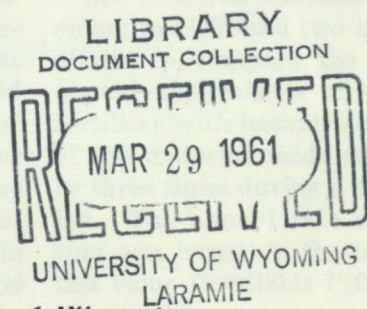


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Phosphate on Alfalfa  
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By L. I. Painter and Richard Kelley



University of Wyoming

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# *Heavy Applications of Phosphate on Alfalfa Compared with Repeated Light Applications*

*By L. I. Painter and Richard Kelley<sup>1</sup>*

 HOSPHATE FERTILIZATION of alfalfa for hay has become an accepted practice on the irrigated soils of Wyoming. The majority of the soils have been found to be relatively low in available phosphate (1, 3), and striking yield increases have resulted from the application of commercial phosphate fertilizer (2).

The quantity of phosphate needed to obtain optimum yields has been correlated to soil-test values for available phosphate and has appeared to be very reliable for making phosphate recommendations. Many farmers make annual applications of phosphate at the recommended rate but would prefer, from the standpoint of time and expense necessary for application, to make one or two relatively heavy applications of material which would maintain high yields for a desired period

of time. Generally, the amount of phosphate recommended by reference to the soil-test value is adequate to obtain 95 percent of the maximum yield possible for that year, but very little is known as to the residual or carry-over value of the material to the succeeding year. Evaluation of residual phosphate carry-over in other states has shown that the effect of a single heavy application may last for as long as seven years, depending upon the soil type and initial rate of application (4).

One test was established in Wyoming in 1955 and two in 1956 on alfalfa to compare the effect of annual applications of phosphate fertilizer with heavier applications of the material made once, twice, or three times during a 4-year period. The annual rate of application was based on the initial soil-test value (available  $P_2O_5$  extract-

<sup>1</sup>Professor of Soils and Former Supply Instructor in Agricultural Economics, respectively. Acknowledgment is made to Jay Partridge, Ned Case, and Wayne Anderson, Soil Technicians, University of Wyoming, for assistance in conducting this study. Phosphate fertilizer materials were supplied by the ANACONDA COMPANY and WESTERN PHOSPHATES, INC.

ed with 0.5 N  $\text{NaHCO}_3$ ) and was calculated to obtain 95 percent of the maximum obtainable yield. The other rates were selected to apply the same total amount of phosphate to the alfalfa in one, two, or three applications. The initial applications were made at the time of seeding, and subsequent treat-

ments were broadcast on the plot areas. Concentrated superphosphate, 42-48%  $\text{P}_2\text{O}_5$ , was used in all tests. The rates of application, dates of application, yields of alfalfa hay, and cost-return analyses of the data from the three trials are listed in Tables 1 through 6.

## Discussion

The total yield of alfalfa hay in the three tests was significantly increased by application of phosphate fertilizer. The method of applying the material, whether annually or in one, two, or three applications, did not affect the total yield of hay produced during the four-year period.

Analysis of the data for costs and returns per acre due to applied phosphate for the four-year study period showed that the most profitable practices were three 80-pound applications at Powell, one initial 320-pound application at Riverton, and three 120-pound applications at Laramie. All meth-

ods of application were profitable in the Powell test with hay selling at \$12.00 per ton, but none was profitable in the Riverton test with hay at the same price. Three applications of 120 pounds of  $\text{P}_2\text{O}_5$  per acre were profitable at Laramie with hay selling at \$15.00 per ton, but the other methods of application showed profit only with hay selling at \$20.00 per ton. All methods of application in the Riverton test were profitable with hay at \$15.00 per ton. Figure 1 illustrates the four-year return over cost from fertilizer at three price levels for hay at Powell, Riverton, and Laramie.

## Conclusions

1. Phosphate fertilizer significantly increased alfalfa hay yields in studies conducted for four years at Powell, Riverton, and Laramie, Wyoming.
2. Residual carry-over from the single heavy application made the first year of the studies maintained yields equal to the multiple applications.
3. The most profitable methods of applying phosphate to alfalfa

in the four-year study period were three 80-pound applications at Powell, one initial 320-pound application at Riverton, and three 120-pound applications at Laramie. *All methods* of application were profitable if the minimum price for hay was \$12.00 per ton in the Powell test, \$15.00 per ton in the Riverton test, and \$20.00 per ton in the Laramie test.

