Phosphated Alfalfa Feed-Value

preliminary studies made of feeding value of alfalfa hay from phosphate fertilized soils of the Imperial Valley

N. R. Ittner, V. V. Rendig, R. S. Ayers, and Wm. C. Weir

That cattle and sheep make poor gains on alfalfa hay from unphosphated soil has been a general belief among farmers in Imperial County.

They have demonstrated that the application of phosphorus to Imperial Valley soils resulted in marked increases in the yield of alfalfa hay. Today it is difficult to find a field of alfalfa in the Valley that shows a significant yield increase because of phosphate fertilization.

The amount of phosphorus which alfalfa hay must contain to give maximum gains in livestock was the unknown factor studied in preliminary tests to learn more about the relationship of phosphorus fertilization and animal performance.

In the first of three tests alfalfa hays from adjoining checks were compared in a feeding trial. One check had not been fertilized for seven years and phosphate fertilizer applied the fall of the sixth year—to a small portion of this check—gave yield increases from 30% to 60% during the spring months of the seventh and eighth years. The hay obtained from the nonfertilized remainder of this check contained 0.19% phosphorus and—for the test—was considered as the low-phosphorus hay.

The other check had been fertilized annually and had a heavy application of 175 pounds P_2O_5 per acre as superphosphate the fall before the hay used for this test was grown. This hay contained 0.24% phosphorus and is referred to as high-phosphorus hay.

The two hays were fed to two lots of five Hereford steers. The animals did not receive any other feed except salt and water.

In this test, the animals on the high-phosphorus hay gained 1.80 pounds while those on the low-phosphorus hay made 1.55 pounds gain per head per day during the 96-day test period.

Feed consumption was almost identical and the amount of feed required to produce 100 pounds of gain was 13% greater for the low-phosphorus hay than for the high-phosphorus lot. The differences in gain or in feed required per 100-pound gain were not statistically significant because of the variation of individual animals within the lots.

The blood phosphate level of the steers was checked periodically as an indicator of the phosphorus nutrition of the animals. At the start of this test, the average value for all steers was 7.74 mg.—milligram—per 100 ml.—milliliter—serum. This value did not change appreciably during the course of the trial.

Composition of the Two Lots of Alfalfa Hay Fed to Steers in Second Feeding Trial*

	Low P alfalfa hay	High P alfalfa hay
	%	%
Calcium	4.94	1.43
Magnesium	0.42	0.27
Potassium	1.87	3.08
Sodium	0.15	0.25
Chloride	0.24	1.30
Sand	6.04	0.76

* Analyses made by Dr. D. G. Aldrich, Jr., Citrus Experiment Station, Riverside.

As the results of the first test were inconclusive, a second test was conducted using hays with a much greater difference in phosphorus content. The low-phosphorus hay for the second trial came from virgin land that had never been phosphated; this hay contained 0.10% phosphorus. The high-phosphorus alfalfa, grown at the University of California's Imperial Valley Field Station, had been fertilized annually and contained 0.25% phosphorus.

In this 91-day feeding test, there was a wide difference in the rates of gain. The animals receiving high-phosphorus hay gained 2.19 pounds per head per day as compared to 0.53 pound for the steers on the low-phosphorus alfalfa hay. The animals on the low-phosphorus hay consumed about half as much as the other group and scoured considerably throughout the experiment.

The average blood serum phosphate of the steers fed the low-phosphorus hay on this second trial dropped from an initial value of 8.15 mg. to 4.79 mg. per 100 ml. of serum at the close of the trial.

The low-phosphorus hay graded U. S. No. 1 extra leafy while the high-phosphorus hay had a grade of U. S. No. 2 leafy, so—in this case—the grade did not indicate the feeding value of these two lots of hay.

As these two hays had been grown under very different soil conditions, chemical analyses revealed marked differences in composition other than phosphorus content.

To determine if the important difference was due entirely to the phosphorus content, a third test was conducted.

Using the same hays, sufficient disodium phosphate was added to the low-phosphorus hay so that the percentage of phosphorus in the ration was the same as that for the lot fed the high-phosphorus hay. There was no change in food intake or rate of gain; both of these were about the same as those in the second experiment. The average blood phosphate level of the lot fed the unfertilized hay and phosphate supplement changed from the average of 4.79 mg. to 8.28 mg. during the 27 days of the test.

Although the three studies are too limited to be used as a basis for any definite conclusions, the data obtained indicated:

1. The grades of alfalfa hay are not always indicative of their feeding value.

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Results of Feeding Trials Using Hereford Steers Fed Alfalfa Hay Containing Different Levels of Phosphorus, 1952

	First test		Second test	
	High P alfalfa hay Jan. 4–Apr. 9 96 days	Low P alfalfa hay Jan. 4–Apr. 9 96 days	High P alfalfa hay Apr. 17–July 17 91 days	Low P alfalfa hay Apr. 17–July 17 91 days
No. of animals*	5	5	5	5
Av. initial wt.	391	392	543	558
Av. final wt.	564	541	743	606
Av. daily gain	1.80	1.55	2.19	0.53
Per cent P in hay	0.24	0.19	0.20	0.10
Av. daily feed alfalfa hay	14.86	14.51	20.58	11.24
Feed/100 lb. gain alfalfa hay	826	936	940	2130

* The same animals were used in both tests. At the start of the second test they were regrouped on the basis of gains made in the first test.

MILK

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on a per-pound-fat basis, it is believed that such rates treat high and low fat producers inequitably and that hauling rates should be related to pounds of whole milk—or cans of whole milk—and not to pounds of milk fat.

This section deals with procedures that might be employed in establishing the Class I prices for milk fat and for the skim milk. However, the previous developments might be used in the pricing of surplus over Class I.

