

HOW TO
IMPROVE
NAPA COUNTY
RANGELAND
BY
FERTILIZATION

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A C K N O W L E D G E M E N T

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Irving Grover, Farm Advisor
Napa County, October 1968

HOW TO IMPROVE NAPA COUNTY RANGELAND BY FERTILIZATION

Range fertilization may be undertaken to provide a more adequate supply of forage for the livestock you now own or normally carry on your ranch. Or you may wish to increase forage production to permit carrying a larger number of animals than before. Whichever it is, increasing ranch income is probably your primary concern.

Forage production can be increased by fertilizing all range and dryland pasture in Napa County. Usually the forage quality is improved at the same time. But you need to be sure fertilization will pay off.

CONSIDER THESE POINTS

Range fertilization can pay you big dividends if you use good judgement and follow these cautions.

1. Fertilize only those areas where there is enough soil to hold moisture and provide good rooting for the forage plants. Avoid thin, droughty soils. They dry out so early in the spring you will not get full return on your investment.
2. Fertilize only open grassland or grassland with well-scattered trees. You can't make money fertilizing oak trees and brush.
3. Use fertilizers containing only those plant nutrients needed. Nitrogen and phosphorous are almost always needed. To date we have not found any primary potash or sulfur deficiencies on rangeland in Napa County.
4. Do not fertilize more of your rangeland than your livestock can use. As a rule, it does not pay to fertilize more than $\frac{1}{4}$ to $\frac{1}{3}$ of your total range area in any given year.
5. Be sure to take into consideration application costs as well as the cost of the fertilizer when calculating costs against expected benefits. If you fertilize in order to carry more livestock, you should also take into consideration the added cost of owning that livestock including the interest on your investment.

WILL IT PAY?

Fertilizer results vary greatly from ranch to ranch and between soil types on any given ranch. Total seasonal rainfall and the seasonal pattern of rainfall can also have good or bad effects on fertilizer results. These variations can have a bearing on whether or not you will benefit from range fertilization. You may wish to establish a test area on your ranch to help decide.

Over the past 21 years the Napa County Farm Advisors' office has cooperated with several ranchers to run fertilizer tests. On the next two pages are the results from three of these tests. They may help you decide whether or not you wish to consider range fertilization for your ranch.

Test Results

The following test results illustrate three different reasons for range fertilization. These are:

1. There is already clover growing on part or all of your range but it does not make up a large enough share of the forage or the clover does not grow vigorously enough.
2. More total feed production is needed on the ranch to make possible a larger number of animals or to more adequately feed the animals already on the ranch.
3. More and better quality forage is needed in the winter and early spring to reduce the need for expensive supplemental feeding.

Situation 1. There is some bur clover or introduced clovers but you wish to increase the clover stand and/or make the clover grow more vigorously.

Table 1: Example Of How Range Fertilization Can Increase Forage Production On Established Subclover Range(Jamison Canyon Area)

Fertilizer & Rate Per Acre	Dry Weight of Forage(lbs. per acre)			
	Subclover	Other Vegetation	Total	% Increase
No Fertilizer	270	440	710	---
Single Superphosphate at 500 pounds per acre	1090	1360	2450	345%

Note: Effect of the fertilizer application is expected to last 3 to 4 years.

Situation 2. You need to increase the amount of forage produced on the ranch to make it possible to carry more cattle or sheep.

Table 2: Example of How Range Fertilization Can Increase Total Forage & Livestock Income on Rolling Hill Range(Carneros Area)

Fertilizer and Rate Per Acre	Pounds Extra Meat Produced Per Acre	Per Acre		Net Income Gain Or Loss From Fertilization
		Value of the Extra Meat*	Cost Per Acre of **Fertilizer	
50 lbs. nitrogen, 60 lbs. phosphate	65	\$13.00	\$13.10	-\$0.10
100 lbs. nitrogen, 60 lbs. phosphate	185	\$37.00	\$22.65	\$14.35

Fertilizer and Rate Per Acre	Days Grazing Per Acre***	Yearling Steer Rate of Gain Per Day
50 lbs. nitrogen, 60 lbs. phosphate	167	1.37 lbs.
100 lbs. nitrogen, 60 lbs. phosphate	280	1.74 lbs.

* Valued at 20¢ per pound, 1955 value

** Fertilizer cost plus charge for airplane application

*** 103 days from Dec. 8, 1954 to June 9, 1955. Number of steers were adjusted from time to time in each test field to assure proper use of forage and protect animal gains.

Situation 3. You wish to avoid so much supplemental feeding during the winter. By fertilizing a part of the rangeland you can substantially increase early grass growth and improve its feed value.

