

Durum Wheat Response to Pre-plant Phosphorus at Safford Agricultural Center, 1999

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Abstract

The economic effect of applying phosphorus at planting of durum wheat is directly correlated to the phosphorus that is available to the plants from the soil. In 1998 a study was done on a field with a bicarbonate soluble phosphorus level of 4.8 ppm, an a sizeable return on the phosphorous fertilizer investment was seen. In 1999 the test field had a phosphorous level of 13.0 ppm and as the University guidelines indicated, returns on phosphoroud expenditures were small. Negative returns were seen with barley and an increase of \$61/ac was seen with 400 pounds of 16-20-0 on wheat.

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

This phosphorus study on hard red wheat and barley was planted on the Safford Agricultural Center in December of 1998. 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:

Elevation: 2954 feet above sea level

Soil type: Pima clay loam variant

Planting date: 22 December 1998

Seeding rate: 200 pounds per acre

Herbicide: 2,4-D on 3-29-99 to control broad-leafed weeds

Fertilizer: 16-20-0 at planting per treatment outlined, 200 lbs/ac urea on 2-25-99, 150 lbs/ac urea on 3-31-99

Insecticides: None

Irrigation: Furrow, watered up plus 8 irrigations for a total of ca. 32 acre inches

Rainfall during the growing season: 0.9 inches

Plot size: 12 feet by 210 feet

Replicates: Four

Harvest dates: Barley - 6-22, Wheat - 6-29 Heat units (40 to 81 °F) from planting to maturity (6-15) = 3244

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

A soil samples was taken at planting time and submitted for chemical analysis. The results of the soil tests are found in Table 1.

Phosphorous treatments applied 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/acre
2	100 lbs/ac 16-20-0 applied	20 lbs/ac P ₂ O ₅	\$10.75/acre
3	200 lbs/ac 16-20-0 applied	40 lbs/ac P ₂ O ₅	\$21.50/acre
4	400 lbs/ac 16-20-0 applied	80 lbs/ac P ₂ O ₅	\$43.00/acre

Results and Discussion

The single most important factor to get a response to applied phosphorus (P) is having a low soil test for phosphorus. The test results shown in Table 1. Test result for 1998 indicate 4.8 parts per million (ppm) of bicarbonate extractable P, which is classified as low in Table 2 (borrowed from Ottman, reference 1) and very low (VL) by IAS Laboratory. Results of the test field in 1999 were very different (even though the fields are less than 1000 feet apart) and it was classified as medium by IAS Laboratory and high by Ottman. These results would indicate little to variable response to phosphorous. To keep this study similar to the study in 1998 (2) phosphorus was applied to the plots in four treatments varying from 0 to 80 lbs/ac P₂O₅.

Table 3 shows the results of the phosphorous treatments on Yecoro Roja variety of hard red wheat. The first column of data shows an increase over 800 pounds per acre with the 100 pound rate of 16-20-0. This compares to the increase of nearly 1400 pounds in durum wheat with the same treatment last year (2). At the highest rates of phosphorous, 1600 pounds/ac and 2100 pounds/acre were seen as the gains over the check plot with the 1999 and 1998 wheat studies, respectively. The differences in the responses were considered to be due to the differences in the level of the soil phosphorous not the class of wheat being grown. The second data column shows the increased value of the crop using 6.5 cents per pound as the value of the wheat and subtracting the cost of the 16-20-0 fertilizer at \$215 per ton. The yield increases were not at great as last year, partially because the durum wheat was valued at 8.0 cents per pound, partially because this year's yields were lower than last year's and the remainder because the soil used this year contained more available phosphorous. None-the-less, the increases from the use of phosphorous fertilizers should be considered as a means to increase yields and profits.

The other agronomic data tabulated in Table 3 were of minimal value in explaining effects of phosphorous fertilization..

Table 4 contains information on the barley study with different phosphorous levels applied at planting. Barley behaved more like Ottman's fertilizer recommendations predicted. The level of soil phosphorous was above the critical level and yield increases were not expected from additions of phosphorous. Yields did increase a bit with the addition of increments of 16-20-0 but using a value of 5.0 cents per pound for the barley, the yield increases didn't pay for the additional cost of the fertilizer.

The recommendation apparent from this research on salty soils in the Safford valley is that soil be tested for

available phosphorous prior to planting. That phosphorous be applied on barley according to Ottman's recommendations and on wheat 50 pounds per acre heavier than recommended. Then, that a test strip be placed in individual fields with 50 pounds per acre of P₂O₅ more and less than the recommendation, to fine tune the best rate for that particular field.

Figure 1 shows the yields and gain and loss in income from the different rates of phosphorous fertilizer applications in this study.

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. 1998. Durum wheat response to pre-plant phosphorous at Safford Agricultural Center, 1998. Forage and Grain, A College of Agriculture Report, The University of Arizona, Tucson, AZ. Series P-114, pp. 68-71.

Table 1. Soil analysis reports for samples submitted from test plots on the Safford Agricultural Center.

