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RESULTS OF NINE YEARS OF MEADOW FERTILIZATION IN MODOC COUNTY

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Summary

Most Modoc meadows respond well to fertilization. Trial results show the following:

1. Surprise Valley area-200-300 lbs. Ammonium Sulfate per acre increases yields 1½-2 tons. May need phosphate under some conditions.
2. Alturas area-200-400 lbs. Ammonium Sulfate per acre increases yields 1¼-2 tons. No phosphate needed.
3. Likely-Jess Valley area-Best results from a nitrogen-phosphate mixed fertilizer such as 16-20-0. Best rate not firmly established. Up to 200 lbs. per acre 16-20 has yielded profitably.
4. Canby-Adin-Davis Creek-Limited number of trials show Ammonium Sulfate at 200-300 lbs. per acre to increase yields 1½ tons per acre.

Introduction

Trials in Modoc County since 1953 show that native meadows need nitrogen (N) and in some cases nitrogen plus sulfur (S). The combination of nitrogen and phosphorous (P) is beneficial in some locations.

This circular discusses the following:

1. Effects of rate and kind of fertilizer on hay yields,
2. Hay quality(crude protein content) as related to stage of plant maturity and fertilizer use,
3. Economics of fertilization,
4. Effects of fertilizer on clover,
5. Time of fertilizer application.

Only one dollar figure is used, profit per acre from fertilizer. This is determined by subtracting the fertilizer cost from the value of increased hay per acre. Values used are as follows:

a. Hay-$15.00 per ton,

b. Ammonium Sulfate-(21% N, 24% S) $54.50 per ton,

c. 16-20-0 (16% N, 20% P, plus 12% S) $80.00 per ton,

d. Ammonium Nitrate-(33½% N) $92.00 per ton,

e. Application per acre costs are as follows:

$1.00 per acre to apply 100-200 lbs.

$1.50 per acre to apply 300-500 lbs.

$2.00 per acre to apply over 500 lbs.

Cost of harvesting the increased hay has not been subtracted from the profit figure. Because haying costs vary from ranch to ranch, a profit figure with haying costs deducted is omitted.

Effects of Fertilizer on Hay Yields

Table I (Page 10) presents results of 5 fertilizer trials conducted in Surprise Valley. Dollar for dollar, ammonium sulfate has given better results than either 16-20-0 or ammonium nitrate. One exception occurred, that in the Talbot trial (now R. A. Westbrook) near Ft. Bidwell. However, no data exists for rates of 16-20 above 100 lbs. of ammonium sulfate per acre in that immediate locality.

Trial results show that 200-300 lbs. of ammonium sulfate per acre will profitably increase hay yields $1\frac{1}{2}$ to 2 tons per acre over unfertilized meadows in Surprise Valley.

Results from six fertilizer trials conducted near Alturas are shown in Table II (Page 11). In addition to nitrogen fertilizers, superphosphate and gypsum have also been tested, but with uneconomic results in most instances. In one case, in a Weber trial in 1956, superphosphate at a high rate did substantially increase hay yields. However, soil tests in the Alturas area show no lack of soil phosphate.

Neither urea nor aqua ammonia have given better responses than ammonium sulfate. Other trials indicate that ammonium sulfate will give equal or better results from 16-20-0.

So, from both a cost and return standpoint, up to 80 lbs. of nitrogen per acre (400 lbs. ammonium sulfate) will profitably increase hay yields in the Alturas area.

While a number of trials have been conducted in the Likely area, the four in Table III (Page 12) show typical results. Apparently, nitrogen and phosphorous are both needed for maximum hay yields in the Likely area. Ammonium sulfate does increase yields but not to the degree of the increases with 16-20.

Also, 16-20 appears to encourage growth of more clover than ammonium sulfate and consequently a higher quality hay.

Table IV (Page 13) presents results from the yield trials conducted in the Davis Creek, Canby and Adin areas. In both the Davis Creek and Canby areas, nitrogen alone is needed for best growth.

Economical increases should be obtained using a rate of 60-80 lbs. of nitrogen per acre (equivalent to 300-400 lbs. of ammonium sulfate).

The Nash and Kresge trial results in the Adin area conflict. However, because of the great economic advantage of ammonium sulfate over 16-20 in the Kresge trial and because soil tests show adequate soil phosphate, a nitrogen fertilizer such as ammonium sulfate will supply nutrients for maximum yields.

Rates of 200-400 lbs. of ammonium sulfate (40-80 lbs. N per acre) will give optimum yields. One exception was noted at Kresge's;in heavy clover areas, fertilizer shows no results. Probably clover was providing ample nitrogen for the grass through nitrogen fixation.

