

Wheat Response to Pre-plant Phosphorus at Safford Agricultural Center, 2001-03

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Abstract

The 2003 study was a follow up of the 2001 and 2002 studies, but the major differences were the selection of a high quality durum wheat with values significantly higher than those seen in the previous two studies and the untreated check was eliminated and a higher level of phosphorus was applied. Treatments applied were 100, 200, 400 and 600 pounds of 16-20-0 planted with the seed through the grain drill. Phosphorus applied at planting improved yields with increasing application rates. In this study, the highest rate of application of phosphorus produced the highest profit.

Introduction

Pre-plant (or at planting) phosphorus is normally applied to winter crops in the high desert soils in southeastern Arizona. The University of Arizona has phosphorus fertilizer recommendations for small grains grown in Arizona based on the bicarbonate soluble P extractions from soils. These guidelines were tested recently in a study by Ottman, et.al. (1) in an effort to encourage growers to test their soils to see if the cost of the phosphorus was justified. This study was established to find the efficacy of pre-plant phosphorus applications in the Safford Valley, particularly at our location.

Materials and Methods

A phosphorus study on hard red wheat was planted in December of 2000 and a follow-up study on hard red wheat was planted on the Safford Agricultural Center in December of 2001. The 2003 study was planted to Kofa durum wheat in December of 2002. Seed was planted with an International 12 foot grain drill with a fertilizer attachment over four 3-foot beds. The crop history follows:

Crop History - 2001:

Elevation: 2954 feet above sea level

Soil type: Pima clay loam variant

Planting date: 21 December 2000

Seeding rate: 150 pounds per acre [Yecora Rojo variety]

Herbicide: None

Fertilizer: 16-20-0 at planting per treatment outlined, 200 lbs/ac urea was side-dressed on 3-1-01

Insecticides: None

Irrigation: Furrow, watered up plus 8 irrigations for a total of ca. 36 acre inches

Rainfall during the growing season: 3 inches

Plot size: 12 feet by 45 feet

Replicates: Four

Harvest dates: Wheat - 6-21-00 Heat units (40 to 81°F) from planting to maturity (6-6) = 3276

Crop History - 2002:

Elevation: 2954 feet above sea level
Soil type: Pima clay loam variant
Planting date: 19 December 2001 Seeding rate: 150 pounds per acre [Yecora Rojo variety]
Herbicide: 2,4-D on 4-8-02 to control broad-leafed weeds
Fertilizer: 16-20-0 at planting per treatment outlined, 200 lbs/ac urea was side-dressed on 2-5-02 and 4-9-02
Insecticides: None
Irrigation: Furrow, watered up plus 9 irrigations for a total of ca. 40 acre inches
Rainfall during the growing season: 3.14 inches
Plot size: 12 feet by 45 feet
Replicates: Four
Harvest dates: Barley - 13 June, Wheat - 15 July Heat units (40 to 81°F) from planting to maturity (6-6) = 3260

Crop History - 2003:

Elevation: 2954 feet above sea level
Soil type: Grabe clay loam
Planting date: 16 December 2002 Seeding rate: 175 pounds per acre [Kofa durum variety]
Herbicide: None
Fertilizer: 16-20-0 at planting per treatment outlined + urea to equal 96 lb/ac, 200 lbs/ac urea was side-dressed on 2-17-03 and 3-31-03
Insecticides: None
Irrigation: Furrow, watered up plus 8 irrigations for a total of ca. 42.5 acre inches
Rainfall during the growing season: 0.9 inches
Plot size: 12 feet by 45 feet
Replicates: Four
Harvest dates: Wheat - 17 June Heat units (40 to 81°F) from planting to harvest = 3128

Plots were harvested with a Gleaner combine with a 13 foot header. Individual plots were weighed using hanging scales and samples were taken to determine moisture, bushel weight and percent protein.

Phosphorous treatments applied per acre at planting:

Trt #	Treatment	P ₂ O ₅ Applied	Cost of Phosphorous Fertilizer
1	Untreated check	0 lbs/ac P ₂ O ₅	\$0.00
2	100 lbs/ac 16-20-0 applied	20 lbs/ac P ₂ O ₅	\$14.25
3	200 lbs/ac 16-20-0 applied	40 lbs/ac P ₂ O ₅	\$28.50
4	400 lbs/ac 16-20-0 applied	80 lbs/ac P ₂ O ₅	\$57.00
5	600 lbs/ac 16-20-0 applied	120 lbs/ac P ₂ O ₅	\$85.50

Results and Discussion

Tables 1 and 2 show the effects of the phosphorous treatments on Yecora Rojo variety of hard red wheat in the first two years of study. Both years showed increases where phosphorus was applied compared to the untreated check. Bushel weight of the untreated check was a bit lower than the phosphorus treated plots in both years, but not different enough to cause concern. Differences in percent moisture of the grain and plant heights also didn't seem to be relevant. Percent grain protein was not measured in 2001, but the differences seen in 2002 might justify further research. Table 3 shows

a summary of yields, crop values and average value after subtracting phosphorus fertilizer costs. This table indicates that the maximum economic yield was achieved with the untreated check. The economic return, however, was still not sufficient to pay the expenses of the crop!

Table 4 shows the effects of the phosphorous treatments on a high quality durum wheat variety. Statistically significant yield increases were seen going from the lowest to the second application rate of phosphorous and again as the highest rate of phosphorous was applied. Base yields were considerably higher than those seen in Tables 1 and 2, perhaps due to the weather, and perhaps due to increases in seeding rate and nitrogen fertility rate. Bushel weights and percent moisture varied a bit with treatment but tended to increase with increased phosphorous application rate. Curiously, the percent protein declined slightly as phosphorous level increased. Table 5 shows the economic analysis of the phosphorous applications. Increased yields caused by the phosphorous application paid for themselves with the maximum economic return being received with the highest rate of phosphorous being applied.

