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Title: Control of Range Weeds, Brush, and Plant Competition by Fire, Chemical, Mechanical, Grazing, and Other Means.

1. Flournoy Ranch - Modoc County (See pages 8-9)

This was the third exceedingly dry year in succession with only 5.37 inches total precipitation. The total for the last three years is 15.57 inches with 4.92 inches in 1958-59, 7.28 " in 1959-60 and 5.37 " in 1960-61. The 38 year average for nearby Alturas is 12.5 inches.

The 449 acres of wheatgrass seedings were not grazed because of the exceeding low moisture availability. The major portion of this area was seeded to Greenar intermediate wheatgrass in the spring of 1958 and has never experienced a year of at least "normal" rainfall. As a result, the plants have never attained a very large size. Plant vigor at the end of the third dry year appears to be good. Production of wheatgrass was measured to be 84 pounds (oven dry) per acre. The associated annuals (98% cheatgrass) produced 76#/acre. Total production was 160#/acre. The adjacent check pasture produced a total of 54# of oven dry forage per acre. Ninety-seven percent of this was cheatgrass. Total ground cover was very low - 6% in the wheatgrass pasture and 3.4% in the cheatgrass check pasture.

Fertilizer plots

1. Nitrogen carryover on cheatgrass range: (see page 10)

There was no apparent response from these plots during this dry season. Check plots only were harvested and yielded a total of 55# per acre.

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There is one interesting difference between these check plots on those of other experiments in the area. The composition has changed from almost entirely cheatgrass to predominantly perennial grasses. The composition by weight was 46% squirrel tail (Sitanion hystrix), 39% bluegrass (Poa secunda), 12% cheatgrass, and 3% miscellaneous. This change can be attributed to complete protection from grazing for seven years. Nitrogen carryover responses will be measured until a year of at least average rainfall occurs.

The newer nitrogen carryover plot established in the fall of 1959 gave a negative response. The check yielded 37#/acre. The N_{120} S_{40} treatment yielded only 11# - less than 1/3 of the check. Total ground cover was 2.8% on the check and 1.2% on the N_{120} S_{40} treatment, again a negative reaction. Both the check and N_{120} S_{40} treatments were predominantly cheatgrass.

2. Repeated N applications on cheatgrass range: (see page 11, 1960)

This plot also gave a negative response with 55# on the check and essentially nothing on the nitrogen treatments.

The new trial established in the fall of 1959 and repeated in the fall of 1960 also gave a negative response with 123#/acre on the check and 39# on the N_{120} S_{40} treatment. There was a decided shift to forbs from 100% cheatgrass in the check to 21% mustard (Descurania pineta) 8% filarce (Erodium sp) and 16% other forbs. Total ground cover was very low with only 2.8% on the check and 1.1% on the N_{120} S_{40} treatment.

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3. Repeated nitrogen applications on wheatgrass: (see page 11, 1960)

This trial has reached its logical conclusion and is being prepared for publication. All plots that received nitrogen treatments, either repeated or carryover, have suffered high mortality in the wheatgrass (Greenar intermediate) stand. The higher the rate, the greater the mortality. Repeated applications gave higher mortality then the single carryover application.

The trial encompassed the three exceedingly dry years, starting on a one-year-old stand of grass. Yields (multiple clippings to similate grazing) were measured each year. Particular care was taken to measure changes in species composition and changes in ground cover. Soil moisture was measured periodically by drying soil samples early in the study and later by gypsum resistance blocks. The soils are being analyzed for any remaining nitrogen. Protein contents of the two primary components of the forage (wheatgrass and cheatgrass) have been made at each clipping. The data is being analyzed for publication next year in cooperation with Raymond A. Evans - USDA-ARS - Reno, Nevada.

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Species trials

Species testing has been a major item of work on the Flournoy Ranch. Following are yield data for the species that were successfully established in the March 1956 planting.

Modoc County Species Trial

Planted March 23, 1956 - Yields are pounds of oven dry forage per acre

	June 1957	July 1958	June 1959	June 1960	June 1961
Agropyron cristatum - Fairway Crested Wheatgrass					
Commercial F.C. 32032	1000	170	240	410	171
A1770		260	280	400	243
Agropyron desertorum - Standard Crested Wheatgrass					
Commercial Crested Wheatgrass - UC purchase	980	360	360	520	283
Commercial Crested Wheatgrass F.C. 32658	1490	430	250	370	219
Nebraska 10		410	350	490	334
Nordan	1550	400	280	480	283
Agropyron elongatum - Tall Wheatgrass					
Tall Wheatgrass - UC purchase	1350	440	340	220	221
Utah		400	350	250	226
Nebraska P.I. 98526		380	280	200	299

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Species Trial (continued)

