SPRING-APPLIED NITROGEN AND PLANT GROWTH REGULATOR EFFECTS ON SEED YIELD OF THIRD-YEAR ORCHARDGRASS

N.P Anderson, T.G. Chastain, A.D. Moore, C.J. Garbacik, and B.C. Donovan

Introduction

Forage grass seed crops, including orchardgrass (*Dactylis glomerata* L.), are a vital part of seed production enterprises in Oregon. Like other cool-season grasses, orchardgrass produces only a fraction of its potential seed yield. Making better use of nitrogen (N) and plant growth regulators (PGRs) is a way to possibly obtain higher seed yields. In comparison with tall fescue and perennial ryegrass, seed yield response to PGRs in orchardgrass is relatively understudied.

Since lodging is exacerbated in the high-N environments present in grass seed production systems, additional work is needed to determine possible interactions between PGRs and spring-applied N under western Oregon conditions. Recommendations for application rates of N fertilizer in orchardgrass have not been revised and have not appeared in the international seed production literature since PGRs were introduced in this important forage seed crop. In Oregon, OSU fertilizer recommendations (Doerge et al., 2000) for orchardgrass seed crops are more than 15 years old, and new information is needed to evaluate whether N rate recommendations should be adjusted to further increase seed yield in current management environments.

The first- and second-year results of this study indicate that a combination of spring-applied N and PGRs can increase orchardgrass seed yield in western Oregon conditions (Anderson et al., 2018; Anderson et al., 2019). Maximum seed yield was attained with 100 lb N/acre, and there was no additional benefit from higher N rates. Conversely, there was no seed yield increase from applying spring N in the third harvest year. Seed yield was also significantly increased by trinexapac-ethyl (TE) and TE + chlormequat chloride (CCC) PGR treatments (by 55% and 37% in the first year and second year, respectively). An interaction of spring-applied N and PGR for seed yield was evident in this first-year study but not in year 2. One interesting finding from both years was that seed yield was enhanced by the use of PGRs even when no spring N was applied.

The objectives of this 3-year study were to (1) measure the effects of multiple N fertilizer rates in the presence and absence of TE and TE + CCC PGRs and (2) define optimum treatment and timing applications of TE and TE + CCC PGR combinations for third-year orchardgrass seed crops.

Methods

A field trial with 'Persist' orchardgrass was established in October 2015 at OSU's Hyslop Research Farm. Plot size is 11 feet x 38 feet. Fungicide and insecticide treatments were applied to manage pests as needed. Fall N was applied to all plots at a rate of 40 lb N/acre during 2015–2018. The third harvest was taken in 2019. The experimental design for the trial was a randomized complete block with a split-plot arrangement of treatments and three replications. Main plots were spring-applied N rates of:

- 0 lb N/acre
- 100 lb N/acre
- 140 lb N/acre
- 180 lb N/acre

PGR subplots included the following treatments and application rates:

- Untreated control (no PGR)
- 1.5 pt TE/acre applied at BBCH 32 (two nodes)
- 1.5 pt TE/acre applied at BBCH 51 (panicles 10% emerged)
- 0.75 pt TE/acre + 1.34 lb CCC/acre at BBCH 32

Spring N was applied on March 5, 2018 using a tractor-mounted orbit-air spreader system with appropriate amounts of 46-0-0. The PGR treatments were applied at the two-node stage (BBCH 32) and when panicles were 10% emerged (BBCH 51) using a bicycle-type boom sprayer operated at 20 psi delivering 20 GPA with XR Teejet 8003VS nozzles. Above-ground biomass samples were taken from each plot near crop maturity, and dry weight of the standing crop was determined. Total tissue N content was measured from the above-ground biomass samples. Tiller height was measured for each treatment at harvest maturity.

Seed was harvested by a small-plot swather and combine, and seed was cleaned to determine yield. Seed weight was determined by counting two 1,000-seed samples with an electronic seed counter and weighing

these samples on a laboratory balance. Harvest index (HI), the ratio of seed yield to above-ground biomass, was also quantified.

Results and Discussion

Spring-applied N had no effect on seed yield in third-year orchardgrass (Table 1). Unlike the first- and second-year studies, maximum seed yield was attained without N fertilizer, and there was no additional benefit from higher N rates. Nitrogen increased seed weight, total above-ground biomass, and fertile tiller number, but had no effect on percent cleanout, seed number, tiller height, or HI. Total tissue N concentration did not increase when rates above 100 lb N/acre were applied (data not shown).

