# RESPONSE OF COOL SEASON GRASSES TO FOLIAR APPLICATIONS OF PALISADE® (TRINEXAPAC-ETHYL) PLANT GROWTH REGULATOR, 2000

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## Introduction

Perennial grasses grown for seed are prone to lodging at the high fertility rates used to maximize seed production. Lodging of the crop can result in increased problems from disease and can reduce the efficacy of pollination. Use of manufactured plant growth regulators (PGRs) to control stem elongation and optimize seed production in cool season grasses had some success in the mid 1980s. Research developed during this period was based on the use of a residual, soil applied PGR in the triazole family (paclobutrazol) that gave reliable control of lodging and was able to improve seed yields. However, due to the longevity of this chemical in the soil, and difficulties in funding registration of chemicals for use on minor crops, use of this family of chemicals is not allowed.

Recent development of foliar applied PGR type chemicals that readily breakdown in the environment and are effective at controlling rapid stem elongation are being studied to assess their potential for use in grass seed production systems. Initial trials using Palisade (trinexapac-ethyl), a foliar applied PGR manufactured by Syngenta Crop Protection, Inc., on perennial ryegrass grown for seed production were conducted on older perennial ryegrass stands in 1997 and 1998. The trials resulted in substantial yield improvement (see 1998 Seed Production Research report). How well this compound works on new stands of perennial ryegrass as well as other cool season grasses (primarily tall fescue and fine fescue) grown for seed in the Willamette Valley was not known. The trials summarized in this report are for the second crop year in perennial ryegrass, creeping red fescue, and chewings fescue. The first crop year results were reported last year (see 1999 Seed Production Research report). Also, trials were conducted in 2000 on a first crop year field of tall fescue.

## Procedure

Established stands of Cutter perennial ryegrass (Hyslop Research Farm), Brittany Chewings fescue (Joe Schumacher Farm) and Silverlawn creeping red fescue (Ioka Farms) entering the second seed crop year were used for this experiment. In addition, a spring 1999 planted stand of Velocity tall fescue (Hyslop Research Farm) in the first year of seed production was included. A factorial design with rate and date as main factors was used as the main experimental design. PGR treatments were applied at walking speed using a bicycle-type 10-foot wide boom sprayer with nozzles at 18 inch spacing. The sprayer operated at 20 psi with XR TEEJET 8003VS nozzles (approx. 30 gal/a water). Treatments at all sites were applied at several rates of trinexepac-ethyl (100, 200, 400, and 600 g a.i./ha) as a single treatment on several dates. Treatment dates were selected to coincide with defined plant growth stages. Application dates (see Table 1) for perennial ryegrass and fine fescue coincided with 2 node stage (1st date), flag visible (2nd date), early heading (3rd date) and full heading (4th date). Tall fescue applications coincided with rapid node expansion and flag leaf emergence (1st date), early heading (2nd date) and fully headed (3rd date). Plot size ranged from 10 ft x 30 ft to 10 ft x 50 ft depending on location. Stem elongation and nodal development was assessed using a weighted average of tiller size and internode expansion from random plant samples to determine treatment dates.

Plots were sampled at early bloom for fertile tiller counts, length measurements, and above ground biomass dry weights. Inflorescences were also randomly sampled for yield component analysis and spike or panicle length measurements. Harvesting was done using a 6 ft wide swather for windrowing and a Hege 180 small plot combine for harvest (see Table 1 for harvest dates). Combined harvested seed samples were cleaned using an M2-B clipper cleaner for final cleanout; sub samples of clean seed were taken for 1000 seed weights.

## Results

<u>Perennial Ryegrass</u>

Seed yield increases from the PGR treated plots averaged 25 percent above the untreated check (Table 2). Increased rates of PGR application resulted in increased seed yield up to the highest rate (600 g a.i./ha). Although the highest rate yielded the highest, the greatest incremental response occurred at the lowest two rates (100 and 200 g a.i./ha). The earliest application date gave the best seed yield response. Later applications gave less yield response though still much better than the untreated. Increases in seed yield appear to come from increased seed number potential (data not included here) and from improved conditions by prevention of lodging.

Rate x date interactions with 1000 seed weight, plant height reduction, and lodging are presented in Table 3. 1000 seed weight decreased with higher PGR application on the 1st application date and as the treatment dates became later there was no effect of PGR rate on 1000 seed weight. The cause of decreased in seed weight at the 1st application date is not apparent, but may have been a result of yield component compensation due to plant resources going to more seeds but a little less to each. The two-way interaction on plant height indicates the greatest effect of holding back growth is from the earliest treatment, and as you apply PGR later the crop has already elongated and less growth can be restricted; thus the height reduction effect is diminished. The same effect as described for the height reduction also applies to the effect on lodging as this is greatly affected by the plant height.