Field/Date	pH	Calcium ppm	Magnesium ppm	Sodium ppm	Potassium ppm	Salinity EC*K ds/m	Nitrate-N ppm	Bicarb-sol Phos ppm	Exc.Na Percent	Free Lime
E1/12-17-97	8.2	6200VH	510 VH	1300 VH	600 VH	7.2 VH	78.2 VH	4.8 VL	13.3	H
I2/1-5-99	8.6	7000 VH	704 VH	1530 VH	760 VH	3.2 M	18.0	13.0 M	13.4	H

Table 2. Phosphorus fertilizer recommendations for small grains grown in Arizona based on bicarbonate extractable phosphorus. (From Ottman reference 1)

Pre-plant P level (ppm)	P level description	Response to P fertilizer	Recommended P rate (lbs/ac)
<6	Low	Likely	50 to 100 lbs/ac P ₂ O ₅
6 to 12	Medium	Variable	0 to 50 lbs/ac P ₂ O ₅
>12	High	Not likely	0 lbs/ac P ₂ O ₅

Table 3. Wheat yield and quality components of yield in phosphorus response analysis on the Safford Agricultural Center, 1999.

Treatment	Yield per acre @10%M	Increase over check (\$/ac ¹)	Bushel Weight	% Moisture	% Protein	1000 Kernal Weight	Plant Height	Stems per Square Foot
Untreated check	3948.7 b ²	\$0.00	63.0 a	8.53 a	15.9	37.8 b	25.3 a	62.0 a
100 lbs/ac 16-20 @ planting	4767.6 a	\$42.47	63.3 a	9.02 a	15.8	44.8 a	24.5 a	75.8 a
200 lbs/ac 16-20 @ planting	4680.0 a	\$26.03	63.5 a	9.33 a	15.9	38.0 b	25.0 a	69.8 a
400 lbs/ac 16-20 @ planting	5545.0 a	\$60.70	64.0 a	9.50 a	15.4	42.8 ab	24.0 a	56.5 a
Average	4735.4	--	63.4	9.09	15.75	40.8	24.7	66.0
LSD(05)	970	--	1.14	1.65	--	6.3	2.77	35.7
CV (%)	12.8	--	1.1	11.3	--	9.7	7.0	33.8

1. Increase over the check is the increased value of the crop calculated at 6.5 cents/lb less the phosphorous fertilizer costs.

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

Table 4. Barley yield and quality components of yield in phosphorus response analysis on the Safford Agricultural Center, 1999.

Variety	Yield per acre @10%M	Increase over check (\$/ac ¹)	Bushel Weight	% Moisture	1000 Kernal Weight	Plant Height	Stems per Square Foot
Untreated check	6514.8 a	\$0.00	41.8 a	15.0 a	40.5 b	23.5 ab	82.5 a
100 lbs/ac 16-20 @ planting	6687.4 a	\$-2.12	54.2 a	15.0 a	40.3 b	23.3 b	64.3 a
200 lbs/ac 16-20 @ planting	6756.8 a	\$-9.40	54.0 a	15.5 a	41.3 b	25.3 ab	63.8 a
400 lbs/ac 16-20 @ planting	7150.8 a	\$-11.20	54.5 a	15.0 a	46.8 a	26.0 a	70.8 a
Average	6777.5		51.1	15.1	42.2	24.5	70.3
LSD(05)	1199.4	--	18.94	0.8	5.21	2.44	32.8
CV (%)	11.06	--	23.16	3.3	7.72	6.23	29.2

1. Increase over the check is the increased value of the crop calculated at 5.0 cents/lb, less the phosphorous fertilizer costs.

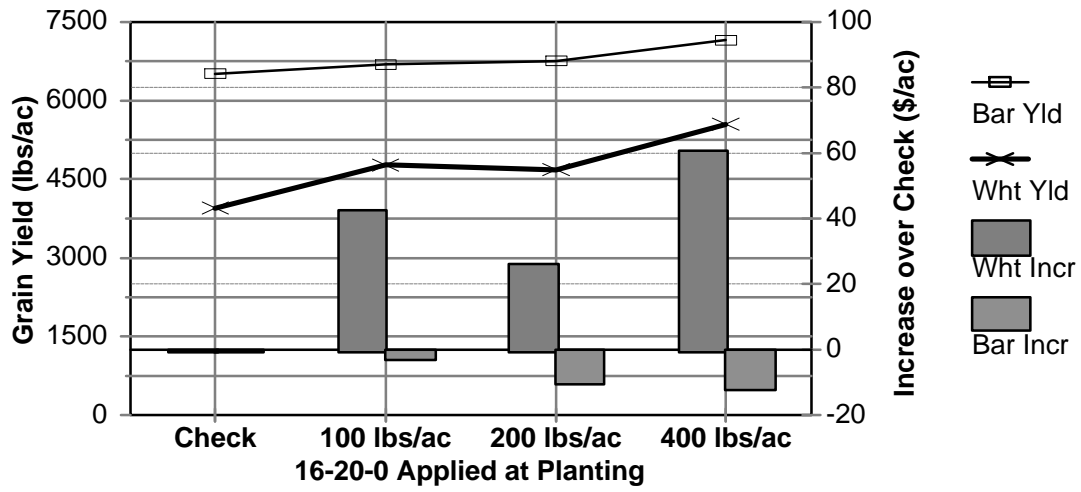


Figure 1. Grain yields and increased value over the check for study at Safford Agricultural Center, 1999.