Phosphorus Fertility and Placement Enhance Wheat Forage Yields

By Travis D. Miller and Brent Bean

Texas research has emphasized the importance of adequate phosphorus (P) and P management for wheat forage and grain yields. Greatest benefit from deep banding of P has been associated with surface moisture shortages.

MOST OF THE WHEAT CROP in west Texas is grazed by lightweight stocker cattle. The amount and intensity of the wheat crop utilized for forage vary with the price of wheat grain and that of feeder cattle, but estimates project that more than 70 percent of the Texas wheat crop is grazed in any given year. The duration of this grazing increases with increasing cattle prices and with decreasing value of the wheat grain crop. In most years, over 40 percent of the Texas wheat crop is grazed out, with no grain harvested. This extrapolates into about 4.5 million acres of wheat grazed in a given year, with at least 2.4 million acres utilized entirely as forage.

Grain yield response to P fertilization in low to medium P testing soils is widely documented, particularly in higher yield environments. In west Texas, P use has been poorly accepted by wheat farmers due to sporadic responses associated with prolonged periods of dry weather in the fall, which limits root development and activity in the surface soil zones where P is concentrated with conventional broadcast P applications. Several site years of P placement studies in west and west-central Texas have revealed that deep (approximately 8 inches) banding of P prior to seeding results in greatly superior forage yields in winter wheat when moisture limits root activity near the soil surface. Forage response to deep banded P has not necessarily equated to a greater grain yield response compared to broadcast P.

Texas Studies

Plots were established at several locations representing conditions typical for wheat planted as a dual purpose crop for forage and grain. Phosphorus placement comparisons in these studies used a fluid P source (10-34-0). Conventional surface-incorporated treatments were compared to deep banded treatments applied with a chisel. In most studies, the spacing between chisels was 10 inches, although in two studies with irrigated wheat at Etter, the spacing was 15 inches. Depth of

Table 1. Dryland wheat forage response to P fertilization.

	Total forage yield, lb dry matter/A					
Fertilizer placement	Runnels '87-88	Baylor '93-94	Baylor '94-95	Wichita '94-95	Abilene '94-95	Average 5 sites
P deep banded	2,583	2,552	4,295	2,357	3,898	3,137
P surface incorporated	1,595	1,248	3,757	1,238	4,770	2,521
0 P check	1,482	1,568	3,615	1,257	2,200	2,024
0 N & P check	–	–	3,607	1,199	–	–
Soil test range	Low	High	High	Med.	Med.	–

Texas

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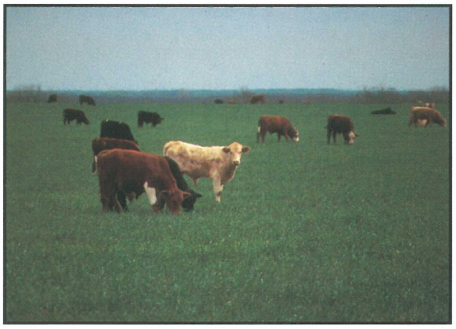

LIGHTWEIGHT CALVES on wheat pasture in Wichita County, TX.

WHEAT FORAGE response to deep banded P and NH_3 is shown at right. Adjoining area at left received only NH_3 (Abilene, TX).

these bands was approximately 8 inches, although depth varied slightly with soil conditions. Forage was hand clipped, oven dried and reported on a dry weight basis. Grain yields were harvested by plot combine.

Forage Yields

Weather during the early growing season was of great importance relative to the response of wheat forage to P placement. In the dryland wheat study, 3 of 5 trials (Runnels, Baylor '94 and Wichita) were conducted with very dry fall weather (**Table 1**). In these three trials, deep banded P produced 84 percent more dry weight forage than wheat which received broadcast, surface incorporated P. Broadcast P produced the same yields as the no P check.