Fertilizer Effects on Clover

It is well recognized that clover in meadow hay adds feed value. However, how best can you maintain good stands of clover? This question, as yet, has no conclusive answer.

Clover thrives best in damp, well drained meadows when temperatures are warm and abundant light is available. In other words, a cold, dry, cloudy Spring does not encourage clover growth.

How about fertilizer? In a few trials where clover content has been measured only two showed clover increased when using either ammonium sulfate or 16-20-0. Other trials showed a depressing effect in clover.

In the Likely area, if clover is present, 16-20 will probably maintain it; ammonium sulfate will decrease it. A trial at Ben Cambron's, Eagleville, comparing nitrogen with and without sulfur and phosphorous,showed that clover did not need phosphorous and was not affected by other fertilizer combinations. However, not over 40 lbs. of N (200 lbs. of ammonium sulfate) was applied. At higher rates of N, grass

may have been stimulated more than clover.

An example of what fertilizer can do to clover content is given in Table V.

Table V

Effects of Fertilizer on Clover Percentage

Fertilizer	Fee Trial (Ft. Bidwell)	Weber Trial (Alturas)	1960 Rice Trial (Alturas)
None	21.6%	15.4%	17.5%
100 lbs. ammonium sulfate	17.5%	2.0%	
200 " " "	5.7%	trace	
400 " " "	7.4%	trace	6½%
800 " " "	3.5%	trace	
500 lbs. 16-20-0	6.3%		6½%
400 " Single Superphosphate			26%
400 " Treble			25%

Notice that addition of even 100 lbs. of ammonium sulfate decreased clover percentage. Whether this means that clover is lacking an essential plant nutirent or that it just could not compete is not known. Most probably, grass was stimulated by nitrogen and clover could not compete with it for light and sulfur, an element needed by legumes.

Without nitrogen fertilizer, as in the Rice trial results with superphosphate, clover did not have grass competition and could grow at its maximum. Nevertheless, yields were only increased .1 ton per acre with phosphate.

As yet no definite conclusions, regarding fertilizer effects on clover, have been made. In all likelihood, site differences, such as surface drainage, earliness of irrigation and temperature will affect clover population more than fertilizer.

What Affects Protein Content??

High protein hay means high feed value hay. The amount of protein is influenced by the stage of maturity at which hay is cut and by the kind of plants in the stand.

As plants mature, protein content goes down. Plants such as timothy, smooth brome, redtop and clovers contain more protein than sedges or rushes at early growth stages. However, as maturity advances, the good grasses and clovers lose protein at a more rapid rate than do sedges and rushes. Then, at maturity, sedge hay generally contains more protein than grass hay.

On three ranches in 1961, hay was cut 3-4 weeks earlier than normal and protein content analyzed. Of course, production was less in June, 60-75% of the July yeilds. However, yields of over 2 tons per acre were achieved using fertilizer.

In general, protein content was not increased until over 80 lbs. of nitrogen per acre were added, regardless of whether hay was cut in June or July. Table VI shows the protein content of June and July-cut hay comparing fertilizer rates of 0 to 80 lbs. N and 160 lbs. N per acre.

Table VI

Crude Protein Per cent as Affected by Date of Cutting and Amount of Fertilizer

	Average all County Samples	J. Weber Trial (Alturas)	L.J.Fee Trial (Ft.Bidwell)	R. Flournoy (Likely)
June-cut 0-80 lbs. N	11.8%	12.7%	11.1%	11.1%
July-cut 0-80 lbs. N	7.5%	8.9%	8.0%	8.7%
June-cut 160 lbs. N		14.7%	11.9%	11.6%
July-cut 160 lbs. N		9.8%	7.4%	9.7%

What does this mean? Early-cut hay contain from 30% to 50% more crude protein than normal-cut hay, but hay yields only 60% to 70% as great in July.

Fertilizer can increase crude protein content but rates over 80 lbs. N per acre (400 lbs. ammonium sulfate) are needed to do it.

How Does Fertilizer Affect Aftermath?

Limited information during 1960 and 1961 from the Weber ranches, Alturas, shows that rates of 400 lbs. of ammonium sulfate or more are needed to encourage aftermath growth above that of no fertilizer.

Fig. 1 shows amount of aftermath in tons per acre following 2 haying dates using varying rates of ammonium sulfate.

