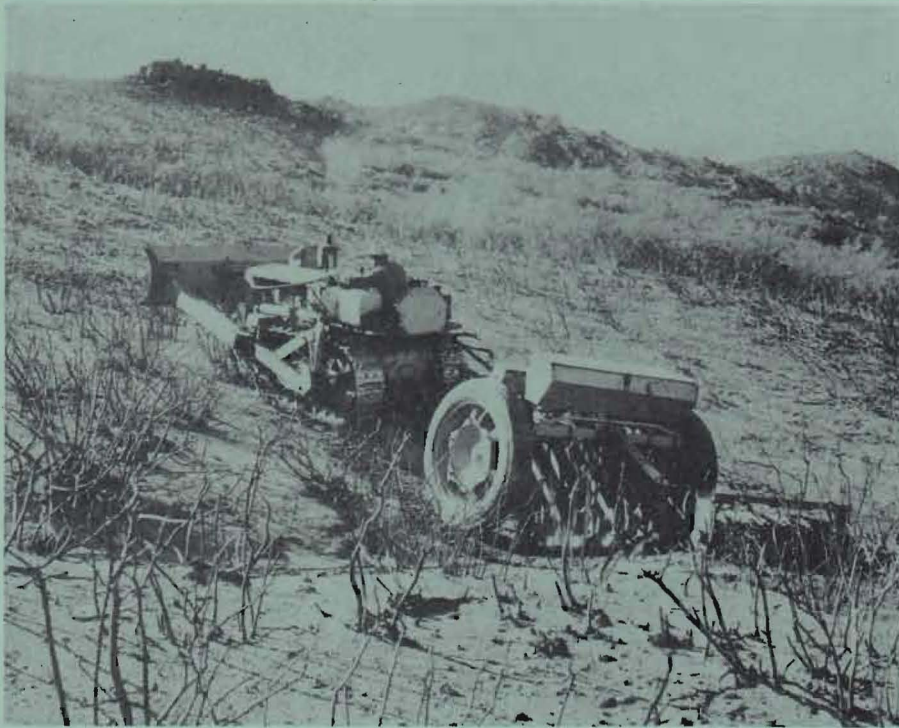


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PROGRESS REPORT

Range Demonstration

1956



University of California
Range Management Investigations

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RANGE MANAGEMENT INVESTIGATIONS

DEMONSTRATION RANGES

Progress Report

Year ending December 1956

Burgess L. Kay, Charles F. Walker, James E. Street, James L. Myler *

INTRODUCTION

The activities of the Range Improvement Demonstration Project are herein reported for the sixth year. It is of special interest to note that the old established demonstration ranges are very definitely focal points of range improvement work from research through extension. Their influence is more than local. Range improvement field days held at demonstration ranges are second only to the Hopland Field Station field day.

Work in Modoc County has extended to acreage spraying of sagebrush and wheatgrass seeding. Spring seeding continues to be superior. A response from nitrogen carryover in fertilizer plots has been measured. Band seeding has produced good stands of perennial grasses and sub clover on three distinct soil types in Humboldt County. Comprehensive chemical stump treatment trials for sprout control also were established in Humboldt County. Extensive chemical control of brush sprouts has been accomplished in Tulare County and San Diego County. Seedings with the heavy duty range drill in Tulare County are very outstanding. The San Diego Demonstration Range visited by an impressive group during a Southland Range and Watershed Tour in the spring. A rancher field day was held there again in the fall.

Control of small range rodents by aerial broadcast of poisoned bait was clearly demonstrated as a result of cooperative studies with Dr. W. E. Howard. A report of this study appeared in California Agriculture. A system of using permanent bait cans to protect experimental plots was also devised.

Converting brush to grass on the experimental watersheds studied by the Department of Irrigation has become an additional responsibility of the Range Improvement Demonstration Project. These watersheds have been left untreated for the past few years during a calibration period. A controlled burn conducted on an experimental watershed at Hopland Field Station was a successful large scale demonstration of simultaneous ignition techniques. This burn has been widely pointed to as an ideal objective in controlled burning.

All activities have been closely correlated with research departments, extension specialists and farm advisors. Likewise able assistance and cooperation has been received from the State Division of Forestry, U. S. Forest Service and

State Department of Agriculture.

The work in progress and results to date are summarized in the following pages under individual headings.

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On the Massey ranch in San Diego County we have been concerned with lands in the Cleveland National Forest at 3000 foot elevation. The project is engaged in a co-operative study with the University Extension Service and the U. S. Forest Service.

The disastrous Inaja Wildfire of 43,000 acres burned to the west boundary of the 600 acre experimental area. However, it was easily contained here, demonstrating the value of an improved range in terms of fire protection and good watershed management. The conversion of brush to grass has been accomplished on two pastures of the demonstration range. A fine stand of perennial grasses and annual legumes has become established and is improving each season. The following paragraphs will contain development procedures and economics of conversion.

Pasture A

This 150 acre pasture was first seeded in November of 1950. The area lies within the NW margin of the Conejos wildfire that burned 64,000 acres. The pasture is conveniently divided into parcels by Sand Creek. The northern half of the pasture was broadcast seeded to perennial and annual range species after the area was railed (no seed coverage). The southern half was broadcast seeded and then railed. It was very evident in the spring of 1951 and also in 1956 that a much better stand was obtained by some seed coverage.

From the original seeding, hardinggrass and smilo have survived and are the major producers of the feed utilized in the pasture.

In order to improve the part of Pasture A that did not have a good stand of grass, about 40 acres was band seeded to harding, veldt, smilo and rose clover in the fall of 1956. One hundred pounds to the acre of 11-48 was placed beneath the seed. Also plots were placed in Pasture A to continue the search for better range legumes. Several sub clover varieties, a new creeping rooted alfalfa, and hybrid orchardgrasses developed by Dr. Stebbins of the Genetics Department were seeded.

Pasture B

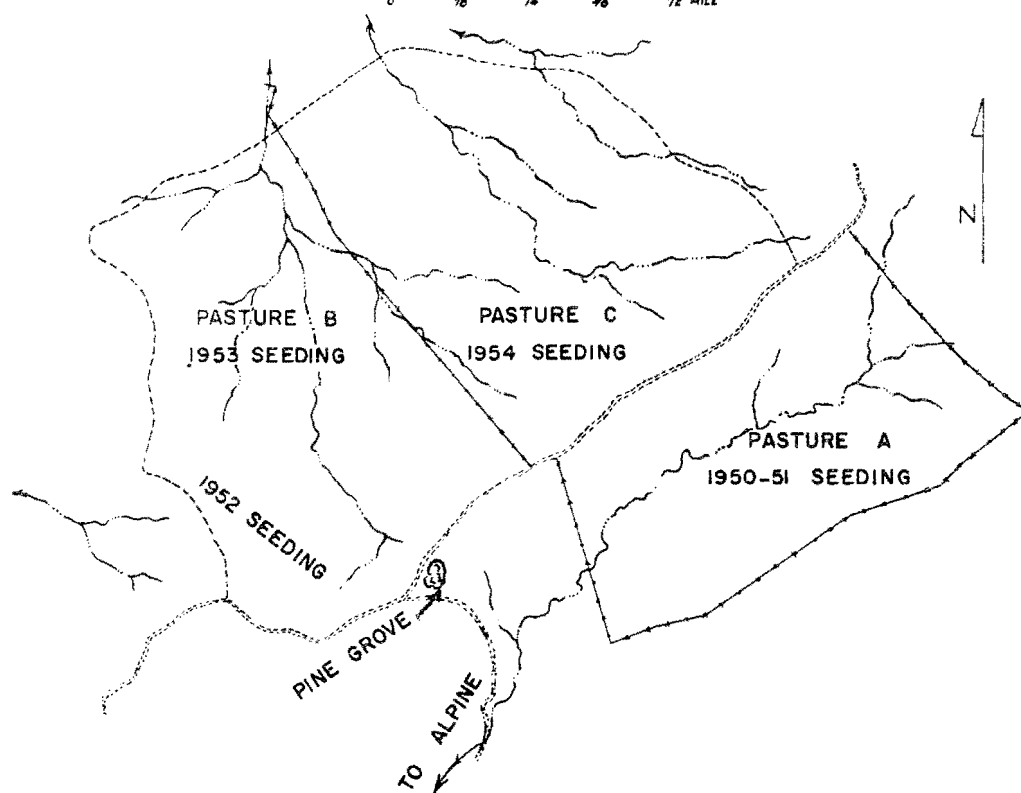
Refer to the map and notice pasture B has two seeding dates. Forty acres of brush on the west side of the experimental range was disked and walked down in 1952. During the fall of 1952 the area was broadcast seeded to a range mix that included veldtgrass. The seed was covered by disking. Harding, veldt and smilo are now leading forage producers in the area.

The east end of the pasture was control burned by the U. S. Forest Service during the summer of 1953. A cross fence divided the area to exclude Pasture C. During the fall of that year a range mix was broadcast on B, and pasture C was seeded to cultivated oats. In both cases, the seed was covered by disking.

Herbage composition and density are described and compared with pasture C

TULE SPRINGS EXPERIMENTAL RANGE

SAN DIEGO CO.



