

Herbicides on Rangeland Forage

reduction of plant competition during seedling establishment on annual ranges by application of pre-emergence herbicides

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Excessive competition from resident annual grasses and forbs—for moisture and nutrients—is one of the primary problems in establishing improved forage species on annual ranges.

Thousands of acres of California's annual rangelands support a cover of undesirable grasses such as medusa-head—*Elymus caput-medusae*—and goatgrass—*Aegilops triuncialis*. Control of medusa-head—the number one annual range weed problem—and other weeds is needed, either by chemical means, through better range management, or both.

Ranchers are giving more attention to better seedbed preparation, better seeding operations, and post-seeding management in an effort to provide a favorable environment for establishment of seeded forage plants. Along with these improvement practices there is the possibility that a selective herbicide would reduce the density of less desirable range species to the benefit of seeded species.

A study was initiated to develop a technique to reduce plant competition by using selective herbicides during the re-seeding of annual rangelands.

Different chemicals, rates of treatments, and times of seeding after chemical application were tested. To effectively fit into seeding operations, a chemical should be active as a pre-emergence herbicide and—when applied prior to the

Herbicides and Rates Used in Weed Control Tests on Annual Range	Rates in lbs./A of active ingredient			
	0	2.0	4	8
EPTC (ethyl N, N-di-n-propylthiolcarbamate)	0	2.0	4	8
CDAA (2-chloro-N, N-diallylacetamide)	0	2.0	4	8
CIPC [Isopropyl N-(3-chlorophenyl) carbamate]	0	2.0	4	8
dalapon (2, d-dichloro-propionic acid)	0	1.0	2	4
simazin [2-chloro-4, (6-bis-ethylamino)-s-triazine]	0	0.5	1	2
monuron [3-(p-chlorophenyl)-1, 1-dimethylurea]	0	0.5	1	2

EPTC, CIPC and simazin were applied on September 20, 1957 in the pelleted form. CDAA, dalapon, and monuron were applied in 50 gallons of water per acre on September 23, the beginning of the first measurable rain.

first fall rains—should be sufficiently rapid in its action to reduce germination of weedy annuals, but leave no harmful residue toxic to seeded species. Control of weedy vegetation was considered successful if a good stand of annual clover or perennial grass—or both—resulted.

The experimental area selected is on the west side of the Sacramento Valley in Solano County. The mean annual rainfall for the area is 18" occurring in fall, winter, and spring months. Soils of the area have deep, well developed profiles which are derived from mixed alluvium on gently sloping to undulating terraces. A claypan exists at 24" to 36" depth and subsurface drainage

is slow. Surface textural classes range from clay to clay loam. Medusa-head appears to be the dominant species on the study area but broad-leaf filaree—*Erodium botrys*—soft chess—*Bromus mollis*—and bur clover—*Medicago hispida*—are also common. Grazing is normally by sheep during the winter and early spring.

The study area was burned on August 16, 1957 to remove accumulated litter and to concentrate seeds at the ground level.

A split plot design with 24 treatments and four replications was used. Main plots, 12' x 16', were split into subplots of 8' x 12' to allow for two dates of seeding. The first seeding was on October 19, 1957, after an accumulated rainfall of 4.35". The second seeding was on November 11, 1957, after an accumulated rainfall of 5.32".

Seeding was done with a rangeland drill. Hardinggrass—*Phalaris tuberosa* var. *stenoptera*—and rose clover—*Trifolium hirtum*—were each seeded at eight pounds per acre in alternate rows 1' apart. The single disk openers of the drill peeled back a sod formed by the previous year's annual vegetation and left a more or less open furrow. Fertilizer, 16-20-0, was banded in the furrow at approximately 200 pounds per acre. Seed coverage was poor because

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Test area before treatment showing dense stand of medusa-head.



Hardinggrass and rose clover were seeded with rangeland drill.



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there was very little loose soil. The ring roller normally used to insure good seed coverage was not used because of possible contamination of chemical from plot to plot.