Seed yield was significantly increased (by 29%) by PGR treatments (Table 2). As in the second year of this study, PGR application timing at the two-node stage (BBCH 32)—both TE and TE + CCC mixture—resulted in significantly increased seed yields and HI compared to TE applied when panicles were 10% emerged (BBCH 51) (Table 2). There was no benefit of TE + CCC PGR combination over TE alone. All PGR treatments increased seed number and decreased tiller height and percent cleanout, but there were mixed effects on seed weight and biomass. There were no PGR effects on fertile tiller number.

An interaction of spring-applied N and PGR for seed yield was not evident in this third-year study. Spring N and PGRs enhanced seed yield independently of one another. In summary, it appears that new recommendations should be developed to optimize seed yields in orchardgrass seed crops grown in the Willamette Valley. Overall results indicate that no more than 100 lb N/acre is needed in the spring and that PGRs should be used and timed at the two-node (BBCH 32) growth stage.

Table 1. Effect of nitrogen (N) on seed yield, yield components, and growth characteristics of third-year orchardgrass.[1]

N treatment	Seed yield	Cleanout	Seed weight	Seed number	Biomass	Fertile tillers	Tiller height	Harvest index
(lb/a)	(lb/a)	(%)	(mg/seed)	(seeds/m^2)	(kg/ha)	(no./ft^2)	(cm)	(%)
0	420	29.9	0.916 a	39,744	4,249 a	22.9 a	78.9	11.8
100	551	17.9	0.959 b	52,905	7,836 ab	36.1 b	86.8	8.3
140	594	19.9	0.940 ab	56,781	7,332 b	35.7 b	90.4	9.4
180	623	18.6	0.947 b	60,048	8,335 c	39.2 b	85.1	8.6
P-value	0.1109	0.0859	0.0238	0.0673	0.000	0.0050	0.2653	0.1765

[1]Means followed by the same letters not significantly different at LSD ($P = 0.05$).

Table 2. Effect of plant growth regulators (PGRs) on seed yield, yield components, and growth characteristics of third-year orchardgrass.[1]

PGR treatment	Seed yield	Cleanout	Seed weight	Seed number	Biomass	Fertile tillers	Tiller height	Harvest index
	(lb/a)	(%)	(mg/seed)	(seeds/m^2)	(kg/ha)	(no./ft^2)	(cm)	(%)
Control (no PGR)	450 a	23.1 b	0.920 a	43,980 a	7,575 b	35.9	110.8 c	6.9 a
Palisade 1.5 pt/a (BBCH 32)	590 c	21.4 a	0.967 c	54,095 b	6,566 ab	32.2	76.6 ab	11.1 b
Palisade 1.5 pt/a (BBCH 51)	546 b	20.9 a	0.933 ab	53,344 b	7,514 b	37.0	85.7 b	8.7 a
Palisade 0.75 pt/a + CCC 1.34 lb ai/a (BBCH 32)	602 c	20.9 a	0.942 b	58,060 b	6,097 a	28.8	68.0 a	11.4 b
P-value	0.0000	0.0186	0.0001	0.0001	0.0333	0.0517	0.0000	0.0001

[1]Means followed by the same letters not significantly different at LSD ($P = 0.05$).

References

Anderson, N.P., T.G. Chastain, A.D. Moore, and C.J. Garbacik. 2018. Spring-applied nitrogen and plant growth regulator effects on orchardgrass seed yield. In N.P. Anderson, A.G. Hulting, and D.L. Walenta (eds.). *2017 Seed Production Research Report.* Oregon State University, Ext/CrS 154.

Anderson, N.P., T.G. Chastain, A.D. Moore, and C.J. Garbacik. 2019. Spring-applied nitrogen and plant growth regulator effects on seed yield of third-year orchardgrass. In N.P. Anderson, A.G. Hulting, and D.L. Walenta (eds.). *2018 Seed Production Research Report.* Oregon State University, Ext/CrS 160.

Doerge, T., H. Gardner, T.L. Jackson, and H. Youngberg. 2000. *Fertilizer Guide: Orchardgrass Seed (Western Oregon)*. Oregon State University, FG 45.

Acknowledgments

The authors thank the Oregon orchardgrass commission and the Agricultural Research Foundation for funding this work.