

REPORT OF WORK

PRIMARY FIELD Field Crops

COMPONENT Range & Pasture

CROSS REFERENCE \_\_\_\_\_

SUBJECT OF REPORT Plant Nutrition

Name(s) William H. Brooks III

County Mendocino

CONTINUING  
 COMPLETED (CHECK ONE)

Period covered by Report 1963 to 1964

DATE OF WRITING November 1964

(If written plan has not previously been submitted, a Plan of Work must accompany this report.)

Copies to: W.E. Martin  
B. Krantz  
J. Street

Use the following headings:

PROCEDURE USED - RESULTS: a. Technical - b. Educational -  
 CONCLUSIONS

PROCEDURE USED

1. Established a test and demonstration of a molybdenum deficiency of sub clover on the Crawford-Austin ranch near Ukiah.
2. Established a phosphorus rate trial on the Hulbert ranch near Yorkville.
3. Collected sub clover and soil samples in 12 locations for checking sulfur and phosphorus deficiencies.
4. Attended five grower meetings on range and pasture fertility.
5. Demonstrated phosphorus, sulfur and molybdenum plots on the farm advisor range tour.
6. Demonstrated a series of sulfur and phosphorus plots on sub clover to the Cattlemen's Association on their spring field day.
7. Demonstrated molybdenum plots to the Wool Growers Association at their spring field tour.
8. Continued a sulfur particle size test on sub clover.
9. Continued ten tests and demonstrations of sulfur and phosphorus on sub clover.
10. Prepared ten radio programs on range and pasture fertilization.

RESULTS

1. Range and pasture fertilizers used in the county are all with a sulfur content.
2. The molybdenum plots produced the following yield results, based on the average yield of four replications.

| CHECK                            | 54.4 grams |
|----------------------------------|------------|
| Sulfur                           | 50.6       |
| Molybdenum                       | 71.1       |
| Phosphorus                       | 129.0      |
| Phosphorus plus sulfur           | 98.0       |
| Sulfur plus molybdenum           | 31.4       |
| Phosphorus plus molybdenum       | 184.3      |
| Phosphorus plus moly plus sulfur | 180.4      |

Samples were taken to try to find a correlation between tissue analysis and molybdenum deficiency. The data showed no correlation.

Sulfur characteristically depressed yield unless in combination with both molybdenum and phosphorus. This depression of yield can be used to diagnose a molybdenum deficiency.

3. The phosphorus rate test produced the following yield data. This data is the average of four replications:

(Continued)

Applied in 1963:

| Phosphorus, lbs/acre | Yield lbs/acre |
|----------------------|----------------|
| 0                    | 1560           |
| 25                   | 3038           |
| 50                   | 2393           |
| 100                  | 3515           |
| 200                  | 6464           |

Applied 1963 and 1964:

| Phosphorus, lbs/acre | Yield lbs/acre |
|----------------------|----------------|
| 25                   | 2963           |
| 50                   | 3176           |
| 100                  | 3069           |
| 200                  | 6596           |

The plots produced a tremendous increase in sub clover production through phosphorus fertilization on a deficient soil. The plot area was stocked with over 90 per cent filaree when we started, and now the phosphorus plots are solid sub clover. It took a deer fence to show the striking differences.

4. Deer and stock have to be excluded from fertilizer plots to get any idea of responses. Plots on the Magruder ranch were only visible when stock were excluded.

CONCLUSIONS

1. A great increase in range fertilization has resulted from the excellent showings with sulfur and phosphorus plots in the county.
2. Sulfur applications last as long as two or three years. Increases in production by sulfur can be as low in cost as \$1.20 per ton on a one year basis.
3. Phosphorus is not leached, so costs can be spread over more than one season.
4. The molybdenum plots show the importance of locating any further molybdenum deficiencies in the county.

REPORT OF WORK

PRIMARY FIELD Field Crops  
 COMPONENT Range and Pasture  
 CROSS REFERENCE \_\_\_\_\_

CONTINUING  
 COMPLETED (CHECK ONE)

Period covered by Report 11/64 to 11/65

DATE OF WRITING November 1965

(If written plan has not previously been submitted, a Plan of Work must accompany this report.)