	June 1957	July 1958	June 1959	June 1960	June 1961
Agropyron intermedium - Intermediate Wheatgrass					
Commercial - UC purchase	1240	380	280	320	237
Greener	1180	520	290	300	218
Amur (A. amurense)	1600	320	310	380	314
Reo (A. int X A. tri.)		550	320	500	334
Agropyron smithii - Western Wheatgrass P.C.32219		100	290	330	230
Agropyron trachycaulum - Slender Wheatgrass - UC purchase	1110	80	140	90	139
Agropyron trichophorum - Pubescent Wheatgrass					
Comm. Pubescent Wheatgrass - UC purchase	1170	270	330	480	258
Topar	1060	340	290	480	203
Mandan 759	1820	350	270	360	194
A-1488	1490	420	300	480	226
Dactylis glomerata - Orchardgrass					
Commercial - UC purchase		150	200	20	5
Stebbins - D. glomerata var hispanica					
Turkey - 7 Km E of Canakkale - 1952					
UCh 117-CAN		280		110	70
D. glomerata x glomerata					
Wadi Higrah - 1953					
Israel x Golden Gate					
UC g x g 373		220	170	80	120

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Species Trial (continued)

	June 1957	July 1958	June 1959	June 1960	June 1961
D. glomerata x D. glomerata					
var hispanica - 1953					
Daila, Samaria,					
Israel x Golden Gate					
DC g x h Mool 1953		220	80	40	200
D. glomerata var hispanica					
17 Km. S of Canakkale - 1952					
DCh 116 CANAKKALE		370		160	203
D. woronowii Iran (U.S. Past. Lab)					
State Col., Pa P.E.I. 141397					
DCw 701 - 1952		120			
D. woronowii x glomerata					
Alguelrao, Portugal x Iran					
DC w x g 3100, 3105 - 1953		190			

	June 56-57	July 57-58	June 58-59	June 59-60	June 60-61
Dactylis glomerata - Orchardgrass					
Trogcon Orchardgrass		110	130		
Danish "		80	90		
Potomac "		60	130		
Akaroa "		130	130		
Oron "		260	170	20	90
Pa. Med. Syn "	1540	250	150	10	30

Species Trial (continued)

	June 56-57	July 57-58	June 58-59	June 59-60	June 60-61
Dactylis glomerata - Orchardgrass					
Pa. Early Syn Orchardgrass	1440	320	240	20	40
Pa. Late Syn "		150	100	10	140
M2-11142-53 "		80	160		
P-2453 "		120	60		
I.O.G.-1 "	1990	80	70		
I.O.G.-6 "	1270	160	120	190	220
Poa ampla - Big Bluegrass					
Sherman	1770	400	830	450	570
Albion	1650	260	280	280	360
Poa ampla - pratensis					
T.O. 2379		180	20		
T.O. 2380		270	150		
Arrhenatherum elatius - Tall Oatgrass					
Commercial	1676	210	130	40	120
Bromus inermis - Smooth Brome					
Mancher	815	190	140	110	30
Medicago sp.					
Rambler alfalfa				1050	200
LSD .05	NS	220	130	160	140
LSD .01		290	170	220	180

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Species Trial (continued)

			June 56-57	July 57-58	June 58-59	June 59-60	June 60-61
Rainfall	July 1-June 30	Alturas	15.48	17.40	9.37	10.28	8.47
	Alturas	Measured @ plot			4.92	7.56	5.37
	Measurements as Percent of Alturas				52%	74%	63%

There are several points of special interest in the yields from the third of three dry years. There doesn't appear to be any difference in yield between any of the popular wheatgrasses. The crested wheatgrass yielded essentially the same as Topar, Greenar, and tall wheatgrass.

Big bluegrass yields were 2 1/2 times as great as the wheatgrasses. This happened before in 1959 - a growing year very similar to 1961. Both years had temperatures warm enough for growth in March, the time when big bluegrass begins to grow, but before crested wheatgrass growth starts. Essentially no precipitation fell after this time. Cooperative studies with the Extension Service are aimed at getting this species under grazing management. The consistency high comparative yields in this study seem to warrant efforts to overcome the management difficulties inherent in this species.

It is interesting that three of the orchardgrasses yielded as high as the wheatgrasses. Two of these are from the materials collected in Turkey and Israel by Dr. Stebbins. Commercial orchardgrass has almost disappeared from the trial.

Rambler alfalfa continues to persist and yielded similar to the wheatgrasses.

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Control of Juniper Trees (see page 24)

Observations in 1961 indicate that some junipers are dying from the higher rates of fenuron. Trees have been slow to react to any of the treatments. Perhaps this is due to the extremely dry years under which this study was undertaken. Final evaluation will be withheld until better growing conditions prevail.

