

Improving Winter Wheat Architecture for Improved Establishment and Harvest

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I: Adding Cytokinins to Gibberellic Acid to Enhance of Fall Establishment (Pavlista & Hergert)

Introducing winter wheat into irrigated cropping systems is limited by an overlap of optimal planting dates and harvest dates of summer crops. Stimulating seedling wheat growth and establishment under cooler conditions could allow wheat to be planted later in fall, and fully establish and survive the winter. Studies on wheat growth promotion by gibberellic acid (GA3) have shown that plant height is promoted. Cytokinins are natural hormones that stimulate cell division. They stimulate greening and induce branching. The objective of this study was to determine whether adding a commercially-available, natural cytokinin such as 6-benzyl adenine (6BA) to GA3 would promote tiller formation and greening, and to further promote rapid and improved seedling establishment under cool planting conditions.

Winter wheat varieties Goodstreak and Wesley were grown under irrigation at the Panhandle Research & Extension Center. Seed was treated with water, GA3 at an active dose, and this GA3 dose mixed with 6BA at either 125, 500 or 2000 ppm. Seed was planted on Sep. 17, Sep. 30, and Oct. 19, 2009. Plant vigor was estimated on Sep. 30 and plant heights were measured one month after planting, and on Nov. 17 (2009), Mar. 26 (2010), May 21, and July 13. Biomass and tiller number were measured in mid-May. Yields were harvested on July 28, 2010. Table 1 (a,b) presents the data on Goodstreak and Table 2 (a,b) presents the data on Wesley.

A few weeks after planting in mid-Sep, plant vigor of both Goodstreak and Wesley was significantly reduced by the highest 6BA rate, 2000 ppm. Plant height on Nov 17 showed that GA3 increased growth but adding 125 or 500 ppm 6BA had no additional effect (Tables 1a and 2a). The highest rate negated the GA3 growth stimulation. On March 26 and May 21, the same trend in plant height was evident. By harvest, however, height on July 13, showed no significant difference between treatments in Goodstreak, but in Wesley, 6BA at 2000 ppm still had a reduced height.

Biomass on May 18 showed the same observations as with plant height (Tables 1b and 2b). With two earlier planting dates for both Goodstreak and Wesley, there was no difference between untreated, GA3-treated, and GA3 plus 125 ppm 6BA-treated plant biomass. However, the biomass of plants from the 500 and 2000 ppm 6BA-treated plots showed less biomass than the untreated ones. The depressive effect of 6BA at these doses was clearly observed with the Oct 19-seeded plants. With later planting, the negative effect of 6BA on plant weight was more evident.

Tiller number on May 21 in Goodstreak demonstrated an increase in tillers per plant when 125 or 500 ppm 6BA was added to GA3 (Table 1b). This promotion was observed at all three planting dates. Wesley did not show this promotion (Table 2b).

The yield of Goodstreak was not different between planting on Sep 17 or Sep 30; there was a 20% yield decrease when planting on Oct 19 in 2009 (Table 1b). There was no effect on yield by GA3 as reported in previous years. The addition of 6BA at 125 and 500 ppm did not have an effect, but yield decreased when 2000 ppm 6BA was added to GA3. This same trend was observed with Wesley, but the decrease in yield is more pronounced from the last planting on Oct 19.

The addition of 6BA did not give a definitive advantage to wheat establishment when added to GA3. However, the rates of 6BA may be too high as demonstrated by the deleterious effect of 2000 ppm. This trial is being repeated using 6BA at 31, 62 and 125 ppm and using a lower rate of GA3, 250 ppm for Goodstreak and 500 ppm for Wesley.