In an effort to control small rodents, poison bait—in one quart oil cans—was distributed and no rodent damage was apparent. Probably, however, some seeds were picked up by flocks of blackbirds frequenting the area.

Soil moisture measuring equipment was installed in three replications of the most promising treatments as indicated by visual inspection of control of annual vegetation on November 4, 1957. Moisture depletion was measured on all EPTC, CIPC and simazin plots.

The area—fenced to prevent uncontrolled grazing by sheep—was grazed during the spring growing season, on March 14, 1958 and on May 10, 1958, using a large concentration of sheep for a few days each time, a standard practice for controlling weeds on new range seedings in California. Some differential grazing occurred during the May grazing, so the plots were mowed at a 3" level and the plant material removed.

On November 26, 1957, all plots were analyzed for species composition and plant cover.

Stand establishment of seeded species was determined on January 3, 1958. The rose clover was sampled again at maturity—May 23, 1958. Results are expressed as mean number of quadrats which contained plants of seeded species. Establishment of Hardinggrass was determined on July 21, 1958 and on Janu-

Weekly Rainfall for Vacaville, Solano County, Four Miles from Study Area. 1957-58 Growing Season

Month	Day of month				Total
	1-7	8-14	15-21	22-30	
Sept.	..	..	..	.87	.87
Oct.	.04	3.20	..	.97	4.21
Nov.	..	.52	.05	..	.57
Dec.	.32	..	3.70	.04	4.06
Jan.	.76	1.09	..	3.82	5.67
Feb.	2.95	2.78	3.25	2.56	11.54
Mar.	..	.73	3.29	2.83	6.85
April	5.24	..	..	..	5.24
May	..	.03	..	.48	.51
June	..	.10	..	..	.10
Total					39.62
Deviation from mean					+15.61

ary 12, 1959 by counting the number of plants in two 10' rows.

Early observations of resident annual species revealed that some of the chemical treatments effectively reduced plant density. A comparison of each chemical application rate with a nearby check plot on November 4, 1957 indicated that EPTC, CIPC and simazin were the most effective in changing the degree of competition offered to the young seeded species. The photographs on these pages compare a particular treatment with control. The step-point analysis on November 26 indicated that EPTC gave good control of weedy grasses such as medusa-head and moderate control of filaree, but was not injurious to clover plants. CIPC markedly reduced the stand of grasses but did not markedly affect the density of filaree. Simazin reduced the density of all annual species with no indication of selectivity. The other chemicals failed to show any visible effects on the stand of annual plants at this time, possibly because of a high degree of leaching or breakdown.

Mean Percent of Ground Covered November 26, 1957 by Annual Vegetation Classes Following Pre-emergent Chemical Application. Data Ranked for Total Percent Cover.

Chemical treatment	Lbs/acre of chemicals	Forbs	Grass	Leg-umes	Total % cover
simazin	2	10.8	5.8	0.4	17.0
CIPC	8	23.2	4.2	3.3	30.7
simazin	1	24.7	11.0	1.0	36.7
CIPC	4	26.2	5.7	5.8	37.7
simazin	1/2	25.6	11.8	2.1	39.5
EPTC	8	31.2	2.0	7.0	40.2
dalapon	4	22.4	23.3	4.0	49.7
EPTC	4	28.2	15.6	8.9	52.7
monuron	1	26.0	26.4	2.6	55.0
monuron	2	34.8	17.1	5.1	57.0
monuron	1/2	19.6	29.6	8.0	57.2
CDA	2	25.1	30.1	3.8	59.0
EPTC	2	38.3	16.2	7.2	61.7
dalapon	1	35.4	23.3	3.8	62.5
CDA	4	34.0	24.5	4.2	62.7
CIPC	2	50.1	8.2	4.4	62.7
dalapon	2	41.2	19.7	4.9	65.8
CDA	8	25.9	34.2	6.4	66.5
CHECKS		33.6	31.1	3.1	67.8
LSD .05 level		14.9		n.s.	14.7

