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Phosphorus Fertilizer Bumps Forage and Beef Production

Forage and Beef production increased sufficiently to exceed the cost of added P.

Summary: *Four annual applications of 40 lbs/A of P_2O_5 raised surface soil test P levels from 9 or 10 ppm to 23 ppm, but did not significantly increase grain yields. Forage production increased by 35 percent, although more dramatically prior to March 1. Beef production increased by 32 percent in the graze-plus-grain system and by 34 percent in the graze-out system. There was no advantage to deep placing fertilizers. Economic returns to land and management in the graze-plus-grain system averaged $42 and $34/A with surface-applied and injected nitrogen (N), phosphorus (P), sulfur (S) fertilizer, respectively, and $30/A with NS fertilizer. The graze-out system was consistently less profitable, returning only $13 and $3/A with surface-applied and injected NPS, respectively, and $5/A with no P in the fertilizers. Although both forage and beef production were increased by one-third and increased income sufficiently to exceed the cost of added P, the profit margin was very narrow in the graze-plus grain system and negative in the graze-out system. The study confirms our belief that grain production is still extremely important in Rolling Plains wheat-stocker cattle production programs.*

Table 1. Mean forage production in grazed pastures of 'Lockett' wheat receiving three soil fertility practices in two management programs during three years at Vernon, Texas.

Fertilizer Applied	Forage* production through February 2000	2002	2003	Mean
	lbs/A			
N surface	1,420	1,190	835	1,150
NP surface	1,650	1,910	1,785	1,780 (55%)
NP deep	2,095	1,450	1,795	1,780
	Forage* production from March through May			
N surface	2,860	2,640	3,015	2,840
NP surface	3,360	3,155	4,220	3,580 (26%)
NP deep	2,825	2,995	3,565	3,125

* Forage yields were estimated as the difference between forage weights in caged and uncaged areas taken one month apart.

Table 2. Beef and grain production from 'Lockett' wheat grown with three soil fertility practices for three years in a graze-plus-grain management system at Vernon, Texas.

Fertilizer Applied	Beef gain per Head/day mean*	Head mean	acre 1999-2000	2001-2002	2002-2003	Grain yield 2003	mean
	pounds					bu/acre	
N surface	2.2	161	85	70	62	32	26
NP surface	2.3	170	102	103	81	38	28
NP deep	2.4	175	108	78	90	41	31

* Means from three years of data.

Nearly 20 million acres of hard red winter wheat are grown in the semiarid Southern Great Plains. The use of winter wheat as a dual-use crop is an extremely important component of the agricultural economies of Texas, southern Kansas, eastern New Mexico, western Oklahoma, and southeastern Colorado.

The grazing value of winter wheat forage has been known since the 1930s. Depending on cattle and grain prices, farmers and ranchers have the option of either grazing out wheat if cattle prices are high relative to wheat grain, or removing cattle and allowing the wheat to develop grain if wheat prices are high relative to cattle. Recent estimates indicate that 30 to 80 percent of the wheat planted is grazed to some degree.

Dual-use wheat production is more complex and requires a higher level of management than permanent pastures, wheat for pastures only, or grain only. Fertilizers, particularly N and P, are essential in maximizing forage and grain production in nutrient-deficient soils. A deficiency in either N or P can result in significantly reduced forage and grain yields. Unfortunately, there is little information on fertilizer management in dual-use wheat/stocker systems. Nitrogen requirements for forage, grain, and that removed by cattle can be estimated. However, the amount of P to be applied is less readily determined. Studies have shown that for acid soils in the southern plains of Oklahoma, broadcasting lime before the initial season and placing 65 lbs/A of diammonium phosphate in the seed furrow each year proved the most economical strategies for dual-use wheat production over five years (to amortize the cost of lime). In wheat trials in the southern Great Plains of Texas, deep placing P increased wheat forage yields 50 percent more than surface-applied P, and 45 percent more than the same rate of N but no P. There is little question that application of P to P-deficient soils will increase both grain and forage yields.

Objectives of this study were to 1) determine the influence of P fertilizer and P fertilizer placement on forage, beef, and grain production from dual-purpose wheat, 2) determine grazing termination dates effects on grain yield and animal performance, and 3) identify economic costs and returns associated with P fertilizer and P placement methods and length of grazing period of winter wheat in the Texas Rolling Plains.

Forage gain

P fertilizer applications increased wheat forage production each year of the study, with the greatest percentage increase occurring during the first grazing phase or prior to March 1. Data in Table 1 indicate that P applications increased forage production 55 percent (630 lbs/A) and 26 percent (740 lbs/A) before and after March 1, respectively. On an annual basis, P increased forage production 35 percent or nearly 1,400 lbs/A. Furthermore, response to P increased each year of the study. Although fall forage production is especially important to stocker cattle programs in the Southern Great Plains, the season-long increase in production is also very valuable but less recognized.

It is apparent that deep placement of fertilizers gave no advantage over surface applications followed by incorporation. However, location of knife rows could be identified visually in late fall by the larger, darker green wheat plants.

Table 3. Economic returns from three soil fertility practices on 'Lockett' wheat in a graze-plus-grain management program during three years at Vernon, Texas.

	N surface		NP surface		NP deep	
	2003	Mean*	2003	Mean	2003	Mean
	dollars/A					
Income						
Grain	92	74	120	93	109	85
Cattle	20	22	27	26	30	28
FSA	12	17	12	17	12	17
Total	124	113	159	136	151	130
Expenses	92	83	106	95	107	96
Returns**	33	30	53	42	45	34

* Means from three years data. ** Returns to indirect costs, land, and management.

Gain per head

Because we attempted to keep forage allowance uniform among all pastures in the experiment, animal gain per head per day (ADG) and gain per head would be expected to be the same in all pastures. Animal gain per acre should reflect the difference in forage production among pastures through higher stocking rates and thus more gain per acre in pastures with more forage production. Data in Table 2 show that ADG and gain per head were very similar among treatments. P applications increased average animal gain by 23 lbs/A or 32 percent during three years in the grazing phase prior to March 1. Increased gains per acre were statistically significant in only 2001 to 2002.

During the three years, grain yields were not significantly increased by P fertilization, although yields increased as much as 9 bu/A in 2003.

Bottom line

An enterprise budget was created for each replication of each fertilizer treatment in order to compare economic returns within each grazing management system.

Table 3 contains income, direct expenses, and returns for the three fertilizer practices in the graze-plus-grain system. Three-year means show that where no P was applied, income averaged $113 per year while income averaged $136 and $130 per year where P was surface applied and knifed, respectively.

Direct expenses were similar among treatments except that P application increased costs by roughly $12/A. Returns of $34 to $42/A where P was applied, compared to $30/A without P, largely reflect the increased income resulting from applied P. In 2003, returns were more favorable but trends were similar. The returns do not include indirect expenses or the costs of land and management.

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