A lysimeter study of

Sulfur Fertilization

of an annual-range soil

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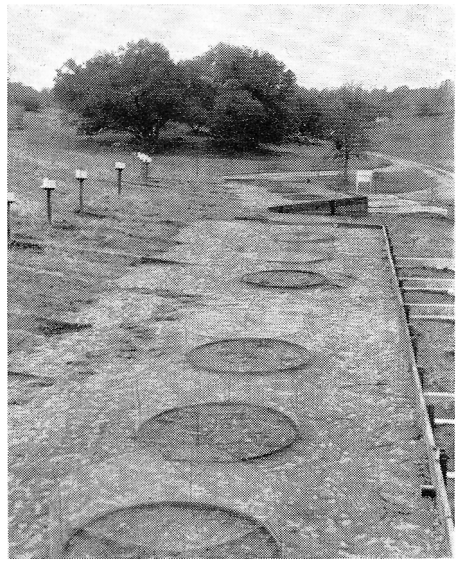
A lysimeter study, to determine the rate and frequency of sulfur fertilization and the source of sulfur for maximum returns, was initiated with the annual legume, rose clover, on Vista sandy loam. Such factors as the availability of sulfur in the soil, sulfur supplied by precipitation and air contact, leaching losses, and the uptake of sulfur by clover plants were considered in the study.

Each lysimeter consisted of a cylindrical tank 74″ in diameter and 25.5″ deep filled with a reconstituted sandy loam profile. The bottom contained a drain so that the percolate could be collected for analysis.

Gypsum containing tracer amounts of radioactive sulfur was applied at rates of 100 and 300 pounds per acre to two lysimeters each. Two lysimeters were treated with a 200 pound per acre rate of non-labeled gypsum and three lysimeters were not treated and served as checks. Use of the tracer material permitted identification of fertilizer sulfur in the percolate and the plants.

Sulfur in gypsum is very susceptible to percolation loss when applied to a coarse-textured soil such as Vista sandy loam. In this experiment sulfur—sulfate sulfur—was lost from the treated tanks at a rapid rate in the initial percolate from early winter rains. The magnitude of the loss was proportional to the amount of gypsum applied. As the rainy season progressed the amount of sulfur loss per unit of percolate gradually declined, as less and less gypsum remained to be leached.

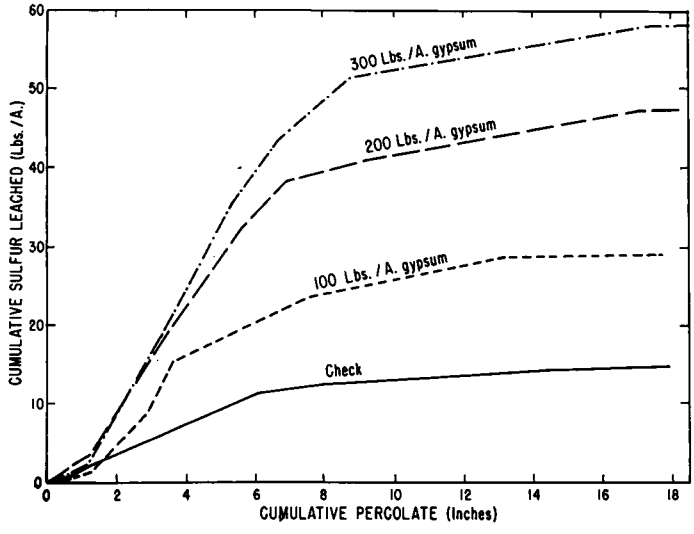


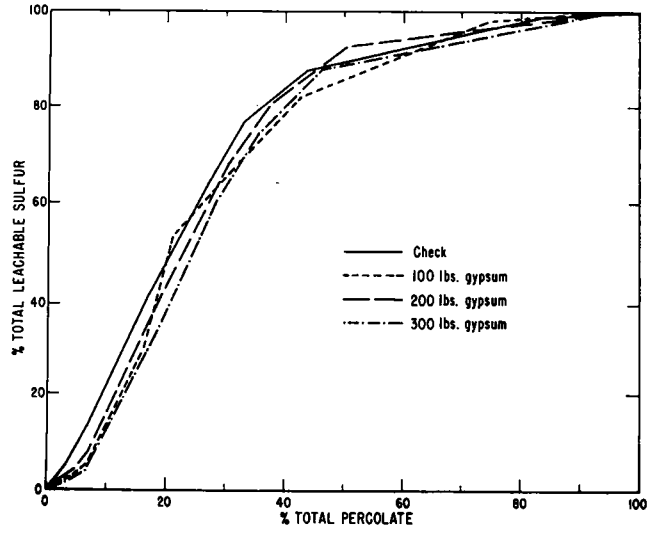
General area of lysimeters showing sloping foothill range and placement of lysimeters.

