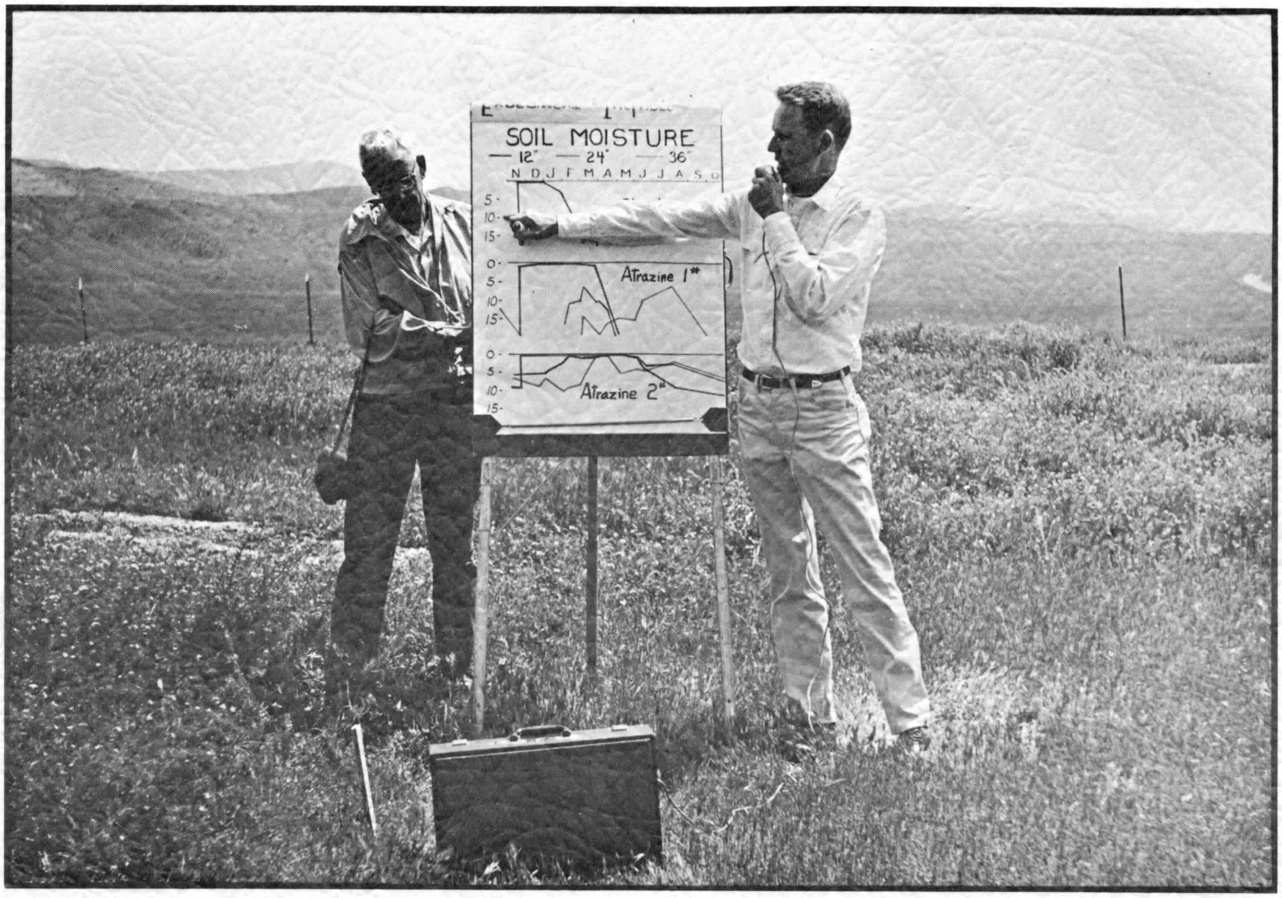
TEMBLOR RANGE RESEARCH

ANNUAL REPORT

1968 - 1969



UNIVERSITY OF CALIFORNIA

Department of Agronomy & Range Science, Davis

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Department of Agronomy, Riverside

COVER PHOTO

On April 10, 1969 approximately 25 people attended a field day at the Elkhorn Experimental Site. The audience, including members of the San Luis Obispo County Board of Supervisors, saw and heard the results of seeding, fertilization, and moisture conservation experiments. Photo by C. A. Raguse, UCD.