Fertile tiller densities and total biomass were not affected by any treatments. Harvest index (a ratio of seed yield to total biomass) tended to increase with applications of Palisade. This is to be expected as the seed yield improved with no changes in total biomass. Culm length was reduced an average of 16% with progressively shorter stems as the rate increased, especially at the early dates (see Table 3). Lodging was effectively controlled compared to the untreated crop. A lodging score of four or higher indicated the heads and plant structures are in contact with the ground. Seed moisture was within 3 percent of the untreated plots at maturity. Thus, all plots were swathed at the same time. At harvest the treated plots were still off the ground, which allowed for easier windrowing. In the higher rate PGR treated plots the windrows were smaller and had less crop residue to combine. The evidence here, and in the previous three years, indicate the best timing for yield responses would be during early internode expansion and prior to flag and head emergence. Early application was especially important if using the higher rates, but at the lower rates (100 and 200 g a.i./ha) yield was less impacted by later application dates.

Table 3. Perennial ryegrass rate x date interactions for 1000 seed weight, percent plant height reduction, and lodging when treated with Palisade PGR, 2000.

| Rate | Date of application | | | |
|---|---|---|---|---|
| (g a.i./ha) | 4/18 | 4/24 | 5/5 | 5/1 |
| | | **1000 SEED WEIGHT (G)** | | |
| 100 | 1.99 a | 1.96 ab | 1.95 a | 1.98 a |
| 200 | 1.92 ab | 1.98 a | 1.91 a | 1.98 a |
| 400 | 1.88 b | 1.94 ab | 1.98 a | 1.99 a |
| 600 | 1.86 b | 1.90 b | 1.98 a | 2.02 a |
| | | **PLANT HEIGHT REDUCTION (%)** | | |
| 100 | 18 b | 2 c | 7 b | 9 a |
| 200 | 16 b | 11 b | 11 ab | 11 a |
| 400 | 32 a | 21 a | 9 b | 10 a |
| 600 | 33 a | 30 a | 18 a | 15 a |
| | | **LODGING SCORE (1-5)** | | |
| 100 | 4.7 a | 4.5 a | 4.3 a | 3.8 a |
| 200 | 4.3 b | 4.2 a | 4.2 a | 3.7 a |
| 400 | 3.7 c | 3.7 b | 3.7 b | 3.8 a |
| 600 | 3.2 d | 3.5 b | 3.7 b | 3.5 a |

*Means in columns followed by the same letter are not significantly different by Fisher's protected LSD values at P=0.05.

Tall fescue

In contrast to 1999, tall fescue was very responsive to PGR applications this year. Comparison of all treated plots with the untreated was highly significant (Table 4). Overall the seed yield was increased by 650 pounds. Harvest index increased by 5% with no statistical change in total biomass, which follows with the perennial ryegrass as previously discussed. Height of treated plots was 20% less than the untreated and lodging very effectively controlled by the PGR applications. Almost no lodging occurred at all treatment rates. Seed size and fertile tiller populations were not affected by PGR applications. There were no differences in seed yield due to rate or date of PGR treatment. There was a tendency for the higher rate to have a higher seed yield, but this was not statically significant. All treatments increased seed yield over the untreated check and all application dates were equally effective (as contrasted with the perennial ryegrass). This was a first-year seed crop for this stand and continued research will be needed to determine if tall fescue will be consistently responsive to Palisade.

Creeping red fescue

Silverlawn creeping red fescue showed very good seed yield responses to applications of Palisade. Seed yield averaged a 62% increase (~700 lb/a) over the check as shown (Table 5). In addition to the factorial design there were other treatments included in the trial (and the Chewings fescue trial) that could be analyzed as a randomized complete block (RCB). Seed yield results for these treatments are shown in Table 6. There was some positive response to the higher rates of Palisade. The 400 g a.i./ha rate and 600 g a.i./ha rate were about the same, but yielded more than the 200 g a.i./ha rate. Timing of the applications at the growth stages observed had an equal effect on seed yield, though the later treatments tended to yield higher at the 100 and 200 g a.i./ha rate (Table 6). The May 22 treatment (at full heading) was not nearly as effective as the same rate at early heading and yielded about 550 lb/a less. The late application at full heading was past the optimum timing and would not be recommended in these conditions. Above ground biomass, fertile tiller density, and 1000 seed weight were not affected by the increased rates of Palisade. Harvest index was improved by 7% as is reflected by the increased seed yield. Plant height was reduced an average of 17% with the highest treatment rate (600 g a.i./ha) reducing plant height by 22%. Lodging was well controlled with all treatments keeping the crop from laying flat on the ground as fine fescue is prone to do. The results from this 2nd year continue to indicate that creeping red fescues may be a good crop species to use Palisade on.