Table 3: Example of How Range Fertilization Can Increase Winter Forage Production (Yountville area)

Fertilizer & Rate Per Acre	Dry Weight of Forage (Lbs. per acre)				
	Total to Jan. 7, 1955		Total to Mar. 18, 1955		Season Total Yield
	Yield	% of Season Total	Yield	% of Season Total	
No fertilizer	1,048 lbs.	35.8%	1,639 lbs.	56.0	2,927 lbs.
80 lbs. nitrogen, 60 lbs. phosphate/ac.	3,205 lbs.	44.1%	4,372 lbs.	60.2	7,260 lbs.
Forage Production increase	2,157 lbs.		2,733 lbs.		4,233 lbs.
*Extra A.U.M. Feed from fertilizer	2.7		3.4		5.3
**Value of Extra AUM as pasture		\$8.10		\$10.20	\$15.90
***Value of Extra AUM as hay		\$21.60		\$19.20	\$42.40
Cost of Fertilizer, including \$2 per acre for spreading					\$19.74

* A.U.M. is the amount of feed required to maintain a 1000 lb. animal for one month. A.U.M. stands for animal unit month.

** The extra forage produced per acre is valued at \$3 per A.U.M. (actual charge) if its value is based on substituting it for renting additional pasture at that price.

*** The extra forage produced per acre is valued at \$8 per A.U.M. if its value is based on substituting it for volunteer hay at \$20 per ton. An A.U.M. equivalent of good quality volunteer hay would be 800 lbs. or .4 ton.

KINDS OF FERTILIZERS AND THEIR CHARACTERISTICS

Fertilizers can be divided into two broad types. One type includes the chemical fertilizers. The second type is sometimes referred to as organic fertilizer and includes animal manures.

Chemical Fertilizers

For range fertilization, we are usually interested in nitrogen, phosphorous, or both. Where sulfur is deficient, this element must also be supplied.

The labels on chemical fertilizers must show the percentage of each plant nutrient. This is sometimes written out in words and figures. Other times, the guaranteed analysis is shown in a conventional 3-part series of numbers.

The first part gives the percent of nitrogen; the second part the per cent of P_2O_5 ; and the third part gives the per cent of potash as K_2O . Sometimes the third part is omitted if the fertilizer contains no potash. Three examples: 16-20-0, 0-20-0, and 10-10-5.

Some Common Fertilizers Containing Nitrogen

<u>Fertilizer</u>	<u>Symbols Used In The Fertilizer Trade</u>		
	<u>N</u> (% Nitrogen)	<u>P</u> (% Phosphate)	<u>K</u> (% Potash)
Ammonium sulfate(21-0-0) 1/	21	0	0
Urea (45-0-0)	45-46	0	0
Ammonium nitrate(33 $\frac{1}{2}$ -0-0)	33 $\frac{1}{2}$	0	0
1/ Contains 24% sulfur			

Some Common Fertilizers Containing Phosphorous

<u>Fertilizer</u>	<u>Symbols Used In The Fertilizer Trade</u>		
	<u>N</u> (% Nitrogen)	<u>P</u> (% Phosphate)	<u>K</u> (% Potash)
Single superphosphate(0-20-0) 1/	0	20	0
Treble superphosphate(0-46-0) 2/	0	42-46	0
1/ Contains 12% sulfur		2/ Contains 2% sulfur	

Some Common Fertilizers Containing Both Nitrogen & Phosphorous

<u>Fertilizer</u>	<u>Symbols Used In The Fertilizer Trade</u>		
	<u>N</u> (% Nitrogen)	<u>P</u> (% Phosphate)	<u>K</u> (% Potash)
(Mono)Ammonium phosphate (11-48-0) 1/	11	48	0
Ammonium phosphate sulfate (16-20-0) 2/	16	20	0
Diammonium phosphate (21-53-0)	21	53	0
1/ Contains 2.6% sulfur		2/ Contains 15.4% sulfur	

Some Materials That Will Supply Sulfur

<u>Material</u>	<u>Per Cent Sulfur</u>
Ammonium phosphate sulfate (16-20-0)	15.4%
Ammonium sulfate (21-0-0)	24%
Single superphosphate (0-20-0)	12%
Gypsum	18.6%
Soil sulfur (elemental sulfur)	99%

Organic Fertilizers

Animal or poultry manures, when properly handled, can be just as valuable as chemical fertilizers for range improvement. Unless you produce the manure on your own ranch or know that the manure was properly stored, results can be extremely variable. Nitrogen content is the most variable factor because it can be so easily lost by evaporation, leaching, or both. The key to maintaining maximum nitrogen content is quick drying (to 15% moisture or less) and keeping it dry.

