PLANT GROWTH REGULATOR APPLICATION IN HRSW

INTRODUCTION

Significant attention has been paid in recent years to the negative aspects of growing tall or weak-strawed wheat varieties. Generally speaking, producers have options from between two classes of wheat varieties; semi-dwarf containing one of the two common semi-dwarf alleles, and wild-type or tall cultivars. Practically, producers would look to the heights reported in variety testing results to make decisions about plant height. In hard red spring wheat (HRSW), increased plant height is often associated with higher grain yield, though there are exceptions. Higher yielding HRSW varieties are often prone to lodging, where due to low straw strength, stem lodging takes a plant from being completely erect, to leaning over. Increased lodging will decrease plant yield. In addition to decreasing grain yield, lodging results in a more challenging harvesting scenario. Often combine speeds will need to be reduced to combine as low as needed to collect the lodged wheat spikes, which also increases risk of colliding with exposed rocks in the field.

Producers have several agronomic practices that can decrease stem lodging, with the most widely used method in recent years being selecting a variety with strong straw strength. Recently, attention in Minnesota has turned to using a plant growth regulator chemical application in season as a practice to reduce lodging. Plant growth regulators have been commonplace in parts of Europe and South American for small grains, and are now being considered in the wheat regions of the USA. Plant growth regulators decrease the internode distance in wheat and can thicken the stems of the plant, successfully shortening the plant. In the U.S. few chemicals are offered as plant growth regulators, though a few choices do exist.

The objective of this research is to understand the effects of the plant growth regulator Palisade EC (Syngenta) on yield, height, lodging, and general combinability in HRSW. Specifically, the hypothesis is that a plant growth regulator application will protect plant yield and increase combinability when an environment for severe lodging is encountered.

MATERIALS AND METHODS

We implemented this trial at six locations in Minnesota, with one trial only having one replication, so we included it in the combined analysis but not as its own location due to no replication. We had a seventh location on durum wheat but it received severe hail and did not go to yield for research. The trial consisted of an application of Palisade EC growth regulator (Syngenta) compared with no chemical application. The participants applied Palisade at a rate of 12 fluid ounces per acre, which is in the middle of the application range of 10.5-14.4 lb ai per acre. The Palisade was sprayed as close to the Feekes 7 growth stage as spray conditions allowed. Feekes 7 is the growth stage where two stem nodes are visible above the ground.

We took stand counts from multiple spots within each plot at almost all locations as a gauge of the producers plant stand. Plant height measurements close to maturity were collected within each plot. We used producer machinery to harvest the trials and measured plot weights with a weigh wagon, with yields adjusted to 13.5% grain moisture. As the grain augured out of the weigh wagon into a truck, we collected sub-samples of the grain from each plot with an attachment to the weigh wagon auger that takes a small stream of continuous grain from the grain off-loading through the auger. Two of the locations were weighed with the participant's grain cart and the sample was taken by manually holding a tube into the stream of grain coming out of the auger. With a Dickey John mini-GAC plus testing device, we immediately analyzed each sample for harvest moisture and grain test weight. We analyzed the samples for protein at the Northern Crops Institute with a Perten NIR and adjusted to 12% moisture.

Table 4. Agronomic details for all six locations of the palisade growth regulator trial in 2016

	Location					
	1	2	3	4	5	6
	Hendrum	**Fertile**	**Fertile**	**Dorothy**	**Red Lake Falls**	**St. Hilaire**
Planting Date	N/A	4/13	4/13	4/18	4/22	4/28
Harvest Date	8/1	8/6	8/6	8/9	8/22	8/13
Previous Crop	Beets	Soybean	Soybean	Soybean	Soybean	Soybean
Soil Type	Bearden Fargo	Chapett Knute	Chapett Knute	Glyndon	Hecla Borup	Clearwater
Variety	Prosper	Forefront	Forefront	Digger	Prosper/ Faller	Prosper
Palisade Date/Stage	6/2 Feekes 7	5/26	Feekes 6.5-7	6/7 Feekes 7.5-8	6/8 Feekes 7-8	6/7 Feekes 7