Table 6. Response of seed yield (lb/a) to different application dates and rates of foliar applied Palisade in Silverlawn creeping red fescue and Brittany Chewings fescue, 2000.

| Treatment (Date) (g a.i./ha) | Silverlawn | | Brittany | |
|---|---|---|---|---|
| Check | 1151 | f | 1190 | d |
| *April 21 – onset of internode elongation* | | | | |
| 200 | 1643 | cde | 1731 | abc |
| 400 | 1803 | abcd | 1673 | bc |
| 600 | 1915 | abc | 1762 | abc |
| *May 1 – 1-2 nodes, flag leaves visible, some heads visible* | | | | |
| 100 | 1416 | ef | 1739 | abc |
| 200 | 1604 | de | 1728 | abc |
| 400 | 2028 | a | 1957 | a |
| 600 | 1978 | ab | 1648 | bc |
| *May 12 – early heading, about 25% heads visible* | | | | |
| 100 | 1702 | bcde | 1529 | c |
| 200 | 1795 | abcd | 1738 | abc |
| 400 | 1984 | ab | 1808 | ab |
| 600 | 1990 | ab | 1655 | bc |
| *May 22 – all heads visible, just pre-bloom* | | | | |
| 400 | 1434 | ef | 1530 | c |
| LSD 0.05 | 295 | | 249 | |

*Means in columns followed by the same letter are not significantly different by Fisher's protected LSD values at P=0.05.

Chewings fescue

Seed yield results for Chewings type fescue in this study was also very good. Palisade plots averaged 47% greater seed yield than the untreated check (~550 lb/a) as shown in Table 7. In this trial there was no statistical effect by the rate or date of the PGR application. The additional treatments in this trial included in the RCB (Table 6) show an even lower rate (100 g a.i./ha) to be equal (May 1) to intermediate (May 12) at the 200 g a.i./ha rate, indicating this crop responds well to lower rates of Palisade. The 400 g a.i./ha rate tended to yield the best with the lower and higher rates yielding less. Total biomass, fertile tiller density, and 1000 seed weight were not affected by Palisade applications at this site. Harvest index increased 5% using a contrast comparison between the treated and the check plots. Treated plant height averaged 19% less than the untreated. Lodging was well controlled and even at harvest the crop was easy to swath in the treated plots. The May 1 (flag leaves emerging) application gave the best lodging control with the highest rate (600 g a.i./ha) most effective.

**Summary**

All four species treated this year were responsive to Palisade applications. Creeping red fescue, Chewings fescue, and tall fescue were the most responsive in seed yield. Seed yield in perennial ryegrass was little less responsive to PGR applications. This compound was effective at controlling lodging and increasing yield. The cause of the yield increase has not been fully accounted for, but from other data collected this season (not presented here), improved seed set, reduced lodging and improvements in yield components are all adding to the increased yield.

The most important part of using this compound will be knowing the optimum stage of crop development to apply Palisade for maximum effect. The timing appears to have different windows in the different crop species, some are more sensitive to timing than others. Perennial ryegrass does not respond well to later applications. The fine fescues and tall fescue have a wider range of response and do well with the range of timings tested here, but very late applications (after 25% head emergence) are much less effective. The best timing and rate for tall fescue is yet to be identified, but it seems to respond similar to the fine fescues. Fine fescues and the tall fescue sites were responsive merely to PGR applications (though the creeping fescue showed an increase with higher rate of applications) and lower rates (100 g a.i./ha) are responsive, but less than the higher rates. Each year is unique, but the responses observed in perennial ryegrass yield and lodging control were very similar to those reported last year, just not as dramatic. In these four trials, every PGR treatment yielded higher than the untreated check. This product appears to be a useful and effective tool in helping improve and realize the yield potential of these grass seed crops.