Poultry manure is perhaps the most readily available organic fertilizer in Napa County. Some poultrymen are equipped to deliver and spread the manure. The cost of this service increases with the distance from the poultry farm.

Value of Poultry Manures As A Source of N and P 1/

Quality of Manure	Chemical Analysis Dry Basis		Replacement Value of N + P per Ton Applied	Less Application costs 2/	Net Value Per	
	% N	% P ₂ O ₅			Ton	Yard
High grade droppings, dried	5.1	6.5	\$26.41	\$5.25	\$21.00	\$8.40
Good grade droppings, dried	4.2	6.2	23.31	5.25	18.06	7.22
Stock piled & fermented	2.1	6.2	18.06	5.25	12.81	5.10
Leached and stock piled	1.8	6.0	17.10	5.25	11.85	5.26

1/ Adapted from "Facts About Chicken Manure As A Fertilizer For Sonoma County Crops: Prepared by W.E. Martin, Virgil Stratton, & Lloyd Harwood in 1963.

2/ Application cost may vary depending on the distance from the poultry farm to your ranch, the amount delivered, the time of year, and the terrain on which it will be spread.

Value Of Other Animal Manures For Fertilizer 1/

	Yards Per Ton	% N	% P ₂ O ₅
Dairy Manure	2.0	0.4 to 0.9	0.4 to 0.8
Steer Manure	2.6	0.7 to 2.3	0.7 to 1.5

1/ Adapted from "Western Fertilizer Handbook" published in 1961 by the California Fertilizer Association.

WHAT FERTILIZER TO USE AND HOW MUCH

For Stimulating Legume Forage Production

Legumes, including clovers, are heavy users of phosphorous and sulfur. If the soil is deficient in either of these elements, legumes will do very poorly. When the deficiency is sufficiently acute, legumes may die out altogether. Grasses seem to get along on less phosphorous and will soon crowd out the clovers if ample nitrogen is available.

On phosphorous deficient soils, apply sufficient fertilizer to supply 100 pounds of P₂O₅ per acre. If you are using single superphosphate (20% P₂O₅) you will need to apply 500 pounds of the material per acre to yield 100 pounds of P₂O₅. This will usually last from three to four years when another similar application should be made. As a general rule, if your aim is to stimulate legume growth only, do not apply fertilizer containing nitrogen. If animal manures are used, be sure to graze closely enough to prevent grasses from crowding out the clover.

Although serious sulfur deficiencies have not yet been found on Napa County rangeland, it is always possible this could become a problem. If you find a sulfur deficiency exists, use a fertilizer or a combination of fertilizers that will supply this plant nutrient. Materials that supply sulfur are listed on Page 4.

The first four of the sulfur sources listed contain sulfate sulfur. This material is very soluble and is quickly available to plants. However, because of the high solubility, sulfate sulfur is easily leached out of the plant root zone so that little remains for the next year.

When fertilizing sulfur deficient areas, it is advisable to apply elemental soil sulfur in addition to other fertilizer materials needed even if they contain sulfate sulfur. Soil sulfur becomes slowly available to plants and will last 3 to 4 years. Coarser soil sulfur should be used in conjunction with fertilizers containing sulfate sulfur.

Elemental sulfur smaller than 100 mesh will produce results the first season. Coarser sulfur will not become available to plants until the year after it is applied. One sulfur product is made up of several sizes of particles so as to be effective over a period of a few years.

Where sulfur deficiencies exist, 80 pounds of elemental soil sulfur per acre should last for 2 to 3 years starting the year after application. Sulfate sulfur in the fertilizers applied for their nitrogen and phosphorous content will supply the sulfur needs for the first season if they contain as much as 40 to 50 pounds of sulfur in the material applied per acre.

If fertilization results in an excellent stand of vigorously growing clover, these legume plants will fix all the nitrogen you need for optimum range forage production. A good stand of clover can hand you a bonus of \$15 worth of nitrogen each year, per acre.

BE SURE TO KEEP CLOVER STANDS GRAZED DOWN. THEY WILL NOT PERSIST UNLESS GRAZED!

For Increasing Forage Production To Support More Animals (Few Or No Legumes Present)

Most of our rangeland is deficient in both nitrogen and phosphorous. If you cannot seed the area to clover, you can increase forage production by as much as three times by applying fertilizer containing both N and P. Apply enough fertilizer to supply close to 80 pounds of actual nitrogen and 100 pounds of P₂O₅.

