


BURGESS L. KAY



Resident vegetation is killed in bands and seed planted in the center of these bands. The remaining vegetation controls erosion during establishment period. Sierra Foothill Range Field Station.

Millions of acres of California rangelands that could otherwise be improved by re-seeding are located on terrain that is steep, erodable, or too rocky for cultivation. Recent research has shown that these ranges can be successfully seeded by spraying the resident annual vegetation with paraquat and planting immediately. Spraying in bands was shown to give adequate weed control. Special seeding equipment has been developed to allow spraying, fertilizing, and planting in one operation on any terrain that can be traversed by a crawler tractor. This article is a progress report of experimental use of paraquat on California rangelands. Further investigation is necessary before federal registration or University of California recommendation will be granted for use of this herbicide on rangeland.

RANGE FORAGE PRODUCTION can often be doubled by seeding to hardinggrass and the annual legumes rose clover and subterranean clover. However, the vast numbers of seeds of resident plants create a severe weed problem. Weed seed production has been measured to be as high as 400 lbs per acre and, soon after germination, weeds may number as high as 20 to 100 per square inch. Under these conditions weeds can be a severe problem

to the successful establishment of the seeded forage species.

Successful seeding is usually the result of a good job of weed control by cultivation. The soil must be cultivated in the spring before the resident plants have set seed, or after germination in the fall if the weather permits. However, many ranges are too steep, rocky, or erodable to be successfully cultivated.

Recent research has proven the feasibility of spraying instead of cultivating to control the weeds. The herbicide paraquat can be applied as soon as the weed crop has germinated in the fall. Reseeding can take place immediately after spraying because the paraquat residue will not damage the newly seeded plants. In practice, the spraying, seeding, and fertilizing can all be done in one operation.

Four-year test

Paraquat was first tested on California annual-type ranges in the fall of 1962. Spraying and seeding were done in one operation about two weeks after the first fall rain. A spray boom was mounted on the tongue of a grain drill. The hardinggrass and clover seed were planted directly into a newly germinated stand of medusahead. Unsprayed plots were also seeded as checks.

The following spring the hardinggrass plants in the unsprayed plots were mere threads with two to three leaves and 2 to 7 inches high, compared with robust

plants 12 inches high having one to six leafy tillers as found in the plots sprayed with paraquat. The plants in the unsprayed areas died during the summer, while those in the sprayed portion survived to produce large mature plants in the second year. Clover established well in both areas; however, the clover stand the year following seeding was much better in the area originally sprayed.

Several locations

Trials were conducted in a number of locations throughout northern California in the following three years. Where rainfall was adequate and well distributed, seedings were generally successful. Weed control was always excellent except where a second germination of weeds occurred. Most of the weed seeds should have sprouted before spraying.

HARDINGGRASS AND SUBCLOVER ESTABLISHMENT ON BAND SPRAYED PLOTS—SONOMA COUNTY

Species Sample date*	Subclover April 22, 1964		Hardinggrass January 12, 1965	
	Grazed	Not grazed	Grazed	Not grazed
Paraquat Treatment	Per cent stocked†			
Complete coverage	81	87	75	29
11-inch band (50% coverage)	80	86	60	19
5½-inch band (25% coverage)	74	84	58	12
Check—no spray	48	6	0	0
LSD .05	14	7	17	17
.01	21	11	25	24

* Planted October 25, 1963.

† Per cent of samples with at least one plant per foot of row in hardinggrass and per six-inch of row with subclover.

PARAQUAT

For Range Seeding Without Cultivation

Paraquat was sprayed in bands of various widths ahead of the drill opener to determine if a narrow weed-free band would provide adequate weed control for seedling establishment. All seedlings were in 22-inch row spacings. Bands of 25% coverage (5½ inches), 50% coverage (11 inches), and 100% (full coverage) were tested.

In many cases the narrow band (5½ inches) was as good as full coverage. This would represent a 75% saving in herbicide costs over spraying the entire area. In all cases the wide band (50%) coverage gave satisfactory results. The unsprayed bands represent a savings in forage and are excellent protection against erosion. The table shows the results of one experiment which is typical of many of the trials. The additional weed control obtained by grazing or frequent mowing aided the establishment of both the grass and the clover.

Planting equipment

The various grain drill openers commonly available were compared for seeding in the undisturbed range sod following spraying. The soils were generally moist to wet at the time of seeding. Also, most of the soils encountered had a high percentage of clay. Under these conditions a double disk opener was superior to either single disk or chisel openers.

The biggest planting problem is obtaining seed coverage. The moist clay soil

Closeup of sprayed band showing effectiveness of weed control two months after spraying. Notice row of hardinggrass seedlings in left row and subclover seedlings in right row.



Modified rangeland drill can control weeds, apply fertilizer, and plant seed in one operation on any terrain that can be readily traversed with a crawler tractor. Hopland Field Station.



does not crumble readily and generally leaves an open furrow with the seed lying exposed in the bottom. The double disk with a depth band to control seeding depth has given the best seed coverage and resulted in the best stands.

