

Benefits Gained by Top-dressing Existing Alfalfa with Phosphorus

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Question:

Are there any documented benefits of "top-dressing" or broadcasting phosphorus or nitrogen fertilizer on existing alfalfa or pasture stands? We frequently hear that phosphorus is very immobile and there may not be any benefit to applying phosphorus to the surface of calcareous soils in most of Montana. Conversely, nitrogen is very mobile and may be lost before the crop can use the nitrogen.

Phosphorus and alfalfa: In a three year study conducted in southeastern Montana, our goal was to determine the responses of existing alfalfa plantings to various methods of phosphorus fertilizer additions. This study was initiated in September, 1991, and continued through October, 1994, at three locations along the Powder River in southeast Montana. We were interested in determining if it made a difference how the phosphorus was applied and when it was applied.

Treatments included subsurface banding (knifing) on 16" centers, topdress broadcast application uniformly across the plot, and surface banding on 8" centers. The same treatments were repeated in mid-March, 1992 at the same sites. Phosphorus rate is 300 # P/acre as P₂O₅. All of the stands were at least three years old when the phosphorus was applied.

Summary table of 1991-1994 Powder River results

Treatment	Average yield per harvest, tons/ac at 12% H ₂ O			
	Griffin (9, 3)*	Jurica (2, 2)	Gay (4, 3)	Overall
Fall broadcast P	2.40	1.69	1.89	2.17
Fall deep band P	2.50	1.65	1.76	2.19
Fall surface band P	2.49	1.57	1.95	2.23
Average	2.46	1.64	1.87	2.20
Fall deep band	2.30	1.43	1.63	2.00
Spring broadcast P	2.38	1.59	1.89	2.14
Spring deep band P	2.42	1.58	1.85	2.15
Spring surface band P	2.36	1.50	2.05	2.16
Average	2.39	1.56	1.93	2.15
Spring deep band	2.21	1.53	1.65	1.97
Check	2.17	1.24	1.73	1.93

* Numbers refer to number of harvests and number of years data collected.

Another way to look at the data is to compare the total or cumulative yields over the three year period of study. These values are total yield of hay in tons per acre at 12.2% moisture. The Gay site was harvested four times during three years, the Jurica site was harvested twice, and the Griffin site was harvested nine times during the three year period. Total yields within a single site followed by the same letter do not differ significantly at the 5% level of probability, i.e., there is a 95% chance that the values are the same and the differences are due merely to randomness or chance.

Treatment	Cumulative Alfalfa Yield 1991-1994		
	Gay site	Jurica site	Griffin site
CHECK	6.92 abc	2.49 a	19.57 a
Fall knife w/o P	6.52 a	2.87 ab	20.68 ab
Spring knife w/o P	6.60 ab	3.07 bc	19.88 a
Fall knife P	7.04 abc	3.30 bc	22.52 b
Spring knife P	7.39 abcd	3.16 bc	21.75 ab
Fall broadcast P	7.54 bcd	3.38 bc	21.63 ab
Spring broadcast P	7.56 bcd	3.19 bc	21.38 ab
Fall surface band P	7.81 cd	3.14 bc	22.44 b
Spring surface band P	8.20 cd	3.00 bc	21.22 ab

Conclusion:

At all three sites, the response to Phosphorus additions was significant, relative to the check treatment. At all three sites, the physical operation of knifing the alfalfa stand caused a significant decrease in yield. Generally, the addition of Phosphorus during the knifing operation partially (but not completely) compensated for the yield reduction due to knifing operation. Over a three year period, the average response to a 300 pound per acre addition of P₂O₅ (approximately 170 pounds of P per acre) was 0.9 tons/acre, 0.7 tons/acre, and 2.1 tons/acre for the Gay, Jurica, and Griffin sites, respectively.

A simple little calculation exercise: If P₂O₅ costs \$0.25 per pound, then 300 pounds will cost \$75.00. You can add whatever delivery and application cost you wish, but our data suggest that the difference in response between methods of application varies from place to place or soil to soil. In any case, surface applications are best. At the Gay site, the Phosphorus addition would have been worth \$90 in alfalfa, at \$100 per ton. At the Jurica site, it would have been worth \$70; and, at the Griffin site, it would have been worth \$210. Now the question is: would have we gotten the same response with 100 pounds of P₂O₅ per acre? Don't know. Will we continue to get a response to the 1991-92 additions for another 3 years? Don't know. Does it pay to add 300 pounds of P₂O₅ per acre to established alfalfa? Well, at a high production site like the Griffin site, with water available for irrigation - Yes. Otherwise, I'd cut back on the rate and add less.