Usually, not more than $\frac{1}{2}$ to $\frac{1}{3}$ of your total range area should be fertilized with nitrogen and phosphorous. If a larger percentage is fertilized, you may have difficulty using the increased production completely during the flush of spring growth. This would likely prevent you from making a profit from the fertilizer applied.

The recommended amounts of plant nutrients must be used to get profitable results. Therefore, if capital for fertilizing range is limited, fertilize a small area at the recommended rate instead of spreading the same amount of fertilizer over a larger area.

Here are a few fertilizers or fertilizer combinations that will do the job for you:

- a. Ammonium nitrate (33 $\frac{1}{2}$ -0-0) 250 to 300 lbs. per acre
Single superphosphate(0-20-0) 300 to 500 lbs. $\frac{1}{2}$ per acre
- b. Ammonium phosphate sulfate(16-20-0) 500 lbs. per acre
- c. Ammonium sulfate(21-0-0) 400 to 500 lbs. per acre
Single superphosphate 300 to 500 lbs. $\frac{1}{2}$ per acre
- d. Poultry manure (good grade) 3 yards per acre.

$\frac{1}{2}$ If there is little or no clover growing in the area to be fertilized, you may wish to use the smaller amount of single superphosphate.

Exception: If you intend to re-fertilize the same area yearly, use the larger amount of single superphosphate. This larger amount will last about 4 years. During that time you will need to apply a fertilizer containing only nitrogen on an annual basis.

Should you use ammonium phosphate sulfate (16-20-0), you will need to apply only ammonium sulfate or ammonium nitrate annually on the same area during the next two or three years until the phosphate is used up.

For Increasing Early Winter Forage Growth

Early winter forage growth on Napa County rangeland is usually slow. Energy value of the forage tends to be low, too. Both the volume and quality of the early forage can be increased by fertilization. By fertilizing a relatively small part of your rangeland, you can reduce or sometimes entirely eliminate the need for supplemental feeding.

Apply fertilizer in sufficient quantity to supply close to 80 pounds of nitrogen and 60 to 100 pounds of P_2O_5 . For quickest results, use fertilizer like ammonium nitrate, that contains some nitrate nitrogen. Use one of the fertilizer or fertilizer combinations (a, b, or c) in the preceding section.

HOW TO APPLY FERTILIZER

Commercial fertilizers can be spread with ground rigs or by airplane. For ground applications, a lime spreader type will do the most even job. Broadcast spreaders are also useful but have a tendency to apply more fertilizer close to the spreader than further out. This problem can be overcome by overlapping each strip sufficiently.

If you use 2 kinds of fertilizer, they must be premixed before spreading with a ground rig. If you are careful, you can mix the fertilizers as you fill the spreader. For airplane application, the two kinds of fertilizer can be mixed in the loading operation.

For airplane application, weight must be reduced to a minimum to keep down costs. Use fertilizers with the highest possible analyses. Here is an example of two fertilizer combinations that will yield close to 100 pounds of nitrogen per acre and 50 pounds of P_2O_5 . Note the difference in total weight of fertilizer.

Mixture One

<u>Fertilizer Material</u>	<u>Plant Nutrients</u>
250 lbs. ammonium phosphate sulfate (16-20-0)	40 lbs. N + 50 lbs. P_2O_5
300 lbs. ammonium sulfate (21-0-0)	63 lbs. N
<u>550 lbs. Total from the combination</u>	<u>103 lbs. N + 50 lbs. P_2O_5</u>

Mixture Two

<u>Fertilizer Material</u>	<u>Plant Nutrients</u>
100 lbs. diammonium phosphate (21-53-0)	21 lbs. N + 53 lbs. P_2O_5
180 lbs. urea (45-0-0)	81 lbs. N
<u>280 lbs. Total from the combination</u>	<u>102 lbs. N + 53 lbs. P_2O_5</u>

Similarly, if only phosphorous is needed, consider the difference in weight of fertilizer per acre to supply 100 pounds of P_2O_5 per acre.

<u>Fertilizer</u>	<u>% P_2O_5</u>	<u>Lbs. Fertilizer Needed Per Acre</u>
Single superphosphate	20%	500 lbs.
Treble superphosphate	45%	222 lbs.

RANCHERS HAVE HELPED DEVELOP THE
INFORMATION IN THIS PUBLICATION

Without the cooperation of many ranchers in the county, it would have been impossible to gather all the information needed for a practical range improvement publication designed to fit Napa County conditions. I have drawn freely on the experiences of many ranchers who have gotten results from fertilizing rangeland. Some have also cooperated with fertilizer tests. These have yielded much specific information on fertilizer requirements in Napa County.

For all this help, I am most grateful. Especially, I wish to acknowledge the help given by the following:

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