*Acknowledgments: This research was supported in part through funds from Syngenta Crop Protection, Inc.*

Table 1. Calendar dates for PGR application, swathing, and combining, 2000.

| Species | 1-2 nodes elongation | Flag leaf emergence | Early heading | Full heading | Swath | Combine |
|---|---|---|---|---|---|---|
| Per. rye. | 4/18 | 4/24 | 5/5 | 5/19 | 7/5 | 7/21 |
| Tall fescue | --------- 4/18 --------- | | 4/24 | 5/5 | 6/30 | 7/18 |
| Cr. red fescue | 4/21 | 5/1 | 5/12 | 5/22 | 7/17 | 7/25 |
| Ch. fescue | 4/21 | 5/1 | 5/12 | 5/22 | 7/3 | 7/13 |

Table 2. Main factor effects of foliar applied Palisade (trinexapac-ethyl) on seed yield, harvest components, and tiller length in Cutter perennial ryegrass, 2000.

| Main factor treatments | Seed yield | | Above ground biomass | Fertile tillers | 1000 seed weight | Harvest index | Culm reduction | Lodging score |
|---|---|---|---|---|---|---|---|---|
| | (lb/a) | (% of check) | (ton/a) | (no./sq. ft.) | (g) | --------(%)-------- | | (1-5)[1] |
| Check vs Treated | | | | | | | | |
| Check | 1259 b[3] | 100 | 6.9 | 445 | 1.93 | 9 | 0 b | 5.0 b |
| Treated (all) | 1570 a | 125 | 6.2 | 509 | 1.95 | 13 | 16 a | 3.9 a |
| Rate of application | | | | | | | | |
| g a.i./ha (pt/a) | | | | | | | | |
| 100 (0.7)[2] | 1437 c | 114 | 6.0 | 510 | 1.97 [4] | 12 | 9 [4] | 4.3 [4] |
| 200 (1.4 ) | 1560 b | 124 | 6.2 | 518 | 1.95 | 13 | 12 | 4.1 |
| 400 (2.9) | 1612 ab | 128 | 6.1 | 508 | 1.95 | 14 | 18 | 3.7 |
| 600 (4.3) | 1671 a | 133 | 6.5 | 500 | 1.94 | 13 | 24 | 3.5 |
| Date of application | | | | | | | | |
| Apr. 18 | 1658 a | 132 | 6.1 | 518 | 1.91 [4] | 15 | 25 [4] | 4.0 [4] |
| Apr. 24 | 1591 a | 126 | 6.5 | 497 | 1.95 | 12 | 16 | 4.0 |
| May 5 | 1566 ab | 124 | 6.3 | 508 | 1.96 | 13 | 11 | 4.0 |
| May 19 | 1466 b | 116 | 6.0 | 512 | 1.99 | 13 | 11 | 3.7 |

[1] Lodging score at harvest 1-5: 1 = vertical; 5 = horizontal
[2] The pint/acre rate is for the 1 lb a.i./gal EC formulation
[3] Within each main factor, means in columns followed by the same letter are not significantly different by Fisher's protected LSD values at P=0.05. No letters = no significant differences
[4] Rate x Date interaction significant $P \leq 0.05$

Table 4. Main factor effects of foliar applied Palisade (trinexapac-ethyl) on seed yield, harvest components, and tiller length in Velocity tall fescue, 2000.

| Main factor treatments | Seed yield | | Above ground biomass | Fertile tillers | 1000 seed weight | Harvest index | Culm reduction | Lodging score |
|---|---|---|---|---|---|---|---|---|
| | (lb/a) | (% of check) | (ton/a) | (no./sq. ft.) | (g) | --------(%)-------- | | (1-5)[1] |
| Check vs Treated | | | | | | | | |
| Check | 1072 b[3] | 100 | 6.9 | 70 | 2.37 | 8 b | 0 b | 4.0 a |
| Treated (all) | 1728 a | 161 | 6.7 | 61 | 2.39 | 13 a | 20 a | 1.7 b |
| Rate of application g a.i./ha (pt/a) | | | | | | | | |
| 100 (0.7)[2] | 1684 | 157 | 7.1 | 67 | 2.38 | 12 | 11 c | 2.6 a |
| 200 (1.4) | 1687 | 157 | 6.9 | 58 | 2.39 | 12 | 15 c | 1.7 b |
| 400 (2.9) | 1731 | 161 | 6.6 | 62 | 2.41 | 14 | 24 b | 1.4 b |
| 600 (4.3) | 1809 | 169 | 6.3 | 58 | 2.38 | 15 | 30 a | 1.2 c |
| Date of application | | | | | | | | |
| Apr. 18 | 1667 | 156 | 6.1 | 61 | 2.37 | 14 | 24 a | 1.6 |
| Apr. 24 | 1799 | 168 | 6.9 | 62 | 2.39 | 14 | 21 a | 1.8 |
| May 5 | 1717 | 160 | 7.2 | 61 | 2.40 | 13 | 16 b | 1.8 |

