Texas Agricultural Extension Service
The Texas A&M University System

Deep P Placement in Wheat in the Texas Rolling Plains

Travis D. Miller
Professor and Extension Agronomist

Wheat and other cool season cereal crops respond readily to applied P fertilizer when deficiencies exist in fields in which they are planted. In field conditions, however there are variables which limit this response. In wheat production in west Texas, the variable most likely to prevent response to applied P seems to be a moisture deficit in the zone enriched by P application and incorporation. In soils which are low in native P, modern cropping systems, typically minimum till, sweep till or chisel tillage, no major soil inversion takes place, and the perennial shallow incorporation of crop residues near the surface results in P stratification. This stratification results in the greatest concentration of P accumulating near the surface, with concentrations in the top 2 inches of soil typically having concentrations two to ten times that found in subsurface strata. In periods of frequent rainfall, surface P concentrations are not unfavorable for the wheat crop. In the western regions of Texas and other Great Plains states, however, P concentrated near the surface is unavailable for a large part of the growing season because soil water content is too low to sustain an active root system. Due to this phenomenon, surface incorporated P causes infrequent relief to the deficient crop, causing erratic crop responses.

As soils wet with rainfall or irrigation, dormant roots near the surface reactivate and appear to pick up P efficiently. With ensuing dry weather, these roots appear to go dormant once more, the supply of P entering the crop diminishes, and growth rate slows relative to that of a crop fertilized with deep banded P. In numerous field trials in Texas over the last 10 years deep P placement has been proven to enhance both forage and grain yields, with the greatest proportional differences between deep, banded P and surface incorporated P being apparent on dry years.

Forage production to many farmers is a more dependable source of income than grain production due to the many stresses involved in wheat production. More than 70 per cent of the Texas wheat crop is grazed in a given year, whereas grain is harvested from about 55 percent of planted acres. Part of the abandoned (grazed out) crop acreage results from unfavorable weather conditions for grain production, but the majority results from a decision based upon the relative economics of grazing out wheat versus that of grain production. In several studies, significant forage yield increases due to deep, banded P were harvested, but grain yield was not different than with surface incorporated P. This result was generally observed in weather patterns with dry fall and winter weather, but adequate spring moisture. In weather patterns where spring moisture was limiting to crop growth, dramatic and significant increases in grain yield were measured with deep banded P relative to surface incorporated treatments or the untreated check. This paper will describe some of the P placement field trials and their results in the Rolling Plains of Texas.

Texas Agricultural Extension Service • Edward A. Hiler, Interim Director • The Texas A&M University System • College Station, Texas

Materials and Methods

In each trial, plots were planted early relative to the optimum date for grain production in winter wheat. This is common in the wheat-stocker cattle production system, as early heat units drive the forage production upon which the stocker cattle component of the system depends. Fertilizer was applied in all trials except those at Abilene as a fluid ammonium polyphosphate (10-34-0). Trials at Abilene compared 11-52-0 (MAP) banded at the 6 inch depth with an air seeder to the same rate surface applied with air boom and incorporated prior to planting. The Abilene trials used anhydrous ammonia as the N source, while UAN was the N source on the other trials. The Abilene trial was treated with 80 lbs. N/A, the other sites with 50 lbs N/A. Other banded applications were injected on 10 inch centers at a depth of 8 inches preplant. Surface incorporated treatments were dribbled on the surface and then incorporated either with a disc or field cultivator. Rate of application was 40 lbs/acre of P_2O_5, with the exception of the Abilene site where the rate was 50 lbs/acre. Wheat was sewn on planting dates from mid-September to early October with a plot drill on 10 inch centers. Forage was hand clipped using a small frame; oven dried and weighed. Grain yield was determined with a machine harvest by a Hege plot combine. Plot design was a Randomized Complete Block with either 3 or 4 replications.

Results and Discussion

In six trials where valid comparisons of grain yield were made between P placement techniques, three yielded significantly higher with deep placed P, with the yield average of deep banded P being 8.4 and 10.5 bu./acre greater than the surface incorporated treatment and the untreated check, respectively (Table 1). This represents a yield increase of 57 and 83 percent under very dry growing conditions. In two trials, there was no difference between P placement techniques with respect to grain yield. In one trial during a very wet growing season, wheat fertilized with the surface incorporated P yielded more than the deep, banded P treatment. Averaged over six sites, deep banded P resulted in grain yields of 2.0 and 9.9 bu/ac greater than the surface incorporated P and untreated check , respectively. In two sites (Wichita '95 and Abilene '96) where drought drastically limited grain yield, no response was obtained to N fertilizer alone or N fertilizer with surface incorporated P, but significant yield response was obtained with deep, banded P and N.

In eight trials where valid comparisons of forage production were made, five comparisons showed significant forage yield increases due to deep, banded P, two were the same as surface incorporated P, and in one comparison, surface incorporated P yielded more forage than did deep, banded P (Table 2). In four of five comparisons where deep P yielded more than did the surface incorporated treatment, fall weather was very dry. In the three comparisons where deep P did not yield significantly more than surface incorporated P, fall rainfall was above average. Across site years, deep P resulted in forage yields 444 and 734 lbs dm/acre or 24 and 47 percent more than did surface incorporated P and the N only check, respectively. In each of the five sites where deep, banded P was significantly greater than the surface incorporated treatment, the N only check had equal yield to the surface incorporated P treatment. Yields were 2567, 1717 and 1771 lbs dm/acre, respectively for deep P, surface P and N only check, giving deep P a 50 and a 45 per cent advantage over surface P and the N only check under very dry conditions.

Table 1. Response of Wheat Grain Yield to Fertilizer P Placement - Texas Rolling Plains

		Grain Yield[1], Bu/Acre			
Location	Year	Deep P+N	Surface P+N	N Only	Check
Runnels	1988	31.0a	25.8b	20.8c	
Baylor	1984	46.0a	47.0a	35.0b	
Baylor	1995	41.4a	39.2a	39.1a	27.9a
Wichita	1995	16.4a	5.1b	4.8b	3.5b
Abilene	1995	34.0b	48.5a	19.5c	
Abilene	1996	22.0a	13.2b	12.2b	7.7d
Average		**31.8**	**29.8**	**21.9**	

Table 2. Response of Wheat Forage to Fertilizer P Placement - Texas Rolling Plains

		Forage Yield[1], Lbs/Acre			
Location	Year	Deep P+N	Surface P+N	N Only	Check
Runnels	1988	2583a	1595b	1482b	
Wichita	1995	2357a	1238b	1257b	1199b
Baylor	1994	2552aa	1248b	1568b	
Baylor	1995	4295a	3757b	3615b	3607b
Abilene	1995	3898b	7440a	2200c	
Abilene	1997	580a	483a	477a	259b
Young	1997	1050a	749bc	935b	598c
WIchita	1997	1003a	929a	912a	
Average		**2290**	**1846**	**1556**	

[1]Yields in the same row followed by the same letter are not different according to L.S.D. test at 95% level of confidence.