Each treatment, including the check, lost essentially the same percentage of the total leached sulfur with each increment of percolate. The amount of water passing through the soil was sufficient, evidently, to maintain maximum solubility. The first 50% of the percolate carried down an average of 89% of the total leachable sulfur for all treatments. During the year of the experiment rainfall was abundant—31.8″—and the first 50% of the percolate resulted from an amount of precipitation almost equal to the annual mean rainfall of 19.4″.

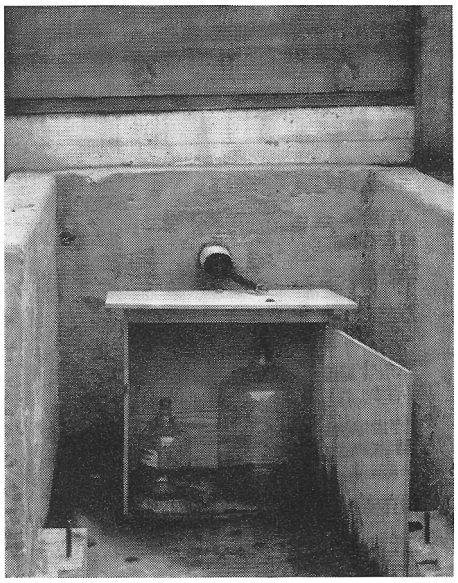
There was considerable variation in the concentration of sulfur in rainwater, ranging from a low of 0.5 ppm—parts per million—to a high of 4.7 ppm, but the concentration was as high in the last storms of the season as it was in the first storms, and no particular trend was evident. The amount of sulfur absorbed from the atmosphere by the soil surface was negligible, 0.1 pound per acre.

Growth of clover planted on the lysimeters was stimulated by the gypsum applications and yields were significantly





***Left:* Cumulative amount of sulfur leached as a function of the amount of percolate from lysimeters receiving several rates of gypsum. *Right:* Relative rate of loss of sulfur by leaching as influenced by the rate of gypsum application.**



Collection bottles for leachate from sulfur fertilized lysimeters.

greater on the 200- and 300-pound treatments than on the checks or the 100-pound treatment. The increases in sulfur content of the plant tissues were not significant. In this experiment, most of the leachable sulfur was lost by the first week of March. Rapid spring growth was initiated by the clover in mid-March, and as a result, high concentrations of sulfur were not available for luxury consumption during rapid plant growth.

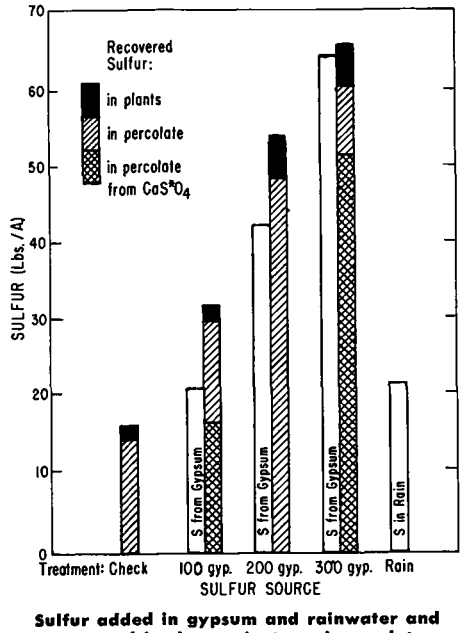
A large proportion of the sulfur applied in the gypsum was lost in the percolate as 77% of the sulfur applied in the 100-pound rate and 78% in the 300-pound rate were accounted for in the percolate collections that would have been lost from the root zone. Although the gypsum applied in the 200-pound treatment was not labeled, the amount of sulfur lost probably did not differ proportionately from the labeled treatments.