FORWARD

Because of the resignation of Dr. C. M. McKell, who has accepted a position at Utah State University, this research is now conducted by the Department of Agronomy and Range Science at Davis. The project is in accordance with Supplement No. 3 to the Master Memorandum of Understanding between the Bureau of Land Management, Department of the Interior, and the Regents of the University of California. Effective date of Supplement is September 13, 1963.

The work is supported in part by grants from the Counties of Kern and San Luis Obispo emanating from Taylor Grazing Fees. Richard E. Owen will be assisting in the projects originating from Davis, and Dr. S. K. Jain of our department, will include the Temblor in his studies on species colonization.

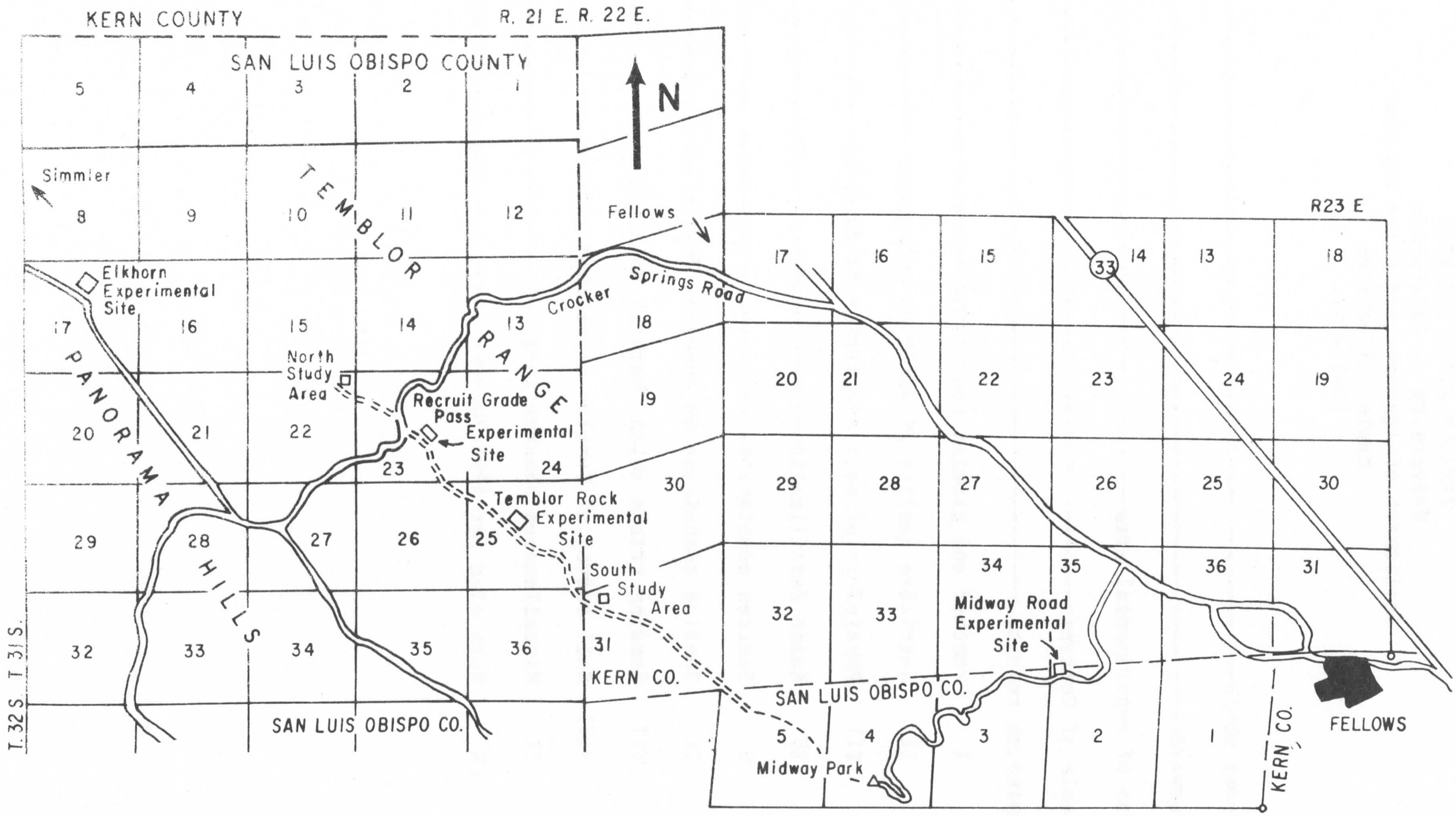
Again we wish to express our thanks to the Boards of Supervisors of Kern and San Luis Obispo Counties, Farm Advisers William Weitkamp and Roy Parker, and officials of the Bureau of Land Management. The continued interest and help of Mr. Carl Twisselman is also acknowledged.

