INDAZIFLAM HERBICIDE USE IN STAND ESTABLISHMENT OF KENTUCKY BLUEGRASS GROWN FOR SEED (YEAR 2)

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Introduction

Grass weed control during the establishment or seedling year of Kentucky bluegrass (*Poa pratensis* L.; KBG) grown for seed is a persistent problem in eastern Oregon. Herbicides currently registered for use in seedling and established KBG stands generally provide less-than-adequate control of key grass weeds when applied as stand-alone treatments. Grass weed control can be improved with the use of multiple herbicides in sequential application programs, but poor weed control and crop injury are still fairly common. In addition, several of these herbicides have long-term soil residual properties that may cause injury to rotational crops.

A multiyear project is underway to investigate the utility of the active ingredient indaziflam (Alion) as a potential herbicide for use in both seedling and established KBG in eastern Oregon seed production systems. Indaziflam is a preemergent herbicide with broad-spectrum weed control activity and excellent safety on established perennial grass plants. The mode of action for indaziflam is inhibition of cellulose synthesis (Herbicide Resistance Action Committee Group 29), and it has activity on germinating seedlings of both grass and broadleaf plants. Currently, there are no Group 29 herbicides registered for use in KBG grown for seed, and it could provide a new mode of action to combat ALS- and/or ACCase-resistant grass weed (e.g., downy brome) infestations.

Alion (Bayer Crop Science) is currently registered for use in carbon-seeded or established perennial ryegrass and tall fescue seed crops in western Oregon and for use in established perennial ryegrass, tall fescue, smooth bromegrass, and wheatgrass seed crops in eastern Oregon. Indaziflam used in Willamette Valley grass seed production has acceptable crop safety if adequate time is allowed between application and subsequent rainfall or irrigation events. Adequate crop safety has been documented from dormant fall applications made to spring-planted perennial ryegrass seedlings in western Oregon (Curtis et al., 2016). Initial testing of indaziflam applied after harvest to established KBG demonstrated acceptable crop safety in irrigated production in the Grande Ronde Valley in northeastern Oregon (Walenta, 2016).

The use of indaziflam in fall- or spring-seeded KBG stands has potential to substantially improve warm- and cool-season grass weed control during the critical period it takes a stand to become well established. Soil surface conditions after seeding a new stand facilitate more direct and uniform contact with the soil compared to postharvest applications in established stands. The long residual activity of indaziflam means that a single application has potential to provide durable preemergence grass weed control into subsequent years of the stand. While safety of indaziflam on well-established perennial grasses has been thoroughly demonstrated, previous evaluation of indaziflam safety on perennial grass seedlings is limited. Recent research in KBG (Spring and Walenta, 2021) demonstrated potential for this use pattern.

The objective of this study was to conduct a second year of crop safety evaluation of indaziflam applied at early crop growth stages during stand establishment of irrigated KBG seed crops in central Oregon and in the Grande Ronde Valley.

Materials and Methods

Field trials were located in two commercial stands of seedling KBG, one in Wheeler County near Clarno, OR, and one in Union County near La Grande, OR. Weed-free sites were selected for the trials. The Clarno trial was in a stand of 'Rockstar' in a loam soil under wheel-line irrigation, seeded in August 2021. In La Grande, the trial was located in a stand of 'Gaelic' in a sandy loam soil under center pivot irrigation, seeded in April 2021. All other production inputs were applied across the trial by the hosting grower using common production practices.

Trials were established in a randomized complete block design with four replicates and an individual plot size of 10 feet x 30 feet (Clarno) or 8 feet x 25 feet (La Grande). Indaziflam was applied as Alion at 1, 2, and 3 oz/acre at each of three growth stages of KBG using CO_2-powered backpack sprayers delivering 15 (Clarno) or 21 (La Grande) gal/acre. Growth stages of KBG were three- to five-leaf, three- to five-tiller, and 10+ tiller. At the La Grande site, the 3 oz/acre Alion rate was omitted at the three- to five-leaf application stage, due to severe injury observed in this treatment in

2021. Applications were made in Clarno on October 5, 2021, November 16, 2021, or March 25, 2022, and in La Grande on May 26, 2021, June 25, 2021, or September 1, 2021.

Crop injury was rated periodically throughout the season using a percent scale from 0 to 100, with no effect at 0 and plant death at 100. At crop maturity, a 6-foot-wide swath in the center of each plot was windrowed and allowed to dry in the field prior to threshing with a small-plot combine. Seed was then rethreshed with a stationary thresher and cleaned with an air-screen cleaner to approximately 98% purity and a bushel weight of 18 lb for calculation of clean seed yield. Kentucky bluegrass test weights were reduced by 2–4 lb/bu in many eastern Oregon fields in 2022, and we were unable to clean samples to standard bushel weight (21 lb/bu), even at extremely high cleanout percentages (50% plus in initial tests).