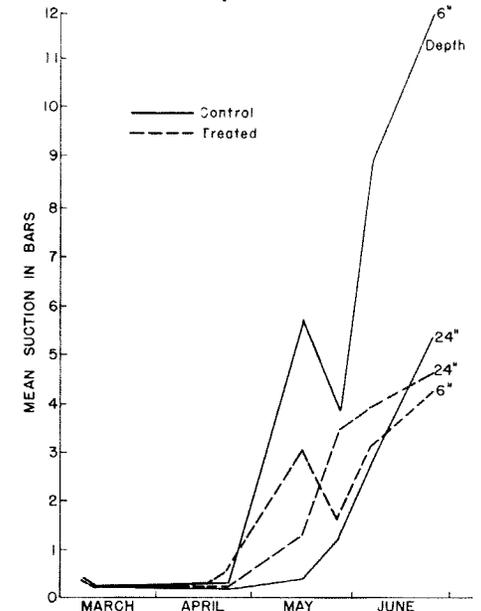
Establishment of Hardinggrass was aided by reduced competition following several chemical treatments. Some chemicals either had little or no effect on competition or had a deleterious effect on the seeded species. As clover establishment in California was better than normal in the wet winter of 1957, there was less opportunity for the experimental treatments to aid in rose clover establishment. No significant differences in subsequent stands of clover were noted as a result of pre-emergence chemical treatments.

Significantly better stands of Hardinggrass resulted from reduction of competition from resident annual grasses and forbs. The best stand of Hardinggrass developed on the plots treated with four pounds per acre of EPTC. Other treat-

Partial control of resident annual vegetation using simazin at one pound/acre. Photo taken March 11, 1958.



Moisture depletion on plots treated with four pounds per acre of EPTC as compared with check plots.



Establishment of Rose Clover and Hardinggrass Following Chemical Control of Competition from Resident Annual Vegetation

Treatment Lbs.	Average % cover resident species	Mean No. of stocked quadrats of rose clover on early and late seedings. ¹ May 23, 1958	Mean No. of Hardinggrass plants on early and late seedings in 40 ft. of row. July 21, 1958
simazin . . . 2	17.0*	22.7	24.5
CIPC 8	30.7*	31.0	7.5
simazin . . . 1	36.7*	28.7	34.5*
CIPC 4	37.7*	31.2	14.0
simazin . . . 1/2	39.5*	27.3	33.7*
EPTC 8	40.2*	29.8	33.0*
dalapon . . . 4	49.7*	29.3	32.7*
EPTC 4	52.7*	32.8	40.2*
monuron . . . 1	55.0	29.5	36.7*
monuron . . . 2	57.0	32.8	25.5
monuron . . . 1/2	57.2	29.5	27.0
CDAAs 2	59.0	31.0	18.0
EPTC 2	61.7	28.5	24.5
dalapon . . . 1	62.5	24.8	15.5
CDAAs 4	62.7	18.3	19.0
CIPC 2	62.7	26.0	17.7
dalapon . . . 2	65.8	27.3	28.2
CDAAs 8	66.5	28.7	26.5
CHECKS	67.8	29.0	15.1

LSD .05 level 14.7 Non-significant 15.2
 * Significantly different from checks.
¹ Completely stocked would be 120 quadrats with rose clover present.

ments which effectively improved Hardinggrass establishment were eight pounds per acre of EPTC, one half pound per acre of simazin, one pound per acre of simazin and four pounds per acre of dalapon. These treatments were also most effective in reducing the density of the annual plant cover. Although eight pounds per acre of CIPC, four pounds per acre of CIPC, and two pounds per acre of simazin were effective in reducing competition, the residues from these materials were apparently still present

Survival of Hardinggrass Plants the First Year Following Chemical Control of Competition from Resident Annual Vegetation. Plant Counts Taken Jan. 12, 1959

Treatment	Lbs.	Mean No. of Hardinggrass plants, early seeding, in 20 feet of row
EPTC	2	13.5
	4	13.0
	8	18.0*
CDAAs	2	4.5
	4	1.0
	8	11.6
CIPC	2	5.7
	4	8.2
	8	2.0
simazin	1/2	16.7*
	1	20.0*
	2	13.2
dalapon	1	3.7
	2	11.0
	4	10.2
monuron	1/2	14.5
	1	11.5
	2	12.7
Check	(mean for 24 plots)	6.4

LSD .05 level 9.17.
 * Significantly different from check.

and toxic at the time of seeding the Hardinggrass.