Table 1a. Goodstreak - Plant Height							
		planting date			planting date		
		17 Sep	30 Sep	19 Oct	17 Sep	30 Sep	19 Oct
GA3	6BA	Height (inch) on Nov 17, 2009			Height (inch) on Mar 26, 2010		
-- ppm --		----- inches -----					
0	0	3.6 D*	2.5 D	0.7 B	2.3	2.2 BC	1.5 B
500	0	5.5 B	4.2 AB	1.4 A	2.4	2.6 A	1.6 AB
500	125	5.9 A	4.4 A	1.5 A	2.3	2.5 AB	2.4 A
500	500	5.4 B	4.0 B	1.4 A	2.2	2.6 A	1.5 B
500	2000	4.0 C	3.2 C	0.9 B	2.1	2.0 C	0.3 C
		planting date			planting date		
		17 Sep	30 Sep	19 Oct	17 Sep	30 Sep	19 Oct
GA3	6BA	Height (inch) on May 21, 2010			Height (inch) on July 13, 2010		
-- ppm --		----- inches -----					
0	0	18 A	17 A	13 A	40	40	41
500	0	18 A	17 A	11 AB	39	39	40
500	125	16 AB	15 B	11 AB	39	41	56
500	500	16 AB	15 B	10 B	39	41	41
500	2000	14 B	13 C	5 C	40	41	51

* Numbers followed by the same letter in a column for each cultivar are not different at the 95% confidence level.

Table 1b. Goodstreak - Biomass, Tiller Number and Yield

		planting date			planting date		
		17 Sep	30 Sep	19 Oct	17 Sep	30 Sep	19 Oct
GA3	6BA	Fresh Biomass on May 18			Dry Biomass on May 18		
-- ppm --		----- grams/6 ft ² -----					
0	0	38 a [^]	37 A	22 A	7.6 A	6.7 A	3.7 A
500	0	37 a	32 AB	11 B	7.2 A	6.0 AB	1.9 B
500	125	35 a	31 AB	13 B	6.5 A	5.6 AB	2.3 B
500	500	33 ab	28 B	9 B	6.0 A	5.2 B	1.5 B
500	2000	22 b	16 C	3 C	3.8 B	2.8 C	0.5 C
		planting date			planting date		
		17 Sep	30 Sep	19 Oct	17 Sep	30 Sep	19 Oct
GA3	6BA	Tiller Number on May 21			Yield (12.5% moisture)		
-- ppm --		----- #/plant -----					
		----- bu/a -----					
0	0	5.8 b	4.1 b	4.2 b	55 a	53 a	39 a
500	0	5.6 b	4.9 ab	5.2 ab	52 a	53 a	34 a
500	125	8.3 a	5.7 a	5.3 a	53 a	50 a	40 a
500	500	7.5 a	5.6 a	5.6 a	51 a	49 a	39 a
500	2000	6.1 b	6.0 a	5.0 ab	42 b	41 b	27 b
<p>* Numbers followed by the same capital letter in a column for each cultivar are not different at the 95% confidence level. [^] Numbers followed by the same small letter in a column for each cultivar are not different at the 90% confidence level.</p>							

Table 2a. Wesley - Plant Height

		planting date			planting date		
		17 Sep	30 Sep	19 Oct	17 Sep	30 Sep	19 Oct
GA3	6BA	Height (inch) on Nov 17, 2009			Height (inch) on Mar 26, 2010		
-- ppm --		----- inches -----			-----		
0	0	4.0 B	2.7 C	0.8 B	2.5 A	2.2 B	1.7 B
1000	0	5.6 A	4.4 AB	1.4 A	2.6 A	3.1 A	2.1 A
1000	125	5.9 A	4.6 A	1.4 A	2.7 A	3.2 A	2.2 A
1000	500	5.6 A	4.1 B	1.4 A	2.7 A	3.1 A	1.9 AB
1000	2000	3.8 B	2.6 C	1.3 B	1.7 B	0.7 C	0 C
		planting date			planting date		
		17 Sep	30 Sep	19 Oct	17 Sep	30 Sep	19 Oct
GA3	6BA	Height (inch) on May 21, 2010			Height (inch) on July 13, 2010		
-- ppm --		----- inches -----			-----		
0	0	18 A	16 A	13 A	31	30	31 A
1000	0	16 A	14 A	11 B	31	30	30 A
1000	125	17 A	15 A	11 B	31	30	30 A
1000	500	17 A	14 A	10 B	30	31	29 A
1000	2000	8 B	10 B	0 C	29	28	24 B

* Numbers followed by the same letter in a column for each cultivar are not different at the 95% confidence level.