		Seed Mixture Lbs/Acre			
PASTURE A	Hardinggrass	1	Smilograss	1	
Burned summer of 1950.	Orchardgrass	1/2	Alfalfa, Calif. common	2	
Seed and rail December 1950.	Tall fescue	3/4	Rose clover	1	
Airplane sprayed spring 1952 and spring 1953	Harlan brome	3/8	Annual ryegrass	2	
		Seed Mixture Lbs/Acre			
PASTURE B West End	Hardinggrass	2	Soft chess	1	
Mechanically cleared winter of 1951-52. Broadcast seeded and disced fall of 1952.	Veldtgrass	2	Harlan brome	1/2	
	Smilograss	2	Rose clover	2	
	Tall fescue	2	Sweetclover	2	
	Orchardgrass	1 1/2	Bur clover	2	
PASTURE B East End	Hardinggrass	2	Soft chess	1/4	
Burned summer of 1953.	Veldtgrass	1	Annual rye	1/4	
Broadcast seeded and disced fall of 1952.	Smilograss	1	Alfalfa	1	
	Tall fescue	1	Mt. Barker sub.	1/2	
	Brome 100	1	Crimson clover	1/2	
	Orchardgrass	1/3	Bur clover	1/2	
PASTURE C	Hardinggrass	1	Alfalfa, Calif. common	1	
Burned summer of 1953.	Smilograss	1	Rose clover	1	
Cropped to oats 1953-54	Veldtgrass	1	Sweetclover	1	
Band seeded fall of 1954.	100 lbs./acre 11-43-0 Fertilizer				

as conclusion of the following paragraphs devoted to pasture C.

Pasture C

Drilling hardinggrass, veldtgrass, smilo and rose clover over a band of 11-48-0 at 100 lbs. to the acre in the fall of 1954 produced a fine stand of seeded grasses and legumes. These grasses were selected as the most tenacious and highest producing of the many species that were broadcast originally in 1950 on pasture A.

The rose clover and alfalfa responded to the banded phosphate fertilizer. After grazing, the rose clover yielded a good seed crop for the following year. The clover came back in increasing amounts during 1955 and has given evidence of becoming established. One pound of rose clover seed per acre was drill seeded in 1954. Seven pounds of seed were produced in 1955 and nineteen pounds per acre were produced in 1956 reflecting the possible establishment of this annual legume. Legumes have not survived in any quantity in pastures A or B.

The advantages of drilling are many fold. The seed has to be covered to insure a stand. This is conveniently done by the drill. A lower seeding rate will give satisfactory stand thereby cutting costs. Banding the fertilizer gives the most advantage to seeded species and gives the slow starting perennials a chance of survival the first year. The fertilizer will increase root growth thus enabling the first year perennials to withstand the expected drought periods in San Diego County.

Forage sampling in pasture C revealed an average of 350 lbs. of dry matter per acre. Several $\frac{1}{500}$ acre plots were clipped using a sythette to simulate grazing. The forage was weighed and oven dried. In 1956 the carrying capacity for the 86 acre pasture was 68 animal unit months of grazing or .75 A.U.M. per acre.

Plant count data in the following table illustrates the plant composition present on pastures B and C in 1955-56. Point step analysis was used as the sampling procedure. Herbaceous density refers to the percentage of ground covered by plants. The figures related to the general classifications, for example "Seeded Legumes", refers to their relative per cent of the herbaceous density. For comparisons between the two pastures, it is necessary to multiply herbaceous density percentage by the general classification percentage. The numbers in parenthesis represent this multiplication. Note the seeded perennials in pasture C almost doubled while in pasture B there was a slight decline. Also seeded legumes have almost disappeared in pasture B and are increasing in pasture C.

	Pasture B		Pasture C	
	4-24-55	4-29-56	4-24-55	4-29-56
Herbaceous density	12%	19%	10%	24%
Desirable Annual Grass	29.50 (3.54)	44.5 (12.25)	25.50 (2.55)	31.0 (7.44)
Undesirable Annual Grass	1.50 (.118)	1.50 (.09)	2.50 (.250)	6.5 (1.56)
Seeded Legumes	0.00 (0.00)	.5 (.09)	16.5 (1.65)	19.0 (4.56)
Desirable Perennial Grass	64.00 (7.68)	33.0 (6.27)	46.50 (4.6)	32.5 (7.8)
Undesirable Forbs	5.00 (.60)	1.5 (.28)	9.00 (.9)	11.0 (2.6)

Herbicides

Pasture A was airplane sprayed in the spring of 1952 and 1953. Seedling control was successful and the sprouting chamise was set back but not entirely killed. Further airplane sprays were discontinued.

Several acre plots were established using ground application techniques. A complete kill of the chamise resulted. Acre plots were established during the months from February through August demonstrating the wide range of application times that a complete kill can be expected.

Approximately 200 acres of the sprouting brush in pastures B and C were sprayed with a ground rig. The equipment included a 4-wheel drive vehicle that transported a 100-gallon spray tank. Two hoses with shut-off valves allowed the operators to cover a wide swath. Using high volume low pressure application the job was completed at a cost of ten dollars per acre. The spray mixture used was a 1 per cent solution of 2, 4-D low-volatile ester. Each tank full contained one gallon diesel, one gallon low-volatile ester of 2, 4-D and 98 gallons of water. An average of 56 gallons of spray was required to treat each acre, taking three man hours labor for application.

Fertilizer Trials

A definite nitrogen-phosphorous soil deficiency has been demonstrated by past trials. Placing the seed over a band of 11-48-0 at 100 lbs. per acre gave excellent results. Further broadcast applications of treble superphosphate were placed on plots throughout the pasture to test whether it will be necessary to keep the phosphate level up to retain the legumes.

Several rates of NP combinations were applied also and will be sampled during the spring of 1957 to retest the nature and economics of NP fertilization on an established stand. Previous exploratory plots have given NP response with observed carry-over two seasons later.

Livestock Scales

Corrals are being constructed and livestock scales installed on the area. Several springs are being developed with the help of the Forest Service. These features will permit expression of capacity of the pastures in terms of actual animal gains.

Rodent and Rabbit Control

Rodents were not only gathering alarming quantities of planted seeds but together with rabbits were consuming grass and legume seedlings. Previous seedings had been somewhat protected by hand broadcast poison baits.

Roller oat groats poisoned with three ounces of 1080 per 100 pounds were airplane broadcast on a 600-acre area in January 1956. Two flaggers were used to guide the airplane on a 30 yard interval on 400 acres and 50 yard interval on 200 acres. The bait fell in swaths about 20 yards wide. Rodent trapping 35 days after poisoning indicated 97 per cent reduction in population. By November, however, the rodent population had recovered to about 50 per cent of January pretreatment density. At this time the area was re-poisoned in similar fashion. Laboratory observations indicate a kangaroo rat might cache 20,000 rose clover seeds on a night of peak activity. This could mean a seed loss of one pound per rat per week.

Aerial broadcasting of rodent poisons is herein reported in greater detail under the heading of Flournoy Ranch. The same material is also reported in California Agriculture, Vol. 10 No. 10, pp. 8-9, October, 1956.

Brush rabbits were controlled by the aerial poisoning but not jack rabbits. An attempt was made to reduce the jack-rabbit population by placing one cup of whole barley at 40 ft. intervals through the center of the pastures. The amount of grain eaten from the piles each night was replenished with fresh grain. On the fourth night, the stations where rabbits were consuming grain were substituted with strychnine barley. Twenty-five dead jack-rabbits were found the following morning.

Field Days

1. Spring Field Day (May 3, 1956): The second day of the two-day Southland Range and Watershed Tour was held on the Massey Ranch. One hundred people were given a tour that traced the present development of the various pastures. After a very enjoyable noon meal, provided by Ranger Blood of Cleveland National Forest, the group heard a panel discussion on range management. Mr. Burle Jones, Agronomist Emeritus, was the moderator of the panel that included members of U. S. Forest Service, State Division of Forestry and University of California. The tour was resumed after lunch and concluded in pasture C where the heavy duty range drill was demonstrated. Emphasis was placed on the excellent results obtained by use of this mechanical equipment to secure a good first year stand of perennial grasses. The importance of eliminating the sprouting brush in an improved range was brought to the attention of the crowd. The net result of these two range improvement steps was not only increased cattle forage but also good watershed management.

2. Fall Field Day (November 9, 1956): Because many ranchers were unable to attend the spring meeting, another field day was arranged. Considerable interest was aroused by the heavy duty range drill and the people wished to see it in operation. As the fall planting schedule included reseeding part of pasture A this afforded an opportunity to view the drill working over rough field conditions.

Thirty-five people were present for this field day and were given an informal discussion of the range reseeding. They were also able to see results of

the chamise spraying program on pastures B and C. As the fall seeding was preceded by aerial broadcast of 1080 poison to control rodents, the group also observed this activity and was given an insight to rodent problems by Dr. W. E. Howard.

Economics 1950 - 1956

	Seeding	Seedbed Prep. and Seed Coverage	Chemical Brush Control	Fencing	Total Cost per acre
Pasture A 180 Acres					
150 Acres Tillable	4.40	2.00	--	1.50	\$ 7.90
Pasture B 240 Acres					
180 Acres Tillable	8.07	2.99	10.00	1.05	22.11
Pasture C 271 Acres					
86 Acres Tillable	4.03 (Seeding Cereal Oats)	3.53	--	3.06	10.62
	10.05 (Band Seeding to Perennials)	4.50	10.00	--	\$24.55

There have been 1240 animal unit months of grazing on the demonstration range since 1950. Over-all cost of development has been \$7874. A 39 per cent total return has been realized for the period 1950 - 1956 if an A.U.M. is valued at \$2.50. Average annual grazing returns as a result of range improvement have been 6.5 per cent. Benefits in terms of watershed improvement and reduction of fire hazard should not be overlooked.

MANLEY RANCH, TULARE COUNTY

300 Acre Pasture

1. Chemical spraying: The final step in the brush to grass conversion was initiated by application of herbicides to sprouting brush. The pasture was originally control burned in 1951, followed by a reburn in 1954.