The time of seeding following the application of chemicals is important to seeding establishment. The seeding on October 19 resulted in 58.9% stocked quadrats of rose clover and 46.4% stocked quadrats of Hardinggrass. The seeding on November 11 had only 21.2% stocked quadrats of rose clover and 10.3% stocked quadrats of Hardinggrass. The extended cool dry season in November and early December was probably the reason for poor results of the later seeding. Ordinarily, an early seeding date is desirable to take advantage of favorable fall temperatures and soil moisture, but a sufficient time must be allowed

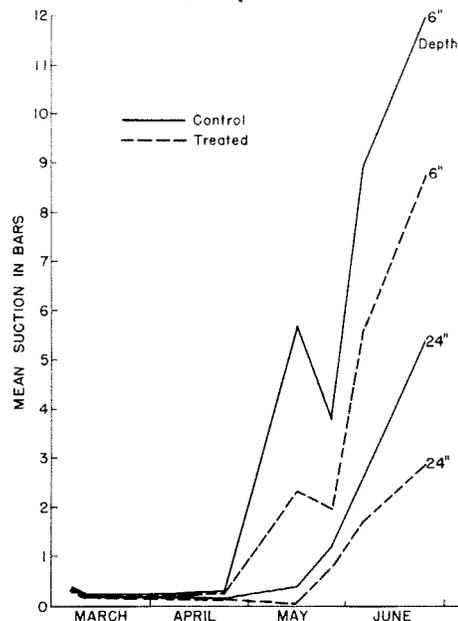
for inactivation of chemical residues. In this study the hazard of most chemical residues was gone at the time of the first seeding, helped by the 4.35" of rainfall, and conditions were favorable for germination and growth. The second seeding was uniformly poor because of unfavorable weather conditions with little effect observed from applied chemicals.

Soil moisture conditions were more favorable on plots where chemicals had reduced plant competition than on control plots. Two treatments, four pounds per acre of EPTC and one pound per acre of simazin, exemplify the effects of pre-emergence herbicides on soil moisture relationships. Both treatments were beneficial in the establishment of Hardinggrass. The four pounds per acre treatment with EPTC reduced total cover of resident species to 52.7% and the one pound of simazin per acre reduced the cover to 36.7% as compared to 67.8% for check treatments. Moisture conditions on these plots were better than on control plots at all depths. No difference in moisture depletion between treated and untreated plots was noted until the latter part of April. During the months of May and June there was a greater reduction of soil moisture reserves on the check plots than on the treated plots. Near the end of June the difference in soil moisture stress between treated and control plots was more accentuated. Plant counts at the end of the summer indicate the importance of soil moisture reserves at the beginning of the dry season.

Reduction of resident annual grass density by chemical treatment was greatest where grass toxic herbicides, such as

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Moisture depletion on plots treated with one pound per acre of simazin as compared with check plots.



Intense competition to seeded species afforded by resident annuals. Photo taken March 11, 1958.



Management of Second Growth Stands of Douglas-fir

Recent studies by Rudolf F. Grah, Specialist in Forestry, University of California, Berkeley, show the effect of low stand density on quantity and quality of yield.

One of the common problems of modern timber management is that some lands tend to regenerate after cutting with far fewer trees per acre—low stand density—than were in original stands at similar ages.

