AGE 14410

Results and Expected Responses to Fertilizer Applications on Glenn County Rangeland

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It has been obvious to stockmen for a long time that animal droppings would increase the growth of range feed. However, applications of commercial fertilizer to rangeland is a comparatively recent practice.

Early in the 1950s, commercial fertilizer was tried on experimental plots in Glenn County. The preliminary results led to a large-scale fertility experiment on the Nye Ranch conducted by Glen Eidman, farm advisor, and W. E. Martin and L. J. Berry, Extension Soil and Range Specialists respectively, in cooperation with ranch owner Bill Sevier and commercial fertilizer suppliers.

In this grazing test, three fields were set up. One remained unfertilized for a control, a second received urea and triple superphosphate every other year and the third field received only urea every other year. Cattle were weighed in and out of each field and numbers were adjusted to utilize the available feed.

The results are shown in Table I. The pounds of beef produced per acre tripled from 27 lbs. on the control to 94 lbs. on the fields the first year of fertilization and to 47 lbs. on the carry-over years. Cost of fertilizing, including air application, ranged from $10.00 to $13.50 per acre.

Each pound of fertilizer nutrient produced more than an extra pound of beef for a cost of about 10¢ per extra pound of beef. This compares favorably with the statewide results shown in Table II. In these trials, fertilizer on range doubled grazing days per acre and tripled beef produced per acre for from 11.3 to 16.4 cents per pound extra beef. Current fertilizer and application costs are lower than during the study period.

Since this early experiment, several test plots and demonstrations have been conducted in the county. A series of these plots is a part of a statewide Soil Vegetation Survey being conducted cooperatively by the University of California, California Division of Forestry and the Pacific Southwest Forest and Range Experiment Station. Small fenced plots were established on major range soils in Glenn County, Sehorn, Millsholm, Newville and Lodo. Nitrogen, phosphorus and sulfur alone and in combination were tested. Besides dry matter yield, plant species counts were taken to determine the effect of fertilizer treatment on species composition. Figure I shows the general locations of these soils and Table III describes some of the soils. These soils vary in type, slope and association and these factors naturally affect their production.

Table IV gives some results of the Sehorn plot. Several important facts are evident.

(1) Elemental sulfur alone or with phosphorus stimulated the bur clover for several years.

(2) Under ungrazed conditions, high rates of nitrogen practically eliminated bur clover.

(3) Response to sulfur and to sulfur and phosphorus was nil where bur clover was not present.

Soil/Fert. Field Day

1/10/67

Other plots on Sehorn soil as well as those on Millsholm, Newville and Lodo have shown nitrogen to be most limiting, followed by sulfur, then phosphorus. They also confirmed the premise that a responsive legume must be present and have reasonably favorable growing conditions to take full advantage of sulfur or sulfur and phosphorus applications. Most Lodo and Newville soils do not have a high producing native legume; therefore, a legume such as rose clover, sub clover or Woolypod vetch must be established before sulfur and phosphorus applications are economical.

Applications of nitrogen start grasses and forbs growing faster. The response is not dependent upon the presence of a few species. However, growing conditions can greatly alter the magnitude of the response. Also, some weeds respond as well as desirable plants. Two to six times as much dry matter was produced on nitrogen-fertilized rangeland compared to the control, the greater response being on the poorer sites, resulting in comparable total dry matter yields with fertilization. In most years the nitrogen will not carry over, but sulfur and phosphorus will stimulate legumes for several years. During a two-year period we can conservatively expect twice as much feed or 1-1/2 tons more of dry feed for $6.00/ton when 300 lbs. per acre ammonium sulfate is applied.

In years of scarce or high priced hay, the early growth of fertilized grass is especially valuable.

Sulfur is an inexpensive nutrient and also is part of our least expensive nitrogen source for range - ammonium sulfate.

The sulfur in gypsum and in ammonium sulfate is soluble and readily available to plants. It also can be lost by water run-off. Elemental sulfur is not soluble but must be oxidized by soil micro-organisms to sulfate sulfur before it is available to plants; therefore, it will carry over in the soil for several years. The rate of oxidation is dependent upon moisture, temperature and sulfur particle size. To insure availability of elemental sulfur the first year, it should be sixty mesh or finer. And as mentioned previously, a responsive legume such as bur clover must be present to benefit from sulfur fertilization. There is some indication that some elemental sulfur can be lost through volatilization.