The recommendation from this 2003 study was drastically different from that of the 2002 and 2001 studies. Increased yields were one factor, but the major factor was the increased price of the product. It is suggested first that one evaluate the prospects of obtaining a wheat contract that will likely generate a profit and then that soils be tested for phosphorous and Ottman's recommendations be followed.

References

1. Ottman, M.J., S.H. Husman and B.R. Tickes. 1997. Barley and Durum response to phosphorus at Buckeye, Maricopa and Yuma, 1997. Forage and Grain, A College of Agriculture Report, The University of Arizona, Tucson, AZ. Series P-110, pp. 125-129.
2. Clark, L.J. and E.W. Carpenter. 2002. Wheat and barley response to pre-plant phosphorous at Safford Agricultural Center, 2001-02. Forage and Grain, A College of Agriculture Report, The University of Arizona, Tucson, AZ. Series P-132, pp. 49-52.

Table 1. Yield and other economic and agronomic variables in phosphorus study on wheat at the Safford Agricultural Center, 2001.

Treatment	Yield per acre @ 10%M	Bushel Weight	Percent Moisture	Percent Protein	Plant Height (inches)
Untreated check	2312.0 b ¹	62.3 b	7.0 ab	--	--
100 lbs/ac 16-20 @ planting	2555.9 a	63.0 a	7.3 a	--	--
200 lbs/ac 16-20 @ planting	2414.2 ab	62.8 ab	6.9 b	--	--
400 lbs/ac 16-20 @ planting	2635.3 a	62.6 ab	7.0 b	--	--
Average	2479.4	62.7	7.0	--	--
LSD(05)	224.2	0.68	0.27	--	--
CV (%)	8.7	1.0	3.7	--	--

1. Values within columns followed by the same letter are not significantly different at the 95% level of confidence using Duncan's Multiple Range Test.

Table 2. Yield and other economic and agronomic variables in phosphorus study on wheat at the Safford Agricultural Center, 2002.

Treatment	Yield per acre @10%M	Bushel Weight	Percent Moisture	Percent Protein	Plant Height (inches)
Untreated check	3297.5 a ¹	61.50 a	10.18 a	16.82	24.2 ab
100 lbs/ac 16-20 @ planting	3527.8 a	61.75 a	9.85 a	15.47	24.1 ab
200 lbs/ac 16-20 @ planting	3522.4 a	62.00 a	10.10 a	15.53	24.6 a
400 lbs/ac 16-20 @ planting	3526.1 a	61.75 a	9.95 a	15.28	23.6 b
Average	3468.5	61.75	10.02	15.8	24.16
LSD(05)	291.99	0.75	0.58	--	0.93
CV (%)	5.26	0.76	3.63	--	2.40

1. Values within columns followed by the same letter are not significantly different at the 95% level of confidence using Duncan's Multiple Range Test.

Table 3. Yield and economic summaries for phosphorous study on wheat at the Safford Agricultural Center, 2001 and 2002.

Treatment	2001 Yield per acre @10%M	2001 Crop Value (\$/ac ¹)	2002 Yield per acre @10%M	2002 Crop Value (\$/ac ¹)	Average Value per acre (\$/ac)	Cost of Fertilizer per acre ²	Value less Fertilizer cost
Untreated check	2312.0	\$87.86	3297.5	\$158.28	\$123.07	\$0.00	\$123.07
100 lbs/ac 16-20	2555.9	\$97.12	3527.8	\$169.33	\$133.23	\$12.75	\$120.48
200 lbs/ac 16-20	2414.2	\$91.74	3522.4	\$169.08	\$130.41	\$25.50	\$104.91
400 lbs/ac 16-20	2635.3	\$100.14	3526.1	\$169.25	\$134.70	\$51	\$83.70

1. Crop values were calculated using \$0.038 and \$0.048 per pound for 2001 and 2002, respectively.

2. Fertilizer cost was \$255/ton.

Table 4. Yield and other economic and agronomic variables in phosphorus study on durum wheat at the Safford Agricultural Center, 2003.

Treatment	Yield per acre @10%M	Bushel Weight	Percent Moisture	Percent Protein	Plant Height (inches)
100 lbs/ac 16-20 @ planting	3606.2 c	61.5 a	8.8 b	14.0 a	30.5 a
200 lbs/ac 16-20 @ planting	4822.1 b	61.3 a	9.6 b	13.3 b	30.0 a
400 lbs/ac 16-20 @ planting	4822.3 b	61.8 a	8.9 b	13.1 b	30.5 a
600 lbs/ac 16-20 @ planting	5830.7 a	62.3 a	10.9 a	13.0 b	30.5 a
Average	4770.3	61.7	9.5	13.3	300.4
LSD(05)	697.1	1.7	1.1	0.5	2.2
CV (%)	4.6	0.9	3.5	1.2	2.2

1. Values within columns followed by the same letter are not significantly different at the 95% level of confidence using Duncan's Multiple Range Test.

Table 5. Yield and economic summaries for phosphorous study on wheat at the Safford Agricultural Center, 2003.

Treatment	2001 Yield per acre @10%M	2001 Crop Value (\$/ac ¹)	Cost of Fertilizer per acre ²	Value less Fertilizer cost
100 lbs/ac 16-20	3606.2	\$270.47	\$14.25	\$256.22
200 lbs/ac 16-20	4822.1	\$361.66	\$28.50	\$333.16
400 lbs/ac 16-20	4822.3	\$361.67	\$57.00	\$304.67
600 lbs/ac 16-20	5830.7	\$437.30	\$85.50	\$351.80

1. Crop value was calculated at \$0.075 per pound.
2. Fertilizer cost was \$285/ton.