SUBJECT OF REPORT Plant Nutrition

Copies to: W. E. Martin  
James Street

Name(s) William H. Brooks III

County Mendocino

Use the following headings:

PROCEDURE USED - RESULTS: a. Technical - b. Educational -  
 CONCLUSIONS

PROCEDURE USED

1. Established 4 range fertilizer trials in cooperation with W. E. Martin. These plots on sub clover are designed to answer the following questions:
  - a) Does sub clover need additional sulfur or phosphorus?
  - b) Is molybdenum needed?
  - c) Is elemental sulfur better than sulfate sulfur?
  - d) Is potassium needed in addition to phosphorus & sulfur?
2. Continued molybdenum deficiency trials on the Crawford ranch.
3. Continued phosphorus rate trials on sub clover on the Hulbert ranch.
4. Continued 9 demonstrations of sulfur and phosphorus fertilization on sub clover.
5. Continued sulfur deficiency trials of sulfur source and particle size on the Fitzgerald ranch.
6. Held 2 field tours to demonstrate range fertilizer trials. Attended 4 grower meetings to present range fertilization information; made 3 radio broadcasts.

RESULTS

1. The phosphorus and sulfur plots in Yorkville were applied in 1960. The heavy phosphate applications still produce over twice the yield of the check, as shown in the following summary of 1964-65 yields:

Table 1. *HULBERT*

| <u>Treatment</u>  | <u>Yield Lbs/acre</u> |
|---|-----------------------|
| 1. Check  | 1490                  |
| 2. Gypsum @ 600 lbs/acre  | 1910                  |
| 3. TVA phosphate @ 200 lbs. P <sub>2</sub> O <sub>5</sub> /acre     | 3620                  |
| 4. Single super phos @ 100 lbs. P <sub>2</sub> O <sub>5</sub> /acre | 4500                  |
| 5. " " " @ 200 " " "  | 4120                  |
| 6. " " " @ 400 " " "  | 4080                  |

The high yields of sub clover in phosphorus plots has created a shortage of sulfur. This is shown by the addition of sulfur, and sulfur plus molybdenum, on a part of treatment No. 6. in Table 1.

Table 2.

| <u>Treatment</u>   | <u>Yield Lbs/acre</u> |
|--|-----------------------|
| Single super phos @ 400 lbs P <sub>2</sub> O <sub>5</sub> /acre plus 100 lbs. sulfur                 | 5420                  |
| Single super phos @ 400 lbs P <sub>2</sub> O <sub>5</sub> /acre plus 100 lbs. sulfur plus molybdenum | 5570                  |
| Single super phos @ 400 lbs P <sub>2</sub> O <sub>5</sub> /acre                                      | 4080                  |

## RESULTS

The Italian thistle plots showed new seedlings starting after each rain. No one spray time was optimum, as early sprays had later seedlings, and late season sprays were too late for adequate control. Two sprays are a minimum for control of this range weed.

The goatgrass program based on Dalapon was a failure. Dalapon treatments that were effective last year, were not this winter. Erratic results were a result of low temperatures. Paraquat is now available, so we will shift this herbicide for this year's program.

Woollypodded milkweed control plots were summarized as follows:

| <u>Material</u> |           | <u>Weed control rating</u> |
|-----------------|-----------|----------------------------|
| Tordon          | 1 lb/acre | 8                          |
| Tordon          | 2         | 8                          |
| Tordon          | 4         | 8                          |
| Amitrol T       | 4         | 7                          |
| Banvel D        | 2         | 7                          |
| Banvel D        | 4         | 8                          |
| 2,4,5-T         | 2         | 5                          |

The above plots were re-treated this summer.

The veratrum control plots were summarized as follows:

| <u>Material</u> |           | <u>Weed control rating</u> |
|-----------------|-----------|----------------------------|
| LV 4            | 2 lb/acre | 8                          |
| Tordon          | 1         | 2                          |
| Tordon          | 2         | 1                          |
| Tordon          | 4         | 1                          |
| Amitrol T       | 4         | 1                          |
| Banvel D        | 2         | 3                          |
| Banvel D        | 4         | 4                          |
| Silvex          | 2         | 7                          |
| 2,4,5-T         | 2         | 1                          |

The LV 4 and the Silvex plots were re-treated this summer.

Concentrate mist blower treatments with LV4 on Woollypod milkweed and veratrum gave excellent initial control of both weeds.