A 200 gallon fire-control sprayer mounted on a 4-wheel drive vehicle was utilized to good advantage in spraying the brush. One hundred feet of 3/8 inch

commercial spray hose was attached to the reel of the sprayer. This added length allowed two men to cover a wide swath from each stop of the truck. Standard shut-off valves and full cone nozzles made possible efficient application with minimum chemical waste,

Dr. Cliver Leonard's recommendation for the mixed chaparral in the pasture was:

- 1/2 gallon of 2, 4-D low volatile ester
- 1/2 gallon of 2, 4,5-T low volatile ester
- 1 gallon of diesel
- 98 gallons of water

The cost analysis per acre:

Chemical	\$4.00
Labor	2.98
Equipment	<u>1.94</u>
	\$8.92

The chemical costs in the table include ten gallons of 2, 4-D amine which was used in the cut surface treatment of 475 oak trees. Chemical killing of trees and shrubs not only increases forage production but aids spring flow for stock water. Two men were able to cut surface treat 160 large oak trees in eight hours. The men used approximately one quart of amine for 12 trees.

The results of the chemical work will be sampled and evaluated this spring. Many of the brush species will probably require a follow up treatment for complete kill.

2. Cattle weights: A livestock scale was installed to weigh cattle on and off of the pasture. The actual pounds of beef per acre produced from the feed on the converted improved range can now be recorded.

On May 1st 100 yearling steers were given a shrink and weighed prior to entering the pasture. The average weight was 674 lbs. They were given an over-night stand without feed or water and weighed off on June 22nd. During the 53 day period, the average daily gain per head was 1.54 lbs.

Future plans include dividing the pasture and fertilizing one half. Facilities for weighing cattle will permit the benefits of fertilization to be measured in terms of livestock weight gains.

3. Economics 1951 - 1956: Cost Study of Range Improvements:

Original control burn and seeding in 1951	1672.28
Reburn and area reseeding in 1954	1422.00
Chemical control of sprouting species in 1956	<u>1784.88</u>
Total	<u>4879.16</u>

Grazing returns:

Year	Actual Use (A.U.M.)	Reimprovement Carrying Cap. (A.U.M.)	Increase in Carrying Cap (A.U.M.)
1952	100	-74	= 26
1953	288	-74	= 214
1954	86	-74	= 12
1955	184	-74	= 110
1956	395	-74	= <u>321</u>
		Total	683
		Average	136

Using the arbitrary value of \$2.50 per A.U.M., the average annual increase in carrying capacity resulting from range improvement is \$340.00 or about 7.6 per cent annual return on the investment. The costs were calculated from average going rates for labor, equipment and materials. Carrying capacity should continue at about the 1956 level which will increase the per cent return on investment. In 1952 and 1955 the pasture was not grazed until the seeded perennial grasses had matured seed. Light grazing in 1954 saved fuel for the reburn.

1000 Acre Pasture

Successes and failures experienced with the 300 acre pasture were used as a guide in the first step of range improvement on a 1000 acre pasture. A controlled burn in August of 1956 followed months of preparation. The value of crushing the brush to concentrate the fuel has been fully realized. Brush was walked down wherever it was possible to take a big crawler tractor.

The burn area was situated in a rather precarious position, being located at the base of a long slope of brush covered National Forest Land with valuable pine timber at the top of the hill. As a very necessary safety precaution a strip several hundred yards wide and adjacent to the hazardous government brush land was burned out during May.

Five lines of electric ignitors facilitated the actual firing August 11, 1956. Use of strategically located electric ignitors permitted rapid interior firing without the hazard of having personnel within the burned area. Although the burn was not an example of over all area ignition or simultaneous ignitors these techniques were advantageously employed together with rapid perimeter firing.

After a successful burn most of the area was airplane seeded in October. At the same time a plot was established using the heavy duty range drill. An October rain of about 1.75 inches was followed by warm dry weather. The drilled seed germinated to an excellent stand but most of the broadcast seed did not remain moist long enough for germination until low temperature became a limiting factor. At present the drilled stand is far superior to the broadcast stand.

Additional advantages of drilling seed in this area are listed:

1. The seed is covered thus giving some protection from bird and rodent depredation.
2. By developing a good rooting system from early germination, many of the plants should withstand the rigors of frost heaving.

Fertilizers

Yield data from a nitrogen sulfur plot which was measured on May 18, 1955 suggested strongly that the resident range vegetation responded to these nutrients. Comparable rates of ammonium nitrate and ammonium sulfate produced vastly different yields. (Data in Manley Ranch, 1955 annual report.)

Two plots were established in early December of 1955. Treatments of one plot consisted of check, ammonium nitrate, ammonium nitrate+gypsum. Treatments of the other plot were two rates of ammonium sulfate.

There was no significant difference between ammonium nitrate and ammonium nitrate+gypsum treatments. However there is a considerable increase in yield between comparable rates of ammonium nitrate+gypsum and ammonium sulfate. The plots were in the immediate vicinity of each other. Very heavy rains were recorded in late December. (8 inches in 24 hours.)

YIELD MEASUREMENTS OF RESIDENT VEGETATION*

	Mean Yield		Mean Yield
Check	2125	N52 S60 (Ammonium Sulfate)	4076
N100 (Ammonium Nitrate)	2904		
S107 (Gypsum)	2019	N104 S120 (Ammonium Sulfate)	4561
N100 S107 (A.N. + Gyp.)	3181		

Source of Variation	D.F.	Mean Square	Source of Variation	D.F.	Mean Square
Treatments	3	2,147,358 ^{**}	Treatments	1	941,395 ^{***}
Error	28	200,474	Error	14	108,225
Total	31		Total	15	

^{**}L.S.D. (at .01 level) = 618

^{***}L.S.D. (at .05 level) = 352

* Yield Measurements in terms of oven dry matter per $\frac{1}{500}$ acre samples.

BROOKE RANCH, VENTURA COUNTY

Competition Control

Four methods of establishing good range species are being tested on this ranch. The area now supports annual grasses that offer limited grazing. The major difficulty encountered in establishment is competition from these annuals.

The four methods are:

1. Direct seeding following seedbed preparation 1953.
2. Seeding to cereal barley after seedbed preparation in fall of 1953 followed by broadcast seeding range species in barley stubble in fall of 1954 and seed covered by harrowing.
3. Drill seed over band of fertilizer after seedbed preparation in fall of 1955.
4. Drill seed over band of fertilizer on spring fallowed ground in fall of 1956.

The direct seeding after seedbed preparation in 1953 had severe competition from annual species common to this area. However in 1956, hardinggrass, veldt-grass, alfalfa, and rose clover gave indications of being permanently established. The stand is rather sparse but it is encouraging to note any survivors, considering the competition.

The rose clover stand is considerably improved from the original seeding in 1953. Large scattered colonies exist throughout the plot. This situation has been observed in other parts of the state. A seeding that looks like a failure the first growing season can gradually form a dense solid stand over a period of years.

The seeding into sudan stubble was unsatisfactory.

The seeding over a band of fertilizer into the annual cover had no success.

The seeding over a band of fertilizer into spring fallowed ground will be evaluated in the spring of 1957.

The present objective of introducing improved forage species to replace the annual cover is being tested on two adjacent areas. The grazing schedule is designed to favor the slower starting perennial grasses. The cattle are turned into the pastures when the annual cover is 6 to 8 inches high. This type of grazing tends to reduce the competition and allow the perennials enough growth to produce seed.

From a ten year old spotted stand of hardinggrass, it was noted that

harding plants that become established are doing quite well. The average basal diameter of the crowns now exceeds twelve inches. If a suitable method of securing a good initial stand can be found, the production of the pasture should be materially increased.

Fertilizers

The testing of a nitrogen-phosphorous response from previous years of exploratory trials was followed this past season with a rate test of NP. The treatments were not replicated. By observing the data however, these observations are made:

1. The highest yield dry weight, resulted from N₁₀₀P₅₀. A ton of forage was produced by addition of \$11.56 in fertilizer. N₅₀P₂₅ produced less total but more per dollar, a ton of forage for \$11.00 in fertilizer.
2. Note-laboratory analysis for per cent PO₄ of the clipped samples indicated a gradual increase of recoverable PO₄ as the rate of application increased.

<u>Actual Pounds of NP Applied</u>	<u>% Protein</u>	<u>% PO₄</u>	<u>Lbs. of dry matter per acre</u>	<u>Cost of Fertilizer per acre</u>
Check	6.94	.47	722	0
P25	7.24	.64	821	\$ 2.37
P50	6.64	.66	1307	\$ 4.75
P100	6.44	.72	1307	\$ 9.50
N50 P0	8.44	.40	1705	\$ 7.50
N50 P25	7.56	.44	<u>2515</u>	\$ 9.87
N50 P50	6.80	.54	2565	\$12.25
N50 P100	6.88	.63	2589	\$17.00
N100 P0	10.44	.36	1730	\$15.00
N100 P25	9.80	.47	1780	\$17.37
N100 P50	8.20	.53	<u>4108</u>	\$19.75
N100 P100	7.78	.62	2552	\$24.50
N150 P0	10.20	.34	1269	\$22.50
N150 P25	10.02	.43	3162	\$24.87
N150 P50	9.08	.53	3822	\$27.25
N150 P100	7.98	.66	4021	\$32.00

N	P ₀ 25				Total	Ave
	0	25	50	100		
0	722	821	1307	1307	4157	1039.2
50	1705	2515	2565	2589	9374	2343.5
100	1730	1780	<u>4108</u>	2552	10170	2542.5
150	1269	3162	3822	4021	12274	3068.5
Total	5426	8278	11802	10469		
Ave	1356.5	2069.5	2950.5	2617.2		

WAGNER RANCH, HUMBOLDT COUNTY

Controlled Brush Burning

The reburn which has been postponed the last two summers because of early fall rains was completed on August 28, 1956. This area was first control burned in 1951.