One hundred pounds per acre fine elemental sulfur has resulted in 50% more dry matter than control areas or 1000 pounds of dry feed per acre per year for three out of four years for $3.00/ton.

Phosphorus is the third most limiting nutrient on most Glenn County range soils.

Applications of phosphorus will become more economical when (1) ranges are fertilized continually; (2) commercial sources of phosphorus become less expensive relative to land values; and (3) higher producing legumes are established on some soils. A sample of the soil should be tested before applying phosphorus.

Total dry matter production is not the only benefit of range fertilization. The fertilized feed is more palatable whether it is green or dry. The protein content of grass is increased by nitrogen fertilization, but the protein of all the feed may be reduced because of a reduction of legumes. First year or carryover response to sulfur and sulfur and phosphorus increases the protein of the feed primarily by increasing the percentage legumes. This is especially important if feed is utilized dry. Green feed is already adequate in protein. In some years it is possible to cause a bloat situation or increase the incidence of Enterotoxemia by stimulating the clover.

On several areas we have increased the stand as well as the growth of bur clover and apparently enabled it to persist where it otherwise would not. Increasing palatability directly or by changing the plant species present is a good way to open up and utilize weedy ranges.

Fertilizing will enable some operators to take a high yielding, high quality native hay crop off open land.

There may also be a reduction in sheet erosion and slips due to increased plant density and vigor.

Ranges may be fertilized by air or ground rig for $.50 to $1.50 per acre.

SUMMARY AND RECOMMENDATIONS

Fertilizing can increase feed quality and palatability, resulting in more uniform and efficient use of green or dry range feed. Fertilization can stimulate feed growth during cold weather, thus saving some expense of supplemental feeding.

If you run cattle or sheep on bur clover ranges west of Willows, apply 300 lbs. per acre ammonium sulfate every three to four years or 100 lbs. fine elemental sulfur per acre every five to six years. You are losing potential income every year you wait.

Livestock operators on gravelly hill ranges west of Orland or ranches west of the Newville, Elk Creek, Stonyford road should check with the Farm Advisor's office before fertilizing. The economics of fertilizing may be risky or available soil phosphorus may be limiting.

Presented by Monte Bell, University of California Farm Advisor, Glenn County
at Soil-Fertilizer Day, January 10, 1967, Willows, California

TABLE I - GRAZING TESTS ON FERTILIZED RANGE

Nye Ranch, 12 miles west of Willows

Cooperators: Sevier, owner; Eidman, Martin, Berry, U.C. Extension Service

Field #1 - 365 acres, unfertilized

Field #2 - 133 acres, fertilized 1953 & 1955 with urea and treble superphosphate (N_{48-64} P_{26-20}) - cost $12.50-13.50/acre

Field #3 - 200 acres, fertilized 1954 & 1956 with urea (N_{60-67}) - cost $10.00-12.00/acre

4 YEAR RESULTS*

	Control	Carryover	Fertilized
Average lbs. of beef/acre/year	27	47	94
Average increase over control field per acre/year		174%	351%
Pounds of beef produced from each pound of actual fertilizer nutrient		1.14 lbs.	

*This includes anticipated carryover effect on field #3 for the 1957-58 season

TABLE II - 4-YEAR COMPARISON OF EFFECTS OF N AND NP FERTILIZERS ON CALIFORNIA RANGELAND BEEF PRODUCTION

	1953-54	1954-55	1955-56	1956-57
Number of Trials	4	9	13	10
Number acres in all trials	1118	1754	2543	4197
Grazing days per acre				
Control	34 days	40 days	37 days	34 days
"Best" treatment	76	90	90	79
Meat produced/acre				
Control	55.8 lbs.	64.0 lbs.	64.8 lbs.	47.2 lbs.
Fertilized	158.6	188.0	162.1	144.2
Increase/acre	102.8	124.0	97.3	97.0
Average fertilizer cost/acre (including application)	$13.09	$15.69	$15.93	$10.96
Fertilizer cost/lb. Extra beef/acre	12.7¢	12.6¢	16.4¢	11.3¢