## CONCLUSIONS

1. The concentrate mist sprayer has created considerable interest in range weed control. In addition to low volume and low cost, this new type sprayer appears to be more effective on some weeds such as veratrum and woolly-podded milkweed.

2. New Canada thistle infestations are constantly being found. With the large infestations in Humboldt County, it will take a vigorous program to keep this weed in check.

Results (Continued)

2. The molybdenum deficiency plots on the Crawford ranch were summarized for the past two crop years:

*entered*

| <u>Table 3.</u><br><u>Treatment</u> | <u>Yield Lbs/A</u> |             | <u>1964 Molybdenum</u><br><u>In ppm sub tissue</u> |
|-------------------------------------|--------------------|-------------|--|
|                                     | <u>1964</u>        | <u>1965</u> |  |
| Check                               | 1741               | 2340        | 0.9  |
| Sulfur (S)                          | 1620               | 2030        | 0.6  |
| Molybdenum (Mo)                     | 2276               | 2620        | 6.5  |
| Phosphorus (P)                      | 4129               | 5040        | 0.5  |
| P plus S                            | 3137               | 4430        | 0.7  |
| S plus Mo                           | 2606               | 2420        | 1.1  |
| P plus Mo                           | 5899               | 5800        | 6.7  |
| P plus S plus Mo                    | 5775               | 6200        | 0.9  |

The phosphorus plus molybdenum plots are the highest yielding, and the addition of sulfur doesn't significantly change yield. Sulfur does materially affect the uptake of molybdenum in the tissue of sub clover. This may be very significant in reducing any danger of molybdenum toxicity in sub clover.

3. The Hulbert ranch phosphorus rate trials were summarized as shown in table 4. These plots will be followed for 5 years at least, to measure how phosphate rates maintain yield over a period of years. Tissue and soil phosphate tests indicate the soil test is a better indication of phosphorus deficiency than the sub clover tissue test.

Table 4.

| <u>Treatment</u>   | <u>Yield Lbs/acre</u> |
|--------------------|-----------------------|
| 1963 phosphorus: 0 | 1280                  |
| 25                 | 2290                  |
| 50                 | 3320                  |
| 100                | 2990                  |
| 200                | 4300                  |
| 1963-64 25         | 3190                  |
| 50                 | 4030                  |
| 100                | 3840                  |
| 200                | 4610                  |

CONCLUSIONS

The sub clover fertility test program has given us a tremendous amount of new information on range fertility for the county. This information is giving us a big step forward in a basic phase of our range improvement program that will affect production, species, and weed control.

We now have the basic information to solve fertility problems on the range on a sound scientific basis, with an organized procedure of symptoms, soil and tissue analysis, and fertilizer rate information.

REPORT OF WORK

PRIMARY FIELD Field Crops  
 COMPONENT Range & Pasture  
 CROSS REFERENCE \_\_\_\_\_  
 SUBJECT OF REPORT Plant Nutrition  
 Name(s) William H. Brooks III  
 County Mendocino

CONTINUING  
 COMPLETED (CHECK ONE)

Period covered by Report 1965 to 1966  
November 1966

DATE OF WRITING \_\_\_\_\_  
 (If written plan has not previously been submitted, a Plan of Work must accompany this report.)

Copies to: W. E. Martin  
J. Street

Use the following headings:

PROCEDURE USED - RESULTS: a. Technical - b. Educational -

CONCLUSIONS

PROCEDURE USED

1. Established three fertilizer trials, in cooperation with Dr. W. E. Martin, testing sulfur, phosphorus, and molybdenum on range.
2. Continued tests on phosphorus rates and frequency of application on sub clover range, in cooperation with Dr. M. Jones.
3. Continued test on molybdenum deficiency on sub clover range.
4. Conducted tour on range fertilizer test plots.
5. Three grower meetings on range fertilization.
6. Eight radio programs and two newspaper articles on range fertilization.

