

Soil Test Calibration for P, K, Mg, and Zn in the Production of Durum Wheat

Thomas Doerge and Mike Ottman

ABSTRACT

Additional data to calibrate and refine current guidelines for interpreting soil test values is an ongoing need in Arizona. This includes information for soils testing above and below the level that may currently be considered adequate for optimum plant growth. An experiment was conducted at the Maricopa Agricultural Center during the 1985-86 crop year to evaluate the response of durum wheat to the application of phosphorus (P), potassium (K), magnesium (Mg), or zinc (Zn) on a soil testing adequate or higher for all of these nutrients. Grain yields from plots receiving every combination of three of the four nutrients were compared to yields obtained when all four nutrients were applied. No significant change in grain yield was measured as a result of withholding any one of the nutrients. Current guidelines used to interpret soil test results for wheat production correctly predicted the nutrient status of this soil with respect to P,K,Mg, and Zn.

INTRODUCTION

Nitrogen (N), and to a lesser extent, phosphorus (P) are the two essential nutrient elements most often limiting the production of wheat in Arizona. Possible deficiencies of other nutrients are of concern to some growers, especially those who may be encouraged to purchase fertilizer materials containing these elements. Preplant soil analysis is a frequently used means for predicting if the application of one or more plant nutrients will be required to achieve optimum yields. Nutrient limitations can also be identified by observation of foliar deficiency symptoms or measurement of low nutrient levels in plant tissue samples from previous crops.

An experiment was conducted at the Maricopa Agricultural Center with the following objectives: 1) to determine whether responses of durum wheat to the application of P, potassium (K), magnesium (Mg), or zinc (Zn), could be attained, and 2) to assess whether routinely used soil testing methods could correctly predict the status of these four nutrients in a sandy loam soil.

METHODS AND MATERIALS

A fertility trial with durum wheat was conducted on a Casa Grande sandy loam at the Maricopa Agricultural Center. This soil series is extensive in Pinal County and is typical of cultivated soils in this area. Chemical properties of the surface foot of soil were, pH, 8.2; electrical conductivity, 1.6 dS/m; ammonium acetate extractable sodium, 0.89 meq/100g; organic matter, 0.5 %; extractable NO₃-N, 2.8 ppm; KCl extractable NH₄-N, <0.3 ppm; and free CaCO₃, high. The soil test levels for P, K, Mg, and Zn and nutrient status of these four elements are given in Table 1. The nutrient treatments applied are listed in Table 2.

Table 1. Soil test values, ratings, and methods of extraction for P, K, Mg, and Zn

<i>Nutrient</i>	<i>Value</i>	<i>Nutrient Status*</i>	<i>Extraction Method</i>
	ppm		
P	15	Medium	0.5 M NaHCO ₃
K	266	very high	1N NH ₄ OAc
Mg	212	high	1N NH ₄ OAc
Zn	0.56	medium	DTPA

* Including very low, low, medium, high, very high.

Phosphorus (P₂O₅) as treble superphosphate, K₂O as potassium chloride, and Mg as magnesium sulfate were applied at the rate of 100 lbs/acre while zinc was applied at the rate of 10 lbs Zn/acre from zinc sulfate. Nitrogen was supplied from urea applied in accordance with the procedure currently recommended by the University of Arizona, involving preplant soil and mid-season stem nitrate-N tests (Pennington et al., 1983). A total of 215 lbs N/a was applied to all plots with 60, 50, 75, and 30 lbs N/a applied preplant and at the 5-6 leaf, boot, and flowering growth stages, respectively.

The P, K, Mg, Zn, and preplant N were all hand-broadcast and worked into the surface 4 to 6 inches of soil prior to preirrigation. The remaining three mid-season applications of N were broadcast on to dry soil no more than two hours before irrigation events. 'Aldura' durum wheat seed was drilled into moist soil on flat borders at the rate of 80 lbs/a on 21 November, 1985.

Table 2. Nutrient treatments applied to 'Aldura' wheat

<i>Treatment</i>	<i>Nutrient(s) Applied</i>
Check	N
-P	N,K,Mg,Zn
-K	N,P,Mg,Zn
-Mg	N,P,K,Zn
-Zn	N,P,K,Mg
Complete	N,P,K,Mg,Zn

Individual plots were 8 X 50 feet and all treatments were replicated four times in a randomized complete block design. A total of 28 inches of water was applied in seven irrigations (including the preirrigation). Rainfall during the growth period was 2.9 inches. Neutron probe readings from an adjacent experiment, also with simultaneously planted 'Aldura' wheat, were used to schedule irrigations. Grain yields were measured on 28 May using a small plot combine.

RESULTS AND DISCUSSION

No significant differences were observed between the grain yields obtained from all of the nutrient treatments ($P < 0.05$) (Table 3). The average grain yield was equal to or slightly higher than the maximum yield attained in an adjacent N fertility trial with 'Aldura' wheat grown under the same conditions, insuring that N was not limiting plant growth.

Table 3. Grain yields of 'Aldura' wheat for various nutrient treatments

Treatment	Grain Yield
lbs/a	
Check	6930
-P	6480
-K	7276
-Mg	7110
-Zn	6510
Complete	6360
LSD 0.05	N.S.

Conventional interpretation of preplant soil test values would predict no response to P, K, Mg, or Zn, as was observed. The results of this experiment underscore the value of soil analysis as an effective tool in sound nutrient management for wheat production.

REFERENCES

1. Pennington, D.A., B.R. Gardner, and T.C. Tucker. 1983. Fertilizing small grains in Arizona. No. 8366. The University of Arizona, Cooperative Extension Service.