The cooperation of the San Luis Obispo County Office of the Agricultural Commissioner in poisoning the rodents is acknowledged. Without their continuing control efforts it would not be possible to do range seeding research in this area.

R. Merton Love
Burgess L. Kay

December 1, 1969

TEMBLOR EXPERIMENTAL SITES



TEMBLOR RANGE RESEARCH
University of California
Department of Agronomy and Range Science
Davis - Riverside
1968 - 69

I. WEATHER AND GROWING CONDITIONS

Rainfall in 1968-69 was 12.45 inches at Elkhorn and 14.65 inches at Temblor Rock (Fig. 1). This is about twice the rainfall in 1967-68 (6.58 inches and 6.76 inches respectively).

The 2 inches which fell on October 14 resulted in partial germination but not any volume of forage. Germination continued through the November 15 and December 25 rains. Soil moisture filled the entire soil profile at both sites due to the heavy rainfall in January.

The final rain at Elkhorn occurred on March 22, while Temblor Rock received the last significant rainfall on April 9. The permanent wilting point was reached at Elkhorn on about April 5 and on about May 7 at Temblor Rock.

Forage production at Elkhorn was 1,090 lbs/acre oven dry, while at Temblor Rock it was 4,300 lbs/acre. This compares with 560 and 780 lbs/acre last year. The vast difference in production between sites is due to the longer growing season and deeper soil at Temblor Rock. Moisture was available for at least 30 days longer at Temblor Rock because of the deeper soil and the one extra rain falling 18 days after the final rain at Elkhorn.

II. NUTRITIVE QUALITY OF *Atriplex polycarpa*

Jerry Chatterton has been studying the yearlong trends in saltbush nutritional value as an animal feed. At monthly intervals for an entire year four plants of saltbush were sampled for chemical analysis. These plants were from the study site north of McKittrick. Also, during the 1967 sampling period soil moisture at one-foot depth under the brush canopy and in the open space between plants was recorded using gypsum-electrical resistance blocks and a neutron-moisture apparatus.

Plant samples obtained from the saltbush were divided into three portions: leaves, new stems, and one- to two-year-old stems. Chemical analyses on the various portions was performed during the past year for protein, fiber, nitrogen-free extract, total ash, calcium, phosphorus and total digestible nutrients.

During the year of the field study (1967), soil moisture at one-foot depth was extremely limiting most of the time, except for January and February (Fig. 2). There was a slight difference in moisture depletion beneath *Atriplex* plants and in the area between plants. This difference may not be of much importance to the *Atriplex* plants in dry years, however. Even in years of favorable moisture the annual grasses and forbs make heavy use of any surface moisture, thus creating intense competition for water with the saltbush.

Moisture measurements at depths greater than one foot, and as deep as eight feet, indicated that the *Atriplex* plants at McKittrick were not obtaining any substantial amounts of water from below one foot in 1967. The soil below one foot was very difficult to work with because of its dryness.