RESULTS a. Technical

1. Crawford phosphorus, sulfur & molybdenum tests. Average of 4 replication.

Treatment

Yield in Lbs/Acre

|                 |      |    |
|-----------------|------|----|
| Check           | 2008 | a  |
| Phosphorus (P)  | 2856 | b  |
| Sulfur (S)      | 2280 | a  |
| Molybdenum (Mo) | 2184 | a  |
| P S             | 3400 | c  |
| P Mo            | 3888 | c  |
| S Mo            | 2326 | ab |
| PS Mo           | 5016 | d  |

This plot showed deficiency of molybdenum and phosphorus. Fertilizer was applied in the fall of 1963. The first two seasons both phosphorus and molybdenum were deficient and sulfur inhibited growth. This season, sulfur with phosphorus alone, and with phosphorus and molybdenum significantly increased yields.

2. Austin Hulbert Phosphorus carrier study details on next page.

Austin Hulbert phosphorus carrier study, 1966, sample April 27, 1966

| Treat. No. | P applied | Total yield | % P  | P uptake |
|------------|-----------|-------------|------|----------|
| 1          | 980       | 1220        | 1.55 | 1.51     |
| 2          | 100 s     | 1220        | 1.73 | 2.10     |
| 3          | 200*71a   | 2540        | 2.75 | 7.00     |
| 4          | 100*ssp   | 4510        | 2.03 | 9.14     |
| 5          | 200*ssp   | 3420        | 2.25 | 7.93     |
| 6          | 400*ssp   | 2700        | 2.62 | 7.04     |
| 7          | CK        | 1072        | 1.66 | 1.79     |
| 8          | 100s      | 880         | 1.54 | 1.34     |
| 9          | 200*TVA   | 3760        | 2.60 | 9.68     |
| 10         | 100*ssp   | 2350        | 2.54 | 5.97     |
| 11         | 200*ssp   | 2880        | 2.18 | 6.00     |
| 12         | 400*ssp   | 4740        | 2.23 | 9.98     |

| Treat. No. | P Applied | Total yield | % P in | P Uptake | Soil P |
|------------|-----------|-------------|--------|----------|--------|
| 1          | 0         | 1104        | 1.70   | 1.85     | 2.5    |
| 2          | 25        | 2456        | 1.68   | 4.07     | 5.0    |
| 3          | 50        | 3640        | 1.69   | 6.16     | 5.5    |
| 4          | 100       | 5088        | 2.04   | 10.36    | 8.0    |
| 5          | 200       | 5376        | 2.53   | 13.49    | 20.12  |
| 6          | 25        | 3960        | 1.76   | 6.95     | 5.5    |
| 7          | 50        | 5048        | 2.21   | 11.10    | 12.75  |
| 8          | 100       | 5552        | 2.80   | 15.51    | 25.0   |
| 9          | 200       | 5640        | 3.48   | 19.65    | 60.75  |

\* Lb/acre P<sub>2</sub>O<sub>5</sub>

This test plot showed significant increases in production in 1966; the application was made in 1960. This demonstration of how long phosphorus fertilizer can last on range is very significant in terms of economic returns due to phosphorus fertilization.

3. Austin Hulbert phosphorus rate study, 1966; sampled April 27, 1966

| No. | Lb/Acre | Total | % P in | P Uptake | Soil P |
|-----|---------|-------|--------|----------|--------|
| 1   | 0       | 1104  | 1.70   | 1.85     | 2.5    |
| 2   | 25      | 2456  | 1.68   | 4.07     | 5.0    |
| 3   | 50      | 3640  | 1.69   | 6.16     | 5.5    |
| 4   | 100     | 5088  | 2.04   | 10.36    | 8.0    |
| 5   | 200     | 5376  | 2.53   | 13.49    | 20.12  |
| 6   | 25      | 3960  | 1.76   | 6.95     | 5.5    |
| 7   | 50      | 5048  | 2.21   | 11.10    | 12.75  |
| 8   | 100     | 5552  | 2.80   | 15.51    | 25.0   |
| 9   | 200     | 5640  | 3.48   | 19.65    | 60.75  |

Botanical comp. % grass % Forb % Clover % P in clover leaves

|                      | 1    | 2    | 3    | 4    | 5    | 6    | 7    | 8    | 9    |
|----------------------|------|------|------|------|------|------|------|------|------|
| Botanical comp.      | 47   | 22   | 16   | 6    | 13   | 19   | 12   | 16   | 16   |
| % grass              | 21   | 6    | 3    | 3    | 3    | 5    | 2    | 4    | 8    |
| % Forb               | 32   | 72   | 81   | 91   | 84   | 76   | 86   | 80   | 76   |
| % Clover             | 21   | 6    | 3    | 3    | 3    | 5    | 2    | 4    | 8    |
| % P in clover leaves | .127 | .140 | .172 | .196 | .237 | .172 | .196 | .206 | .232 |
|                      | a    | ab   | bc   | c    | d    | bc   | c    | cd   | d    |