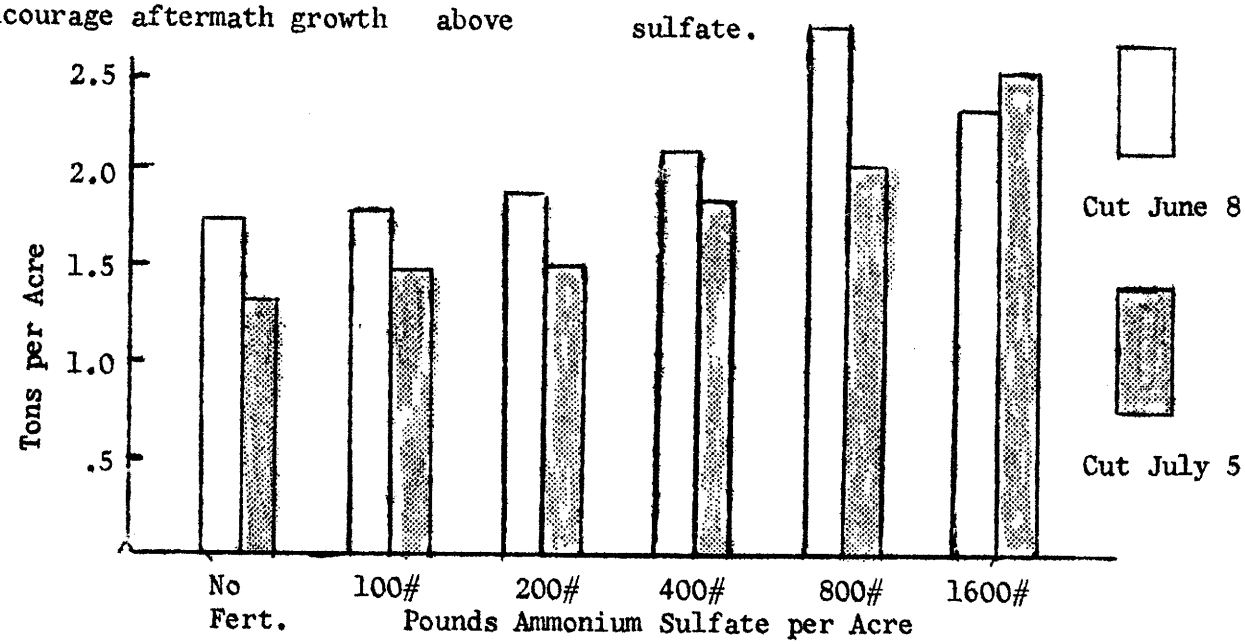

Fig. 1. Aftermath yields cut September 1, 1961 following haying on June 8 and July 5, John Weber Ranch, Alturas.

What this graph does not show is that aftermath following June haying was ready to graze during early July. Trials at Ft. Bidwell and Likely confirmed this observation. Notice that aftermath yields following the July haying do not increase until the 400 lb. rate of ammonium sulfate. In other words, it took almost 400 lbs. of ammonium sulfate to produce the initial hay crop.

Protein content on September 1, averaged about 12% in the July aftermath and about 11% in the June aftermath. There was only a slight tendency for heavily fertilized aftermath to be of higher protein content.

Another trial in 1960 compared

1000 lbs. ammonium sulfate with 100 lbs. per acre. Aftermath in December was 1 3/4 tons for the 1000 lb. rate compared to 1.2 tons for the low rate. Cattle utilized 88% or over $1\frac{1}{2}$ tons per acre in the heavy rate area and only 60% or about .7 ton eaten on the low rate plot. The forage from the 1000 lbs. per acre plot had 7.5% crude protein compared to 6.3% for the 100 lbs. plot.

Time of Fertilization

Fertilizer applied in Spring appears to give better results than that applied in Fall.

A trial at Bud Williams, Likely, compared January, February and March time of application. February and March appeared better than January. Many ranchers combine fertilizer application and dragging meadows into one operation.

