

SULFOSULFURON FOR ROUGHSTALK BLUEGRASS CONTROL IN SEEDLING KENTUCKY BLUEGRASS SEED CROPS

J.F. Spring, R.P. Affeldt, and D.L. Walenta

Introduction

Kentucky bluegrass (*Poa pratensis* L.; KBG) and roughstalk bluegrass (*Poa trivialis* L.) have both been successful seed crops in central Oregon for decades, despite the fact that most KBG markets tolerate little or no seed contamination from roughstalk bluegrass. While volunteer roughstalk bluegrass is a common weed in seedling KBG in central Oregon, it has been successfully controlled with the ALS-inhibitor (Group 2) herbicide primisulfuron, formulated as Beacon and as a premix with dicamba as NorthStar.

Production of primisulfuron was discontinued by the primary registrant Syngenta in 2018, and it has been unavailable in the retail chain since then. Despite acquisition of the active ingredient by Gowan Company in late 2020, manufacture of primisulfuron has not yet resumed, and it is unclear if or when this might occur. Best predictions available at the time of writing are that primisulfuron will remain out of production and unavailable for at least 3–5 years. Production and regulatory concerns (specifically, the need to generate required federal feeding tolerances for primisulfuron to allow reregistration in KBG) both contribute to this anticipated delay.

On the basis of previous work done in central Oregon (Jeliazkova et al., 2020; Spring and Affeldt, 2021) and trials conducted in 2021 (described below), the ALS-inhibitor herbicide sulfosulfuron (Outrider, Valent USA) recently received 24c Special Local Needs registration for use in seedling and established KBG in Oregon (SLN No. OR-220002).

In the 2021 crop year, field trials were established in newly seeded irrigated KBG stands in Jefferson and Union counties (Madras and La Grande, respectively) with the following goals:

- To complement results of previous trials in central Oregon.
- To evaluate Outrider activity on witchgrass and green foxtail in spring-planted KBG in northeast Oregon.
- To continue data generation in support of the recently approved 24c SLN registration for KBG in Oregon.

Materials and Methods

Field trials were established in Jefferson County (Madras area) in five newly planted commercial stands of KBG established with typical production practices in August 2020. Only two of these trials were completed through seed yield (due to inadvertent overspray by the grower, winter stand loss to cattle damage, or severe volunteer wheat competition, depending on the site).

Trials were arranged in a randomized complete block design with four replicates and individual plot size of 10 feet x 30 feet. Site 1 was a stand of 'Wildhorse' in a furrow-irrigated loam soil, and Site 2 was a stand of 'Rockstar' in a loam soil under center pivot irrigation.

Beacon and Outrider were applied at several rates and timings (Figure 1):

- In the fall only (Outrider at 0.38, 0.5, and 0.76 oz/acre)
- Split-applied in both fall and spring (Beacon at 0.38 oz/acre followed by 0.38 oz/acre)
- Split-applied in both fall and spring (Outrider at 0.38 oz/acre followed by 0.25 or 0.38 oz/acre)

Applications were made with a CO₂-powered backpack sprayer calibrated to deliver 15 gal/acre using coarse droplet size. All treatments included MSO at 1% v/v and liquid AMS at the equivalent of 8.5 lb AMS/100 gal. Fall herbicide applications were made in late October to early November when KBG was at the two- to four-tiller stage. Roughstalk bluegrass was present only at Site 1 and had three to six tillers at the time of application. Spring applications were made in mid-April, after the first irrigation of the season.

Crop injury was rated in late April and again in June (at KBG heading) on a scale from 0 to 100%, with no effect at 0 and complete plant death at 100%. In June, accurate delineation of individual roughstalk bluegrass plants from within the dense KBG sward was not possible, so weed control was rated on a 0 to 3 categorical scale, with 0 indicating absence from an individual 10-foot x 30-foot plot, 1 and 2 representing one or two individual headed roughstalk bluegrass plants within an individual plot, and 3 representing three or more headed individuals. Severely suppressed plants that had not

produced seed heads were excluded from evaluation.