TABLE III - A DESCRIPTION OF SOME MAJOR RANGE SOILS IN GLENN COUNTY

Soil map symbol	204	239	250	264
Designation	Nacimiento	Sehorn	Millsholm	Newville
Slope	10-30%	No. face 30-65%	So. face 30-65%	30-50%
Surface texture	Clay loam - clay	Clay loam - silty clay	Clay loam	Gravelly loam
Subsoil texture	Clay loam - clay	Silty clay	Clay loam	Gravelly clay
Profile group	VIII	VIII	VIII	IV
Depth	20-36"	20-60"	10-20"	Over 60"
Permeability	Moderate permeability	Moderate permeability	Moderate permeability	Slow permeability
Surface reaction	Calcareous pH 7.5 up	Slightly acid pH 6.1-6.5	Slightly acid pH 6.1-6.5	Slightly acid pH 6.1-6.5
Subsoil reaction	Calcareous pH 7.5 up	Neutral pH 6.6-7.3	Slightly acid pH 6.1-6.5	Neutral pH 6.6-7.3
Surface color	Grayish brown	Brown	Brown	Brown
Subsoil color	Brown	Brown	Brown	Reddish brown
Parent material	Sedimentary rocks	Sedimentary rock alluvium	Sedimentary rock alluvium	Gr. soft. con. rocks
Surface drainage	Good	Good to excessive	Good to excessive	Good
Subsoil drainage	Good	Good	Good	Imperfect
Alkali	Free	Free	Free	Free
Erosion	Very little	Slight sheet erosion	Slight sheet erosion	Slight sheet erosion
Fertility	Good	Good	Good	Fair
Natural cover	Grass	Woodland-grass	Woodland-grass	Woodland-grass
Rainfall	18"	20"	20"	20"
Storie index	36	15	11	14
Grazing	Very high less than 10 ac.	High 10-20 ac/cow/year	Medium 20-40 ac/cow/yr	Low 40-60 acres

TABLE III - A DESCRIPTION OF SOME MAJOR RANGE SOILS IN GLENN COUNTY

	239	250	264	278
	Sehorn	Millsholm	Newville	Lodo
	No. face 30-65%	So. face 30-65%	30-50%	30-65%
m - clay	Clay loam - silty clay	Clay loam	Gravelly loam	Shaly clay loam
m - clay	Silty clay	Clay loam	Gravelly clay	Shaly clay loam
	VIII	VIII	IV	VIII
	20-60"	10-20"	Over 60"	Less than 10"
permeability	Moderate permeability	Moderate permeability	Slow permeability	Moderately rapid perm.
us pH 7.5 up	Slightly acid pH 6.1-6.5	Slightly acid pH 6.1-6.5	Slightly acid pH 6.1-6.5	Slightly acid pH 6.1-6.5
us pH 7.5 up	Neutral pH 6.6-7.3	Slightly acid pH 6.1-6.5	Neutral pH 6.6-7.3	Slightly acid pH 6.1-6.5
brown	Brown	Brown	Brown	Grayish brown
	Brown	Brown	Reddish brown	Grayish brown
ary rocks	Sedimentary rock alluvium	Sedimentary rock alluvium	Gr. soft. con. rocks	Sedimentary rocks (shale)
	Good to excessive	Good to excessive	Good	Good to excessive
	Good	Good	Imperfect	Good
tle	Free	Free	Free	Free
	Slight sheet erosion	Slight sheet erosion	Slight sheet erosion	Slight sheet erosion
	Good	Good	Fair	Fair
	Woodland-grass	Woodland-grass	Woodland-grass	Grass
	20"	20"	20"	20"
	15	11	14	4
less than 10 ac.	High 10-20 ac/cow/year	Medium 20-40 ac/cow/yr	Low 40-60 acres	Very low more than 60 acres

TABLE IV - SOIL VEGETATION PLOT - SEHORN SOIL, FRUTO

Cooperators: J. E. Drew, Powell, Bell

Dry Matter Yield, Lbs. Per Acre

	No fert.	S100	P88, S100	N150, S100	N150, P88, S100
1958	2186[a]	2992[a]	4704[b]	5386[bc]	6342[c]
1959	1597[a]	2246[ab]	2637[b]	2160[ab]	2272[ab]
1960	1776[a]	2658[b]	3354[c]	1800[a]	1860[a]
1961	2052[a]	3211[b]	2400	(2052[a])	(2052[a])
	7611	11107	13095	11398	12526
Average	1902	2777	3274	2850	3132

% Bur Clover

1958	22	50	88	5	10
1959	7	21	28	4	3
1960		15	21	T	
1961	+	23	+		

Bur clover (responsive legume) absolutely necessary for S and P response

[a,b,c] Yields within years having the same superscript are not significantly different $P < .05$.

