M. B. JONES

SULFUR

critical for maximum production of

SUBTERRANEAN CLOVER FORAGE

Stand of subclover and annual grasses fertilized with gypsum, left, as compared with check plot to right at Hopland Field Station.

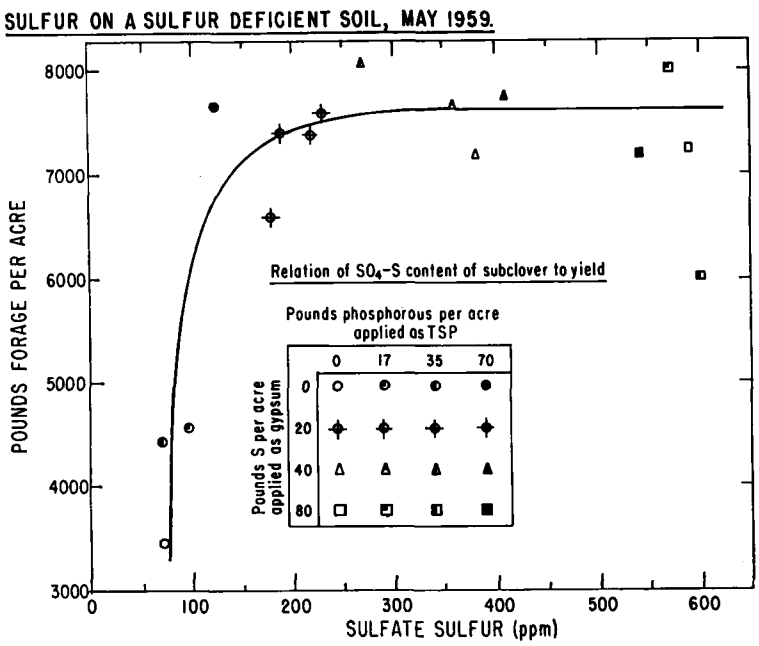
STUDIES ON the sulfur requirements of subclover, *Trifolium subterranean* L., were initiated because of the importance of this species in the coastal counties of California where sulfur deficiencies in the soils are widespread. It has been discovered, for example, that many yield increases formerly attributed to phosphorus were actually due to the sulfur content of the phosphate carrier.

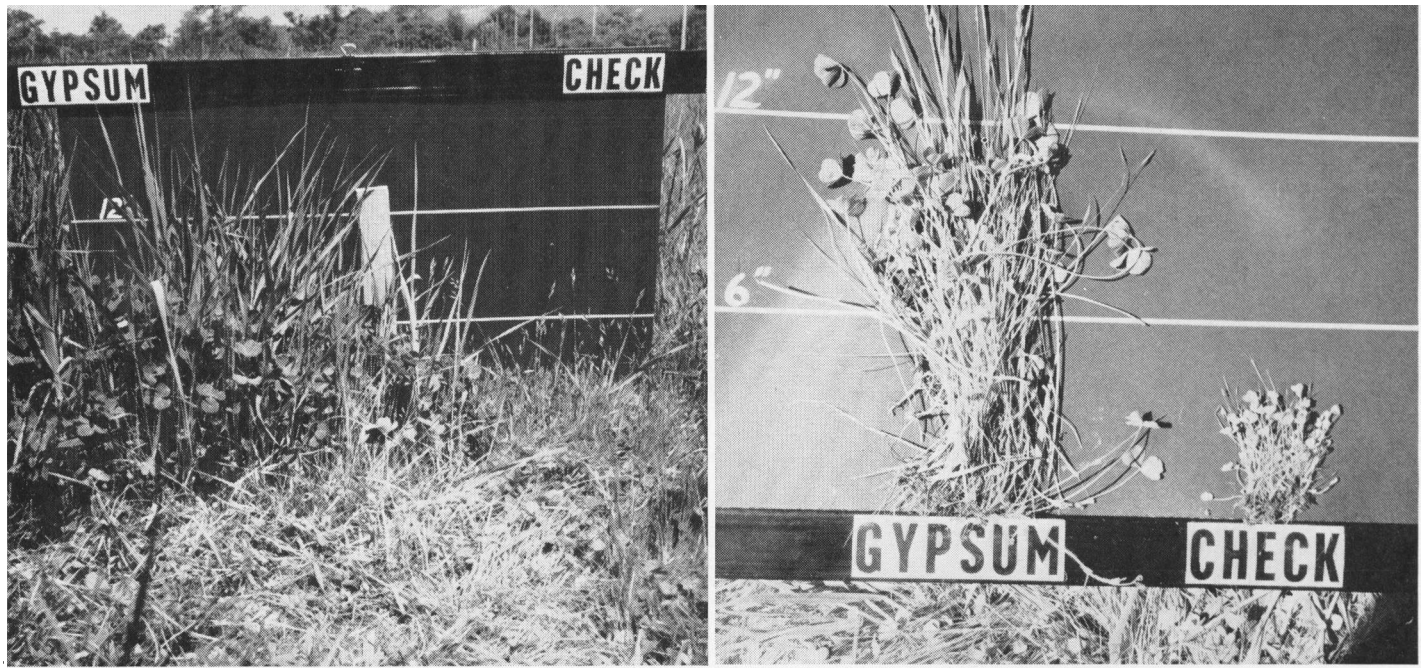
The critical concentration of a sulfate sulfur in the tissue of subclover was determined to be about 170 ppm according to these studies. Critical concentration is defined as that nutrient concentration which is just deficient for maximum growth.