The Baylor '95 and Abilene plots received unusually high rainfall during the fall and early winter. Forage response to deep placed P was better than broadcast P, but the advantage was only about half of the response measured at the Baylor site in 1994. At the Abilene site, the surface broadcast P treatment was significantly better than deep banded P and both placement techniques caused very large forage responses compared to no P. The 5-site year average indicated forage grown with deep banded P was 24 percent greater than surface incorporated P and 55 percent greater than no P checks.

In the Northern High Plains, irrigated wheat forage response to P placement was much the same as in dryland

Table 2. Irrigated wheat forage response to P fertilization.

Fertilizer placement	Total forage yield, lb dry matter/A			
	1992	1993	1994	Average
P deep banded	4,137	5,475	5,502	5,038
P surface incorporated	4,957	3,759	4,590	4,435
0 P check	2,317	3,294	1,999	2,537

Soil test P: Medium — Etter, TX

Table 3. Early wheat forage responses to P fertilization.

Fertilizer placement	Early forage[1] yield, lb dry matter/A					
	Runnels '87-88	Wichita '94-95	Etter '91-92	Etter '92-93	Etter '93-94	Average
P deep banded	1,516	2,086	1,267	844	4,006	1,944
P surface incorporated	848	1,002	1,768	361	3,128	1,421
0 P check	967	999	531	500	1,272	854
0 N & P check	–	920	–	–	–	–
Soil test range	Low	Med.	Med.	Med.	Med.	–

[1] Early forage refers to clipping taken at or before normal livestock removal dates. — Texas

WHEAT MATURITY and grain yield response to deep banded P. Check strip in center of photo received no P.

wheat (**Table 2**). In the 1992-93 and 1993-94 crops, forage yield response to deep banded P was 46 and 20 percent, respectively, greater than surface incorporated P. In a high rainfall year (1991-92), forage yield on the deep banded P treatment was 17 percent less than surface incorporated P. Over the 3 year study, deep banded P averaged 15 percent greater forage yield than surface incorporated P treatments and 99 percent greater yield than no P check plots.

Total forage yield doesn't tell the entire story. Most wheat farmers use the crop for overwintering stocker cattle on high quality forage; removing livestock near growing point differentiation, and managing the crop for the remainder of the season as a grain crop. In this scenario, early forage yield is a more important number. Early season forage yield response summarized for five of these studies showed that deep banded P was more effective than surface broadcast P in four cases, averaging 37 percent greater forage yield than broadcast P and 128 percent more than the no P check (**Table 3**).

Grain Yields

Grain yield response to P application method was less consistent than effects on forage yields. Under unusually dry weather in Wichita County, grain yield was significantly improved (more than 11 bu/A) by deep P placement, while the reverse was true at Abilene where surface incorporated P yielded more (14.5 bu/A) than deep banded P (**Table 4**). Little difference was noted at three other sites. Either method of P application increased grain yields about 10 bu/A over the no P checks.

In the 3-year irrigated study at Etter, grain yield with deep banded P was superior (8 bu/A) to surface incorporated P in only one year with no difference between P placement methods in the other years. Either P application method increased grain yields an average 13 bu/A over the no P checks.

Summary

On low P soils in a dry climate typical of west Texas where forage production represents a significant part of the value of a crop, preplant deep banding of P fertilizer can give substantial yield advantages. In years with wet fall weather, the advantage of deep banding P is lost. Grain yield responses are not so closely associated with P placement overall. This research shows that P fertilization is a key in both dryland and irrigated wheat forage and grain production, and that placement technique should be adjusted to reflect available soil moisture. ■

Table 4. Wheat grain yield responses to P fertilization.

	Yield, bu/A					
Fertilizer placement	Runnels '87-88	Baylor '93-94	Baylor '94-95	Wichita '94-95	Abilene '94-95	Average
P deep banded	31	46	41	16	34	34
P surface incorporated	26	47	39	5	49	33
0 P check	21	35	39	5	20	24
0 N & P check	–	–	28	4	–	–
Soil test range	Low	High	High	Med.	Med.	–

Texas