This test plot shows optimum phosphorus rates, and uses one and two applications. The split application made no significant difference in final production. The botanical composition shows the change as a result of the fertilizer treatments.

more



4. Mailliar Range Plot, Mendocino County 1966

Yield of forage harvested:

| Treatment         | Fresh Wt., Lbs/Acre<br>3 Reps | % Dry Matter<br>2 Reps | Dry Wt., Lbs/Acre<br>2 Reps |
|-------------------|-------------------------------|------------------------|-----------------------------|
| None              | 5606                          | 27.0                   | 1513                        |
| Gyp.              | 5171                          | 26.1                   | 1536                        |
| P                 | 8627                          | 24.0                   | 2112                        |
| P + Gyp + KCl     | 7578                          | 24.6                   | 1935                        |
| P + Gyp           | 7910                          | 23.8                   | 2109                        |
| P S               | 10061                         | 23.4                   | 2278                        |
| P S Mo            | 12365                         | 21.3                   | 2665                        |
| L S D<br>5% Level | 1433                          | 1.9                    | 166                         |

The Mailliar test plot shows a definite response to phosphorus and molybdenum. This plot is a part of the program to determine how extensive molybdenum deficiencies are in the county.

RESULTS b. Technical

The impact of the phosphate deficiency on some of our ranges was not completely understood by many growers until we had deer fences around the plots. The range tours on our fertilizer tests have created a considerable increase in range fertilization in the county.

CONCLUSIONS

The cheapest feed increase on much of our rangeland is fertilizing sub clover. The correlation of phosphate deficiency to soil type should be studied so that we could give growers more reliable recommendations.



REPORT OF WORK

PRIMARY FIELD Field Crops  
 COMPONENT Range and Pasture  
 CROSS REFERENCE \_\_\_\_\_

CONTINUING  
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Period covered by Report 1966 to 1967

November 1967

DATE OF WRITING \_\_\_\_\_  
 (If written plan has not previously been submitted, a Plan of Work must accompany this report.)

SUBJECT OF REPORT Plant Nutrition  
 Name(s) William H. Brooks III  
 County Mendocino

Copies to: W. E. Martin  
J. Street

Use the following headings:

PROCEDURE USED - RESULTS: a. Technical - b. Educational -  
 CONCLUSIONS

PROCEDURE USED

1. Conducted 14 tests and demonstrations on range fertilization.
  - a) Six range fertilization plots were established in co-operation with Dr. W. E. Martin, testing sulfur, phosphorus, molybdenum, and potash.
  - b) Three range fertilizer experiments were in cooperation with Dr. Milton Jones, testing sulfur, phosphorus, and molybdenum.
  - c) Five range tests and demonstrations on the value of phosphorus and sulfur fertilization were conducted in different sections of the county.
2. Four range tours for growers were held on range fertilizer tests and demonstrations.
3. Four grower meetings were held on range fertilization in the county.
4. Fifteen radio programs were broadcast, and four newspaper articles were prepared on range fertilization.

RESULTS a. Technical

1. The McGuire fertilizer test on sub clover was harvested March 29. The following table is the average of three replications:

Jim McGuire, Harvested March 29, 1967

| <u>Treatment</u> | <u>Yield Fresh lb/A</u> | <u>% Dry Matter</u> | <u>Yield Dry Lb/A</u> |
|------------------|-------------------------|---------------------|-----------------------|
| Check            | 22,058                  | 19.3                | 4,222                 |
| Gypsum           | 23,416                  | 16.7                | 4,373                 |
| Sulfur           | 26,520                  | 18.3                | 4,269                 |
| Aver No. P       | 24,000                  |                     | 4,288                 |
| TSP              | 35,250                  | 15.2                | 5,278                 |
| S. Super         | 35,600                  | 14.4                | 5,388                 |
| PS               | 37,950                  | 15.4                | 5,777                 |
| PS Mo            | 35,350                  | 15.8                | 5,365                 |
| PS Mo +K         | 39,890                  | 13.6                | 5,382                 |
| Aver. +P         | 36,800 (153%)           |                     | 5,438 (127%)          |
| LSD              | 6,732                   | 2.1                 | 661                   |
| CV               | 12.0%                   | 7.6%                | 7.5%                  |

This plot showed a significant increase in production on all phosphorus treatments. The potash plots increased production, but not at a significant level.

