Plant Growth Regulator Testing to Prevent Spring Barley Lodging in Tulelake

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Introduction: Tulelake's climate and soils are favorable for irrigated barley production, and growers consistently obtain some of the highest barley yields reported in California. The downside to these high yields is several barley varieties tend to lodge, the bending over of the stems near the ground level, in Tulelake. One solution to lodging is to apply a plant growth regulator (PGR) that shortens the internodes and strengthens the stem through inhibition of cell elongation. This study tested the effectiveness of PGRs applied at different timings and rates for reducing spring barley lodging. A similar study was conducted in 2018 and 2019 with winter wheat and 2020 with spring barley; report summaries are cited in IREC Research Reports #187, #192, and #196.

Methods: The 2021 study was established in April using the spring 2-row malt barley variety 'Copeland'. The broadcast study was set up as a RCB design with four replications using 9 ft by 21 ft plots. Treatments included an Eastman PGR (Test PGR) with the active ingredient, chlormequat chloride, and a Syngenta PGR (Palisade) with the active ingredient, trinexapac-ethyl, broadcast applied at 20 gallons per acre alone and/or in combination with the fungicide Quilt Xcel for suppression of stripe rust. PGR treatments were applied at three application times: tillering (23), early stem elongation (31-32), and flag leaf emergence (38).   The trial included a standard nitrogen fertilizer control (70# N/A) and high nitrogen fertilizer control (110# N/A).   Data collected includes crop injury, stem thickness, plant height, stripe rust incidence, lodging, grain yield, and grain quality.

Results: PGR treatments did not cause phytotoxicity after all application times (data not shown). PGR treatments influence on plant height and lodging was variable in 2021, unlike 2020 where PGR's applied at stem elongation or split applied at stem elongation and flag leaf emergence reduced plant height at anthesis compared to the high fertility control (Table 1). Barley stem thickness, seedhead production, and the incidence of stripe rust were similar across treatments (Table 1).

PGR treatments increased barley grain yield compared to the controls even though plant height and lodging were variable (Table 2). Barley bushel weight and kernels per 10 seedheads were similar across treatments. PGR treatments where the test PGR was applied at tillering had lower seed weight (g) per 1000 barley seeds compared to PGR treatments with later application dates and the controls.

Figure 1. Aerial view of barley plots at flowering.

Figure 2. Picture of barley roots for select treatments at flowering.

Table 1. Influence of Plant Growth Regulator (PGR) Treatments on Barley Growth, Lodging, and susceptibility to stripe rust in 2021.

Trt #	Treatment Name[1]	Application Timing[2]	Product Rate per acre		Stem thickness (mm) at anthesis	Stem thickness (mm) at harvest	Plant Height (cm) at anthesis	Plant Height (cm) at harvest	Lodging at anthesis 1-9 scale	Lodging at harvest 1-9 scale	# of seedhead per 3ft of row	Stripe rust % incidence
1	*Control Standard N Fertility*	--										
1	Quilt Xcel	D	28	fl oz	3.74a[3]	3.39a	117.6a	110.9a	5.75b	3.50a	102.5a	0
2	*Control High N Fertility*	--										
2	Quilt Xcel	D	28	fl oz	3.79a	3.35a	110.5b	105ab	3.75b	4.25a	93a	0
3	Test PGR	C	31	fl oz								
3	Quilt Xcel	D	28	fl oz	3.47a	3.38a	113.1ab	103.2ab	8.75a	4.88a	119.5a	0
4	Test PGR	D	31	fl oz								
4	Quilt Xcel	D	28	fl oz	3.74a	3.5a	111b	106.9ab	6b	4.50a	115.3a	0
5	Palisade	C	14.4	fl oz								
5	Quilt Xcel	D	28	fl oz	3.63a	3.3a	110.2b	101b	9a	4.88a	112.3a	0
6	Test PGR	C	15.5	fl oz								
6	Test PGR	D	15.5	fl oz								
6	Quilt Xcel	D	28	fl oz	3.82a	3.33a	109.4b	104.7ab	9a	3.5a	111.3a	0
7	Test PGR	B	15.5	fl oz								
7	Test PGR	C	15.5	fl oz								
7	Quilt Xcel	D	28	fl oz	3.71a	3.52a	113.7ab	109.3a	9a	3.63a	120.5a	0
8	Test PGR	B	15.5	fl oz								
8	Test PGR	D	15.5	fl oz								
8	Quilt Xcel	D	28	fl oz	3.64a	3.37a	111.2ab	106.6ab	9a	4.00a	118.3a	0

[1] All treatments with Quilt Xcel included nonionic surfactant added at 0.25% v/v; All PGR treatments were grown with high fertility (110# nitrogen fertilizer split-applied per acre); the standard

[2] Application timings A= 3 leaf unfolded (growth stage 13); B=tillering (23); C=stem elongation (31-32); D=flag leaf emergence (38).

[3] Treatment means with the same letter within columns are not statistically different using the Tukey HSD mean comparsion test.

Table 2. Influence of Plant Growth Regulator (PGR) Treatments on Barley Yield & Quality in Tulelake, CA 2021.

Trt #	Treatment Name[1]	Application Timing[2]	Product Rate per acre		Grain yield (tons/acre)	Bushel weight (lbs)	Kernels per 10 seedheads	grams per 1000 seeds
1	*Control Standard N Fertility*	--						
1	Quilt Xcel	D	28	fl oz	2.66cd[3]	52.4a	26.9a	46.68ab
2	*Control High N Fertility*	--						
2	Quilt Xcel	D	28	fl oz	2.28d	53a	27a	48.95a
3	Test PGR	C	31	fl oz				
3	Quilt Xcel	D	28	fl oz	2.79bc	51.6a	27.5a	45.58abc
4	Test PGR	D	31	fl oz				
4	Quilt Xcel	D	28	fl oz	2.87abc	52.4a	26.2a	47.08a
5	Palisade	C	14.4	fl oz				
5	Quilt Xcel	D	28	fl oz	3.29a	52a	27.9a	49.08a
6	Test PGR	C	15.5	fl oz				
6	Test PGR	D	15.5	fl oz				
6	Quilt Xcel	D	28	fl oz	3.02abc	51.6a	26.9a	45.47abc
7	Test PGR	B	15.5	fl oz				
7	Test PGR	C	15.5	fl oz				
7	Quilt Xcel	D	28	fl oz	3.18ab	52.9a	27.2a	41.49c
8	Test PGR	B	15.5	fl oz				
8	Test PGR	D	15.5	fl oz				
8	Quilt Xcel	D	28	fl oz	3.07abc	51.7a	26.7a	42.67bc

[1] All treatments with Quilt Xcel included nonionic surfactant added at 0.25% v/v; All PGR treatments were grown with high fertility (110# nitrogen

[2] Application timings A= 3 leaf unfolded (growth stage 13); B=tillering (23); C=stem elongation (31-32); D=flag leaf emergence (38).

[3] Treatment means with the same letter within columns are not statistically different using the Tukey HSD mean comparsion test.