

SEED YIELD ENHANCEMENT BY PALISADE: YIELD COMPONENT AND STAND AGE EFFECTS IN PERENNIAL RYEGRASS SEED CROPS

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Introduction. Palisade (trinexepac-ethyl) is a powerful growth regulator registered for use in perennial ryegrass seed crops. Palisade retards plant growth by inhibiting the 3 β hydroxylation of the growth inactive form of gibberellic acid to the active form. Application of Palisade can reduce or delay lodging in perennial ryegrass. Lodging of the crop during flowering is generally thought to restrict pollination, reduce the rate of fertilization, and can later inhibit seed filling due to self-shading of the lodged crop. Very little specific information is known about how this compound enhances seed yield in cool-season grasses. A better understanding of how Palisade functions in seed yield formation would allow for greater use efficiency and economy. We would also like to know the consequences of the long-term use of Palisade since stand-age related decline in seed yield is a widespread phenomenon in grass seed production.

The objectives of our investigation was to determine how Palisade improves seed yield in perennial ryegrass and to measure the long-term impact of annual applications of Palisade on stand life and seed yield. This report outlines our progress to date on this project.

Results. An experimental field of Cutter perennial ryegrass was established in autumn 1998 at Hyslop Farm. This trial was designed to determine the long-term impacts of annual and alternate year applications of Palisade on crop yield and yield components (spike number, spikelets per spike, florets per spike) of perennial ryegrass. Eight treatments were identified to provide all possible combinations of single applications over a three-year period and were replicated in four randomized blocks. Palisade was applied in single applications each year at 400 grams ai per acre in early May 1999 and 2000.

Yield components. There was no significant effect of Palisade on spike number, above ground dry weight, or spikelet number per spike in the 1st and 2nd year crops (Table 1). Application of Palisade did increase seed yield by 25% over the untreated control in the 1st year and by 41% in the second year. An increased number of florets per spikelet likely accounted for a portion of the seed yield increase noted in Palisade-treated plots. Significant increases in floret number were noted in spikelets located in the top, middle, and bottom portions of the spike in the 1st year, but only in the middle portion in the 2nd year. Palisade also caused reduction in spike length that may have contributed to the increase in seed yield.

Table 1. Palisade treatment effects on yield components and seed yield of Cutter perennial ryegrass.

Yield component	Year 1		Year 2	
	Untreated	Treated	Untreated	Treated
Spikes/ft ²	276	277	338	308
Spikelets/spike	21	21	24	23
Spike length (cm)	22.6	19.9	21.4	20.1
Florets/spikelet				
Top	8.4	9.7	7.1	7.3
Middle	10.8	12.3	7.5	7.8
Bottom	9.1	11.0	7.2	7.5
Seed yield (lb/a)	2215	2772	1354	1912

Spikes were harvested from the field trial in the 2nd year prior to seed shattering losses to determine whether Palisade alters source-sink relations within perennial ryegrass spikes and spikelets during seed maturation. Seeds were removed from paired spikelets in the top, middle, and bottom portions of each spike, and from within the distal (upper), central (middle), and proximal (lower) portions of these spikelets (Figure 1).

Figure 1. Seed positions within spikes and spikelets used to illustrate the effect of Palisade applications on seed partitioning in Cutter perennial ryegrass.

Floret conversion to seed (% seed set) was significantly increased by Palisade in top and middle spikelet positions within the spike (Table 2). In other words, more seed were produced in these spikelets when treated and this contributed to the seed yield increase. The greatest seed set was recorded in central and proximal floret sites in Palisade-treated plots. Individual seed weight was affected by spike position and spikelet position but not by Palisade treatment. These results suggest that seed yield enhancement by Palisade resulted from

increased seed number, not by increased seed weight in the 2nd seed crop.

Table 2. Effect of Palisade treatment and seed position within spikes and spikelets on seed partitioning in Cutter perennial ryegrass (Year 2).

Palisade treatment	Seed position		Seed set (%)	Seed weight (mg)
	Spike position	Spikelet position		
Treated	Top	---	87	1.94
	Middle	---	87	2.16
	Bottom	---	84	1.99
Untreated	Top	---	77	2.05
	Middle	---	80	2.14
	Bottom	---	80	1.95
Treated	---	Distal	76	1.68
	---	Central	91	2.10
	---	Proximal	92	2.31
Untreated	---	Distal	71	1.71
	---	Central	82	2.10
	---	Proximal	84	2.35

Seed yields were increased by Palisade in both years, but this increase was manifested via a different mechanism in each of the years. Seed number increases in the 1st year crop attributable to Palisade were based on greater numbers of florets per spikelet without an increase in seed set. Seed number in the 2nd year crop was increased through Palisade-induced increases in seed set. The ability of Palisade to increase yield by more than one mechanism contributes to the consistency of results observed with this treatment. However, it is not clear whether increased seed yield results solely from the lodging control provided by Palisade or by other effects of this compound on development of crop yield components.

Root samples taken during the winter indicate that Palisade application had no effect on root biomass density at all depths in the soil profile (Figure 2). However, shoot samples taken at this time had 8% less dry matter when treated with Palisade than in the untreated control.

Figure 2. Palisade (trinexepac-ethyl) treatment and untreated (control) effects on root biomass distribution in Cutter perennial ryegrass.

Stand Age. Seed yields for the eight stand age treatments harvested in the 1st year (1999) and 2nd year (2000) crops are presented in Table 3. The 3rd year (2001) treatment data will be presented in the next update report.

Table 3. Effect of stand age and Palisade treatment on seed yield of Cutter perennial ryegrass through Year 2 of the trial.

Palisade treatment	Year 1	Year 2
(1st, 2nd, 3rd year)	----- (lb/acre) -----	
1. <i>Untreated, Untreated, Untreated</i>	2144 a†	1325 a
2. <i>Treated, Treated, Treated</i>	2719 b	1922 b
3. <i>Treated, Untreated, Untreated</i>	2785 b	1336 a
4. <i>Treated, Treated, Untreated</i>	2789 b	1926 b
5. <i>Untreated, Treated, Untreated</i>	2179 a	1922 b
6. <i>Untreated, Treated, Treated</i>	2209 a	1876 b
7. <i>Untreated, Untreated, Treated</i>	2262 a	1354 a
8. <i>Treated, Untreated, Treated</i>	2773 b	1399 a

†Means in columns followed by the same letter are not significantly different.

Prior treatment of Palisade in the 1st year had no effect on seed yield in the 2nd year (Table 3). In other words, yield in the 2nd year was the same whether or not the crop was treated in the previous season. Therefore, there was no carry over effect of Palisade from the 1st to 2nd year. Palisade treatment in the 2nd year stand had more effect on seed yield than in the 1st year stand. Seed yield declined from the 1st to 2nd year regardless of treatment, but Palisade treatment in the 2nd year greatly lessened this yield loss.

Cumulative seed yield over the two seasons was 4678 lb/acre when treated with a single application of Palisade each year compared to 3543 lb/acre when not treated over the two sea-

sons, a yield increase of 1135 lb/acre. The magnitude of this seed yield increase is essentially equivalent to the yield that might be normally harvested from a 3rd year crop of untreated perennial ryegrass. When the crop was treated in only one of the two seasons, yield averaged 4120 lb/acre or 558 lb/acre more than the untreated crop.