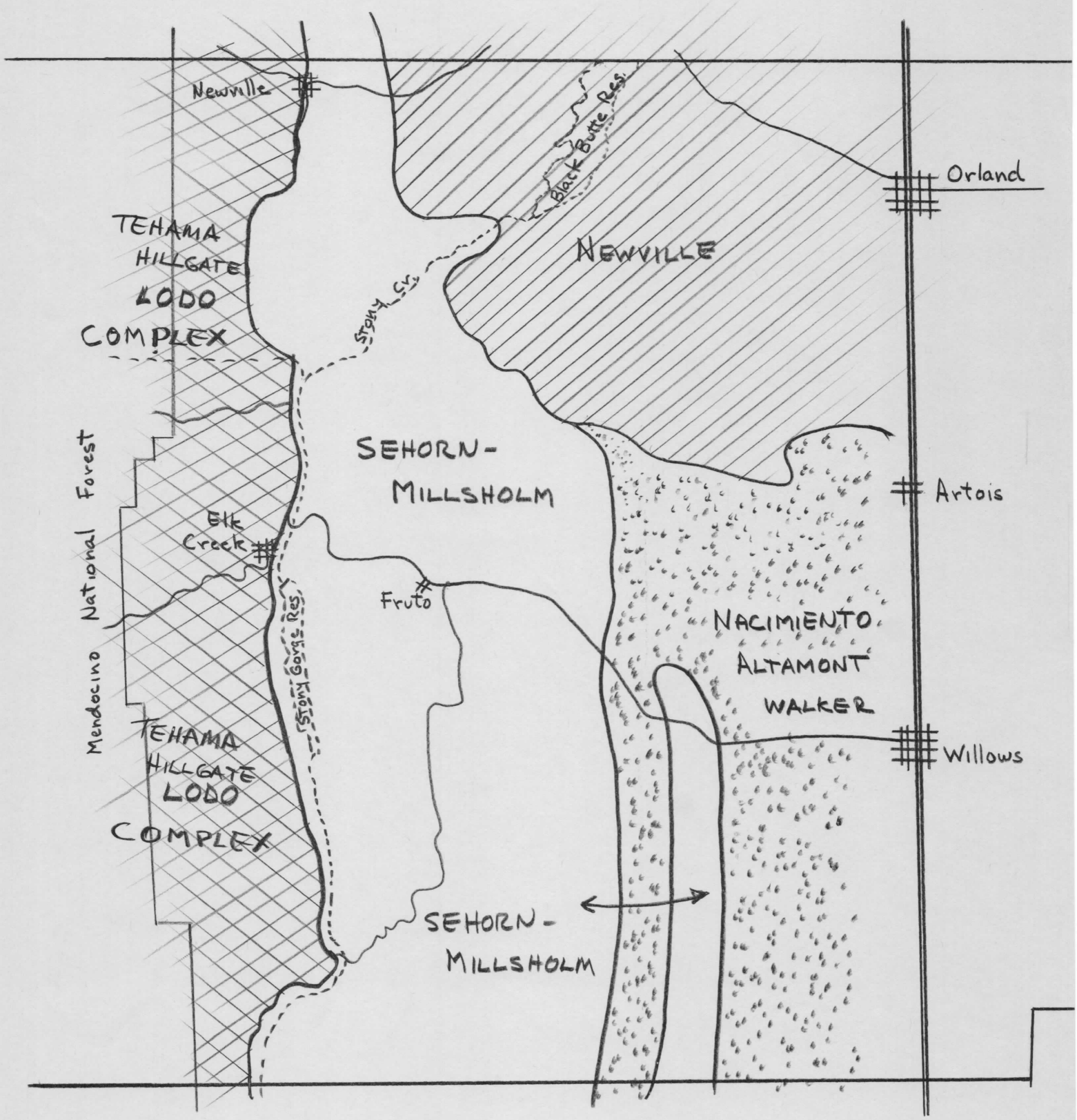

Figure 1. Major Range Soils, Glenn County