NEWS & VIEWS

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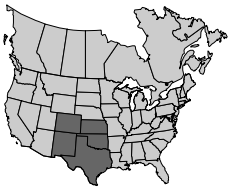

Dr. W.M. Stewart, Great Plains Director
July 2000

Phosphorus Fertilization of Wheat… Let's Talk Placement

PHOSPHORUS (P) affects wheat growth throughout the season in several ways. It's important in seedling development. The young plant has limited root surface for P absorption so a high concentration of available P in the root zone aids in early-season development. Enhanced availability of P encourages the early season development of adventitious roots. Winterhardiness is improved with adequate P. Abundant P results in an early proliferation of tillers which increases forage and grain yield potential. Also, wheat with adequate P matures earlier and more uniformly.

Several factors control crop response to P fertilizer. One of the first that comes to mind is soil test P level. While this is important, there are several others that often come into play. Soil characteristics such as temperature, moisture, pH, salinity, and compaction are important, as is placement of P fertilizer. Stratification of fertilizer P and how samples for soil tests are taken may also be important variables. These and other factors act individually and in combination to affect crop response to P fertilizer.

Studies investigating effects of these factors on wheat forage and grain yield response to P fertilizer have been conducted across Texas over the past several years.

A long-term wheat P fertilization study was conducted in the Blackland prairie. Heavy textured soils dominate the Blacklands. Average annual rainfall in the region ranges from about 30 to 40 inches. The influence of P fertilizer placement over 17 years and 48 locations was evaluated. In this study, P fertilizer was applied in-furrow with the seed, drilled half way between seed rows, and broadcast incorporated. Rates ranged from 0 to 90 lb P_2O_5/A. Phosphorus fertilization up to 40 lb P_2O_5/A, regardless of method of application, increased grain yields by an average of 12 bu/A. The largest yield increases were where soil test P was low (**Figure 1**). Although P fertilization in general significantly increased yields, in-furrow placement was the most efficient method of application. Fall development of the adventitious root system was three to five times greater where P was banded with the seed. The massive root system and enhanced tillering associated with the in-furrow application resulted in greater yield potential. In addition, on soils very low in available P, fertilizer placed with the seed produced two to three times as much winter forage as the other methods of application.

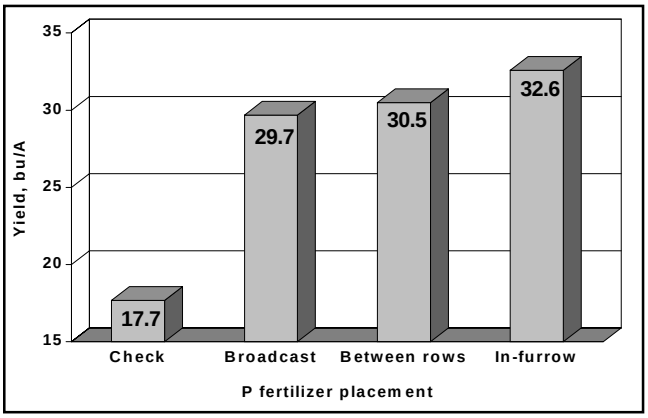

Figure 1. Effect of P fertilization and placement on wheat yield in the Texas Blacklands (14 locations, low soil P level).

In another Blackland study, the effect of planting date (soil temperature) and P fertilizer management on wheat yield was evaluated. The three methods of application used in this experiment were in-furrow, broadcast incorporated, and broadcast and left on the soil surface. Rates of P fertilization were 50 and 100 lb P_2O_5/A. The soil test P level at the study site was 25 parts per million (ppm), high, using the Texas A&M method. **Figure 2** shows grain

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yield response at the 50 lb P_2O_5/A rate.

Phosphorus fertilizer provided no yield increase at the early planting date (September 20) when the soil temperature was highest. However, P fertilizer tended to increase yield across all application methods as planting date was delayed. The least overall response was where P was broadcast and left on the surface. This is not surprising since P is relatively immobile and availability to plant roots is rather limited at the soil surface. As planting date was moved up and soil temperature at planting decreased, yields decreased but response to P fertilizer improved. Where wheat was planted in cool soils, fertilizer P helped offset yield loss due to later planting, even though soils tested high in available P. Proximity of the fertilizer material to the wheat seed becomes much more important in cool, wet, poorly drained soils which are typical of the Blacklands. In-furrow P fertilizer application provided the greatest response at the later planting dates. With the December planting where 50 lb P_2O_5/A was applied in-furrow, an 80 percent increase in grain yield was observed (**Figure 2**), while the 100 lb P_2O_5/A application increased yield by 89 percent over the check. Forage yield also showed significant response to P fertilizer at the later planting dates.