Effects of Fire

The effects of fire on forage yields associated with sagebrush ranges is being studied. Paired plots were established on burned and unburned sagebrush range. Thirteen plots ten feet square were fenced on an area burned approximately twenty years ago and still free of brush. Plots 20 feet square in unburned sagebrush were carefully paired and fenced in an adjacent area.

An area of one square yard (9 sq. ft.) was clipped from each of the burned plots and a circular plot ten feet in diameter (78.5 sq. ft.) was clipped from the unburned plots. This difference in plot sizes compensated for the difference in variation between the two types allowing for a comparable degree of sampling accuracy.

	Pounds Oven-dry Forage/Ac		Ground Cover Percent	
Species	Burn	Sagebrush	Burn	Sagebrush
Cheatgrass	148	10.0	5.40	0.075
Annual forbs	25	4.0	0.47	0.049
Sitenion histrix	1	3.5	0.03	0.016
Poa secunda		0.2		0.003
Stipa sp.		0.3		0.007
TOTAL	174.**	18.0**	5.90	0.15

** Differences significant @ .01 level.

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Total forage yields were nearly ten times as great in the burned area as the unburned area. The forage on the burned area was almost entirely cheatgrass while cheatgrass made up only a little more than one-half of the forage in the sagebrush. Total ground cover was extremely low in both areas being less than 6% in the burned and only a fraction of one percent in the sagebrush. In addition to this, the sagebrush crowns covered 17.4% (measured by line intercept) of the ground. Much of the other forage grew under these brush plants.

This study will be continued for at least ten years. It is important because burning appears to be the only feasible treatment for these lands which have no understory of native perennial grasses and are too rocky to farm. Burning, however, indicates we are willing to manage these areas which were inherently perennial grass ranges as an annual type. Before this major management decision can be made, it is necessary to have long term information on the effects on vegetation. That is the purpose of this study.

Cooperative Range Studies with B.L.M.

Cooperative range studies are being undertaken in cooperation with the Bureau of Land Management (USDI), Ranchers of Modoc and Lassen Counties and the Agricultural Extension Service.

The site location is the west portion of the Nelson Corral allotment located 2 miles northwest of the town of Madeline near the boundary of Lassen and Modoc Counties on B.L.M. land.

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The 8,500 acres will be divided into six pastures. Four of these will be used in a rest-rotation management system. The remaining two will be grazed continuously during the entire grazing season and will serve as check pastures. This allows for two replications in the long run and can be analyzed statistically.

A forage inventory of the area was made during July and August of 1961. This information will be used in locating the fences to make the six pastures as equal in carrying capacity as possible. Other considerations will be accessibility to feed (topography and cover), and availability of stock water. Actual fence locations will not be available until calculations are completed late in the winter of 1961.

The forage yield will be sampled in each of the six pastures each year, preferably during the last three weeks of July. This means that the samples must be protected from grazing in three of the pastures each year (both of the continuous grazing pastures and the rotation pasture which is grazed the first half of the season). Samples will be clipped before the cows enter the pasture to be grazed during the second half of the season. Two of the rotation pastures will be left ungrazed each year.

The three pastures which are grazed before sampling time will each need 100 cages--a total of 300. All of these cages will have to be moved each year, in two pastures the cages being moved within the pasture and the third group being moved to a new pasture each year.

The type of cage conventionally used to protect forage plots will not

work because of the sagebrush. The cage proposed here is made of four 4' x 10' panels fastened at the corners, and protecting an area 10' x 10'. A circular plot of 9.6 sq. ft. (3.5' diameter) will be clipped from these.

Livestock scales and corrals will be installed and pasture production in pounds of beef per acre will be measured.

Various research projects are planned for the area. Both the Range Weed Control and Crops Research Sections of the ARS in Reno, Nevada have been invited to share the facilities and do cooperative research.

The speed and scope of the program hinges on the availability of funds from various sources and the cooperation of individuals and agencies.

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II. Reduction of Plant Competition During Establishment of Improved Forage Species by Application of Pre-emergence Herbicides to Annual Ranges. (In Cooperation with C. M. McKell, formerly ARS Davis, now Dept. of Agronomy, UC-Riverside.)

See pages 28-32, January 1961. This trial was repeated for the fourth straight year. Establishment was completely unsuccessful for all treatments. The lack of success can be attributed to two factors, first the dry fall which delayed the planting until January, and the soil type which puddled extensively and effectively flooded out the seeded species.

New data on the 1959-60 trials show a significantly greater amount of rose clover on six of the treatments applied the previous year. All three rates of incorporated eptam were significant (only the two higher rates were significant the first year). Only the highest unincorporated rate was significant in the second year. The lowest rates of incorporated simazine atrazine were significant. Atrazine was not significant the first year. (See following table.)