Data on quantity and quality of yield of Douglas-fir were analyzed to show that, within the range of initial stand densities considered, the net harvestable volume is not significantly affected by stand density. On the other hand, quality as measured by knot size and amount of

excessively fast grown wood was shown to be very greatly affected by density. From an economic viewpoint, stands grown at low initial densities yielded a soil expectation value of \$44 per acre less than those of full density. Three general conclusions are drawn which have application to current management practice: 1. Low initial density reduces financial value of Douglas-fir stands; 2. Fill-in planting and pruning to overcome quality deficiencies are effective and profitable investments; and 3. Stand improvement investments are most profitable on the better sites, and those sites should be given priority in the allocation of funds.

STRAWBERRY

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southern California probably can not be delayed as long as those for Lassen.

The Solana strawberry apparently requires a longer minimum growing period, during the establishment season, if optimum performance is to be realized. Also, Solana probably should be established with stored plants and the plantings made early in the summer, compared to Lassen. Winter planting of Solana is not recommended.

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CIPC, were used. Residues from such herbicides may be injurious to perennial grass species seeded at a later date unless rapid breakdown of the chemicals occurs. Complete elimination of some resident annual grasses may not be desirable because certain grass species, such as soft chess, provide food forage. However, reduction or elimination of weedy grasses would greatly improve the range, particularly if followed by the introduction of desirable annual clovers or perennial grasses. The effect of applying legume selective herbicides such as EPTC and CIPC not only failed to damage the seeded rose clover but also resulted in a greater cover of native annual legumes.

The promising results of this investigation justify further work on the prob-

lem of reducing competition during seedling establishment of annual rangelands by the application of pre-emergence herbicides.

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POTATOES

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rates above five pounds per acre provided control of broadleaved weeds and grasses for a period of three weeks. NPA and CDAA failed to provide adequate control. This may have been due in part to a rapid leaching of these materials from the upper soil. Yellow nutgrass which was present was not controlled by any of the herbicides tested.

Neburon and CDEC were the only herbicides which provided weed control with no injury to the potatoes at the highest rates used. Simazin caused a reduction in tuber formation at concentrations which fell in the range best suited for weed control. Monuron and diuron, while controlling weeds, left a narrow margin of safety for the crop plant. CDAA and NPA failed to provide adequate control under conditions of the field trials.

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Growers Ralph and Robert Broady of Chino cooperated in the field trials.

COTTON

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and higher supports during the past few years. If farmers take full advantage of the allowed acreage, greater surpluses than ever may be in prospect for the immediate future, in spite of reduced price support levels.

The United States gained only about 6% in cotton production and consumption between two five-year periods—from 12.9 million bales produced, and 12.1 million consumed in 1935–1939 to 13.7 and 12.8 million in 1953–1957.

Foreign use of United States cotton declined about 6%—1.0 million bales—but a 29% increase in United States use—2.0 million bales—offset this drop and resulted in a 6% gain in world-wide consumption between the same periods.

The rate of growth in the world cotton market has slowed, and little change has occurred since 1955, although foreign production has tended to expand as United States cotton output contracted.

United States cotton growers lost ground in the world market in the period beginning just before World War II, a disadvantage that is both absolute and relative. The United States is selling less cotton abroad now, in spite of the fact that foreign consumers are using more total cotton. The one major change that has prevented a still worse position for California and United States growers is increased consumption in the domestic market. However, both per capita and total bale consumption in the United States have declined since 1955.

The facts relative to the cotton situation are quite important to California and United States growers as they consider whether to elect Plan A or Plan B for the 1959 and 1960 seasons. At the upper extreme, if all growers chose Plan B and obtained yields equal to those in 1958, the result would be an overwhelming surplus. Plantings might reach about 22,834,000 acres; an average yield of 470 pounds of lint per acre would mean total production at about the 21.5 million bale level. The estimated 1958–59 disappearance—about 12.25 million bales—would still leave about 9.5 million bales to add to the August 1, 1959, carryover of 8.7 million. The result would be that carryover into 1960–61 would be over 18 million bales—an unworkable figure that would undo all progress in recent seasons toward working off surpluses.

To be continued

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