Full use was made of all firing and igniting devices available. Electric ignition circuits were placed in the bottoms of the three canyons which divide the burn into four ridges. The perimeter was ignited by three firing crews - two with flame throwers and one with drip torches. An additional line of fire some 50 yards inside the fire line was accomplished by the use of ignitors launched from slingshots on the fire line.

The 58 acres of steep north slope covered with tanoak contained little material which could be considered good fuel. There was practically no dead material on the ground. All the grasses present were seeded and native bunchgrasses too green to burn.

The area was ignited 2:20 p.m. August 28, 1956. The humidity was 30% and the temperature 85°. Ignition was completed in 20 minutes. Fire crews were removed from the fire line and on their way home by 4:00 p.m.

The results of the burn were poor by comparison with other burns throughout the state. However, by comparison with other burns on the Wagner ranch, the results were good. The burn was fast and safe.

Areas of the burn which burned successfully were broadcast seeded to a mixture of hardinggrass, smilo, tall oatgrass, and subterranean clover.

Chemical Tree Control

An experiment was undertaken to determine the best treatment to prevent hardwood stumps from sprouting after logging. Forty madrone and 40 tanoak trees or clusters of sprouts were sawed down and the stumps treated on each of four dates during the year. Months of treatment were January, April, July, and October.

Treatments being used are:

1. Check - trees sawed down and stumps allowed to sprout.
2. Stump tops brush painted with 2,4-D Amine at 4 lbs.A.E./gal.
3. Entire stump sprayed wet to ground surface with mix of four per cent Ester 2,4-D (4 lbs. A.E./gal) and 96 per cent diesel oil.
4. Entire stump sprayed wet to ground surface with mix of two per cent Ester 2,4-D (4 lbs. A.E./gal) and two per cent Ester 2,4,5-T (4 lbs.A.E./gal) and 96 per cent diesel oil.

These stumps will be observed and results recorded during the summer of 1957 and final tabulation made in the summer of 1958.

There may be a place for treating hardwood stumps after logging. Some south slopes which are now supporting scattered stands of douglas fir, hardwoods, and brush could support a good forage crop. There has been some interest in slashing these hardwoods after harvesting the merchantable douglas fir with the idea of converting the area to range. Successful treatment of these hardwood stumps is necessary or the areas will revert to a jungle of hardwood sprouts.

Another possibility is the conversion of hardwood stands to range with the intermediate step of charcoal production. The areas could be logged for the hardwoods, the stumps treated, the area burned and seeded to perennial grasses. The value of hardwoods for charcoal should easily pay for the costs of the range improvement.

A third possibility is the slashing of the hardwoods following douglas fir logging in areas of good fir production. In this case the hardwood stumps should be treated to prevent sprouting as the sprouts would inhibit maximum fir establishment and production.

Chemical Brush Control

Brush sprouts were sprayed in areas of our grass seeding to prevent them from recapturing the sites. Two applications will probably be necessary for complete control.

A field day was held with the personnel of the Humboldt County Agricultural Commissioner's Office and Agricultural Extension Office to observe the results of brush spraying plots established in the spring of 1955. A series of plots had been put out with the help of Dr. Oliver Leonard of the Botany Department of the University and equipment belonging to Humboldt County. Repeat application of some of the treatments used together with new treatments is planned for the spring or summer of 1957.

Dr. Leonard has established numerous brush spraying plots, soil sterilization plots, stump treatment plots, and cut-surface treatments on the Wagner Ranch during the past two years. We are grateful for this on-the-spot research which may produce information we can use in demonstrating range improvement.

1956 Subterranean Clover Seeding

This seeding started out as simple test to measure the costs and returns of establishing subterranean clover from seed. The cost of establishment was returned from the increase in forage production during the first growing season.

Clipping studies and plant counts indicate that total pasture production and the abundance of subterranean clover has decreased during the second growing season to only slightly more than the unseeded unfertilized area. This can be compared to a threefold increase the first year.

Management, clipping, and plant count studies on this area will be continued

for several more years to measure the pattern of clover establishment and production. Observations on older seedings indicate that stands of such clover which are initially good tend to be poor for several succeeding years and then again become quite good. Four hundred pounds of single super phosphate per acre was applied to the study area in the fall of 1956. Plant counts and yields will be measured again in 1957 and 1958.

Establishing sub clover by the use of straw and burs.

Perhaps one of the surest methods of establishing sub clover is through the use of the straw and burs raked from an established stand of subterranean clover. Sub clover straw and burs were broadcast on a plot of cultivated native range in the fall of 1954. The establishment of sub clover plants was determined by the point step analysis in the spring of 1955 and 1956. The results of this treatment were not outstanding the first season following seeding. However, they are striking during the second season when compared with other treatments.

Table No. 3

Treatment - October 1954	Per cent ground cover Sub clover	
	April 13, 1955	April 19, 1956
Disked, subterranean clover straw broadcast, rolled, fertilized with 400 lbs. SSP.	10-15	10-15
Disked, harrowed, seeded, rolled, fertilized with 400 lbs. SSP.	10-15	<5
Disked, harrowed, seeded, rolled, fertilized with 800 lbs. SSP.	25-30	5-10
Disked, harrowed, seeded, rolled, fertilized with 400 lbs. SSP. Mulched with alfalfa hay.	10-15	<5
Disked, harrowed, fertilized with 400 lbs. Ammonium sulphate, seeded, rolled. 400 lbs. SSP applied Dec. 1955	15-20	5-10
Disked, harrowed, seeded, rolled	10-15	<5

The comparison here is probably misleading. All of the seedings received ten pounds of subterranean clover seed per acre except the area broadcast with straw and burs. There was probably far in excess of ten pounds of seed in the straw. However, this method of establishing subterranean clover can be recommended as a "sure-fire" technique. The cost of raking, hauling, and broadcasting the straw may be prohibitive.

Seeding of Forage Species

The adaptability of perennial grasses and annual legumes and methods of their establishment is being studied on three soil types on the Wagner Ranch. Areas on each of the Josephine, Laughlin, and Yorkville soil types were prepared and planted to sudangrass in the spring of 1955. These areas were then drilled to a mixture of perennial grasses and perennial and annual legumes in the fall of 1955.

Band seeding was tested on each of these soil types. Additional seedings were made without any seedbed preparation.

1. Josephine Soil Type: The results of band seeding on the Josephine soil type were outstanding. This is normally considered a "timber soil", indicating that it is best suited for growing trees. However, the forage production achieved from a seedling stand of perennial grasses was outstanding. Tall oatgrass reached a height of four feet during the first growing season. Species used were harding-grass, tall oatgrass, orchard, tall fescue, smilo, Ladak alfalfa and Mt. Barker subterranean clover.

The best results were obtained from tall oatgrass, hardinggrass, orchard-grass and subterranean clover. All of these species remained green throughout the growing season including the subterranean clover! Of the plots banded with 11-48-0 at 125 lbs/acre, 16-20-0 at 125 lbs/acre, and no fertilizer, the plots banded with 16-20-0 were far superior in growth. Portions of this plot received applications of nitrogen, phosphorous, and combinations of N & P in the fall of 1956.

2. Yorkville Soil Type: Personnel of the Soil-Vegetation Survey expressed interest in the suitability of Yorkville soils for growing perennial grasses. This soil is readily recognized by the blue subsoil and the tendency to slip or slide. The location of the plot in question is at the base of one of these slides as it grades into a Josephine-Hugo complex.

The results of seeding in the area precropped with sudan were very encouraging. The plot was grazed heavily by sheep during the late spring and the entire summer to the point where the hope of obtaining any establishment of perennial grasses was abandoned. However, an examination made in August of 1956 indicates there is quite a good stand of perennial grasses remaining. Counts will be made in the spring of 1957 to determine exactly how many of these plants survived.

A seeding made in Yorkville soil without any seedbed preparation was a failure.

3. Loughlin Soil Type: Seedings made in this grassland soil were successful with and without cultivation. However, the lack of grazing control on the area without seedbed preparation and severe washing on the cultivated area make the measurement of actual yields impossible. It is worthwhile to note that this washing of cultivated soil was caused by water coming from a road above the plots. There was no excessive washing in the other cultivated areas in spite of the 100 inches of precipitation during the winter of 1955-56.

Fertilizer Trials

A rate test of phosphorous was established late in the fall of 1955. The high volume of the immediate rains made the results of this test inconclusive. The test has been abandoned. However the general area produced an abundance of subterranean clover and annual grasses.

The application of deluxe rates of nitrogen, phosphorous and sulphur for

two consecutive years on native range on a Laughlin soil type has produced a phosphorous and nitrogen response each year. There is a possibility of a sulphur response. Maximum forage production in 1956 was slightly over 3,000 lbs/acre while check or unfertilized plots yielded 2,000 lbs. The differences would have been much greater without deer grazing. The most important effect has been the change in species composition between the various treatments. The nitrogen plots were a pure stand of weedy annual grasses while the plots receiving phosphorous for two years were predominately native annual clovers. The check plots contained only a small percentage of these weedy annual grasses and annual clovers.

Current Investigations

The possibility of establishing subterranean clover on native grass ranges through the use of a mulch is being investigated. The addition of a mulch should tie up the nitrogen present and inhibit the competitive grass growth. This could reach practical application in the use of sawdust as a mulch. Sawdust is readily available for the cost of hauling.

Further experimenting with band seeding on Laughlin soil is being done. Different rates of N,P, and NP fertilizers are being tried as well as different rates of seeding. Trials were made in prepared and unprepared seedbeds.

A nursery of some 61 forage species was band seeded on Laughlin soil with five 15-foot rows for each species.

A rate of seeding trial of subterranean clover was established on Laughlin soil. Rates used were 2, 5, 10, 20 and 40 pounds per acre.