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Shellhammer Ranch - Solano County 1959-60

Effect of Pre-emergence Herbicides on the Establishment of Forage Species

		Herbicides Incorporated					Surface Application				
Herbicide	Rate	Rose Cl #/Acre	Harding % stocked 3' quad.	Ground Cover 3-11-60	Rose Cl #/Acre Second yr.	Harding Plants 32' row	Rose Cl #/Acre	Harding % stocked 3' quad.	Ground Cover 3-11-60	Rose Cl #/Acre 2nd yr.	Harding Plants 32' row
Eptam	1 1/2	429	65*	19	1480*	19	304		52^{+}	1509	3
	3	330**	42	13^{+}	1568*	9	478*		28^{++}	1730	0
	6	1013**	21^{+}	6^{++}	1856**	9	327	14	36^{++}	2089*	1
Simazine	1/2	614*	64*	27	1760**	6	233		66	1470	0
	1	466	42	12^{+}	1130	13	206		52^{+}	1950	3
	2	241	8^{++}	5^{++}	510	4	270	23	17^{++}	1760	5
Atrazine	1/4	463	68**	28	1760**	15	191		52^{+}	1920	0
	1	230	28	7^{++}	670	13	246		43^{++}	1790	4
	2	7^{++}	1^{++}	3^{++}	100	0	258	32	26^{++}	1184	7
Check		349	43	27	900	1^{+++}	178	0	67	1500	1
LSD	.05	250	19	13	580		250		13	580	NS
	.01	335	25	17	800		335		17	800	

* Increase significant at .05 level
** " " at .01 level

\+ Decrease significant at .05 level
++ " " at .01 level
+++ Check significantly different from other treatments as analyzed by X^2 test. - Cochran, W. G. Some methods for strengthening the common X^2 tests. Biometrics 10:417-451. 1954

The difference in check plots is also interesting. Clover yields the first year were nearly twice as great on the cultivated (incorporated) plots as the non-cultivated plots. However, the reverse was true on second year yields. The non-cultivated plots yielded nearly twice that of the cultivated plots. These interactions were not statistically significant.

The establishment of harding grass was poor in general, but was much better on some of the treatments than the check if the herbicides were incorporated. All three incorporated herbicides produced significantly better stands of hardinggrass. The unincorporated materials did not produce significant increases.

The 1959-60 Modoc County trial produced some interesting differences the second year which weren't apparent the first year. This trial differed from the one above in that none of the herbicides were incorporated and greemar intermediate wheatgrass was seeded instead of rose clover and hardinggrass.

The plots were rated for stand and vigor. The stand was significantly poorer with 2# of atrazine. No other stand differences were significant. Significant increases in vigor were noted for all of the simazine and atrazine treatments.

All the above material on the use of pre-emergence herbicides is being assembled for publication in the near future.

Cooperative trials with R. A. Evans (ARS) in Modoc County on pre-emergence materials produced such variable results on this dry year that nothing could be read from them. New trials are being established.

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III. Reduction of Plant Competition During Establishment of Improved Forage Species by Application of Post-Emergence Herbicides to Annual Ranges.

A. Tolerance of annual clovers to 2,4-DB

(See pages 33-37, Jan. 1961) The complete data on the 1959-60 2,4-DB trial appear in the following tables. The effects on forage and seed yield were discussed last year except for seed yield of sub clover. Completion of the data on sub clover showed no significant effect on the production of seed.

There were some very interesting effects on seed quality. One hundred seeds of each treatment in each of 8 replications was germinated @ 20°C. Data was recorded on normal seed (exclusive of hard seed), hard seed, and 2,4-D type damage as described by Williams and Leonard.*

Normal seed - no differences were noticed in the normal seed of rose clover. Applications of 2,4-DB ester at both rates in the one leaf stage, the amine at the low rate in the 6-10 leaf stage and the low rate of the ester in the pre-bud stage produced significant decreases in the amount of normal seed in sub clover. All materials applied to crimson clover in the full bloom stage produced significant decreases in the normal seed.

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* Williams, W. A. and O. A. Leonard. Effect of 2,4-D on the Growth, Seed Production, and Seed Viability of Rose Clover. Agron. Journ. 52:229-234. 1960.

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Hard Seed - The hard seed content of sub clover was increased by 2# of the ester in the one leaf stage, and 3/4# of amine in the 6-10 leaf stage. 2# of amine in the pre-bud stage increased the hard seed in crimson clover. None of the treatments effected the hard seed content of rose clover.