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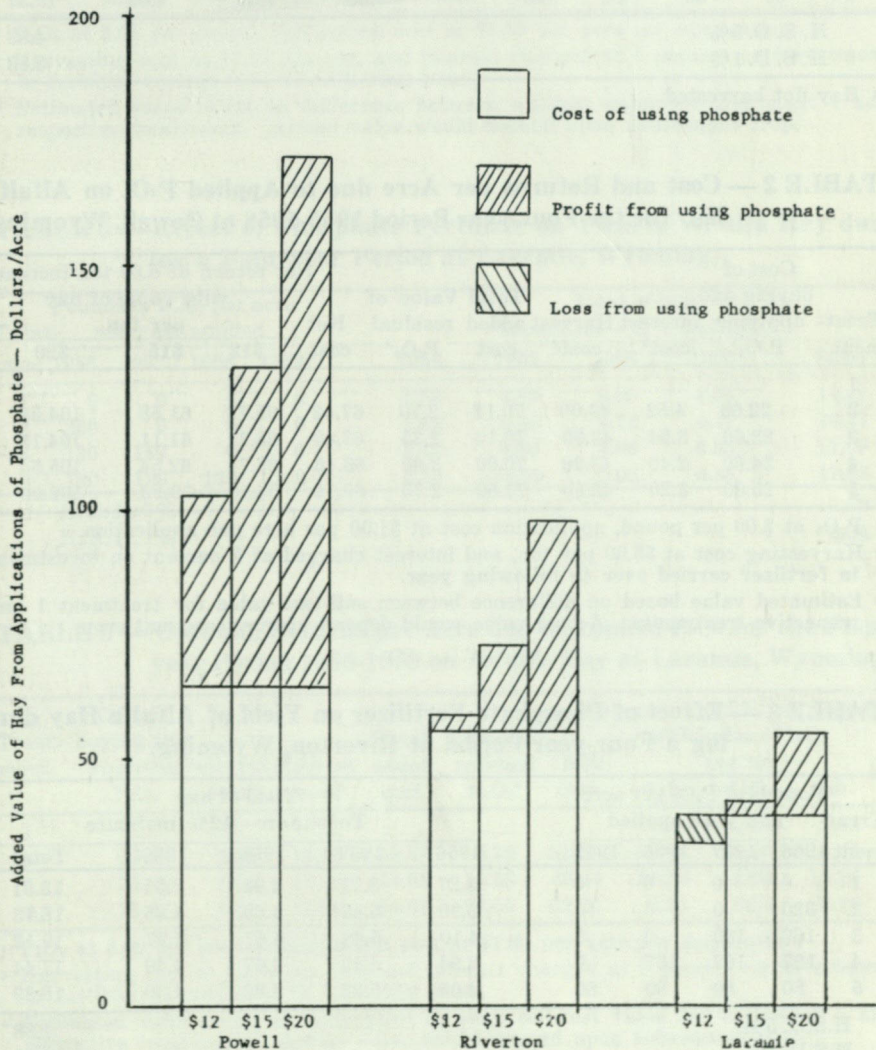


FIG. 1—Four-year return over cost from fertilizer at three price levels for hay at Powell, Riverton, and Laramie, Wyoming

**TABLE 1 — Effect of Phosphate Fertilizer on Yield of Alfalfa Hay during a Four-year Period at Powell, Wyoming.**

Treatment	Pounds of P <sub>2</sub> O <sub>5</sub> per acre and year applied				Yield of hay Tons/Acre—12% moisture				
	1955	1956	1957	1958	1955 <sup>1</sup>	1956	1957	1958	Total
1	0	0	0	0		4.42	3.85	2.61	10.88
2	240	0	0	0		7.18	7.94	3.60	18.72
3	120	0	120	0		7.82	8.27	4.16	20.25
4	0	80	80	80		6.79	8.42	4.39	19.60
5	60	60	60	60		7.66	7.66	4.05	19.37
H. S. D. 5%									4.83
H. S. D. 1%									5.83

<sup>1</sup> Hay not harvested.

**TABLE 2 — Cost and Returns per Acre due to Applied P<sub>2</sub>O<sub>5</sub> on Alfalfa Hay for the Four-year Period 1955-1958 at Powell, Wyoming.**

Treatment	Cost of buying and applying		Interest cost <sup>2</sup>	Harvest cost <sup>2</sup>	Total Value of added residual		Net return of 8.60 ton increase with value of hay per ton			
	P <sub>2</sub> O <sub>5</sub> <sup>1</sup>	cost <sup>2</sup>			cost	P <sub>2</sub> O <sub>5</sub> <sup>3</sup>	cost	Net cost	\$12	\$15
1	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
2	22.60	4.52	43.00	70.12	2.70	67.42	35.78	61.58	104.58	
3	23.60	3.54	43.00	70.14	2.25	67.89	35.31	61.11	104.11	
4	24.60	2.46	43.00	70.06	3.60	66.46	36.74	62.54	105.54	
5	25.60	3.20	43.00	71.80	2.70	69.10	34.10	59.90	102.90	

<sup>1</sup> P<sub>2</sub>O<sub>5</sub> at \$.09 per pound, application cost at \$1.00 per acre per application.