At crop maturity, a 6-foot x 27-foot portion of each plot was swathed, allowed to dry in the field for 2–5 days, and threshed with a small plot combine. Samples were further processed with experimental-scale cleaning equipment (stationary thresher and air screen cleaner) to clean seed yield of approximately 98% purity and bushel weight of 21–23 lb/bu.

In Union County, a single field trial was established in a commercial field of ‘Gaelic’ planted in April 2021 in a fine sandy loam under wheel line irrigation. Outrider was applied postemergence at several rates (0.25, 0.38, 0.5, 0.76 oz/acre) at two application timings (two- to five-tiller and five- to eight-tiller KBG). Split applications were not evaluated at this site. The trial was arranged in a randomized complete block design with four replicates and individual plot size of 8 feet x 25 feet. Applications were made in 21 gal/acre using medium droplets with MSO at 1% v/v and AMS at 8.5 lb/100 gal. Trials were evaluated on a visual rating scale as previously described.

Results and Discussion

Warm-season grass control

Water shortages prevented full irrigation of the spring-seeded KBG field in which the Union County trial was located, and warm-season grass emergence was minimal. Evaluation of Outrider activity on warm-season grass weeds was thus not possible. Preliminary observations in other locations have indicated potential activity (data not shown), but confirmation will require further work. Crop safety was excellent, with minimal ($\leq 5\%$) or no crop injury observed at any rate on either one-tiller or five-tiller KBG plants (data not shown). This trial is not considered further in this report.

Preemergent applications

Additional treatments in the five initial trial sites in Jefferson County included postplant preemergent applications of Outrider (0.38 and 0.76 oz/acre). At two locations, this application timing resulted in complete

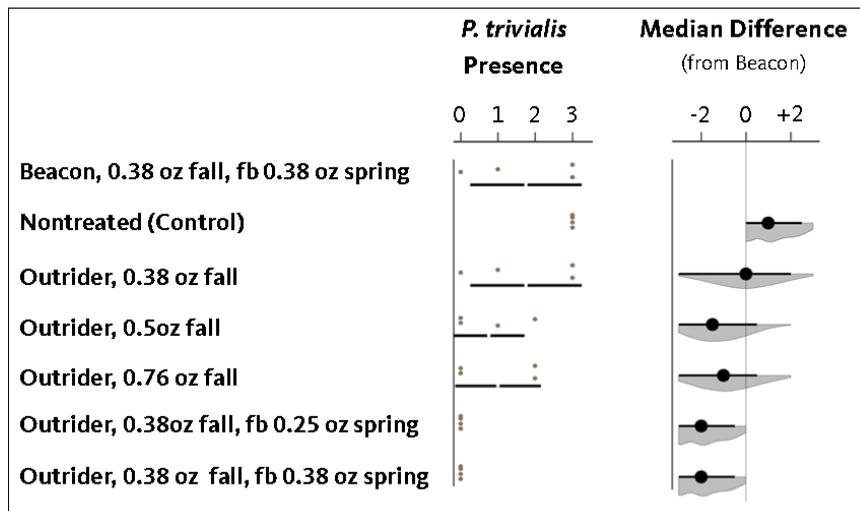


Figure 1. Roughstalk bluegrass presence at KBG heading. Presence was rated on a scale from 0 to 3, with no plants at 0 and highest density at 3. The plot on the left shows raw data for four replicate plots per trial (points), plus mean and standard deviation (bars). The plot on the right shows the median difference from the midpoint (median) of the Beacon reference treatment. Black bars are nonparametric 95% confidence intervals, and the gray curve is the sample error distribution for the interval estimate. Positive median difference values indicate more roughstalk bluegrass plants were present per plot than in the Beacon standard, and negative values indicate fewer.

loss of KBG stands at both rates and no roughstalk bluegrass emergence (data not shown). At three locations, moderate to severe KBG injury was observed but not stand loss. The cause of major differences in crop safety at nearby locations on similar soils within the same year is unknown. Regardless, this application timing indicates that crop injury potential from Outrider likely increases markedly on early growth stages of KBG; thus, this timing does not warrant further investigation. The remainder of the discussion below considers only postemergence timings.