[1] Lodging score at harvest 1-5: 1 = vertical; 5 = horizontal
[2] The pint/acre rate is for the 1 lb a.i./gal EC formulation
[3] Within each main factor, means in columns followed by the same letter are not significantly different by Fisher's protected LSD values at P=0.05. No letters = no significant differences

Table 5. Main factor effects of foliar applied Palisade (trinexapac-ethyl) on seed yield, harvest components, and tiller length in Silverlawn creeping red fescue, 2000.

| Main factor Treatments | Seed yield | | Above ground biomass | Fertile tillers | 1000 seed weight | Harvest index | Culm reduction | Lodging score |
|---|---|---|---|---|---|---|---|---|
| | (lb/a) | (% of check) | (ton/a) | (no./sq. ft.) | (g) | --------(%)-------- | | (1-5)[1] |
| Check vs Treated | | | | | | | | |
| Check | 1151 b[3] | 100 | 4.8 | 309 | 1.06 | 13 b | 0 b | 4.7 b |
| Treated (all) | 1860 a | 162 | 4.9 | 301 | 1.04 | 20 a | 17 a | 3.2 a |
| Rate of application | | | | | | | | |
| g a.i./ha (pt/a) | | | | | | | | |
| 200 (1.4)[2] | 1680 b | 146 | 4.5 | 293 | 1.04 | 19 b | 15 b | 3.4 |
| 400 (2.9) | 1938 a | 168 | 5.4 | 318 | 1.04 | 18 b | 14 b | 3.3 |
| 600 (4.3) | 1961 a | 170 | 4.6 | 292 | 1.04 | 22 a | 22 a | 2.9 |
| Date of application | | | | | | | | |
| Apr. 21 | 1787 | 155 | 4.6 | 298 | 1.05 | 20 | 16 ab | 3.6 |
| May 1 | 1870 | 162 | 5.2 | 300 | 1.03 | 18 | 13 b | 3.0 |
| May 12 | 1923 | 167 | 4.8 | 305 | 1.04 | 20 | 21 a | 2.9 |

[1] Lodging score at harvest 1-5: 1 = vertical; 5 = horizontal
[2]The pint/acre rate is for the 1 lb a.i./gal EC formulation
[3]Within each main factor, means in columns followed by the same letter are not significantly different by Fisher's protected LSD values at P=0.05. No letters = no significant differences

Table 7. Main factor effects of foliar applied Palisade (trinexapac-ethyl) on seed yield, harvest components, and tiller length in Britanny Chewings fescue, 2000.

| Main factor Treatments | Seed yield | | Above ground biomass | Fertile tillers | 1000 seed weight | Harvest index | Culm reduction | Lodging score |
|---|---|---|---|---|---|---|---|---|
| | (lb/a) | (% of check) | (ton/a) | (no./sq. ft.) | (g) | --------(%)-------- | | (1-5)[1] |
| Check vs Treated | | | | | | | | |
| Check | 1190 b[3] | 100 | 4.8 | 311 | 0.980 | 11 b | 0 b | 3.5 |
| Treated (all) | 1744 a | 147 | 4.8 | 312 | 0.987 | 16 a | 19 a | 2.7 |
| Rate of application | | | | | | | | |
| g a.i./ha (pt/a) | | | | | | | | |
| 200 (1.4) | 1732 | 146 | 4.6 | 321 | 0.985 b | 16 | 13 c | 2.6 |
| 400 (2.9) | 1812 | 152 | 5.2 | 334 | 0.981 b | 15 | 21 b | 2.5 |
| 600 (4.3) | 1688 | 142 | 4.4 | 306 | 1.003 a | 17 | 31 a | 2.6 |
| Date of application | | | | | | | | |
| Apr. 21 | 1722 | 145 | 4.5 | 311 | 0.982 b | 17 | 18 | 2.8 a |
| May 1 | 1778 | 149 | 4.5 | 314 | 0.978 b | 17 | 26 | 1.9 b |
| May 12 | 1733 | 146 | 5.2 | 337 | 1.009 a | 15 | 22 | 2.9 a |

[1] Lodging score at harvest 1-5: 1 = vertical; 5 = horizontal
[3]Within each main factor, means in columns followed by the same letter are not significantly different by Fisher's protected LSD values at P=0.05. No letters = no significant differences