Table 2b. Wesley - Biomass, Tiller Number and Yield

		planting date			planting date		
		17 Sep	30 Sep	19 Oct	17 Sep	30 Sep	19 Oct
GA3	6BA	Fresh Biomass on May 18			Dry Biomass on May 18		
-- ppm --		----- grams/6 ft ² -----					
0	0	39 A	27 A	20 A	7.8 A	4.7 AB	3.2 A
1000	0	40 A	24 A	12 B	6.7 A	4.3 AB	2.1 B
1000	125	38 A	28 A	10 B	7.1 A	5.1 A	1.7 B
1000	500	35 A	21 A	4 C	6.6 A	3.7 B	0.7 C
1000	2000	6 B	3 B	0 D	1.1 B	0.6 C	0 D
		planting date			planting date		
		17 Sep	30 Sep	19 Oct	17 Sep	30 Sep	19 Oct
GA3	6BA	Tiller Number on May 21			Yield (12.5% moisture)		
-- ppm --		----- #/plant -----			----- bu/a -----		
0	0	5.4	5.6	6.3 A	64 A	67 A	58 A
1000	0	5.6	4.8	5.5 A	70 A	62 A	45 B
1000	125	4.8	4.6	5.6 A	68 A	63 A	41 B
1000	500	5.4	5.4	7.1 A	65 A	61 A	30 C
1000	2000	6.4	6.6	0 B	28 B	24 B	6 D
<p>* Numbers followed by the same capital letter in a column for each cultivar are not different at the 95% confidence level. ^ Numbers followed by the same small letter in a column for each cultivar are not different at the 90% confidence level.</p>							

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II: Gibberellic acid for deep-planted Wesley under dryland conditions (Pavlista & Lyon)

Winter wheat variety Wesley grown under dryland conditions is planted deeper than when planted under irrigation. Because it is a semi-dwarf, Wesley may have difficulty establishing itself under these conditions. The objective was to determine whether treating seed with gibberellic acid (GA3) at the optimal rate determined under irrigation would improve growth of the plants. Wesley seed was treated with 0 and 1000 ppm GA3, and planted 3 inches deep on Sep 17, 2009 at the High Plains Ag Lab, Sidney. Stand and vigor of Wesley were slightly improved by GA3 (Table 3a). Plant height at five and nine weeks after planting (WAP) was increased by GA3 treatment as well (Table 3b). The height stimulation, however, did not continue into spring and summer. Biomass was not affected nor was yield affected by GA3 (Table 3a). This trial is being repeated this season. Wesley was planted on Sep 16 and seeds were treated with GA3 at 0, 1000, and 2000 ppm.

Table 3a. Stand and Vigor of Wesley on Oct 23, 2009 (5 WAP) and Biomass on May 26, 2010.					
GA3	Stand	Vigor	Fresh Biomass	Dry Biomass	Yield
	October 23, 2009		May 26, 2010		July 21, 2010
ppm	%	scale 0-5 (best)	----- gram / 6 sq ft -----		bu/a (adjusted)
0	91.0 b [^]	4.0 b	715	160	78.9
1000	97.0 a	5.0 a	670	152	79.2

[^] Numbers followed by the same small letter in a column for each cultivar are not different at the 90% confidence level.

Table 3a. Wesley height from Oct 23, 2009 (5 WAP) to July 15 (43 WAP), 2010.					
GA3	Plant Height, inch				
	October 23	November 18	March 30	May 26	July 15
ppm	----- inch -----				
0	4.95 B*	4.63 B	3.3	14.8 b [^]	28.8
1000	6.44 A	6.09 A	3.3	16.1 a	28.7

* Numbers followed by the same capital letter in a column for each cultivar are not different at the 95% confidence level. [^] Numbers followed by the same small letter in a column for each cultivar are not different at the 90% confidence level.