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

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Aberdeen, Idaho, 2015

Simplot

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Providing enhanced early season and extended NPK availability is an essential part of any wheat fertilization program. Maintaining adequate phosphorus (P) availability over 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, which 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 be easily 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 of irrigated hard red winter wheat.

Procedures

The experiment was conducted during the 2014–2015 growing season with "Whetstone" hard red winter wheat grown on a sandy loam soil. Preplant soil test concentrations were NO_3-N =14 ppm, P = 20 ppm, K = 195 ppm, Zn = 1.2 ppm and Mn = 4.2 ppm. 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 experiment was arranged as randomized complete block design with application method/rate/combinations as treatments with five replications. Hard red winter wheat ("Whetstone") was planted Sept. 25, 2014, using an 8-foot-wide drill with 7-inch-wide rows. Treatment plots were 8 feet wide by 50 feet long. Banded 6-24-6 applications were made at planting by injecting the fertilizer at the 3–4 inch depth in the seed row. Additional N applications were made with a hand spreader prior to planting to adjust for the N applied with the 6-24-6 applications. No additional broadcast N was applied in the fall since soil N was 112 lbs N/acre based on the preplant soil test.

Topdress applications of 30 lb N/acre each as urea were made at boot and tillering with a hand operated spreader bringing the total broadcast N application to 60 lbs N/acre. In-season foliar applications were made at tillering (April 23) and early boot stage (May 12). The foliar 6-24-6 were applied at rates ranging from 0.75 to 2.25 gallons/acre in a total spray volume of 20 gallons/acre 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. All other nutrients were determined to be adequate according to University of Idaho guidelines.

Table 1. Rates for banded and foliar applications of 6-24-6 in the 2015 winter 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[2] (lbs N/acre)	K applied (lbs K_2O/acre)
1	0	0	0	0	0
2	3.0	0	8	66	6
3	6.0	0	16	71	11
4	9.0	0	24	77	17
5	1.5	1.5 (2x0.75)	8	66	6
6	3.0	3.0 (2x1.50)	16	71	11
7	4.5	4.5 (2x2.25)	24	77	17

[1]Foliar 6-24-6 applications were split between equal amounts made at tillering and boot.
[2]Includes 30 lbs N/acre topdressed at tillering and 30 lbs N/acre at boot.

All pesticides were applied according to University of Idaho guidelines, including Starane and Brox-M for weed control. The field was irrigated with a 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 (July 20) to determine dry matter accumulation and N, P, K concentrations, from which N, P, and K uptake was calculated.

On August 13, 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

Band and split applications of 6-24-6 produced marked increases on all variables measured, except for test weight (Table 2). In general, plant N, P, and K uptake steadily increased with increasing rates of 6-24-6, although N, P, and K uptake for the split treatment at the 3 GPA rate was similar to the check.

Uptake of N, P, and K was consistently higher for the band treatments than the split treatments. Mean nutrient uptake for the band and split treatments, averaged across all fertilizer rates, was 34.0 and 27.7 g/m^2 for N, 9.1 and 7.4 g/m^2 for P, and 9.6 and 8.0 g/m^2 for K, respectively.

Total plant dry matter production also increased significantly with increasing rates of 6-24-6, up to the maximum rate (Table 2). As observed for N, P, and K uptake, dry matter was higher for the band treatments at each fertilizer rate. Average dry matter production was 9,710 lb/acre for the band treatments and 8,711 lb/acre for the split treatments.

Grain yield followed the same pattern, increasing steadily as the rate of 6-24-6 increased (Table 2). However, in contrast to the trends observed for nutrient uptake and dry matter production, grain yields for the split treatments were only slightly lower than those for the band treatments at each of the three fertilizer rates. Average grain yield for the band treatments was 100.3 bu/acre, while the split treatments averaged 97.1 bu/acre.

Grain protein content also increased as the fertilizer rate increased, although the increases were proportionately smaller than those observed for the other measured variables. In addition, there were no significant differences in grain protein content between the band and split treatments. Test weight was not affected by any of the treatments.

Conclusions

This study was conducted under conditions of moderately low N availability to allow us to focus on the effects of the band and band + foliar 6-24-6 treatments. In this we were successful in showing the response of winter wheat to 6-24-6 across a range of application rates. Nutrient uptake, protein content, grain yield, and dry matter yield all increased as the 6-24-6 rate increased from 3 to 9 GPA. Banding all the fertilizer proved to be more effective than split applications for increasing nutrient uptake and yield, although the differences in grain yield were comparatively small.

Table 2. Whetstone winter wheat N-P-K response to 6-24-6 rate and timing, Aberdeen, Idaho, 2014-2015.

Total N	Total P	Total K	Preplant Banded gal/acre	Split *Applied Foliar gal/acre	Dry Matter Grams N/m^2	Dry Matter Grams P/m^2	Dry Matter Grams K/m^2	Dry Matter lbs/A	Yield bu/A	Protein %	Test Weight lb/bu
---------- lb/acre ----------											
0	0	0	0	0	22.7	6.1	6.6	8,394	89.8	13.0	60.1
6	8	6	3	0	30.9	8.4	8.9	8,865	92.4	13.6	59.7
11	16	11	6	0	32.9	8.9	8.7	9,162	95.8	13.8	59.5
17	24	17	9	0	38.3	9.9	11.3	11,103	112.7	13.9	59.2
6	8	6	1.5	1.5*	228	6.2	6.4	7,382	88.2	13.3	59.3
11	16	11	3.0	3.0*	27.5	7.7	8.2	8,386	93.8	13.7	59.9
17	24	17	4.5	4.5*	32.8	8.2	9.4	10,366	109.4	13.9	59.5
Pr> F					0.063	0.061	0.041	0.067	0.037	0.058	0.687
LSD@0.10					3.3	0.7	0.9	947	6.3	0.6	NS

*Applied April 23 and May 12, 2015.