Radioassay indicated that clover grown on the 100- and 300-pound treated lysimeters obtained an average of 30.8% and 57.4% of its tissue sulfur from gypsum. Recovery by the clover of sulfur from applied gypsum amounted to 2.8% and 6.7% of that applied in the sulfur fertilizer.

A sulfur-balance sheet was constructed for each treatment. Additions of sulfur to the soil were from gypsum, rain water, air contact, and seed. Losses resulted from leaching—by far, the greatest—and by crop removal. It is apparent from the soil of the check lysimeters that the abundant rainfall did not leach all available native soil sulfur, but added about five pounds per acre to it. However, the contribution of sulfur from rainfall probably would be considerably less in years of normal or subnormal rainfall.

Chemical analysis of the soil at the end of the season showed an average increase of 6.9 pounds per acre of extractable sulfur in the 100 pound-treated lysimeters and 14.7 pounds per acre in the 300 pound-treated lysimeters relative to the checks. The increase may be attributed to the added gypsum.

In a wet year gypsum applied to correct a sulfur deficiency on sandy loam soils may be subject to considerable leaching loss. A high rate of sulfur application, intended to last for several years, could be lost as easily as a lower sulfur application rate intended for one year. But during a succession of dry years a substantial application of gypsum will remain available to plants. Hence after a season of above-normal precipitation reapplication should be considered.



Sulfur added in gypsum and rainwater and recovered in clover plants and percolate.

Sulfur Content of Rainwater Collected at the San Joaquin Experimental Range Lysimeter Site July 1, 1957, to June 30, 1958

Collection interval	Rain (in.)	Sulfur content (ppm)
9/17–12/3	2.99	2.75
12/4–5	0.54	0.50
12/6–16	1.73	3.61
12/17–18	0.54	3.25
12/19–22	0.18	4.70
12/23–1/9	0.27	2.32
1/10–24	2.10	3.88
1/25–27	1.66	2.35
1/27–2/5	2.73	3.45
2/6–13	0.68	1.32
2/14–19	1.30	0.85
2/20–25	2.57	2.50
2/26–3/17	6.14	2.73
3/18–24	3.20	3.47
3/25–4/7	5.14	3.61

Season total 31.77 W'td. mean 2.97

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The Pacific Southwest Forest and Range Experiment Station, U. S. Forest Service, cooperated in the experiments.

Yield and Sulfur Content of Rose Clover Grown in Lysimeters Treated with Various Amounts of Gypsum

Gypsum treatment (lbs/A.)	Clover yield (lbs/A.)	Clover sulfur content (%)	Sulfur in clover obtained from gypsum (%)	Clover recovery of sulfur from gypsum (%)
0	2,480	0.10	...	..
100	1,351	0.14	30.8	2.8
200	4,433	0.11	...	..
300	5,357	0.14	57.4	6.7
LSD (5%)	3,025	N.S.	...	..

Additions, Losses, and Apparent Absorption of Sulfur by Vista Sandy Loam Treated with Gypsum

Item	Sulfur per acre (lbs.) from lysimeters treated with indicated gypsum per acre			
	0	100 (lbs)	200 (lbs)	300 (lbs)
Sulfur added from:				
Gypsum	0.0	21.3	42.7	74.3
Rain	21.4	21.4	21.4	21.4
Air	0.1	0.1	0.1	0.1
Seed	0.1	0.1	0.1	0.1
Total	21.6	42.9	64.3	85.9
Sulfur lost in:				
Percolate (gypsum)	...	−16.4	−47.7*	−50.1
Percolate (rain, air and seed)	−14.2	−12.8		− 8.7
Crop removal (gypsum)	...	− 0.6	− 6.0*	− 4.3
Crop removal (rain, air and seed)	− 2.5	− 1.3		− 3.2
Total	−16.7	−31.1	−53.7	−66.3
Calculated sulfur absorption from:				
Gypsum	...	4.3	10.6*	9.9
Rain, air and seed	4.9	7.5		9.7
Total	4.9	11.8	10.6	19.6

* Non-labeled gypsum used; thus source of sulfur not distinguishable.