Total germination (normal seed plus hard seed) was not affected in sub clover. Total germination of rose clover was reduced by both rates of 2,4-DB ester in the full bloom stage. All treatments in the full bloom stage of crimson clover as well as the 2# of the ester in the 6-10 leaf stage and the amine @ 1 & 2# in the pre-bud stage reduced the total germination.

2,4-D type damage was of a low magnitude and did not produce data suitable for statistical analysis. In general the greatest effect was from herbicide application in the full bloom stage, and greatest in crimson clover, least in sub clover, and intermediate in rose clover.

The effects of 2,4-DB on production of pure live seed, determined by multiplying total germination data times seed yield data produces the most usable data pertaining to seed production. There was no significant effect on sub clover. Rose clover was reduced by the low rate of the amine in the pre-bud stage and high rate of the amine and both ester treatments in the full bloom stage. Crimson clover was the most affected. Converting the data to yield of pure live seed made differences evident which didn't appear in either the seed yield data or total germination data. Production of pure live seed of crimson clover was re reduced by all treatments except those in the one leaf stage and the low rate of the amine in the 6-10 leaf stage.

Effect of 2,4-DB on Forage and Seed Production of Annual Clovers 1959-60

	Treatment	Rate (Pound active per acre)	Growth Stage	Forage Grass per 6' Yield row - air dry			Seed Yield Grass 8' row - air dry			Seed Yield Grams/8' row Pure live seed		
				Rose	Sub Crimson		Rose	Sub Crimson		Rose	Sub Crimson	
1	Amine 2,4-DB	3/4	One Trifoliate leaf	699	518	361	132	73	48	124	67	40
2	"	2	"	816	513	441	152	69	64	145	63	54
3	Ester 2,4-DB	3/4	"	722	512	340**	136	63	52	132	62	45
4	"	2	"	833	485	314**	150	64	44	143	59	38
5	Amine 2,4-DB	3/4	6-10 leaves	714	405	423	126	67	43	121	61	38
6	"	2	"	823	571	458*	152	81	38	147	72	34*
7	Ester 2,4-DB	3/4	"	675	397	369	123	57	32	125	53	28**
8	"	2	"	755	450	260**	145	65	22*	139	60	20**
9	Amine 2,4-DB	1	Pre-bud 3-5" rosette	644	466	386	116*	66	22*	114*	58	20**
10	"	2	"	730	476	424	125	66	23	120	60	21**
11	Ester 2,4-DB	1	"	718	433	295**	136	61	14**	122	56	13**
12	"	2	"	804	563	204**	129	64	8**	126	60	7**
13	Amine 2,4-DB	1	Full bloom	767	563	383	154	77	45	127	66	32**
14	"	2	"	677	457	383	118	59	40	111**	54	27**
15	Ester 2,4-DB	1	"	759	485	332	80**	56	23	71**	51	16**
16	"	2	"	703	437	341**	58**	52	18*	47**	46	14**
17	Check			804	596	436	145	76	52	142	70	43
	LSD .05			NS	NS	47	28	NS	23	28	NSD	8
	LSD .01			NS	NS	62	37	NS	30	37	---	10
			CV-%	22	22	13	22	27	84	23	24	27

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Effect of 2,4-DB on Seed Quality of Annual Clovers 1959-60

Date	Treatment	Normal Seed-Percent (Exclusive of Hard Seed)			Hard Seed - Percent			Total Germination Percent (Normal & Hard Seed)			2,4-D Type Damage Percent		
		Rose	Sub	Crimson	Rose	Sub	Crimson	Rose	Sub	Crimson	Rose	Sub	Crimson
	1	59	79	79	35	14	5	94	93	84	3	0	0
	2	59	81	73	37	14	5	96	95	84	1	1	1
	3	65	79**	83	33	13	7	97	92	87	1	3	1
	4	68	72**	73	28	19**	6	96	91	85	4	3	1
	5	63	79**	80	34	18*	8	96	92	88	5	4	3
	6	61	79	80	36	11	7	97	90	87	1	2	2
	7	67	81	80	29	13	7	96	94	87	2	1	1
	8	71	83	82	25	13	7	96	96	89**	1	0	0
	9	65	83	80	33	9	9	98	92	89**	1	1	1
	10	54	80	80	41	12	10*	95	92	91**	3	0	1
	11	69	77*	81	29	14	7	98	91	88	3	1	2
	12	57	87	83	40	8	6	97	95	89	1	0	1
	13	57	78	64**	38	11	6	95	89	71**	3	0	13
	14	61	87	61**	34	4	5	95	91	66**	2	2	21
	15	51	83	22**	37	8	4	88**	89	26**	8	1	57
	16	52	83	13**	33	7	2*	85**	90	13**	11	1	67
	Check 17	64	84	79	34	9	6	98	92	84	0	0	0
	LSD .05	NSD	7	6	NSD	6	4	5	NSD	5			
	.01	NSD	9	7	NSD	8	NSD	7	NSD	7			

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1960-61 Trial

The trial was repeated using a low and high rate of 2,4-DB amine and a low rate of 2,4-DB ester and only three stages of growth -- one leaf, 8-10 leaves, and full bloom. This reduced the total number of treatments to 10, making a latin square design possible. Five replications were dropped early in the experiment because of an excessively weedy condition. In spite of this loss, the sampling accuracy as measured by the coefficient of variation was markedly improved. For example, the CV on rose clover forage yields were reduced from 22% to 14% and sub clover from 22% to 17%, even though the number of replications was reduced from 6 to 5. Apparently this was a more uniform field.