Roughstalk bluegrass control

Roughstalk bluegrass was present only at Site 2. By crop heading, control from fall applications of Outrider was equivalent to the Beacon standard treatment (Figure 1). Higher rates of fall-applied Outrider gave better control than the Beacon standard, but the relatively large degree of variability in the data precludes confident conclusion that this is a true difference. Split applications of Outrider (fall followed by spring) did improve control of roughstalk bluegrass relative to Beacon (Figure 1).

Kentucky bluegrass safety

Crop safety was evaluated in late April (KBG at second-node stage) and again during pollination. In April, crop safety differed notably between sites, with more severe crop injury at Site 2 from both Beacon and Outrider treatments (Figure 2). Relative differences among treatments, however, were fairly consistent across sites. By KBG head emergence, between-site differences had largely disappeared, and identical treatments showed similar levels of crop injury across sites.

In general, safety of the lower rates of fall-applied Outrider (0.38 and 0.5 oz/acre) was similar to that of the Beacon standard (Figure 2). At heading, Outrider at 0.76 oz/acre caused slightly higher crop injury than Beacon, with the difference evident mostly as reduced height and growth stage delays of approximately 1 week relative to the Beacon standard.

Split applications of Outrider had consistently higher injury than the Beacon standard, averaging approximately 10–15% higher, but with considerable variability around the average. Again, injury presented primarily as crop stunting and delayed crop development, but there was some visible reduction in panicle size as well. Patterns of crop safety were generally consistent with differences in observed seed yield.

Kentucky bluegrass yield

Clean seed yield was equivalent to the Beacon standard for fall Outrider at 0.38 and 0.5 oz/acre, while the 0.76 oz/acre rate reduced seed yield by nearly 25% (Figure 3). Split applications of Outrider also reduced seed yield by approximately 10 to 15%, depending on rate.

In both split Outrider treatments and the 0.76 oz/acre fall Outrider treatment, maturity was delayed by an estimated 3–5 days relative to the rest of the treatments. Swathing was done at a single timing, based on the surrounding field, which corresponded well to the Beacon standard but was not ideal for all Outrider treatments. This earlier-than-optimal swathing for some Outrider treatments might explain some of the yield reduction relative to the standard, but not all.

No effect was observed on seed germination rates from application of Beacon or Outrider (data not shown).

Discussion

Outrider offers a suitable option for control of roughstalk bluegrass in seedling KBG seed production fields. Across trial years, fall applications of Outrider at 0.38 or 0.5 oz/acre provided good crop safety and offered levels of roughstalk bluegrass control broadly comparable to Beacon in most cases.