Results and Discussion

At the La Grande location, visually apparent crop injury in early May was minor (< 10–15%) at the earlier application timings and increased slightly with increasing Alion rate (Figure 1, bottom). No crop injury was observed in 10+ tiller treatments. Seed yield was equivalent to the nontreated check at 1 oz/acre Alion applied to three- to five-leaf KBG but showed a moderate reduction (estimated 200–300 lb/acre loss) at 2 oz/acre. The 3 oz/acre rate was not tested at this application timing in this trial.

For three- to five-tiller applications, seed yield was equivalent to the nontreated check at 1 oz/acre Alion, equivalent or slightly less at 2 oz/acre, and considerably reduced at 3 oz/acre. For all Alion rates applied to 10+ tiller KBG, seed yields appear equivalent to the nontreated check at the level of precision the somewhat variable data from this site can support. Overall results from this spring-seeded stand are consistent with those seen in two fall-seeded stands in 2021 (Spring and Walenta, 2021).

At the Clarno location, no crop injury was apparent in May for any rate of Alion applied at the three- to five-leaf stage (Figure 1, top). At the three- to five-tiller stage, minor crop injury (< 10%) was apparent and appeared to increase slightly with increasing Alion rate. Applications made to 10+ tiller KBG in the spring caused the highest levels of injury observed in the trial at the 2 and 3 oz/acre rates (Figure 1). At the 3 oz/acre rate, very few seedheads were produced (data not shown). Rate did not influence injury level for treatments applied at the three- to five-leaf stage, but there appears to be a pattern of slightly increasing injury with increased rate at three- to five-tiller applications.

Although visible crop injury at earlier application timings was minor (three- to five-tiller treatments) or nonexistent (three- to five-leaf treatments), all Alion rates applied at these timings appear to have resulted in slight to moderate seed yield reduction relative to the nontreated check. Considerable variability is evident in the data, which prevented precise estimation of yield reduction, but losses ranged from approximately 200 to 400 lb/acre. This level of yield loss is similar to that observed from the same treatments in trials conducted in 2021. Yield reductions were of similar magnitude at 1 and 2 oz/acre rates applied at the 10+ tiller stage and were very high at the 3 oz/acre rate.

The pattern of crop injury at Clarno (i.e., good safety, relatively minor yield reduction from applications made to early growth stages, and much higher injury observed from the last application timing made to well-established seedlings) is opposite that observed at the La Grande trial in 2022 and in both trials conducted in 2021. In all of these trials, Alion applications made to small KBG seedlings were most injurious, and safety generally increased with KBG growth stage at time of application. We suspect that differing soil water dynamics between trials may be the cause of this difference. Alion is known to require adequate binding time to dry soil (at least 48 hours is recommended on the label) in order to "fix" to the upper profile and be resistant to downward leaching with water, which can otherwise result in crop root damage.

At the Clarno site, relatively good crop safety was obtained from early applications (three- to five-leaf and three- to five-tiller) made to a dry soil surface with at least 3 days elapsing prior to the next irrigation. However, at the 10+ tiller application timing, an application window with dry surface soil was not possible due to consistent rains and cool spring conditions that prevented soil drying. Thus, the 10+ tiller application was made to a partially moist soil surface. With subsurface recharge from wet soil deeper in the profile, the soil was not able to remain dry for an extended time period.

We presume that this lack of upper soil drying prevented the herbicide from binding to the soil and allowed movement into the crop root zone when the

first irrigation of the year occurred about 5 days after application. In contrast, very dry spring conditions in 2021 allowed for adequate binding time on dry soil at this application timing, and relatively minor injury was observed in 2021 trials. At all other sites, the soil surface was at least somewhat moist at three- to five-leaf application timing and dry following the 10+ tiller application.

The unexpected reversal of crop safety versus KBG developmental stage at time of application observed at the Clarno trial has potentially important implications. It suggests that soil surface moisture at, and shortly after, application may play an important role in crop safety of indaziflam applications. Under certain conditions (such as at the Clarno site), soil moisture conditions may be more important than the expected pattern of increasing crop safety on larger, better-established seedlings that was observed at the other three trial locations to date. We presume that soil moisture conditions are the controlling factor, although this hypothesis requires further investigation. If application to dry soil does increase crop safety independent of seedling growth stage as speculated, it may be possible to develop refined use guidelines that reduce the risk of crop injury from indaziflam applications to small seedling KBG.