Accepting the established base price for 100 pounds of milk of 3.8% fat test, the price schedule for other tests of milk must be determined.

Fluid milk operations are different from plant to plant because of the diversity in the composition of output. This variability prevents one from employing a simple net-value approach to the Class I pricing problem. Consequently, one must seek some economic factors in the dairy industry which might be employed as indicators of the values of milk fat and skim milk in Class I uses. Two procedures of approaching this problem are given in the table on this page.

The first procedure assumes that the relative prices of all dairy products tend to remain fairly stable through utilization shifts and that the relative values of fat and skim milk in some other alternative dairy operation should be a fair indicator of the relative values of these components in fluid uses. The relative values of these two components could be determined for milk of 3.8% fat test when used as an alternative dairy operation and then applied to the basic Class I whole milk price to determine separate values for Class I fat and skim milk in 100 pounds of base test milk. Prices per pound of Class I fat and skim milk would be secured by dividing the latter values by the 3.8 and 96.2 pounds of fat and skim milk in a hundredweight of 3.8% milk, respectively.

If the nonfat solids content of the skim milk should be reflected in the Class I skim milk price, then the skim milk price should be converted to a nonfat solids value. The conversion factor would be $^{96.2}/_{8.76}$. This value could be applied to the nonfat solids content of skim milk at other fat tests to secure the entire Class I whole milk pricing schedule.

If, on the other hand, the value of skim milk for Class I uses is not affected by differences in nonfat solids content, then the initial component prices should be applied directly to the amounts of fat and skim milk per 100 pounds of whole milk to get the Class I pricing schedule.

The second procedure recognizes that sanitary and institutional barriers in the Grade A market as well as fairly rigid Class I product prices relative to other dairy products tend to reduce the validity of the first procedure. The second procedure employs a price indicator in the Grade A market which is free of administrative pricing and, consequently, should reflect distributor evaluations in a market area. This indicator is the Grade A jobbing price for 40% cream. Legally and physically, it has the same components as Class I whole milk except that the proportions are different. Consequently, if one adjusts this cream price back to a plant-entry level by making allowances for physical losses and processing costs, this adjusted cream price can be used with the basic 3.8% whole milk price established by the Bureau of Milk Control in conjunction with the differing fat and skim milk percentages for the two products to secure Class I prices for fat and skim milk. With allowances for locational differences from the areas where the cream prices are quoted, this procedure could be adjusted to meet geographic pricing problems.

James B. Hassler is Instructor in Agricultural Economics, University of California, Berkeley.

D. A. Clarke, Jr., is Assistant Professor of Agricultural Economics, University of California, Berkeley.

Class I Prices for Fat and Skim Milk Components of Whole Milk (General Results)

Item	Procedure 1* skim milk differentiated	Procedure 1* Skim milk not differentiated	Procedure 2
Fat price (P_f) per pound	$\frac{P_{3.8}(RV_f)}{3.8}$	$\frac{P_{3.8}(RV_f)}{3.8}$	$\frac{96.2V_{40} - 1.5P_{3.8}}{90.5}$
Skim milk price (P_s) per pound		$\frac{P_{3.8}(RV_n)}{96.2}$	$\frac{P_{3.8} - 3.8V_{40}}{90.5}$
Class I Nonfat solids price (P_n) per pound	$\frac{P_{3.8}(RV_n)}{8.76}$		
BFD	$.1P_f + .044P_n$	$.1P_f - .1P_s$	$.1P_f - .1P_s$

* The butter-dry nonfat solids operation is the alternative considered here. Any other alternative operation could be employed.

$RV_f + RV_n = 1$, means (Relative value of fat) + (Relative value of nonfat solids) = 1.

$$RV_f = \frac{4.55(P_b - C_b)}{4.55(P_b - C_b) + 8.85(P_n - C_n)} = \frac{\text{net value of butter}}{\text{net value of butter} + \text{net value of nonfat solids}}.$$

V_{40} is the 40% cream price expressed on a per pound of fat basis and adjusted for plant losses and processing costs.

$P_{3.8}$ is the base Class I price per hundredweight of whole milk.

ALFALFA

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2. The average rate of gain of a group of steers fed alfalfa hay containing 0.24% phosphorus grown on a soil which had been phosphate fertilized was slightly greater than a similar group fed unfertilized hay containing 0.19% phosphorus, but the difference was not statistically significant. The yield response obtained by phosphate fertilization had indicated that this soil was moderately deficient in phosphorus.

3. Alfalfa hay grown on an extremely phosphate-deficient soil and containing 0.10% phosphorus—when free-fed to steers—can significantly lower the blood phosphate level.

4. The unpalatability of the hay and poor rate of gain of the steers fed this particular hay of extremely low-phosphorus content was not corrected by supplemental feeding of phosphate salt for 27 days.

Additional information is needed to show whether this is a problem of phosphorus requirement of the animals or whether secondary factors such as palatability are involved.

N. R. Ittner is Associate Specialist and Imperial Valley Field Station Superintendent, University of California.

V. V. Rendig is Assistant Soil Chemist, University of California, Davis.

R. S. Ayers is Farm Advisor, Imperial County, University of California.

Wm. C. Weir is Assistant Professor of Animal Husbandry, University of California, Davis.

Average Phosphate Phosphorus Content of Blood Serum from Steers Fed Alfalfa Hay Varying in Phosphorus Content. Phosphorus Expressed as Milligrams per 100 Milliliters of Serum

	First test 96 days Start	First test 96 days End	Second test 96 days Start	Second test 96 days End	Third test 96 days Start	Third test 96 days End
High P hay lot	8.07	8.80	8.13	7.32	7.32	6.90
Low P hay lot	7.53	7.46	8.15	4.79	4.79	8.28