicide Treatment	Perennial ryegrass seed yield		
	120 lb/a nitrogen	180 lb/a nitrogen	Average
	(lb/a clean seed)		
Untreated check	691 a	687 a	689 A
Rely 0.25 + Avenge 1 April 17	538 b	520 bc	528 B
Rely 0.25 April 17	537 b	616 ab	577 B
Rely 0.3 April 17	546 b	530 b	538 B
Rely 0.375 April 17	393 cd	376 d	385 C
Rely 0.5 April 17	323 d	340 d	331 C
Average	505 x	511 x	

Means followed by the same letter do not differ at the P=0.05 level. Nitrogen rate by herbicide treatment interaction was non-significant.

Table 4. Annual bluegrass and perennial ryegrass response to selected fall-applied treatments at the Tangent perennial ryegrass site.

Herbicide Treatment (lb a.i./a)	Annual bluegrass ground cover March 25	Seed yield July 7	
		Annual bluegrass	Perennial ryegrass
	(%)	(lb/a clean seed)	
Vacuum sweep treatments			
Untreated check	52 a	314 a	1001 d
1-leaf: Prowl 3 + Goal 0.125	31 b	216 bc	1333 abc
1-leaf: Prowl 6 + Goal 0.125	20 bcd	134 fg	1381 ab
1-leaf: Prowl 3 + Goal 0.125 / 4-leaf: Goal 0.25 + Diuron 1.2	28 bc	173 c-f	1266 abc
1-leaf: Dual Magnum 0.94 + Goal 0.25 / 4-leaf Diuron 1.6	33 b	254 b	1206 bcd
1-leaf: Axiom 0.51 / 4-leaf: Goal 0.25 + Diuron 1.2	5 d	112 g	1455 a
Full straw load chop treatments			
Untreated check	19 bcd	211 bcd	1035 d
1-leaf: Prowl 3 + Goal 0.125	30 b	222 bc	1218 bcd
1-leaf: Prowl 6 + Goal 0.125	20 bcd	138 fg	1321 abc
1-leaf: Prowl 3 + Goal 0.125 / 4-leaf: Goal 0.25 + Diuron 1.2	21 bcd	141 fg	1161 cd
1-leaf: Dual Magnum 0.94 + Goal 0.25 / 4-leaf Diuron 1.6	24 bc	185 c-f	1209 bcd
1-leaf: Axiom 0.51 / 4-leaf: Goal 0.25 + Diuron 1.2	12 cd	157 d-g	1257 bc
1-leaf: Axiom 0.64 / 4-leaf: Goal 0.25 + Diuron 1.2	16 bcd	147 efg	1302 abc

Means followed by the same letter do not differ at the P=0.05 level.