2. The James Smith fertilizer test in Comptche was applied on March 8, and harvested June 8. In spite of this short period, there were large differences in production. The following table is the average of four replications:

James M. Smith, Comptche.  
 Applied March 8, 1967, Harvested June 8, 1967

|               | <u>Lbs. Green Matter</u> | <u>Lbs. Green Matter/A</u> |
|---------------|--------------------------|----------------------------|
| Check         | 17.63                    | 4741                       |
| Elemental S   | 14.13                    | 3799                       |
| Average No. P | 15.88                    | 4270                       |
| P (TVA)       | 37.10                    | 9976                       |
| SSP @ 500     | 35.85                    | 9640                       |
| SSP @ 1000    | 36.45                    | 9801                       |
| TVA+S+Mo      | 33.75                    | 9075                       |
| Average +P    | 35.89                    | 9623                       |

The phosphorus applications gave large increases in production. No other element tested gave any indication of a significant yield increase.

3. The Austin Hulbert range fertilizer test consists of two different trials. One test of phosphorus sources was applied in 1960. Increases in production are still continuing and this plot will be maintained so that we will see how long a phosphorus application will last. The second test is a phosphorus rate trial, and includes split applications. The following table summarizes the two plots:

| <u>Lb. P/Ac Applied</u> |         | <u>Yield Lb/A 5/25/67</u> |
|-------------------------|---------|---------------------------|
| Nov '63                 | Nov '64 |                           |
| 0                       | 0       | 944 a                     |
| 25                      | 0       | 3376 b                    |
| 50                      | 0       | 3488 b                    |
| 100                     | 0       | 7376 c                    |
| 200                     | 0       | 7984 cd                   |
| 25                      | 25      | 4272 b                    |
| 50                      | 50      | 8056 cd                   |
| 100                     | 100     | 9488 d                    |
| 200                     | 200     | 7952 cd                   |

*Entered*  
 Phosphorus source test, applied November 1960

| <u>Lb. P<sub>2</sub>O<sub>5</sub>/A</u> | <u>Carrier</u> | <u>Yield Lb/Acre</u> |
|---|----------------|----------------------|
| 0                                       |                | 1968                 |
| 0                                       | Gypsum         | 1520                 |
| 200                                     | TVA-TSP        | 4530                 |
| 100                                     | SSP            | 5168                 |
| 200                                     | SSP            | 5570                 |
| 400                                     | SSP            | 5180                 |
| Plus Gypsum Nov. 1963                   |                |                      |
| 0                                       |                | 1248                 |
| 0                                       | Gypsum         | 1888                 |
| 200                                     | TVA-TSP        | 7184                 |
| 100                                     | SSP            | 4704                 |
| 200                                     | SSP            | 4640                 |
| 400                                     | SSP            | 7248                 |

Results show that phosphate applications can last seven years, so the cost of fertilizer is relatively low. The phosphorus rate trial shows no difference between one application or splitting the application into two increments.

4. The Crawford-Austin plot was a test of sulfur, phosphorus, and molybdenum. The table attached analyses the results. A significant increase in production resulted from phosphorus applications. Last season molybdenum gave a significant increase in production in combination with sulfur and phosphorus. This year there was no significant difference with molybdenum.