Comparing the two years data there was again no reduction in forage production of rose clover. Sub clover yields were decreased by both rates of the amine when applied in the one leaf stage. There were no differences in sub clover in the first year's experiment. Crimson clover yields were decreased by all applications in the one leaf stage. Only the ester produced decreases at this stage of growth in the first trial. However, other decreases were noted in crimson clover the first year which were not made apparent this year.

Seed yields of rose clover were reduced by the high rate of 2,4-DB amine and the ester applied in the bloom stage. This is similar to the first year. Crimson seed yields were reduced by all treatments in the bloom stage, and by the 2# amine on 3/4# ester treatments in the 8-10 leaf stage. This differs from the first year's data in that the effect was more pronounced in the pre-bud stage than the full bloom stage.

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Effects of 2,4-DB on Annual Legumes

1960-61

		Forage Yields			Seed Yields		
		Rose	Sub	Crimson	Rose	Sub	Crimson
one leaf	3/4# amine	1050	630*	520**	131		68
	2# "	1060	620**	490**	125		61
	3/4# ester	1100	760	560*	146		93
8-10 leaves	3/4# amine	1120	810	660	152		79
	2# "	1030	870	690	132		70**
	3/4# ester	1010	950	640	127		69**
bloom	1 amine	1140	750	650	110		69**
	2 "	1030	750	580	86*		64**
	1 ester	970	710	660	34**		38**
	Check	940	880	670	126		89
	LSD .05	HSD	180	100	40		14
	.01	---	240	130	54		19
	CV	14.21	17.18	12.51	26.6		15.22

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This study will be terminated when the seed quality information for the second year is completed.

8. Tolerance of annual clovers to dalapon. (See pages 37-38, Jan. 1961.)

The complete data on the 1959-60 dalapon appears in the following table. The effects of dalapon on forage and seed yield were discussed last year except for sub clover seed yields. Seed yields of sub clover were reduced by dalapon applications at all dates except early ripe.

There were many effects on seed quality as well as seed yield. Total germination (normal plus hard seed) was not affected in crimson clover. Sub clover was reduced at the bloom stage only. Rose clover was reduced by dalapon applications in the one leaf, 6-10 leaf, bud, and bloom stages.

Normal seed percentages were increased at the expense of hard seed in rose and sub clovers. Crimson clover was little affected.

Yield of pure live seed was determined from the above data and showed marked reductions at all dates except the early ripe stage of sub and crimson clover. Yields of pure live rose clover seed were reduced by all dates of spraying with dalapon.

Seeds of some of the more severe treatments are being grown out in the field this season to check for abnormalities.

1960-61 trials - A similar trial was conducted this year except at lower rates (for reasons discussed last year). Dalapon was applied at rates of 1, 2, & 3 pounds at the growth stages - one leaf, 6-10 leaves, and bloom stage.

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Effect of Dalapon on Annual Clovers
Davis, 1959-60

	Growth Stage	Reps	Forage Yield Grams/8'row-air dry			Total Seed Yield Grams/8'row			Seed Yield Grams/8'row Pure Live Seed		
			Rose	Sub	Crimson	Rose	Sub	Crimson	Rose	Sub	Crimson
1	One leaf	4	238**	219**	196**	41**	21**	11**	39**	19**	10**
2	6-10 leaves	4	491*	294**	330*	24**	15**	20**	21**	14**	16**
3	Pre-bud	4	388**	305*	269*	14**	10**	12**	13**	8**	10**
4	Bud	5	370**	249**	318*	7**	6**	4**	7**	6**	3**
5	Bloom	5	480*	356	337*	7**	6**	20**	6**	5**	16**
6	Early ripe	5	674	462	429	69**	44	50	67**	40	42
7	Check		707	476	431	119	54	54	105	50	46
	LSD .05		166	128	85	14	13	9	19	12	7
	LSD .01		222	172	115	19	20	12	25	16	10