Wheat forage and grain production in drier climates requires a different way of thinking when it comes to P placement. Research has been conducted in the Rolling Plains of Texas for several years on the effect of deep (6 to 8 inches) banding P fertilizer on forage and grain yield **(Table 1)**. Forage production for winter pasture is important in this area. Therefore, wheat was planted relatively

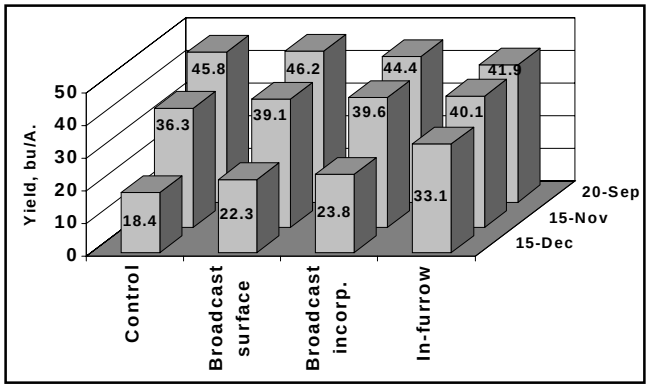

Figure 2. Effect of P fertilizer placement and planting date on wheat yield in the Texas Blacklands (50 lb P_2O_5/A rate, high soil P level).

early in all of the trials. Yields were generally higher where P was banded 6 to 8 inches deep than where broadcast on the surface and incorporated. This can be explained in terms of the position of available soil moisture, fertilizer P, and root activity. Where fertilizer P is surface applied and shallow incorporated, stratification of available P in the upper few inches of soil tends to develop. When the upper 2 to 3 inches of soil are moist, the crop can use the P since roots are active in this zone. However, in the drier climate of west Texas, as the crop reaches deficit moisture conditions in the fall and winter, the shallow P-enriched zone is too dry for active root uptake of P. Early planting for forage production compounds this effect because of the extraction of large amounts of soil water in the fall. By placing P fertilizer deep (6 to 8 inches) the crop is able to maximize P uptake since it is at a depth where soil moisture and root activity are more abundant. Hence, soil moisture is an important consideration in maximizing positional availability of P fertilizer.

What conclusions can we make from this information? First of all, P is an important component of profitable wheat production. Second, several factors affect response to fertilizer P and which method of placement is likely to be the most efficient. Soil test level and stratification are certainly important, but should be considered with other factors. Soil temperature is important. Where the crop is planted late, in a relatively cool soil, the probability of response to P fertilizer increases, especially in-furrow applied P. This is true even if soil test P level is high. Soil moisture is another important factor. In drier regions where the upper few inches of soil are likely to be moisture deficient in the late fall and winter, banding P fertilizer deeper than normal will result in more efficient P use and higher forage yields. ■

Table 1. Effect of P fertilizer placement on wheat forage and grain yield in Texas.

Location, County	Year	Deep P+ N	Broadcast incorp. P+N	N only	Check
		- - - - - - - - - -Forage yield[1], lb/A- - - - - - - - - -			
Runnels	1988	2583a	1595b	1482b	---
Wichita	1995	2357a	1238b	1257b	1199b
Baylor	1994	2552a	1248b	1568b	---
Baylor	1995	4295a	3757b	3615b	3607b
Abilene	1995	3898b	4770a	2200c	---
Abilene	1997	580a	483a	477a	259b
Young	1997	1050a	749bc	935b	598c
Wichita	1997	1003a	929a	912a	---
Average		**2290**	**1846**	**1556**	
		- - - - - - - - - - Grain yield[1], bu/A - - - - - - - - - -			
Runnels	1988	31.0a	25.8b	20.8c	---
Baylor	1994	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**	

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

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