Table I---Yields and Returns From Surprise Valley Fertilizer Trials

Fertilizer Per Acre	L.Fee-1961 (Ft. Bidwell)		H. Talbot-1958 (Ft. Bidwell)		K. Heard-1953 (Lake City)		L. Cockrell-1953 (Lake City)		J. Grove-1953 (Eagleville)		Average	
	Tons Hay Per Acre	Profit Per Acre	Tons	Profit	Tons	Profit	Tons	Profit	Tons	Profit	Tons	Profit
None	2.27		1.0		2.44		1.51		2.78		2.0	
100 # Ammonium Nitrate							1.75	Neg.	3.83	$10.15	2.29	
200 # Am. Nit.							2.14	Neg.	4.55	$16.35	3.35	
300 # Am. Nit.							2.86	$5.00	4.43	$9.45	3.64	$7.20
100 # Am. Sulf.	3.04	$7.82	1.65	$6.00	3.54	$12.77	1.92	$2.42	4.40	$20.57	2.91	$9.90
200 # Am. Sulf.	3.49	$11.84	2.3	$13.00	4.76	$28.34	2.28	$5.09	4.66	$21.74	3.82	$16.00
300# Am. Sulf.					3.76	$10.14	2.85	$10.44	5.30	$28.14	3.97	$16.24
400 # Am. Sulf.	3.85	$11.28									3.85	$11.28
800 # Am. Sulf.	4.61	$11.26									4.61	$11.26
1600 # Am. Sulf.	4.54	Neg.									4.54	Neg.
100 # 16-20-0			2.5	$17.50	4.07	$19.45	2.75	$13.60	3.88	$11.50	3.4	$15.50
200 # 16-20-0					4.12	$16.20	2.32	$3.15	4.50	$16.80	3.65	$12.05
300 # 16-20-0					4.55	$18.15	2.62	$3.15	5.03	$20.25	4.07	$13.85
500 # 16-20-0	3.64	Neg.									3.64	Neg.

Table II----Yields and Returns From Alturas Fertilizer Trials

Fertilizer Per Acre	Bayley Dorris (1956)		Randall Collis (1953)		J--D (1954)		J--D (1961		Jack Rice (1960)		Jack Rice (1961)	
	Yield	Profit Per Acre	Yield	Profit	Yield	Profit	Yield	Profit	Yield	Profit	Yield	Profit
None	1.0		3.1		.9		1.43		2.11		2.3	
100 # Am. Sulf.			3.78	$6.47	2.0	$12.77	1.78	$1.52				
200 # Am. Sulf.			4.35	$12.24	2.3	$14.54	2.37	$7.64				
300 # Am. Sulf.			5.2	$21.54								
400 # Am. Sulf.							3.18	$13.83	3.66	$10.80	3.6	$7.00
800 # Am. Sulf.							3.97	$14.26				
1600 # Am. Sulf.							4.38	Neg.				
100 # Urea					1.9	$8.50						
200 # Urea					2.0	$4.50						
500 16-20									3.5	$3.50	3.85	$1.75
32 # N(Aqua Ammonia)	1.7											
65 # N(Aqua Ammonia)	1.7											

Table III Yields & Returns From Likely-Jess Valley Fertilizer Trials

Fertilizer Rate	Walter Cantrall (1953)		Walter Cantrall (1954)		Warren Flournoy (1954)		Rob Flournoy (1961)	
	Yield	Profit Per Acre	Yield	Profit	Yield	Profit	Yield	Profit
None	1.77		.9		1.4		1.78	
100 # 16-20	3.33	$18.40	1.8	$8.50	1.8	$1.00		
200 # 16-20	3.4	$15.45	2.2	$10.50	1.9	Neg.		
300 # 16-20	3.7	$15.45	2.3	$7.50	2.5	$3.00		
500 # 16-20							3.57	$7.35
100 # Am. Sulf.	3.1	$16.22			1.5	Neg.	1.78	Neg.
200 # Am. Sulf.	2.26	$1.00			1.7	Neg.	1.93	Neg.
300 # Am. Sulf.					2.7	$9.90		
400 # Am. Sulf.							2.47	Neg.
800 # Am. Sulf.							2.7	Neg.

Table IV Yields and Returns From Davis,Creek, Canby, Adin Fertilizer Trials

Fertilizer Per Acre	C.M. Bishop Davis Creek (1953)		E. W. Caldwell Canby (1953)		John Nash Adin (1953)		Marcel Kresge Adin (1961)	
	Yield	Profit Per Acre	Yield	Profit	Yield	Profit	Yield	Profit
None	2.26		1.7		1.53		2.19	
100# Am. Nitrate	4.05	$21.40	3.86	$26.80	3.02	$16.90		
200# Am. Nit.	5.52	$38.70	4.1	$25.80	3.19	$14.20		
300# Am. Nit.	6.4	$46.80	3.21	$ 7.30	3.38	$12.45		
100# Am. Sulf.	3.44	$13.97	3.8	$27.63	2.62	$12.62	2.62	$2.72
200# Am. Sulf.	4.67	$26.69	3.8	$25.04	3.24	$19.20	2.98	$5.39
300# Am. Sulf.	5.05	$32.19	4.25	$28.59	3.64	$22.00		
400# Am. Sulf.							3.72	$10.53
100# 16-20	4.35	$26.35	2.93	$13.45	3.6	$26.05	2.62	$ .45
200# 16-20	4.92	$20.90	3.21	$13.65	3.6	$22.35	3.19	$4.00
300# 16-20	5.22	$30.90	4.5	$28.50	3.74	$19.65		
500# 16-20							3.14	$ .25