A one acre area was band seeded to subterranean clover on Laughlin soil using 10 lbs. of seed and 100 lbs. single super-phosphate. Past experience indicates that this will be a good method of establishing subterranean clover without cultivation. Total costs would be about \$15.00 by this method as compared with \$35.00 by the conventional methods used in past seedings on the Wagner ranch.

Field Days

A field day was held in conjunction with the Wagner control burn. A group of ranchers and technicians were given a tour of work illustrating herbicidal control of brush, band seeding and a demonstration of area ignition techniques.

ALDRIDGE and WISBAR RANCHES, SHASTA COUNTY

Reburn Plans

The reburn scheduled so long for Blue Mountain failed again to materialize. However, the chances of completing a reburn during the summer of 1957 appear to be good.

Maximum efforts were made by project personnel, the Agricultural Extension Service, California Division of Forestry and some of the ranchers involved. A plan has been formulated to burn the Aldridge property on Blue Mountain as a unit. The location of a satisfactory fire break has been determined. For reasons of maximum safety a small portion of the Wisbar Ranch has been used.

Fire break construction was begun in December of 1956. Some brush mashing is being done this fall to insure a burn on the top of the mountain. If possible these mashed areas will be burned before the major controlled burn. This will provide a fire break 200 to 500 feet wide at the most critical spots.

Forage Production

The winter of 1955-56 was the fifth normal growing season for the Aldridge and Wisbar ranches since the controlled burn. Forage production appears to be higher than ever in areas cleared of brush. However, large areas are again grown over to blue brush and are now not producing any forage except for a small amount of browse.

Rose clover and smilo appear to be spreading at a greater rate each year. Hardinggrass, which was included in the University mixes, but not the rancher mix is very vigorous and productive under the current management.

Economics 1950-1956

Aldridge Ranch:

Investment Per Acre
Investment, dollars per acre 1950

	Rancher	PMA	CDF	Total
Burning	.29		.20	\$.49
Fence repair	.11			.11
Seed	.45	1.80		2.25
Seeding	.30			.30
Totals	1.15	1.80	.20	\$3.15

Investment Total:

Summary of Total Costs

Forage used as fuel 150 A.U.M.* at \$2.50	\$ 375.00
Burned and fence repaired, 3500 acres at \$.60	2100.00
Seed and seeding 1000 acres at \$2.25	2550.00
Experimental seeding 50 acres at \$3.75	188.00
1951 Seeding and seed on about 75 acres at \$4.00	<u>300.00</u>

Total Cost \$5513.00

Returns:

Feed Utilized: **	1951-52	1952-53	1953-54	1954-55	1955-56
A.U.M. after burn	1139	1221	1361	834	1349
A.U.M. before burn	<u>300</u>	<u>300</u>	<u>300</u>	<u>300</u>	<u>300</u>
A.U.M. increase	839	921	1061	534	1049

* Animal Unit Month as described by Shultis and Burlingame, "Figuring Pasture Production", Agricultural Extension Service, Mimeo., 3.26, June, 1949.

** Supplemental feed such as hay and barley which was fed during these periods was converted to Total Digestible Nutrients and then to A.U.M. on the basis of 330 lbs. TDN per 800 lb. cow per month equals one A.U.M. These A.U.M. were then subtracted from the gross grazing yields to give the above net figures of Animal Unit Months.

If a value of \$2.50 is placed on an A.U.M. grazing the returns on the Aldridge Ranch investment of \$5,513.00 for brush range improvement has been as follows:

1951-52	\$2097.50	-	\$5513.00	38%
1952-53	2302.50	-	5513.00	42%
1953-54	2662.50	-	5513.00	48%
1954-55	1315.00	-	5513.00	24%
1955-56	2622.50	-	5513.00	47%

Thus the returns in increased feed from brush range improvement paid for the improvement costs before the end of the third grazing season. The total returns due to range improvement amount to \$11,020 at the end of the fifth grazing season.

Chemical Work

Trees on two areas were cut-surface treated during March of 1954. These trees all appeared to be dead when observed in the summer of 1955. Observations made on these areas in November of 1956 indicate many of these trees have fallen to the ground. They should be consumed in the reburn next summer.

Fertilizer Trials

Observations were again made on old fertilizer trials. No harvests were made. There appears to be no significant response to phosphorous or sulphur in any of the plots. There is a nitrogen response in all cases but of no great magnitude.

FLCOURNOY RANCH, MODOC COUNTY

Seedings

The fall of 1956 completes the second growing season since work began on this range. The results of fall seeding, early spring seeding and late spring seeding indicate that an early spring seeding is best. The dates of seeding and sampling results are shown in Table No. 1.

The species used in these seedings has varied only slightly. Crested wheatgrass is still the standby. Intermediate wheatgrass has been included in all seed mixes and has always become well established. Intermediate wheatgrass is leafier and remains green longer than crested and so bears watching. Pubescent wheatgrass has also consistently become well established. Even though pubescent wheatgrass does not produce as highly as intermediate, it spreads well to fill any gaps in the stand. Tall wheatgrass does not appear to be as well adapted as the above three and so has been left out of the later trials.

Species Trials

Fifty-one species of perennial grasses and 19 legumes were tested in the spring of 1955. These were planted in replicated trials of five 16-foot rows in each trial. The species which showed promise in this test were tried again in the spring of 1956 as well as many new species.

Fifty-three species of perennial grasses were band seeded in March of 1956. These were placed in five 16-foot rows in each of three replications. Approximately 125 lbs/acre of ammonium sulphate was banded beneath the seeding with the heavy duty range drill. The seed was then added to the furrow and covered with a Columbia planter. The stand obtained in every case was outstanding. The real test of these species is whether or not they will survive the present winter. Samplings for adaptability and possibly yields will be made in the summer of 1957.

In addition some legumes were seeded in randomized replicated blocks in May of 1956. Many of the legumes became well established. Of particular interest is the Canadian creeping-rooted alfalfa or "rambler alfalfa". Approximately one acre was seeded to this species in addition to the testing in plots.

All of the above species trials were fenced to exclude rabbits except the one acre of alfalfa. The one acre of alfalfa was well on its way to becoming established before the surrounding range areas dried up. However, the rabbits then concentrated on the alfalfa and chewed it down to pencil stubs. A small rabbit enclosure affords striking evidence of the intensity of rabbit grazing. Some means of rabbit control will probably be necessary before alfalfa can be used in the general seeding mixes.

Fertilizer Trials

Broadcasting of fertilizer on wheatgrass seedling stands does not appear to be of any benefit to the seedling stand or to the ultimate establishment as measured on two year old stands.

Further testing of band seeding results indicate there may be some benefit from placing a narrow band of fertilizer beneath the seed at the time of seeding. However, we have not been able to measure the benefit. Perhaps the differences will show up as the stands get older. Fertilizer may add vigor to the seedling

and result in better ultimate establishment.

Replicated fertilizer trials on native cheatgrass range have shown some interesting results. Nitrogen applied before the growing season in the spring of 1955 failed to show any response during the spring and summer of 1955. However, these same plots showed up to a threefold increase in forage at the end of the second growing season (spring and summer of 1956) from the initial application of nitrogen in May of 1955. Applications of nitrogen at the beginning of the second growing season produced additional yields over those plots which did not receive a second application.

Sulfur produces a response on greenhouse trials with this soil but does not appear to be significant in the field.

Nitrogen and sulfur were applied to a one year old stand of wheatgrass at the beginning of the second growing season. Yields from this plot indicate a response to all rates of nitrogen and no significant response to sulfur. One hundred twenty pounds of N per acre more than doubled the yields. Separations of the species in this stand indicate the response was mainly by the native annual cheatgrass. The wheatgrass responded, but only slightly.

The economics of this method of increasing forage production are questionable. An extra ton of forage produced during the past season by fertilizing a two year old stand of wheatgrasses and the associated native species would have cost about \$33. This price is based on 15 cents per pound of actual N and one dollar per acre to apply the fertilizer. The \$33 per ton of additional forage may not be out of the question. However, this can be achieved only on a year of good forage production such as the spring of 1956. On such a year feed is not a problem. On a "normal" year such as the spring of 1955 there was no visible response to nitrogen or sulfur.

All the above fertilizer trials had to be fenced from rabbits during the entire growing period up to the time of clipping.

Chemical Brush Control

Chemical brush control efforts of June 1955 were unsatisfactory. Apparently the application of herbicides was made too late in the growing season. The kill was less than 50 per cent in all trials.

Forty acres were sprayed on the demonstration area on May 24, 1956. Two pounds of low-volatile ester 2,4-D (4 lbs A.E./gallon) and two quarts diesel oil in nine gallons of water per acre were applied by agricultural aircraft.

Recent observations indicate the kill of this application is above 90 per cent. These areas will be drilled without further cultivation during the spring of 1957.

Mechanical Brush Control

The following table shows the results of various efforts to control sagebrush by cultivation:

Table No. 2 Cultivation Treatment	No. of plants remaining per acre in July 1956	% Kill
1. Check area - native sagebrush range with no cultivation	4,000	--
2. Plowed to 10" fall 1954	129	97
3. Plowed twice to 10" in the fall of 1954	16	99
4. Double disked in spring of 1955	1,682	58
5. Single disking in spring of 1955 - no control	4,000 (est.)	0

Satisfactory but expensive control is achieved by plowing. A D-6 tractor plowed only 5 acres in eight hours. Single disking was totally unsatisfactory. Double disking in the spring killed most of the mature plants but many of the seedlings escaped between the disks. With the resultant reduction in competition and benefits of cultivation the brush seedlings grew at a rapid rate and will be a problem in a few years.

Controlled Burn

Long term plans were laid last year to schedule a controlled burn. The amount of grass normally present between brush plants is not sufficient to carry a fire. Plans were made to protect an area from grazing for several years in an effort to increase the amount of fuel present.