RESULTS AND DISCUSSION

The growth regulator Palisade impacted plant height, grain test weight, and yield combined over six diverse environments in NW MN in 2016. The impact of Palisade on plant height was clear in our research. Palisade reduced plant height by 4.6, 3.5, 2.7, and 3.1 inches at locations 1, 2, 3, and 5, respectively, and 3.6 inches combined over all locations where we measured height. Lodging was observed at all locations, but the exact effect of Palisade on lodging was difficult to quantify over the large plot size. At location 3, the researchers saw no lodging (score of 1) in the palisade treated plots, and an average lodging of a 45 degree angle on the plant stem (4-5 lodging score) in the untreated plots, as an example of the lodging seen. Palisade increased the test weight of the grain by 0.7 lb bu^{-1} combined over all locations, which was numerically evident at all locations. This result of an increase in test weight with Palisade has been replicated in other Palisade trials, however not in all years or locations. Protein was not impacted by Palisade, as expected.

We found a significant increase in grain yield with Palisade compared to the untreated check at all locations besides 1 and 4. When combined over all six locations, a 3.0 bu ac-1 yield increase was found with Palisade above the untreated check. At location 4 there was no yield increase from Palisade, so analyzing the combined analysis without that location increased the yield advantage with Palisade to 3.7 bu ac^{-1} (data not reported). When looking at an input that has a cost attached to it, a cost-benefit analysis is useful for determining if the input makes economic sense. When looking at a 3 bu ac^{-1} increase with Palisade compared to the untreated check, the yield increase does not pay for the application cost (Table 6).

Table 5. Effect of the plant growth regulator Palisade EC (Syngenta) applied at the two nodes above ground growth stage in HRSW on test weight, grain protein, and yield, at 5 diverse environments throughout NW Minnesota and combined over all 6† environments, 2016.

Treatment	Location					
	1	2	3	4	6	Combined
	----------Height (inches)----------					
No Palisade	32.5	39.7	NA	33.2	33.8	35.6
Palisade	27.9	36.2	NA	30.5	30.7	32.0
LSD (0.05)	1.63	2.1	NA	NS	3.0	2.2
	----------Test Weight (lb bu^{-1})----------					
No Palisade	61.8	62.1	62.4	62.3	60.7	61.7
Palisade	62.3	62.7	62.6	63.0	62.3	62.4
LSD (0.05)	NS	NS	NS	NS	0.7	0.2
	----------Protein (%)----------					
No Palisade	13.7	12.8	12.7	13.9	12.4	13.2
Palisade	13.5	12.6	12.6	14.1	12.4	13.2
LSD (0.05)	NS	NS	0.1	NS	NS	NS
	----------Yield (bu ac^{-1})----------					
No Palisade	65.2	87.4	84.7	78.9	83.5	78.3
Palisade	68.8	91.8	88.2	78.6	86.9	81.3
LDS (0.05)	NS	1.6	1.5	NS	2.0	2.1

NS – non-significant difference at the 95% confidence level.
LSD – least significant difference, if the means differ by more than the LSD number the numbers are statistically different.
† 6 environments includes one that did not have replication within the trial, so we included it in the combined analysis but did not report numeric means in for the location alone.

Table 6. Economic analysis of the palisade application of all locations individually and the combined analysis, NW MN, 2016.

	Location					
	1	2	3	4	5	Combined
No Palisade	65.2	87.4	84.7	78.9	83.5	78.3
With Palisade	68.8	91.8	88.2	78.6	86.9	81.3
Yield gain/loss	3.6	4.4	3.5	-0.4	3.4	3.0
$ Yield gain/bu	14.94	18.36	14.69	-1.51	14.31	12.60
Application Costs[1]	$28.40	$28.40	$28.40	$28.40	$28.40	$28.40
Financial outcome	-$13.46	-$10.04	-$13.71	-$29.91	-$14.09	-$15.80

[1] September wheat price of $4.20. Considering 2 bu/ac lost due to tire tracks from application. Palisade cost of $1 per ounce at a $12 oz per acre rate.

CONCLUSIONS

Combined across all locations the application of the growth regulator Palisade decreased plant height by 3.6 inches, and increased yield by 3.0 bushels per acre. When looking at the economic analysis the application of Palisade was not profitable at any individual location or the combined results, but it was not so far off as to discourage the use of the chemical for other purposes. In a more lodging-prone environment, the benefit of wheat that has lodged less would add into the financial outcome quite significantly.