#### RESULTS b. Educational

The extensive range and pasture fertilization test program, with grower tours, has been a basic reason for the big increase in range reseeding this past season. The plots have shown big and economic increases in production of sub clover. A demonstration ranch has doubled the livestock carrying capacity in 12 years, primarily based on phosphorus fertilization.

more

*entire*

Crawford-Austin Ranch, Sub clover fertilization  
Harvested May 23, 1967 - Grms dry wt/3 sq. ft.

| Treatment | I   | II  | III | IV  | EX  | $\bar{X}$ | Lbs/Acre |
|-----------|-----|-----|-----|-----|-----|-----------|----------|
| Check     | 86  | 58  | 86  | 40  | 270 | 67.5      | 2160 a   |
| P         | 109 | 114 | 188 | 134 | 545 | 136.25    | 4360 b   |
| S         | 89  | 82  | 105 | 66  | 342 | 85.5      | 2736 a   |
| Mo        | 107 | 57  | 72  | 79  | 315 | 78.75     | 2520 a   |
| PS        | 151 | 171 | 110 | 146 | 578 | 144.5     | 4624 b   |
| P Mo      | 141 | 154 | 109 | 132 | 536 | 134.0     | 4288 b   |
| S Mo      | 118 | 72  | 51  | 108 | 349 | 87.25     | 2792 a   |
| PS Mo     | 132 | 127 | 150 | 163 | 572 | 143.0     | 4576 b   |

#### CONCLUSIONS

The cheapest feed increases possible on our rangeland is by fertilizing sub clover with sulfur and/or phosphorus. The big increase in reseeding and fertilizing range this season should encourage further development in this program next year.

MIDDLE RIDGE RANCH, HOPLAND, CALIFORNIA

Yield of forage and per cent clover in plots fertilized with various rates of gypsum, elemental sulphur and single super phosphate.

| Fertilizer Treatment           | Lbs. of Actual Sulphur | Yield of Forage Lbs/Acre | Estimated Per Cent Clover | Pounds Clover Per Acre |
|--------------------------------|------------------------|--------------------------|---------------------------|------------------------|
| Unfertilized                   | 0                      | 1910                     | 8                         | 153                    |
| 59 Lbs/A gypsum                | 10                     | 2610                     | 25                        | 652                    |
| 118 " "                        | 20                     | 3010                     | 53                        | 1600                   |
| 236 " "                        | 40                     | 3310                     | 76                        | 2520                   |
| 10 Lbs/A sulphur               | 10                     | 2900                     | 60                        | 1740                   |
| 20 " "                         | 20                     | 3390                     | 70                        | 2370                   |
| 40 " "                         | 40                     | 3580                     | 80                        | 2860                   |
| 83 Lbs/A single sup. phosphate | 10                     | 2920                     | 51                        | 1490                   |
| 166 " " " "                    | 20                     | 3250                     | 70                        | 2280                   |
| 332 " " " "                    | 40                     | 3410                     | 78                        | 2660                   |
| L.S.D. (.05) Level             |                        | 560                      |                           |                        |

There was no significant difference between gypsum, elemental sulphur and single superphosphate. Yield increased rapidly up to the 20 pound per acre rate. As the rate of applied sulphur increased from 20 to 40 pounds per acre, there was a small increase in forage production.

RALPH COCHRANE RANCH, BOONVILLE, APRIL, 1961

|                        |    |      |      |
|------------------------|----|------|------|
| Gypsum                 | 0  | 3376 | 473  |
|                        | 10 | 3836 | 1381 |
|                        | 20 | 3598 | 1007 |
|                        | 40 | 3867 | 1740 |
| Elemental sulphur      | 0  | 2670 | 427  |
|                        | 10 | 4150 | 1868 |
|                        | 20 | 4678 | 3275 |
|                        | 40 | 4563 | 3422 |
| Single super phosphate | 0  | 3316 | 365  |
|                        | 10 | 3481 | 1323 |
|                        | 20 | 4145 | 2238 |
|                        | 40 | 4956 | 3965 |
| L.S.D. (.05)           |    | 1029 |      |

There was no significant difference in total yield of forage between gypsum, elemental sulphur or single super phosphate.

POINT ARENA, MAY 15, 1961

| <u>Fertilizer Treatment</u> | <u>% Clover</u> | <u>Sub Clover<br/>Lbs/Acre</u> | <u>Grass<br/>Lbs/Acre</u> | <u>Total Yield<br/>Lbs/Acre</u> |
|-----------------------------|-----------------|--------------------------------|---------------------------|---------------------------------|
| Unfertilized                | 25.2            | 704                            | 1921                      | 2625                            |
| P100 superphosphate         | 24.6            | 752                            | 2397                      | 3149                            |
| P200 "                      | 27.5            | 948                            | 2728                      | 3676                            |
| P400 "                      | 37.7            | 1211                           | 2067                      | 3278                            |
| P100 rock phosphate         | 18.5            | 568                            | 2386                      | 2954                            |
| P200 "                      | 38.1            | 1232                           | 2076                      | 3308                            |
| P400 "                      | 39.3            | 1343                           | 2109                      | 3452                            |
| P800 "                      | 45.5            | 1456                           | 1758                      | 3214                            |
| 1000 lbs. SSP 1960          | 51.6            | 1755                           | 1529                      | 3284                            |
| L.S.D. .05% level           | N.S.            | N.S.                           | N.S.                      | N.S.                            |