	Total Germination (Normal & Hard Seed)			Normal Seed			Hard Seed			2,4-D Type Damage		
	Rose	Sub	Crimson	Rose	Sub	Crimson	Rose	Sub	Crimson	Rose	Sub	Crimson
1	93*	93	87	61**	69**	80	32**	24**	7	6	0	2
2	90**	91	80	48	72*	72*	42**	19	8	4	1	2
3	96	90	83	55*	65**	76*	41**	25**	7	1	1	2
4	92**	94	85	50	69**	77	42**	25**	8	2	0	3
5	91**	83*	82	60**	73*	74*	31**	10	8	3	1	2
6	97	91	81	46	79	75*	51	12	6	0	0	5
7	99	93	87	42	82	82	57	11	5	0	0	0
LSD .05	5	7	NSD	11	9	6	9	9	NSD			
.01	7	NSD	--	14	13	NSD	12	12	--			

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Forage yields were reduced in all three species, but most often in rose, and least in sub. Rose clover yields were reduced by all dates and rates of spraying. The 8-10 leaf stage affected the yields the greatest. This is in general agreement with the first year's data (even though rates were higher the first year).

Seed yields of rose and crimson clovers were reduced at all dates of application. Sub seed yields are not available yet. In general, the lowest rates of Dalapon had the least effect on seed yield and the highest rates the greatest effect.

This study will be terminated when the seed quality information for the second year is complete. Further trials under range conditions are planned.

Effects of Dalapon on Annual Legumes
1960-61

		Forage Yields			Seed Yields		
		Rose	Sub	Crimson	Rose	Sub	Crimson
one leaf	1	1030*	620	500*	10**		88**
	2	820**	460*	450**	****		58**
	3	630**	450*	370**	21**		37**
8-10 leaves	1	820**	550	420**	75**		52**
	2	600**	530	390**	54**		47**
	3	710**	320**	370**	54**		40**
bloom (rose-bud)	1	940*	720	620	62**		83**
	2	1000*	770	610	24**		60**
	3	940*	670	630	32**		45**
Check		1170	710	630	107		107
LSD .05		170	200	110	23		13
.01		230	270	150	31		17
CV		15.21	26.55	17.26	27.9		16.40

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C. Post emergence plots under range conditions.

Field tests were conducted under range conditions with both grass and broadleaf weed killers. Trials were conducted in Solano County and the Sierra Foothill Range Field Station in Yube County on new seedings of harding grass and rose clover.

The Solano County trials gave some interesting changes in species composition between treatments. Much valuable data was lost due to conditions other than treatments. The seeded species were unable to grow because of a water logged soil condition. Interesting changes in weed composition were noted.

Two pounds of dalapon applied in the one leaf stage (rose clover) eliminated the grasses. The same treatment applied at the 3-5 leaf stage reduced the ground cover of grass from 5.8% to 2% as did a mixture of 1# of dalapon and 3/4# 2,4-DB amine.

Reductions in ground cover of forbs - particularly filaree - were noted. 3/4# of 2,4-DB amine applied at either the one or 3-5 leaf stage gave marked reductions in total ground cover of forbs without materially affecting the resident annual legumes. One pound of 2,4-D amine gave the best control of forbs, but also killed the annual legumes.

The trial at the Sierra Field Station gave excellent stands of both harding grass and rose clover. The weeds were primarily wild oats and yellow star thistle, although 7 grasses and 13 forbs were recorded in the step point data. Only the 2,4-D amine treatment produced a statistically significant change in the species composition. 2,4-D reduced the forbs, and at the

Effects of Post-emergence Herbicides on Ground Cover -

1960-61 Sampled 4/24/61

	One Trifoliate Leaf rose clover				3-6 leaves - rose clover			
	Check	3/4#2,4-DB amine	3/4#2,4-DB amine + 1# dalapon	2# dalapon	3/4#2,4-DB amine	2# dalapon	3/4#2,4-DB amine + 1# dalapon	1#2,4-D amine
Total Ground Cover	74	60	64	56	22	66	50	13
Grasses - Fescue	1.4	12.0	1.3		5.5			5.3
Medusa-head	T				T			T
Soft chess	0.8	10.2	1.3		0.9			1.0
An. Rye	2.2	23.4	1.9		5.7	2.0	2.0	3.0
Wild Oat	1.4	1.2			1.8	T		1.6
Sub Total Grasses	5.8	46.8	4.5	0	13.9	2.0	2.0	10.9
Forbs - Filaree	63.0	1.8	57.6	55.4	4.6	62.6	47.5	2.0
Trifolium sp.	3.6	4.8	1.3		2.6		0.5	0.1
Bur. clover	0.8							
Rose clover	0.8	0.6						
Other forbs		6.0	0.6	0.6	0.9	1.4	T	T
Sub Total Forbs	68.2	13.2	59.5	56.0	8.1	64.0	48.0	2.1