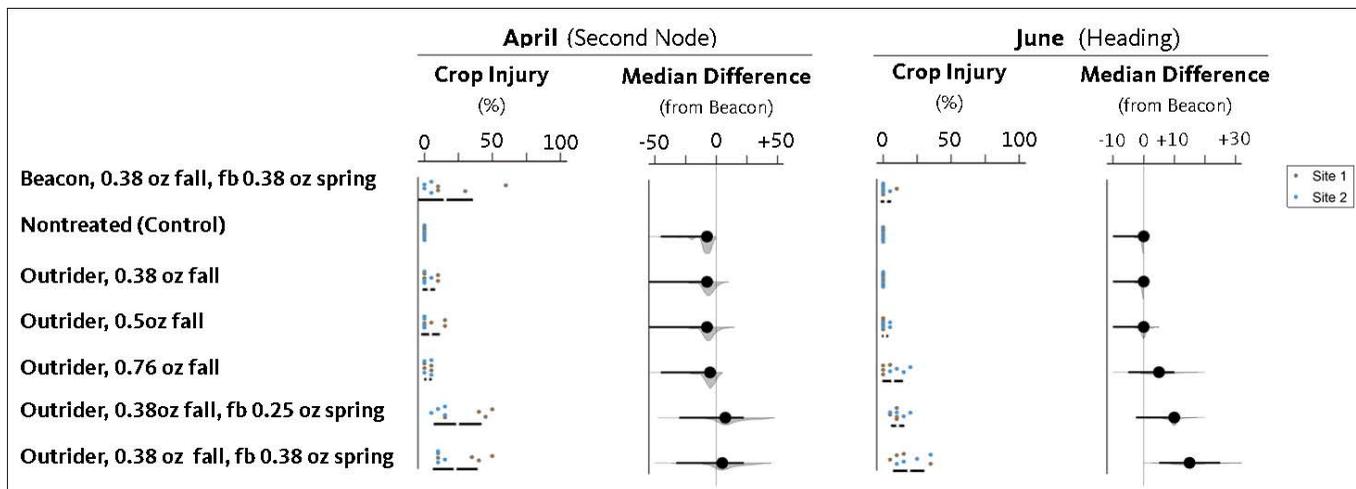


Figure 2. KBG injury from herbicide treatments at second-node and heading growth stages. Injury was rated on a scale of 0 to 100%, with no injury at 0 and complete plant death at 100%. The plot on the left shows raw data for four replicate plots per trial (points), plus mean and standard deviation (bars). The plot on the right shows the median difference from the midpoint (median) of the Beacon reference treatment. Black bars are nonparametric 95% confidence intervals, and the gray curve is the sample error distribution for the interval estimate. Positive median difference values indicate more crop injury than the Beacon standard, and negative values indicate less.

Fall applications of 0.76 oz/acre Outrider gave equivalent to slightly improved control of roughstalk bluegrass relative to split applications of Beacon but at the cost of higher potential for crop yield loss. Actual loss varied from year to year: from 0 to as much as approximately 25% yield reduction. This contrasts with results from four trial locations in the 2020 crop year, in which fall applications at this rate did not reduce clean seed yield (Spring and Affeldt, 2021). Both Beacon and Outrider are known to have year-to-year variability in crop injury, presumably due to complex and unpredictable interactions with environmental conditions, even with favorable weather windows for application occurring in both study years.

It is assumed that such environmental variation was responsible for year-to-year differences in crop injury from the same application pattern. This observed variability is a valuable measure and can be interpreted as representing the range of likely outcomes that can be expected from year to year with fall applications of Outrider.

Split applications of Outrider (fall followed by spring) reduced KBG seed yield by approximately 10% (and approximately 20% across 2020 trials) but provided consistently better control of roughstalk bluegrass than the Beacon standard (both years).

All plots required supplemental hand-roguing to attain full control of roughstalk bluegrass.

Use Recommendations

Note: The current 24c label (SLN No. OR-220002) should be read thoroughly prior to making any application of Outrider to KBG. Summary recommendations that follow will not be complete without a full understanding of the label.