Joe Halliday

November

A. Hulbert Rate Study (Applied 1963-64)

| Treatment |      |     | Yield 1968 |
|-----------|------|-----|------------|
| P         | P205 |     | Yield 1968 |
| 1         | 0    | 0   | 1780 a     |
| 2         | 25   | 57  | 3460 b     |
| 3         | 50   | 115 | 3960 c     |
| 4         | 100  | 230 | 4920 cd    |
| 5         | 200  | 458 | 5220 d     |
| 6         | 400  | 916 | 5080 d     |

| P | P   | Total P | Yield 1968 | 05.25      | 04.27      | Yield 1965 | Yield 1964 | Clover Yield 1965 | Protein % in Clover 1965 | Protein % in Grass 1965 | Total Lbs/Acre |       |
|---|-----|---------|------------|------------|------------|------------|------------|-------------------|--------------------------|-------------------------|----------------|-------|
|   |     |         |            | Yield 1967 | Yield 1966 |            |            |                   |                          |                         |                |       |
| 1 | 0   | 0       | 1780       | 944        | 1104       | 1280       | 1560       | 280               | 17.2                     | 8.8                     | 6668           |       |
| 2 | 25  | 0       | 25         | 3460       | 3376       | 2456       | 2290       | 3038              | 1560                     | 18.6                    | 11.8           | 14620 |
| 3 | 50  | 0       | 50         | 3700       | 3488       | 3640       | 3320       | 2390              | 2310                     | 18.3                    | 11.9           | 16538 |
| 4 | 100 | 0       | 100        | 4820       | 7376       | 5088       | 2990       | 3515              | 1340                     | 17.6                    | 13.5           | 23789 |
| 5 | 200 | 0       | 200        | 5400       | 7984       | 5376       | 4300       | 6464              | 3360                     | 19.3                    | 12.4           | 29524 |
| 6 | 25  | 25      | 50         | 4260       | 4272       | 3960       | 3190       | 2963              | 1890                     | 18.9                    | 13.0           | 18645 |
| 7 | 50  | 50      | 100        | 5020       | 8056       | 5048       | 4030       | 3176              | 2700                     | 18.8                    | 14.0           | 25330 |
| 8 | 100 | 100     | 200        | 5040       | 9488       | 5552       | 3840       | 3069              | 2440                     | 18.1                    | 13.3           | 26989 |
| 9 | 200 | 200     | 400        | 5080       | 7952       | 5640       | 4610       | 6596              | 3110                     | 18.9                    | 10.9           | 29878 |

Date: start 60.11

HULBERT CARRIER FERTILIZER STUDY

|                | 1964-65 | <sup>04.27</sup><br>1965-66 | Plus Gyp | <sup>05.25</sup><br>1967 | Plus Gyp | 1968 |
|----------------|---------|-----------------------------|----------|--------------------------|----------|------|
| Check          | 1490 a  | 980 a                       | 1072 a   | 1968                     | 1248     | 1820 |
| Gyp            | 1910 a  | 1220 b                      | 890 a    | 1520                     | 1888     | 2050 |
| TVA P200       | 3620 b  | 2540 b                      | 3760 bc  | 4530                     | 7184     | 4720 |
| SSP P100       | 4500 bc | 4510 c                      | 2350 b   | 5168                     | 4704     | 4910 |
| SSP P200       | 4120 b  | 3420 bc                     | 2840 b   | 5570                     | 4640     | 4840 |
| SSP P400       | 4080 b  | 2700 b                      | 4400 c   | 5180                     | 7248     | 4780 |
| P-400 + S      | 5420 c  |                             |          |                          |          |      |
| P-400 + S + Mo | 5570 c  |                             |          |                          |          |      |