The studies were conducted both in the greenhouse and in the field. At one location in the field it was found that the addition of phosphorus alone had no effect upon plant growth. However, as the graph indicates, even the 3% sulfur content of treble superphosphate, which contributed only 6 pounds of sulfur per acre, increased yields from 3,400 pounds per acre to about 4,500 pounds per acre. Yields increased to 7,600 pounds of forage per acre as the rate of sulfur application was increased to 12 pounds per acre. Additional amounts of sulfur did not increase forage yields. The concentration of sulfate sulfur in flowering subclover increased very little where yields increased with increasing rates of sulfur. But when the critical concentration was reached, the sulfate sulfur concentration increased rapidly, while yields increased very little.

In the greenhouse, subclover plants were harvested at the first, third and fifth flower growth stages, and the plant material was divided into leaves, petioles and stems. The sulfate sulfur concentration did not change significantly over these three stages of growth. The relation of clover yield to sulfate sulfur concentration indicated that at the critical sulfate value, the sulfate sulfur concentration

Relation of total forage production to the sulfate sulfur content of subterranean clover plants receiving increasing amounts of sulfur on a sulfur deficient soil.





Hardinggrass, annual grass and subclover plants from trials fertilized with sulfur as gypsum at Burns Ranch, Mendocino Co., with untreated checks.

was the same in the three plant parts. In the high sulfur treatments more sulfate accumulated in the stems than in the leaves and petioles, but at the low levels of sulfur the sulfate sulfur concentration in the three parts was about the same. Rates of sulfur up to 20 pounds per acre increased yields and the organic sulfur concentration in the plants. The sulfate sulfur concentration in the plants changed very little up to this point. At rates in excess of 20 pounds per acre, however, yields were not increased. Organic sulfur increased very slowly, but the sulfate concentration increased rapidly.

It was concluded that the sulfate sulfur concentration in whole subclover plants can be used to identify sulfur deficient plants, but that it cannot be used to indicate the degree of deficiency. The present studies were conducted with soils known to be deficient in sulfur, and the levels of other plant nutrients were carefully controlled or known. The availability of other elements for plant growth may affect the level of sulfate sulfur in the plant. For example, if phosphorus were more limiting than sulfur to plant growth, but sulfur was also low, the sulfate concentration in the subclover would likely be above the critical value until the phosphorus deficiency was corrected. Thus the whole nutritional status of the plant must be considered. Further work is now under way to determine the application of these findings under a wide range of field conditions in California.

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SPINOSE EAR TICK OF LIVESTOCK CONTROLLED WITH SG 67-PHOSPHATE

HIGHLY EFFECTIVE CONTROL of the spinose ear tick, *Otobius megnini* D., found infesting Thoroughbred race horses, Arabian horses, mules and purebred Polled Hereford cattle, was obtained in southern California ranch tests by using the silica aerogel dust SG 67 (Dri-Die 67) impregnated with 2% dimethyl 1,2-dibromo-2,2-dichloroethyl phosphate insecticide (Dibrom).

When abundant, these ticks can cause serious damage to livestock and other animals. The ticks pierce the tender skin in the ears of animals and suck blood, causing painful irritation, inflammation and often secondary infections. The ear of an infested animal can contain several thousand larval and nymphal ticks in varying stages of development extending from the surface inward to the ear drum itself. The ticks are usually engulfed in a waxy exudate from the ear of the animal as well as their own excretions. The constant irritation caused by heavy infestations of ticks causes some infected animals to continually shake or jerk their heads, appear dull, worried and extremely irritable and sometimes become unmanageable. Loss of weight, unthrifty appearance and deaths are often attributed to heavy infestations of ear ticks in beef cattle on the range.

In these successful trials, each ear of each infested animal was dusted with ¼ to ½ ounce of the 2% phosphate-SG 67 mixture, applied with a polyethylene hand duster. The long spout of the duster was placed deep into the ear and the ear folds held around the spout as the dust was released. The quick knockdown effects of the phosphate insecticide caused a number of the ticks to become dislodged from the ears of the animals shortly after the test compound was applied. These ticks were well covered with the dust and completely immobilized. The dust did not have any adverse effect on the treated animals. One week after dusting, the ears of the animals had dust still within them. The silica aerogel dust removes the waterproof layer of the insect's epicuticle through a continuous adsorption of the lipid elements or by abrasion of this layer—causing abnormal water loss leading to death.

All treated animals remained free of ticks for 28 days or longer without being redusted. The degree of reinfestation was slight compared with the original infestations. Several subsequent dustings kept the animals free of ticks.—*I. Barry Tarshis, Assistant Professor of Entomology and Assistant Entomologist, Experiment Station, U.C., Los Angeles.*