



Helicopter Fertilizing of Foothill Range

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ABSTRACT: Helicopters may prove the best method of applying sulfur fertilizer on rangeland too steep for ground application, or with no nearby landing strip for fixed-wing aircraft. Helicopter fertilization of 457 acres of the San Joaquin Experimental Range in central California in 1960 and 1963 was fast and practical.

In 1960, a new grazing management study on the San Joaquin Experimental Range, near O'Neals, California, called for fertilizing a 457-acre area with 60 pounds of sulfur per acre. In past research at the Range, sulfur application has been by ground equipment or

fixed-wing aircraft. On small areas of fairly level, open rangeland the most practical method has been application of pit-run gypsum with a whirlwind spreader mounted on a small tractor. Soil sulfur has been applied by fixed-wing aircraft on larger, rougher areas. However, rolling topography and numerous trees make it difficult for pilots traveling at high speeds to see flagmen on the ground. Poor ground-to-air communications once resulted in an uneven distribution, which is particularly undesirable for research purposes. Also, suitable landing strips were not available nearby and each load had to be ferried several miles, increasing over-all costs.

First Application

For the 1960 sulfur fertilization, steep slopes and size of the area made application by tractor both unsafe and impractical. Air application was necessary and uniform distribution a must.

Firms using fixed-wing aircraft and helicopters were asked to bid. A low bid of \$3.00 per acre was submitted by a helicopter firm in Fresno. To our knowledge, rangeland fertilization by helicopter was new, but we felt it would give us more uniform distribution, and if it worked out well, the foothill rancher with relatively steep land would have another good fertilization tool.

The initial application was scheduled for mid-October 1960, before fall rains normally start and when air temperatures are usually low enough for safe handling of sulfur. There is an ever-present danger of sulfur igniting inside, or as it leaves, the hopper. At temperatures higher than 75° the danger increases rapidly. All flying was done in early morning before temperatures reached 70°. Also, winds are usually low or absent early in the morning, minimizing drift problems.

Several possible heliports were located along the roads. The pilot selected an open hilltop, centrally located and the highest spot in the area, as an ideal heliport; it was used throughout the application.

For aerial application, sulfur must be as pure as possible to eliminate unnecessary bulk and costly handling. Fifteen tons of soil sulfur were obtained. The sulfur, in 80-pound bags, was hauled to the heliport and at the pilot's request, placed in two parallel stacks, with room for the helicopter between. This made loading fast and easy.

A Hiller 12-B helicopter, 210 hp. model, with homemade dusting hoppers was used. A map of the area and a quick flight helped the pilot locate the boundary fences and flagged corners of the area to be fertilized. In the initial test period to calibrate for effective swath width, optimum helicopter speed, and rate of application, several problems were apparent. The dusting hoppers, equipped with electric-powered adjustable openings and spiked agitators, and the spreader with air blast from the engine blower did not adequately disperse the soil sulfur. The sulfur, some of which was rather lumpy, would not feed through the openings properly, partly because of a tendency to bridge-over above the agitators. Considerable equipment modification was necessary before a satisfactory flow of sulfur was obtained. The maximum hopper openings were enlarged and more and longer spikes were put on the agitators.

After the trial and error phase the 457 acres were fertilized in the early morning hours of October 21 and 23. Winds were negligible both mornings. At each loading, three sacks of sulfur were dumped into each hopper, for a total of 480 pounds. The helicopter easily flew with this load at the thousand-foot elevation of the Experimental Range. Runs were made at 45 to 50 miles per hour; the effective swath was 40 feet. Altitude varied because the pilot often had to "hop" over large digger pine or blue oak trees in the path.

Application rate was 63.5 pounds of sulfur per acre, very close, for a first attempt, to the desired 60 pound rate.

Second Application

The same pilot contracted the fertilizing job in 1963. Far less time was spent in preliminary work. A more powerful helicopter and a different hopper-spreader combination made application faster.

The new 'copter, a 340 hp. Hiller 12-E, made payloads of 640 pounds per trip possible. The new hopper-spreader, with rotating-drum agitators and axial-flow blowers of 600 c.f.m. capacity, worked almost flawlessly. There was little or no bridging-over of the sulfur. Only one difficulty was encountered. A thick paper strip ripped from the top of a sulfur bag was accidentally dropped into a hopper. It jammed the rotating drum and took about an hour to remove. As in 1960, the area was fertilized early in the morning of two days. The same heliport was used. Application rate was practically on the nose--60.4 pounds per acre.

Uniform Distribution

For research purposes, uniform distribution of sulfur was essential. In 1960 and 1963 two flagmen marked each 40-foot swath by waving flags on long poles. The pilot made every effort to keep the swaths properly aligned. On occasion, when he lost sight of a flag, he paused, rose up until it was located, then dropped down and resumed his run. Thus, the helicopter's maneuverability was extremely valuable in obtaining even distribution.

A thorough field check showed that distribution over the study area was excellent, and that slop-over onto adjacent non-fertilized areas was negligible. The pre-application calibration time and continued effort of the pilot to keep proper swath alignment and speed had paid off.

Costs

Cost of application in 1960 was \$3.00 per acre. The sulfur cost \$1.83. The total cost, \$4.83 per acre, was for a 3-year period. Both application and material cost less in 1963: application cost \$2.70 and sulfur \$1.41, for a total of \$4.11 per acre over a 3-year period.

Incidental costs such as calibration and flagging time are not included. We probably spent more time on these tasks, to insure even distribution, than a rancher normally would in fertilizing rangeland.

Conclusions

Helicopter application of sulfur for fertilization of large or steep areas of California foothill rangeland shows definite promise. Considering the reasonable cost, satisfactory rate of application per acre, and uniform distribution, these first attempts were successful.

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