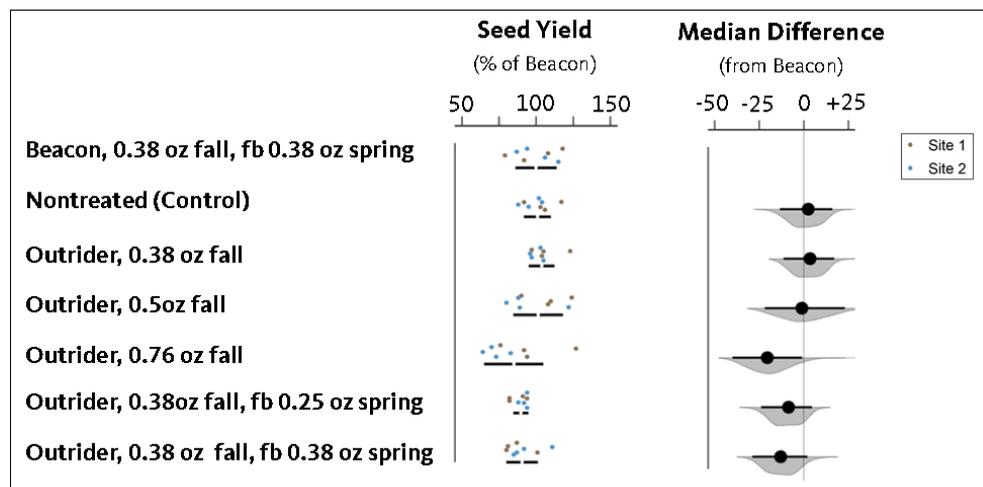


Figure 3. KBG clean seed yield (21–23 lb/bu and approximately 98% purity). The plot on the left shows raw data for four replicate plots per trial (points), plus mean and standard deviation (bars). The plot on the right shows the median difference from the midpoint (median) of the Beacon reference treatment. Black bars are nonparametric 95% confidence intervals, and the gray curve is the sample error distribution for the interval estimate. Positive median difference values indicate higher yield than the Beacon standard, and negative values indicate lower yield.

Roughstalk bluegrass control in seedling KBG stands

Outrider may be applied in KBG up to 0.76 oz/acre total per crop year. One option is to apply Outrider as a single application of 0.38–0.76 oz/acre in the fall once KBG plants have at least two tillers but prior to winter dormancy. Alternatively, Outrider may be applied in a split pattern, including a fall application of 0.38 oz/acre followed by an application of 0.25–0.38 oz/acre in the spring between green-up and second-node emergence.

For fields with light roughstalk bluegrass pressure, the most conservative approach is probably a fall application of 0.5 oz/acre. This rate should reliably provide acceptable crop safety regardless of annual weather variation, and it leaves 0.25 oz/acre of the seasonal use maximum for a spring follow-up if needed. In trials to date, any given rate of Outrider has had variable activity (both crop injury and roughstalk bluegrass control) from year to year, presumably due to differences in environmental conditions between years.

In years in which Outrider is more “active,” both efficacy on roughstalk bluegrass and crop injury are higher. In such years, the 0.5 oz/acre rate applied in the fall may provide adequate roughstalk bluegrass

control, and crop injury likely would exceed tolerable levels at higher use rates. In years in which Outrider activity is lower (reducing both roughstalk bluegrass control and crop injury), the remainder of the seasonal use maximum can be applied in the spring to obtain improved control with acceptable crop safety.

In fields with moderate to heavy roughstalk bluegrass pressure, economic loss will undoubtedly be sustained either from excessive seed loss during cleaning or due to herbicide damage. Split applications of 0.38 oz/acre in both fall and spring are likely the best treatment option in this scenario.

All trial work for roughstalk bluegrass control included MSO at 1% v/v and AMS at 8.5 lb/100 gal. While the label also permits use of NIS, the more aggressive surfactant package used to date in trial work (MSO + AMS) is recommended for best control of roughstalk bluegrass, particularly if it has more than two tillers at time of application.

Warm-season grass control in spring-planted seedling KBG

While the efficacy of Outrider on warm-season annual grasses such as witchgrass and foxtail has not been confirmed experimentally, preliminary observations indicate that Outrider may have soil residual activity on these weed species, and postemergence activity is presumed as well. Limited trial work in spring-seeded stands to date suggests that patterns of crop safety should not differ substantially between fall-planted stands in central Oregon and spring-planted stands in northeastern Oregon as long as KBG plants are at a labeled growth stage when Outrider is applied. In the absence of sufficient data, our initial recommendation is to apply 0.38 oz/acre Outrider when KBG plants reach three tillers or when the first flush of summer annual grasses reach the three- to five-leaf size, whichever is later.