Special drill

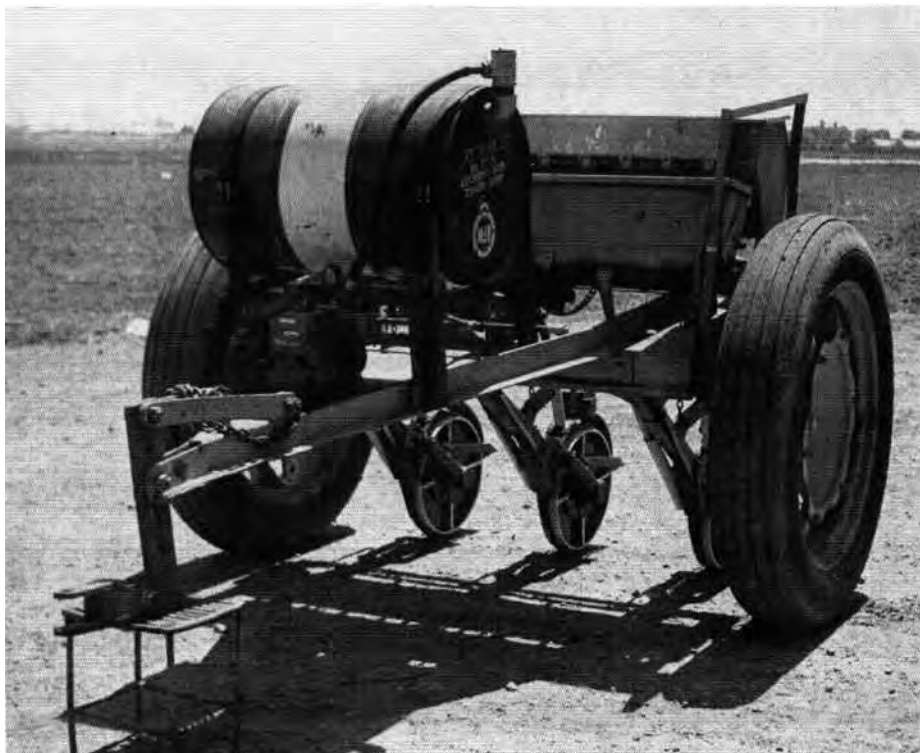
A heavy duty rangeland drill—originally developed by the U. S. Forest Service for use on sagebrush range—was modified for the range seeding trials. Fundamentally, the machine is a grain or grass seed drill with a rugged frame and 51-inch pneumatic rubber-tired wheels to provide a maximum clearance of 26 inches to operate over rocks, stumps, and brush stubs. Standard grain and grass seed boxes with adjustable-gate, fluted, force-feed seed delivery, will handle large and small seed at rates down to one pound per acre.

The 20-inch single disk openers were replaced by custom-built 20-inch double disk openers with 24-inch spacing between openers. Each opener is equipped with a one-inch-depth ring. The openers are pressed into the soil by weight alone. Each opener weighs 188 lbs. Actual weight bearing on the disk is 157 lbs. Additional weight may be added to each opener for operation in hard seedbeds. A spraying system is attached to each opener and is protected by a steel plate with the nozzle spraying through a hole in the plate.

The fertilizer attachment on a standard grain drill delivers either granular or pelleted fertilizers, which allows single superphosphate to be applied to the soil surface in a band approximately six inches wide immediately ahead of each opener. Thus equipped, the rangeland drill can control weeds, fertilize, and plant



Closeup of the twenty-inch, double disk opener. Note the spray nozzle and depth rings. This unit weighs 188 lbs.



Rangeland drill with modified openers to be used on undisturbed annual grass sod. Sprayer and tank for weed-killing chemicals are mounted on drill.

the seeds, all in one operation. The drill will operate on any terrain accessible to a crawler tractor.

Experience to date indicates that weed control is frequently better and longer lasting with paraquat than with cultivation. There is practically no erosion hazard when seeding with paraquat. The dead vegetation not only provides excellent erosion control, but creates a better environment for the new seedlings. The mulch of dead vegetation helps retain moisture, controls temperatures, and reduces the hazard of frost heaving. The minimum disturbance also results in a firm seedbed, allowing accurate control of seeding depth as well as providing a firm pasture for earlier grazing of the seeded area.

Seeding after the spraying of newly sprouted weeds generally means planting into moist soil which will often assure germination of the planted seeds. This moisture is particularly important to the survival of legume bacteria which are essential to the establishment of subclover on California rangelands.

The cost of applying paraquat in 11-inch bands at the rate of 0.25 to 0.50 lbs per acre is comparable to, or cheaper than, cultivation. The greatest advantage is that seeding can be done on ranges that cannot be cultivated.

An obvious limitation is that spraying and seeding must be done within a rela-

tively short time in the fall. The date of seeding is limited to a period beginning after the first fall rains (which are necessary to germinate the weeds). Seeding should be completed before winter temperatures become too low for plant growth, preferably before December.

B. L. Kay is Associate Specialist in the Department of Agronomy, Davis. Many range and livestock farm advisors and ranchers cooperated in the field trials. This research is financed in part by contributions from the Chevron Chemical Company and Ingersoll Products.

CALIFORNIA AGRICULTURE

Progress Reports of Agricultural Research, published monthly by the University of California Division of Agricultural Sciences.

William W. Paul *Manager*
Agricultural Publications
Jerry Lester *Editor*
Chispa Olsen *Assistant Editor*
California Agriculture

Articles published herein may be republished or reprinted provided no advertisement for a commercial product is implied or imprinted.

Please credit: University of California Division of Agricultural Sciences.

California Agriculture will be sent free upon request addressed to: Editor, California Agriculture, 207 University Hall, 2200 University Avenue, Berkeley, California 94720.

To simplify the information in California Agriculture it is sometimes necessary to use trade names of products or equipment. No endorsement of named products is intended nor is criticism implied of similar products which are not mentioned.