Evaluation of 6-24-6 for Improving Yield and Quality of Hard Red Spring Wheat

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Simplot

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Providing enhanced early season and extended N-P-K availability is an essential part of any wheat fertilization program. Maintaining adequate phosphorus (P) availability during the course of the growing season can be a significant challenge, particularly in calcareous soils where orthophosphate can be quickly tied up by soil cations, rendering it less available to the crop.

Simplot's 6-24-6 is an ortho-poly blend of phosphates that provides improved early season P availability to crops as well as enhanced P availability later in the growing season. It is highly soluble and the orthophosphate is readily absorbed by plant tissue, which enhances P fertilizer efficiency. The polyphosphate-P is initially protected from being tied up by soil cations, but when conditions are favorable, it is hydrolyzed to release orthophosphate, which is available for plant uptake.

In addition, 6-24-6 has a relatively low salt index, which allows it to be applied closer to the seed than many conventional fertilizer sources. It is also compatible with micronutrient solutions and can easily be blended to provide an excellent source of macro- and micronutrients.

Objective

Compare the effects of different rates and methods of application of 6-24-6 on yield, protein content, dry matter production, and nutrient concentrations of irrigated hard red spring wheat.

Procedures

The experiment was conducted during the 2015 growing season with "Cabernet" hard red spring wheat grown in a sandy loam soil. Preplant soil test concentrations were 12 ppm NO_3-N, 24 ppm P, and 195 ppm potassium (K). The treatments included (1) banded applications of 6-24-6 made at planting, and (2) split applications combining banded and foliar applications as shown in Table 1.

The experimental design was a randomized complete block with application method/rate/ combinations as treatments with five replications. Hard red spring wheat ("Cabernet") was planted April 21 using an 8-foot-wide drill with 7-inch-wide rows. Treatment plots were 8 ft wide by 50 ft long. Banded 6-24-6 applications were made at planting by injecting the fertilizer directly in the seed row. In-season foliar applications were made at tillering (June 3) and early boot stage (June 14). The foliar 6-24-6 was applied at rates ranging from 0.75 to 2.25 GPA in a total spray volume of 14–20 GPA with a tractor-mounted sprayer. This treatment structure allowed us to compare the relative effectiveness of banded and split banded/foliar applications of 6-24-6. The remaining nitrogen (N) fertilizer requirement was broadcast preplant to bring the entire field up to the optimal N rate (140 lbs N/acre), according to the University of Idaho (UI) fertilizer recommendations. No additional P or K fertilizer was applied. All other nutrients were applied according to UI guidelines.

Table 1. Rates for banded and foliar applications of 6-24-6 in the 2015 spring wheat study.

Treatment	Banded 6-24-6 (gallons/acre)	Foliar 6-24-6[1] (gallons/acre)	Total P applied (lbs P_2O_5/acre)	N applied (lbs N/acre)	K applied (lbs K_2O/acre)
1	0	0	0	0	0
2	3.0	0	8	6	6
3	6.0	0	16	11	11
4	9.0	0	24	17	17
5	1.5	1.5 (2×0.75)	8	6	6
6	3.0	3.0 (2×1.50)	16	11	11
7	4.5	4.5 (2×2.25)	24	17	17

[1]Foliar 6-24-6 applications were split between equal amounts made at tillering and boot.

All pesticides were applied according to UI guidelines. The field was irrigated with a solid-set sprinkler system scheduled to maintain available soil water content above 60% throughout the growing season. Whole plant samples were harvested from a 3 ft section of row in each plot at the hard dough stage (August 6) to determine dry matter accumulation and N-P-K concentrations, from which N, P, and K uptake were calculated.

On Sept. 3, a 4 ft by 30 ft section was harvested from the middle of each plot with a small plot combine. Grain was weighed and test weight and protein content were determined.

Results

Preplant band (band) and preplant band + foliar (split) applications of 6-24-6 at 6 and 9 GPA significantly increased N-P-K uptake compared to the untreated check (Table 2), but, applications at the 6 GPA rate did not. Uptake of N-P-K steadily increased with increasing rates of 6-24-6, with the exception of the band application at the 9 GPA rate. Averaged across application rates, the mean banded and split treatments were 32.2 and 30.2 g/m^2 for N, 6.3 and 6.2 g/m^2 for P, and 5.7 and 5.9 g/m^2 for K, respectively.

Total plant dry matter increased as the banding rate increased from 3 to 6 GPA, but it leveled off as the banded 6-24-6 rate increased from 6 to 9 GPA. By comparison, increasing the rate of split 6-24-6 from 3 to 9 GPA steadily increased the production of plant dry matter. Mean dry matter production averaged across fertilizer application rates was 7,020 lbs/acre for the banded treatments and 6,818 lbs/acre for the foliar treatments.

Applying banded and split 6-24-6 increased grain yield compared to the check (Table 2). Within each application method there were no differences in grain yield produced by band or the band + foliar treatments for the 3, 6, and 9 GPA application rates. However, there were differences between the grain yields produced by the band and split treatments at the 3 and 6 GPA application rates. In both cases the band treatments produced significantly higher yields than the split treatments, indicating that for spring wheat, preplant band applications of 6-24-6 are more efficient than split band + foliar applications with regard to grain production.

Grain protein content for both the band and split treatments increased with increasing 6-24-6 rates up to 6 GPA, but leveled off or declined at the 9 GPA rate. However, there were no significant differences between the band and split treatments at each application rate. Test weight increased significantly with the application of 6-24-6, but there were no differences among the fertilized treatments.

Conclusions

Increasing rates of in-row applications of 6-24-6 at planting and split band + foliar 6-24-6 applications both increased plant dry matter production and N-P-K uptake. Band applications tended to be slightly more effective at increasing dry matter production but effects on nutrient uptake were similar. Preplant 6-24-6 was the primary determinant of grain yield, since increases in yield were greater when applying all of the 6-24-6 in an in-row band compared to applying half as a foliar spray. Interestingly, foliar 6-24-6 applications did increase plant N and K uptake to levels similar to the band treatments, but these increases did not produce comparable increases in grain yield.

Table 2. "Cabernet" spring wheat yield, dry matter production and N-P-K uptake as influenced by 6-24-6 application method, rate, and timing, at Aberdeen, Idaho, 2015.

Total N	Total P	Total K	Preplant banded gal/acre	Split applied* foliar gal/acre	Plant Uptake** Grams N/m^2	Grams P/m^2	Grams K/m^2	DM lbs/A	Yield bu/A	Protein %	Test Weight lbs/bu
---------- lbs/acre ----------											
0	0	0	0	0	22.7	5.1	5.0	6,008	102.1	13.8	56.3
6	8	6	3	0	27.0	5.2	5.3	6,431	116.5	14.3	60.4
11	16	11	6	0	36.9	6.2	5.7	7,310	117.5	14.8	60.5
17	24	17	9	0	33.1	7.5	6.2	7,319	116.4	14.7	60.7
6	8	6	1.5	1.5*	24.8	5.5	5.2	5,658	107.5	14.5	60.5
11	16	11	3.0	3.0*	29.0	6.0	5.8	6,697	109.3	14.9	60.5
17	24	17	4.5	4.5*	36.8	7.2	6.7	8,099	112.2	14.6	61.1
Means					30.6	6.1	5.7	6,789.2	111.6	15.0	60.0
Pr> F					0.022	0.035	0.049	0.021	0.057	0.047	0.029
LSD@0.10					3.1	0.6	0.6	438	6.2	0.4	2.3

*Foliar applications made on June 3 and June 14.

** Whole plant samples harvested August 4.