Downy brome control in established stands

Outrider is labeled for control or suppression of downy brome in wheat and other registered crops, and it has acceptable activity for this use in limited trials conducted in established KBG (Spring and Walenta, 2022). Best efficacy will be achieved by including Outrider at 0.67 oz/acre (wheat use rate) to 0.76 oz/acre (maximum KBG seasonal use rate) as part of an early postemergence tank mix applied to one- to two-leaf downy brome.

As with many ALS inhibitors used for control of downy brome, application timing is absolutely critical to obtaining acceptable control with Outrider, and applications to downy brome plants with more than two leaves can be expected to provide suppression only, not control. (Similar results should be expected from preemergent applications.)

A tank-mix partner from a different herbicide mode-of-action group with postemergence activity on downy brome (e.g., oxyfluorfen) is highly recommended. For best results, an effective preemergence herbicide program should be applied prior to watering back established stands, followed by the early postemergent Outrider tank-mix. Later follow-up applications of a PSII-inhibiting herbicide (e.g., terbacil) may be needed to obtain acceptable control of heavy downy brome infestations.

Cautions

While Outrider has some general similarities to Beacon, direct inferences about Outrider performance by analogy to Beacon may be ill founded. For example, the registered use rate for Outrider appears to be much closer to the limits of crop tolerance than the registered use rate for Beacon. Inadvertent over-label applications of Beacon (for instance, double rates in areas of accidental boom overlap) have been known to offer agronomically acceptable levels of crop safety in many situations; however, similar over-label rates of Outrider likely will result in severe crop injury.

Beacon is also well known to show increased crop injury in response to environmental stressors around the time of application, especially cold or freezing temperatures. Observations made during trials in central Oregon indicate that Outrider is considerably more likely to cause increased crop injury in this situation. If daily low temperatures fall below 30–32°F within 3–4 days on either side of Outrider application, risk of substantial crop injury increases dramatically, and unacceptable injury should be expected with lows below 28–29°F during this period.

Finally, Outrider has considerable potential for carryover injury to sensitive crops, a trait that should be considered prior to use. Consult the wheat section of the Section 3 Outrider label (found on the container) for specific crops and instructions. Plant-back restrictions for many sensitive crops listed approach 2 years.

Full cautions and restrictions for Outrider use in KBG can be found in the 24c SLN label, SLN No. OR-220002. Plant-back restrictions are found on the Section 3 label.

References

- Jeliazkova, E., R.P. Affeldt, and J.F. Spring. 2020. Replacing Beacon for control of roughstalk bluegrass during Kentucky bluegrass stand establishment. In *Central Oregon Agricultural Research and Extension Center 2019 Annual Report*.
- Spring, J.F. and R.P. Affeldt. 2021. Sulfosulfuron for control of roughstalk bluegrass during Kentucky bluegrass stand establishment. In N.P. Anderson, A.G. Hulting, D.L. Walenta, and C. Mallory-Smith (eds.). *2020 Seed Production Research Report*. Oregon State University, Ext/CrS 164.

Spring, J.F. and D.L. Walenta. 2022. New herbicides in sequential fall programs for downy brome control in established Kentucky bluegrass. In *Central Oregon Agricultural Research and Extension Center 2021 Annual Report*.

Acknowledgments

Project funding from the Jefferson County Seed Growers Association and Eastern Oregon Kentucky Bluegrass Work Group is gratefully acknowledged. Keelie Kirby and Hoyt Downing provided excellent technical research support, and Matthew Bucy (ODA) and Rachel Zuger (Valent USA) led label development and registration efforts. The authors also thank the many grower collaborators that hosted trial sites in 2021 and earlier years.