Forage production during the summer of 1956 was outstanding. We felt there was more fuel present due to this excellent growing season than could ever be accumulated by protection from grazing. A controlled burn was organized and fire lines, men and equipment readied.

The burn was attempted on September 5, 1956. Only the brush plants ignited by hand burned. The fire failed to carry from one bush to another. Individual bushes burned very well.

Attempts at simultaneous ignition failed. About ten strips 20 feet apart were lit at the same time. Even this method would not burn any plants other than those ignited by hand.

Various types of ignitors were tried. The drip pot was the most satisfactory. Railroad flares were also used. One very good method of lighting fires was demonstrated by the local ranchers. They towed a hot burning truck tire on a cable behind a jeep. The jeep was driven just inside the fire line at five to ten miles per hour. Flaming molten blobs of rubber were scattered all along the route.

It appears that satisfactory burns in such a sagebrush area can be achieved only under wildfire conditions.

Table No. 1

1954-56 WHEATGRASS SEEDINGS - FLOURNOY RANCH, LOGAN COUNTY

Date of Drilling and Type of Drill	Site Preparation	Acres	Date of Sample	Percent Stocked*	Rating**		
Sept. 17, 1954 J.D. Van Brunt 12"	Mechanically cleared, subsoiled, and seeded in fall of 1951. Initial stand was a failure. Reseeded on Sept. 17, 1954 without any further cultivation.	40	7/26/55	12.0	Poor		
Nov. 2, 1954 J.D. Van Brunt 12"	Area plowed Nov. 1, 1954 to 10"-Sagebrush turned under. Seedbed very soft and seed placed at 4".	1	7/5/55	21.0	Poor		
March 22, 1955 J.D. Van Brunt 12"	Area plowed Nov. 1, 1954 to 10"-Sagebrush turned under. Seedbed firm.	6	7/5/55	54.0	Excellent		
			7/26/55	64.5	Excellent		
			7/25/56	62.5	Excellent		
	Same as above with 250# Ammonium Sulphate broadcast.	1	7/26/55	58.5	Excellent		
May 19, 1955 J.D. Van Brunt 6"	Area plowed Nov. 1, 1954 to 10"-Sagebrush turned under. Seedbed firm.	2	7/26/55	Less than 9.0	Failure		
Nov. 1, 1955 Heavy Duty Range Drill	Sagebrush sprayed in June 1954. Drilled directly into partially killed stand of sagebrush and rabbit brush. Soil very sandy.	Band Seeded	1	7/25/56	34.5	Fair	
		No Fertilizer	1	7/25/56	35.5	Fair	
	Drilled directly into sagebrush. Soil not sandy. Area sprayed in May 1956. No rabbit brush present.		1	7/25/56	58.0	Excellent	
		Area double-disked in March 1955.	Band Seeded	1	7/25/56	46.5	Good
			No Fertilizer	1	7/25/56	51.0	Excellent
		March 23, 1956 Heavy Duty Range Drill	Brush was sprayed in June 1954. Drilled directly into partially killed stand of sagebrush and rabbit brush. Soil very sandy.	Band Seeded	1	7/25/56	66.5
No Fertilizer	1			7/25/56	73.5	Excellent	
Area double disked in March 1955 and single disked in March 1956. Seedbed soft.	Band Seeded		1	7/25/56	67.0	Excellent	
	No Fertilizer		1	7/25/56	56.5	Excellent	
Mechanically cleared, subsoiled and seeded in fall of 1951. Reseeded fall 1954. Stands were failure and poor, respectively. Drilled again on 3/22/56	Band Seeded		1	7/25/56	30.0	Fair	
	No Fertilizer		1	7/25/56	39.5	Fair	
Mechanically cleared, subsoiled and seeded in fall of 1951. Reseeded fall 1954. Stands were failure & poor, respectively. Disked & drilled again 3/23/56	Band Seeded		1	7/25/56	40.0	Good	
	No Fertilizer		1	7/25/56	22.0	Poor	

* Per cent Stocked refers to per cent of square feet in area which has at least one seeded plant.

** As judged by D. N. Hyder and F. A. Sneva, Journal of Range Management, Vol. 7, Number 2, page 89.

Rodent Control

The rodent population was sampled several times during the growing season by Dr. W. E. Howard, Associate Specialist, Agricultural Experiment Station, University of California. Samples were taken with large mousetraps baited with walnut meats. Populations were very high. Two major efforts were made to control these small range rodents.

1. Aerial poisoning: The first effort was aimed at temporary control during the time of seeding. Primary considerations were cost, safety, speed, and effectiveness. Whole oats poisoned with compound 1080* and dyed yellow to protect the birds were used as bait. Other poisons could have been used but testing the method of bait distribution was of primary interest. On March 29, 1956 this bait was applied by agricultural aircraft in strips 50 to 100 yards apart. The swath width was 20 yards. The average amount of bait used was one pound per acre. Six hundred acres were treated with 600 pounds of bait.

Results of trapping before treatment and again 11 days after poisoning measured an 87 per cent reduction in small rodent population. A third trapping seven months after poisoning indicates a rodent population build up to pretreatment level. Populations on an adjacent unpoisoned area remained constant throughout the period. Although protection is of short duration, especially on small acreages, rodent damage can be practically eliminated during critical seedling establishment period.

Aerial control of rodents has the following advantages over other types of control:

1. Cost - The poisoning operation should be much cheaper than putting the bait out by hand, particularly if the terrain is rugged. Cost figures are based upon three experiences, one in Modoc County and two in San Diego County. In each case the cost of bait from the local agricultural commissioner was ten cents per pound. The cost of application in each case was ten cents per pound. The total cost per acre of temporary rodent control was 20 cents.
2. It will take less bait to do a better job of rodent control.
3. There is less hazard that a careless employee will put out too much bait and poison domestic livestock or game animals.
4. There is less chance of missing large areas.
5. No harm is done if an area receives a double dosage at this low rate of application. One pound of whole oats per acre is only about one kernel in three square feet.
6. Control can be established at more favorable times of the year. Rain wouldn't idle a large crew of men assembled for the express purpose of putting out the bait.
7. The use of aircraft might encourage the control of rodents over extensive

* Courtesy of Modoc County Agricultural Commissioner

areas at one time. The larger the area treated the longer time will be necessary for rodents to reinvade the area.

Bait applied in strips 50 to 100 yards apart averaging one pound per acre will effectively control small rodents. Less bait may be equally as good. There is a good possibility that the optimum distance between strips of bait may be greater than the distances used.

2. Permanent bait stations: The second effort at controlling rodents was designed to protect small areas over an entire growing period. Places where such protection is needed are forage species trials for yield and adaptability and fertilizer plots where the total yields must be clipped. The presence of rodents in these cases often results in voids in the stand of forage species being tested or a harvest of the forage crop by the rodents before desired information can be obtained from the plot.

To achieve a lasting control it is necessary to have bait on the area at all times. This means the bait must be weatherproof or placed in a bait station or bait box to protect it from rain and snow. At present there are no persistent baits so it is necessary to use bait stations.

For an inexpensive bait box discarded one quart oil cans were used. The $1\frac{1}{4}$ inch opening made by the punch-type opener in oil stations is just the right size to admit field rodents up to and including kangaroo rats. Ground squirrels cannot enter the cans but they are able to reach in and pull out the poison grain.

A small handful of poison grain (several grains and several poisons were tried) was placed in each can. The side of the can was dented below the opening to prevent ground water from entering the can. The cans were placed 50 to 100 feet apart on the 20-acre area on November 1, 1955.

Twenty-nine mice were trapped on the 20-acres, and six mice on the control area just before poison was put out. The site was retrapped five months later (April, 1956). No rodents were caught on the poisoned area and six mice and two kangaroo rats were caught in the control area using the same number of traps on the same nights on the two areas. These trapping results only served to bear out what was observed on the ground. Rodent activity had apparently ceased in the 20 acres protected by the oil cans. There were no fresh runs or burrows. Dead rodents were found on the area and in the cans.

This was far better success than anticipated. Results were so encouraging that we now have 400 of these cans protecting plots in various areas of the state.

Suggestions concerning the use of these cans:

1. Keep fresh bait in cans at all times. Discard spoiled or moldy bait and replace with fresh bait.
2. Change baits and poisons occasionally. Individual rodents may receive a sub-lethal dose of poison and avoid that kind of bait in the future. Using a different bait in other cans or changing bait in the same cans may catch these individuals. Use only one kind of poisoned bait in each can at one time. Don't

mix the poison baits.

3. The local agricultural commissioner is working with rodent control and will recommend the type of poison and grain to use. He may even sell the bait at a nominal charge.

4. The use of adhesives to insure the bait staying in the can is currently being tested. Paraffin and rubber cement are two materials which have been tried and are apparently satisfactory.

5. On small plots with fewer cans the cans should be closer together. Also, replacing the bait every few months is then desirable.

WESTSIDE EXPERIMENTAL RANGE PLOTS

Work has continued on three sections of land on the west side of the San Joaquin Valley in Fresno, Kings and Kern Counties. The principal effort has been to establish a ground cover that would reduce wind erosion. A search is underway to find suitable species that would be adaptable to this low rainfall area.

The 1955 plantings included these species:

- Tall wheatgrass
- Intermediate wheatgrass
- Wimmera ryegrass
- Hardinggrass
- Brome 100
- Rose clover
- Dwalganup sub clover

These species were drilled with fertilizers that included rates of nitrogen and phosphorous.

The fertilized rows were discernible, however, as in previous years, no appreciable seed was set. Light rainfall limits the growth of perennials sufficient to prevent their establishment.

In an effort to hasten maturity and seed set, phosphorous alone was banded under the species planted in November 1956.