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Sierra Station - 1360-61

Post-emergence Herbicides on Seedling Stand of Harding grass and Rose Clover

Treatments		Ground Cover 4/26/61			Rose Cl. Grams / 4' Row 5/16/61	Harding-grass
Rose Cl Growth Stage	Herbicide	Total	Forbs	Grasses		
	Check	86	70	12	30	
one leaf	3/4# 2,4-DB amine	88	69	19	37	
	2# dalapon	82	65	17	20	
	3/4# 2,4-DB amine + 2# dalapon	86	77	9	16**	
3-4 leaves	3/4# 2,4-DB amine	78	62	14	28	
	2# dalapon	72	70	2	8**	
	3/4# 2,4-DB amine + 2# dalapon	70	58	11	20	
	1# 2,4-D amine	58	7**	51**	2**	
late bud	3/4# 2,4-DB amine	78	63	16	32	
	2# dalapon	90	77	13	29	
	1# 2,4-D amine	62	50**	12	17*	
	LSD .05		14	11	12	
	.01		18	15	15	

To be sampled January 1962.

earlier stage of growth allowed for a significant increase in the amount of grass. This may prove to be equally significant in the esteblishment of hardinggrass which will be sampled in January 1962.

Rose clover yields were not significantly increased by any of the treatments. 2,4-D significantly reduced the yield at both dates of application. 2# of dalapon at the 6-8 leaf stage and the combination of 2,4-DB and dalapon also reduced yields. The lack of success is probably due to the fact that the primary weed was yellow star thistle. The only selective herbicide available for use in annual legume, 2,4-DB, does not kill yellow star thistle. General observations on 2,4-DB indicate it is selective with respect to certain broad leaf weeds. This will definitely limit its use in range work because of the large variety of such weeds encountered on the annual range.

Observation trials on an established stand of subterranean clover on the Hopland Field Station produced interesting changes in species composition. Rates of 1, 2, and 3 pounds of dalapon and 3/4# 2,4-DB amine were applied to a heavily grazed stand of sub clover on January 17, 1961. The weeds were predominantly grasses (annual fescue and hordeum) with a representation of small early maturing annual forbs. The plots were sampled by the step-point analysis in February and May.

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Percent Forage Composition - Hopland Field Station - Applied 1/17/61

	2/25/61				5/10/61			
	Check	1# Dalapon	3# Dalapon	3/4# 2,4-DB amine	Check	1# Dalapon	3# Dalapon	3/4# 2,4-DB amine
Sub clover	18	14	21		67		69	78
Grasses	51	21	24		21		3	18
Forbs	31	65	55		12		31	4

Grass control was excellent with 2# and 3# of dalapon without damaging the sub clover. Ground cover of sub clover was increased by the application of 3/4# of 2,4-DB apparently because of the partial control of the forbs. Yields were not taken because the plot was not fenced and was heavily grazed periodically during the growing season.

Next year's plans include a more formal trial with logarithmic applications of 2,4-D amine, 2,4-DB amine, and dalapon at three dates, all early in the growing season. The plot should be fenced early in the period of rapid growth to measure the regrowth of subterranean clover.

B. Dalapon rate tests on medusa-head

Two years' data on the rate of dalapon necessary to control medusa-head suggest that rates less than the usual recommendation of 4-5# for annual grasses may suffice. A rate test sprayed on March 21, 1960, at rates of 1, 2, 3, 4, and 5 pounds per acre indicated 37% control at

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2#/acre, 99% @ 3# and 100% @ 4 and 5# as indicated by counting seed heads at the end of the growing season. Total ground cover remaining on these plots was very low, indicating that seed production was low and possibly competition the following year would be low. Rose clover was drilled through all treatments and reps. in the fall of 1960. The clover was clipped from the plots in the spring of 1961 and indicated no difference in yield between treatments, possibly because of the late start of the growing season. Ground cover percent was high. The check plot produced 77 seed heads per square foot and 23 @ 1#, 7 @ 2#, 7 @ 3#, 10 @ 4#, and 7 @ 5#. The individual treatments were small, 15' x 15', so medusa seed blown in from adjacent untreated acres and check plots would account for some of these invading plants.

The trial was repeated in the 1960-61 growing season at two dates - December 20 and February 20. Again, most of the medusa-head was eliminated by 2# of dalapon. Total ground cover was reduced by 3# in December and 2# in February. Grass was reduced and forbs consequently increased by all rates at both dates. Step point data show the grass which remained was of species other than medusa-head - predominantly soft chess.

It is hoped that this information can be combined with that on dalapon tolerance of the annual legumes to develop a program to maintain high producing legume pastures in the face of the increasing acreage of medusa-head.