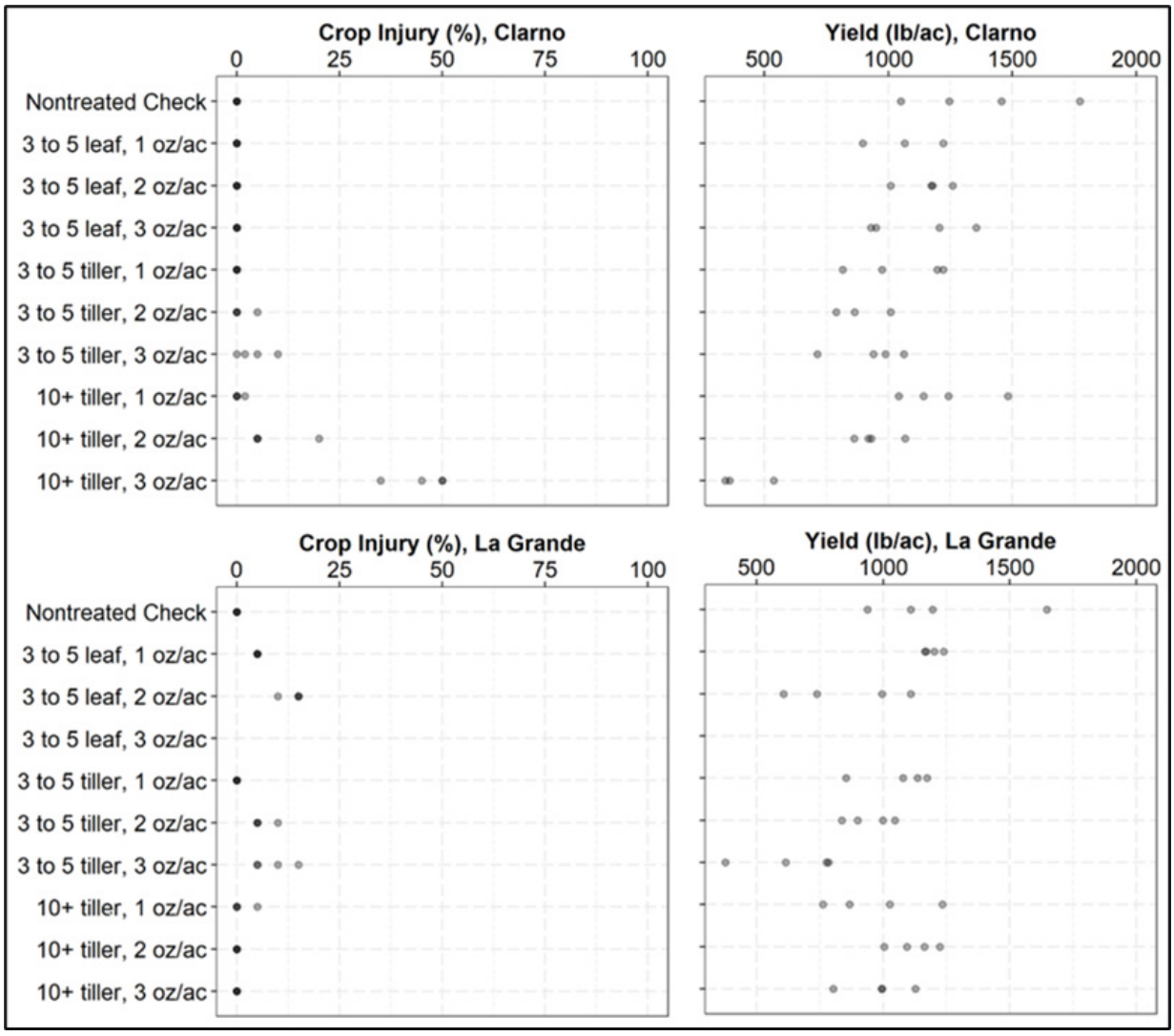

Figure 1. Crop injury at the onset of rapid stem elongation following second node emergence in early May 2022 (scale of 0 to 100%, with no injury at 0 and plant death at 100) and first-year clean seed yield (approximately 98% purity and 18 lb bushel weight) following treatment of seedling Kentucky bluegrass stands with experimental applications of indaziflam (Alion). Each point represents response of an individual plot, with four replicate plots per treatment at each site.

In summary, the combined observations of indaziflam applied to seedling KBG across four trial locations in two production regions suggest that Alion offers potential for early postemergence use, particularly at 1 or 2 oz/acre. The unexpected pattern of crop injury observed at the Clarno site in 2022, however, indicates that further investigation is needed to better understand the relative importance of soil moisture and KBG growth stage on crop injury. Trials are being repeated in central and northeastern Oregon in 2023.

References

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