A small seeding of Dr. Ledyard Stebbins' hybrid orchard grasses was included in the November plot. The parents of these hybrids originated in desert countries of the Mediterranean region.

GULENOC RANCH, LAKE COUNTY

Old Seedings

The broadcast seedings of annual clovers on serpentine soils have looked poor since their establishment in 1953. However, small colonies of clovers are becoming established and beginning to increase.

Fertilizer Trials

Deluxe applications of nitrogen, phosphorous, and sulfur have shown responses of N,P, & NP on serpentine soils. Forage production was increased from 1200 lbs. to 2000 lbs/acre by the addition of phosphorous. This additional forage would have cost about \$45./per ton. However, this additional feed was produced only during the excellent growing season of 1955-56. The responses on the same area in 1954-55 (a colder and drier winter) were not considered worth harvesting. Perhaps of more importance is the change of species composition in these plots. The areas receiving phosphorous are predominately bur clover, while the check plot and surrounding areas have only an occasional clover plant.

Band Seeding and Drilling of October 1955 in Sudan Stubble

Excellent seedling stands of perennial grasses and perennial and annual legumes were obtained on serpentine soils using the heavy duty range drill. Late season competition from tarweed may have been an important factor in determining if these plants will survive. Small plots were sprayed or mowed for tarweed control. The use of herbicides appears to have been 100 per cent effective and mowing about 80 per cent effective. It is unfortunate that the entire area was mowed or sprayed for tarweed control. Actual establishment counts will be made at the end of the 1956-57 growing season.

Responses to fertilizer placed beneath the seed are questionable. All stands appeared to be the same when sampled on May 13, 1956.

Band Seeding in Seedbed Fallowed for One Year

This seeding appears to have been drowned out even though it is a stony soil and the plot was on some of the highest ground. Serpentine soils are frequently water logged in winter. The area received 70 inches of rain in the short season from December 1 to March 15.

Drilling in a Chamise Burn with Heavy Duty Range Drill

An area controlled burned in the summer of 1954 and unsuccessfully seeded by airplane was band seeded in the fall of 1955. Our heavy duty drill enabled us to drill the seed and fertilizer in an area of three foot chamise stubble with six inches of crown sprouts. An excellent stand of perennial grasses and annual legumes was present on the area on May 13, 1956. There appeared to be no response to the use of a band of fertilizer beneath the seed. Counts of actual establishment will be made at the end of the 1956-57 growing season.

The brush sprouts on the area were sprayed with a brush killer mix on June 5, 1956.

Field Days

A field day was held by the farm advisor and project personnel on the afternoon of May 14, 1956. The tour consisted of band seeding results on sudan seedbeds and a brush burn, as well as fertilizer trials on native forage. A group of about ten local ranchers and technicians attended this event on the Guenoc Ranch.

BACKBONE RIDGE PLOTS, SHASTA COUNTY

These plots were established in the fall of 1955 in an area adjacent to the Backbone Range Project. The Backbone Range Project is a range improvement demonstration conducted by the Shasta County agricultural Extension Service and the California Division of Forestry.

The purpose of these plots was to compare two types of seed mixes and demonstrate the effects of drilling the seed with and without fertilizer. The project area was broadcast seeded to a mix of predominately annual grasses and legumes. The plots described here were drilled with a heavy duty range drill using a mixture of perennial grasses and annual legumes. The brush had been mashed and burned on portions of the area and mechanically cleared on the remainder of the three acres by the California Division of Forestry.

This has been an outstanding example of a response to band seeding. The area was drilled in 12-inch rows with 125 lbs. of 16-20-0/acre placed beneath the seed with the following seed mix:

- 2 lbs. Hardinggrass/acre
- 1 lb. Tall fescue/acre
- 1 lb. Orchard/acre
- 1 lb. Smilo/acre
- 1 lb. Rose clover/acre
- 1 lb. Subterranean clover/acre
- 1 lb. Crimson clover/acre

The results can be seen in the following photograph:



FIGURE 1. Area mechanically cleared and drilled in October 1955. Above photograph taken June 14, 1956. The five rows of grass seedlings on the right were band seeded with 125 lbs. of 16-20-0/acre. The five rows on the left were drilled with the same equipment without fertilizer.

The sprouts on the area were sprayed in June 1956 with a brush killer mix. Control appears to be good at this time except for some five per cent of the sprouts which were obviously missed. These and any new sprouts will be sprayed in June of 1957.

The yields of this stand of perennial grasses will be compared with the yields on an adjacent 40-acre stand of annual grasses and clover. This kind of comparison cannot be made until the second or third growing season when the annual grass stand has reached full density and the perennials have better development.

GOLD DREDGINGS- NATCHAS LAND COMPANY, SACRAMENTO COUNTY

Esperimental work in establishing grasses and legumes on land which has been dredged for gold was started in February of 1955. This work was initiated in response to an interest in the area which was expressed by Messrs. L. H. Cloyd and Trev Wright of Region II of the California Department of Fish and game. Their interests were in establishing a cover type on these denuded areas which provide food and cover for quail and other game species.

A species trial of 14 legumes and 8 perennial grasses was established on a recently dredged area near Mills Station. The seeding was done on February 4, 1955. A few brief rains came shortly after seeding and then a dry spell of about two months followed. In spite of the poor season of planting and even poorer pattern of rainfall some of the species were still alive in early December of 1955. The best ones surviving for one year were:

Narrowleaf trefoil
Alfalfa
Hubam clover
Sweetclover

Another trial was established in the fall of 1955 before the first rains. Included in this trial were:

Rose clover	Hairy vetch
Yellow blossom sweetclover	Crimson clover
Mt. Barker subterranean clover	Tangier pea
Narrowleaf trefoil	Purple vetch
Lana wooly-pod vetch	Hardinggrass
Ladak alfalfa	Tall fescue
Bur clover	Orchardgrass
Common vetch	Smilo
Hubam clover	Soft chess
	Burnet

All of these species became well established during the winter and spring of 1956. The most outstanding were the annual clovers. Rose clover was by far the best. The trefoils continue to be very good.

Trefoil, alfalfa, hubam clover, sweetclover and rose clover continue to look good in the area seeded in the spring of 1955. Initial establishment was poor but those which got a start survived the summer. Rose clover has spread remarkably in only one season.

As the result of the first plot established in this area the California Department of Fish and Game seeded about 200 acres in January 1956. The seeding was after the recommended date, and after the heavy Christmas rains. The results do not compare with the plot established two months earlier in the same area. The aircraft they used had not been adapted for seeding and as a result very poor distribution of seed was obtained.

All of these plots will be observed for several years. No further plot work is anticipated in this area.

DEMONSTRATION PLANTINGS BY FARM ADVISORS

ASSISTED AND SUBSIDIZED BY RANGE DEMONSTRATION PROJECT

Year (Fall)	No. Counties	No. Plantings	Acreage
50	12	15	--
51	--	73	320
52	19	51	217
53	22	54	527
54	24	55	561
55	27	50	212
56	25	64	162

The primary objective of this project has been to encourage seeding the best possible forage species a site will support. Satisfaction with species of low seed cost and short duration of quality production is false economy. Supplies of seed, especially of those species that were difficult to obtain have been made available to farm advisors upon their request. These seed lots were planted in pastures and blocks from $\frac{1}{2}$ acre to 40 acres in size. In many cases they were the first acreage seedings of perennials in the county. One season inoculation of legumes was stressed in a memorandum included with inoculum for seed sent to Farm advisors. At present there is a great interest in proper inoculation of range legumes. Often a seeding of this nature gave the county range improvement program a big boost and was of material assistance to extension personnel who had newly assumed responsibility for range improvement work. Very often these county demonstration plots were subject matter for field day meetings with ranchers and not infrequently the success of a planting has been announced in newspapers and other periodicals for popular consumption. Recent efforts have been made to restrict the size of each planting to about two acres.

COVER MANIPULATION ON HYDROLOGY STUDY WATERSHEDS

Watershed 1-A Hopland Field Station

1. Description of area: The hydrologic effects of brushland range improvement practices are being studied on a watershed of about forty acres. Commonly used techniques of burning, seeding and chemical brush control are employed in conjunction with sheep grazing. Some of the treatments deviate from ranch practices to maintain consistency throughout the area and hasten rather complete cover type change from brush and trees to herbs. The experiment is thereby accelerated and reporting simplified.

A Parshall flume stream gaging station was installed by Department of Irrigation in September 1952 to measure surface runoff. Eroded materials are collected in a sedimentation basin below the flume.

As can be seen in the following photograph steep slopes predominate.



Aerial view looking to the northwest shows entire area of 57.8 acres to be burned. The gaging station visible at the end of the road measures runoff and erosion from about 40 acres. This photo was taken a few minutes before the burn. Firelines are complete and trees on north exposure have been slashed and drying for two to three months.

The gaging station is at 950 feet elevation and annual rainfall has varied from 19 to 47 inches in the past four years. Northerly exposures are typically Josephine soils supporting a rather dense stand of madrone and black oak with light herbaceous ground cover. Chamise brush and Maymen soils predominate on the south slopes.

2. Preparation of fuels: To ensure a good burn the trees were felled by chainsaw in June and early July of 1956. Two choppers cut 10,640 stems on about 30 acres area in 780 man hours. To reduce sprouting the tops of all stumps were painted with methylene blue dyed 2, 4-D amine a few minutes after cutting.

A bulldozed firebreak was constructed around the area in July. At the same time a 30 to 100 foot wide band of chamise immediately inside the north firebreak was crushed by tractor.