<sup>2</sup> Harvesting cost at \$5.00 per ton, and interest charged at 5 percent on investment in fertilizer carried over to following year.

<sup>3</sup> Estimated value based on difference between soil-test value for treatment 1 and respective treatments. Actual value would depend upon subsequent crop.

**TABLE 3 — Effect of Phosphate Fertilizer on Yield of Alfalfa Hay during a Four-year Period at Riverton, Wyoming.**

Treatment	Pounds of P <sub>2</sub> O <sub>5</sub> per acre and year applied				Yield of hay Tons/Acre—12% moisture				
	1956	1957	1958	1959	1956	1957	1958	1959	Total
1	0	0	0	0	3.27	3.71	4.02	2.51	13.51
2	320	0	0	0	3.90	5.49	4.69	4.65	18.73
3	160	160	0	0	4.10	5.38	4.67	4.97	19.12
4	107	107	107	0	3.94	4.43	4.67	4.40	17.44
5	80	80	80	80	4.05	5.22	4.82	4.30	18.39
H.S.D. 5%									1.88
H.S.D. 1%									2.38

**TABLE 4 — Cost and Returns per Acre due to Applied P<sub>2</sub>O<sub>5</sub> for the Four-year Period 1956-1959 on Alfalfa Hay at Riverton, Wyoming.**

Treatment	Cost of buying and applying and Interest Harvest				Total Value of added residual P <sub>2</sub> O <sub>5</sub> <sup>3</sup>	Net cost	Net return of 4.92 ton increase with value of hay per ton		
	P <sub>2</sub> O <sub>5</sub> <sup>1</sup>	cost <sup>2</sup>	cost <sup>2</sup>	cost			\$12	\$15	\$20
1	.....	.....	.....	.....	.....	.....	.....	.....	
2	29.80	5.96	24.55	60.31	1.80	58.51	0.41	15.14	39.69
3	30.80	5.39	24.55	60.74	0.99	59.75	-0.83	13.90	38.45
4	31.80	4.77	24.55	61.12	0.90	60.22	-1.30	13.43	37.98
5	32.80	4.10	24.55	61.45	0.45	61.00	-2.08	12.65	37.20

<sup>1</sup> P<sub>2</sub>O<sub>5</sub> at \$.09 per pound, application cost at \$1.00 per acre per application.  
<sup>2</sup> Harvesting cost at \$5.00 per ton, and interest charged at 5 percent on investment in fertilizer carried over to following year.  
<sup>3</sup> Estimated value based on difference between soil-test value for treatment 1 and respective treatments. Actual value would depend upon subsequent crop.

**TABLE 5 — Effect of Phosphate Fertilizer on Yield of Alfalfa Hay during a Four-year Period at Laramie, Wyoming.**

Treatment	Pounds of P <sub>2</sub> O <sub>5</sub> per acre and year applied				1956	Yield of hay Tons/Acre—12% moisture				Total
	1956	1957	1958	1959		1956	1957	1958	1959	
1	0	0	0	0	1.38	4.89	4.09	4.06	14.42	
2	360	0	0	0	1.82	5.46	4.72	4.47	16.47	
3	180	180	0	0	2.10	5.80	4.86	4.33	17.09	
4	120	120	120	0	2.13	5.86	5.02	4.85	17.86	
H. S. D. 5%									1.52	
H. S. D. 1%									2.04	

**TABLE 6 — Cost and Returns per Acre due to Applied P<sub>2</sub>O<sub>5</sub> for the Four-year Period 1956-1959 on Alfalfa Hay at Laramie, Wyoming.**

Treatment	Cost of buying and applying and Interest Harvest				Total Value of added residual P <sub>2</sub> O <sub>5</sub> <sup>3</sup>	Net cost	Net return of 2.72 ton increase with value of hay per ton		
	P <sub>2</sub> O <sub>5</sub> <sup>1</sup>	cost <sup>2</sup>	cost <sup>2</sup>	cost			\$12	\$15	\$20
1	.....	.....	.....	.....	.....	.....	.....	.....	
2	33.40	6.68	13.60	53.68	0.72	52.96	-20.32	-12.16	1.44
3	34.40	6.02	13.60	54.02	10.58	43.44	-10.80	-2.64	10.96
4	35.40	5.31	13.60	54.31	22.05	32.26	0.38	8.54	22.14

<sup>1</sup> P<sub>2</sub>O<sub>5</sub> at \$.09 per pound, application cost at \$1.00 per acre per application.  
<sup>2</sup> Harvesting cost at \$5.00 per ton, and interest charged at 5 percent on investment in fertilizer carried over to following year.  
<sup>3</sup> Estimated value based on difference between soil-test value for treatment 1 and respective treatments. Actual value would depend upon subsequent crop.

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