3. Burning technique: Ralph L. Fenner was employed to design the burning plan and assume the responsibility of Fire Boss. Forty-five electric ignitors were placed at 80 to 100-foot intervals on a loop circuit strung along both sides of the main drainage channel. This loop was designed to ignite the base of both slopes from the gaging station to within 150 yards of the upper end of the watershed. Another circuit of 27 ignitors made a loop on each slope below the gaging station. The mouth of the watershed was thereby saturated with fire to stop dangerous and cooling indrafts from running the length of the watershed.



Along the north side of the burn September 7, 1956. To avoid disturbance of the watershed, materials from the firebreak were pushed to the outside. Spotters into these slash piles caused trouble after the main burn.

4. Burning: At 4:10 p.m. on the 5th of September the electric circuits were fired. This was the signal for a crew of twelve men stationed on the perimeter to start firing with drip pots and flame throwers. The igniting was complete in about two minutes. The tremendous volume of fire throughout the area created twenty-mile-per-hour indrafts. A majority of the burning was completed in 17 minutes. As the fire subsided indrafts were dominated by the gentle southerly wind and spotovers occurred along the north side. The spotovers were into a non-hazardous area within the secondary firebreak.

The burn was very complete. Some of the larger tree trunks, stumps and stems of standing brush were charred but not consumed.

5. Seeding: On September 18, 1956 the entire burn was airplane seeded. The seed mix was composed of the following species and poundage per acre: hardinggrass 4, smilo 2, Palestine orchardgrass 1/2, Tallarook sub clover 1/2, Mt. Barker sub clover 1/2. Legumes were inoculated with Nitragin the day before seeding. The seeding plane flew on 20-foot intervals as directed by two flagmen. One hundred and twenty ten-inch buckets were placed at five-foot intervals on a line perpendicular to the line of flight. Half of the buckets were on a ridge 20 to 30 feet below the airplane and the remainder were near the gaging station and about 200 feet below the airplane. Although seed distribution was far better than usual for airplane seeding of brush burns the line graphs on the next page indicate considerable variation of seed distribution and overlapping of flight lines. Based on the bucket sample that actual seeding rate was 72 seeds per square foot.

Ten acres of steep south exposures of Maymen soils were over-seeded by hand with soft chess at two pounds per acre.

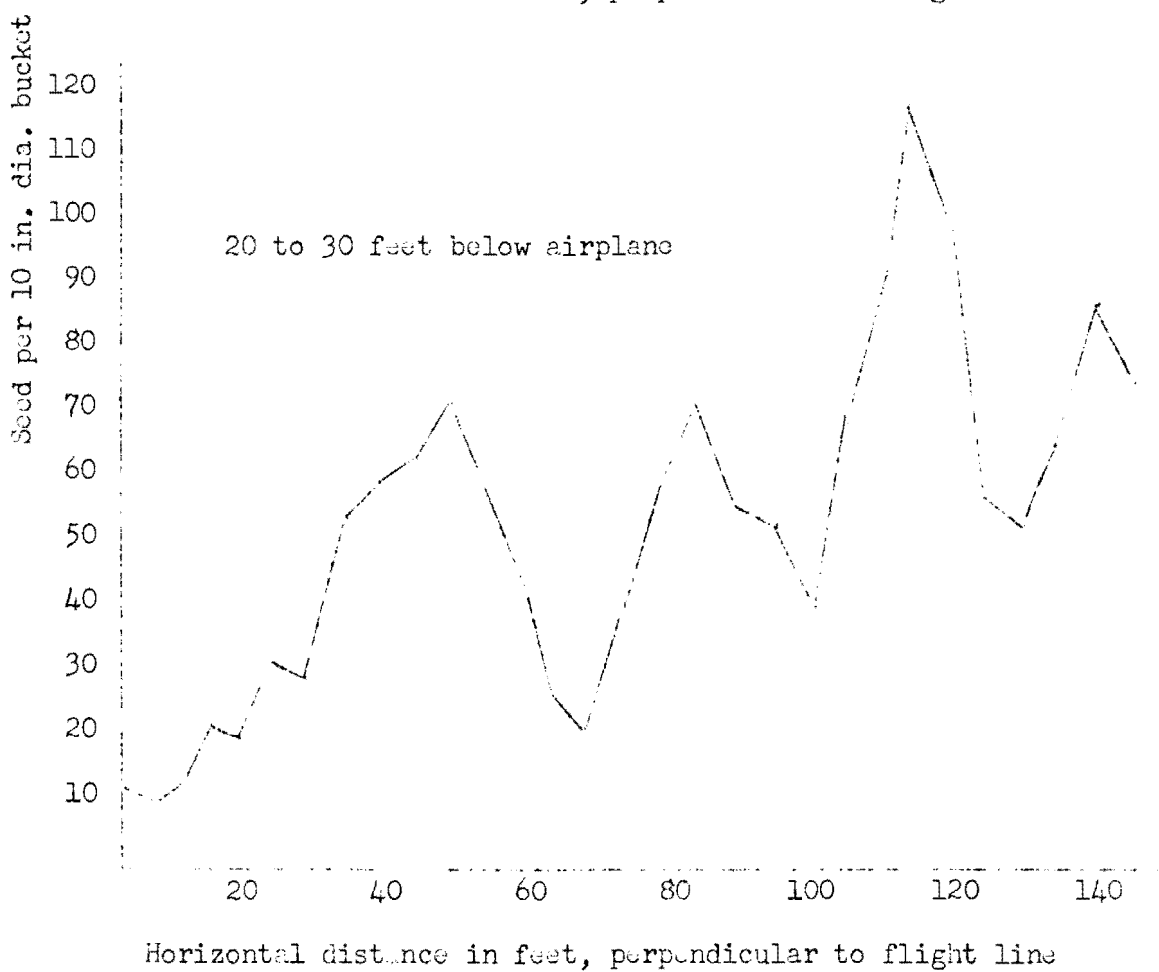
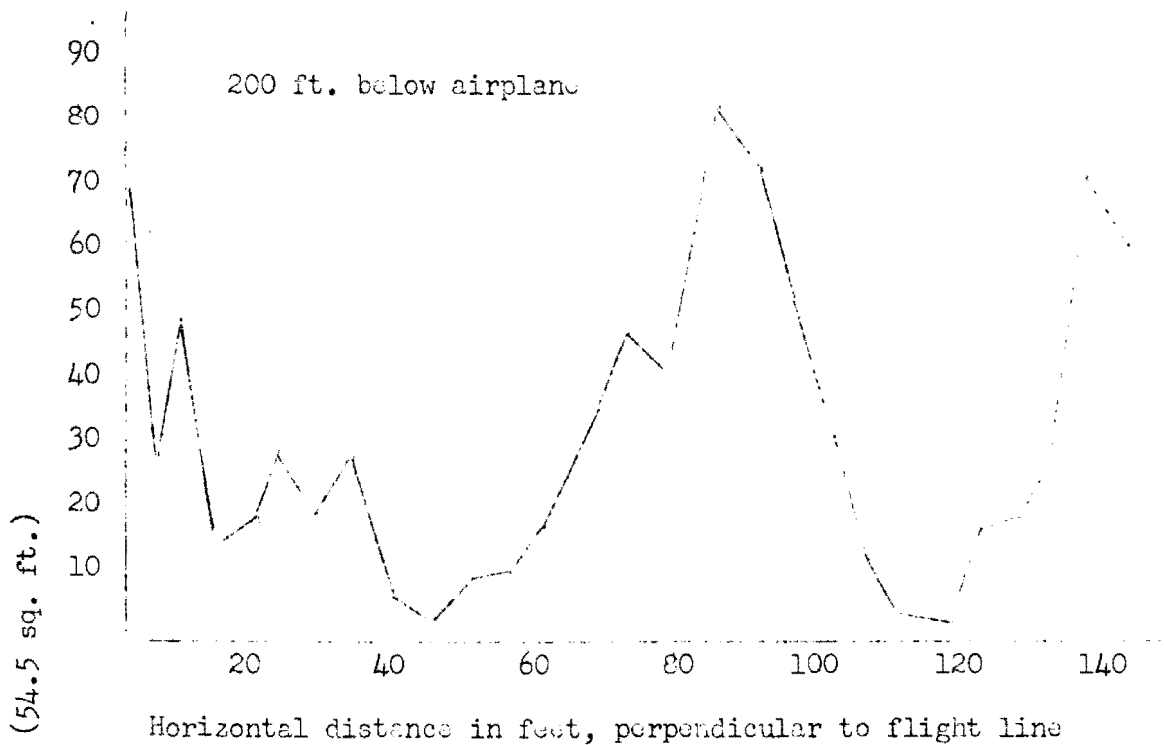
6. Future management: Brush sprouts will be sprayed with herbicide in 1957. The watershed is fenced from other pastures and will be grazed by sheep after the middle of July. The area will be reburned about five years hence.

Tulare County Watershed

Standing brush on the experimental watershed near Badger was bulldozed into windrows during the summer. On October 24 the windrows and brush piles were burned. A mix of 45 pounds intermediate wheatgrass, 45 pounds of tall fescue, 45 pounds soft chess and 15 pounds of inoculated rose clover was broadcast on the 15-acre cleared area in October.

Diamond Range Watershed

The treated watershed now has a good stand of hardinggrass, lesser amount of tall fescue and traces of rose clover. The sprouting brush was hand sprayed with a high-volume one per cent brush killer on July 19, 1956.



HEAVY DUTY RANGE DRILL

Detailed description of band seeding on the demonstration ranches is found under the ranch name subtitle. Additional plots were established in Mendocino, Shasta, Solano, Placer, Mariposa and Tulare Counties.

A rancher in Shasta County is currently having a like machine constructed. Ranchers in Tulare County will probably construct a heavy duty range drill prior to seeding time next fall.

In soils where a soil deficiency can easily be corrected by addition of fertilizer band seeding is undoubtedly one of the best methods of establishing better forage plants.