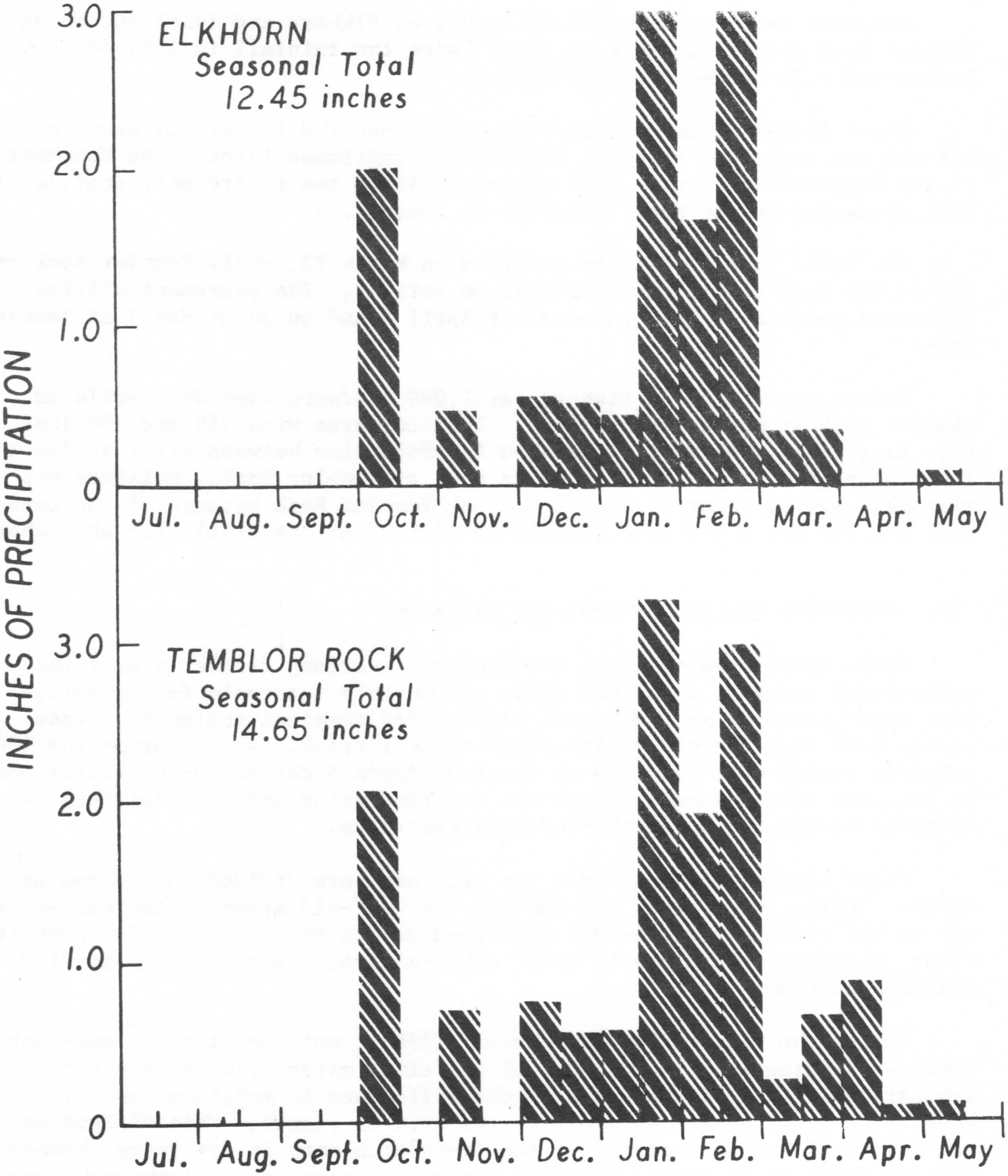


Figure 1. Precipitation on Temblor Experimental Sites - 1968-69.

Figure 2.

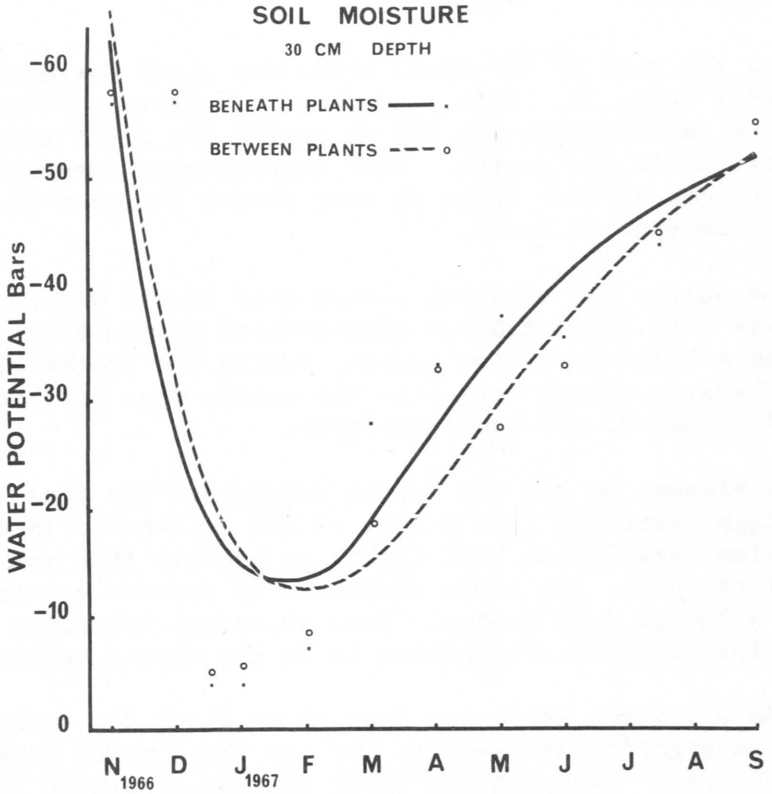
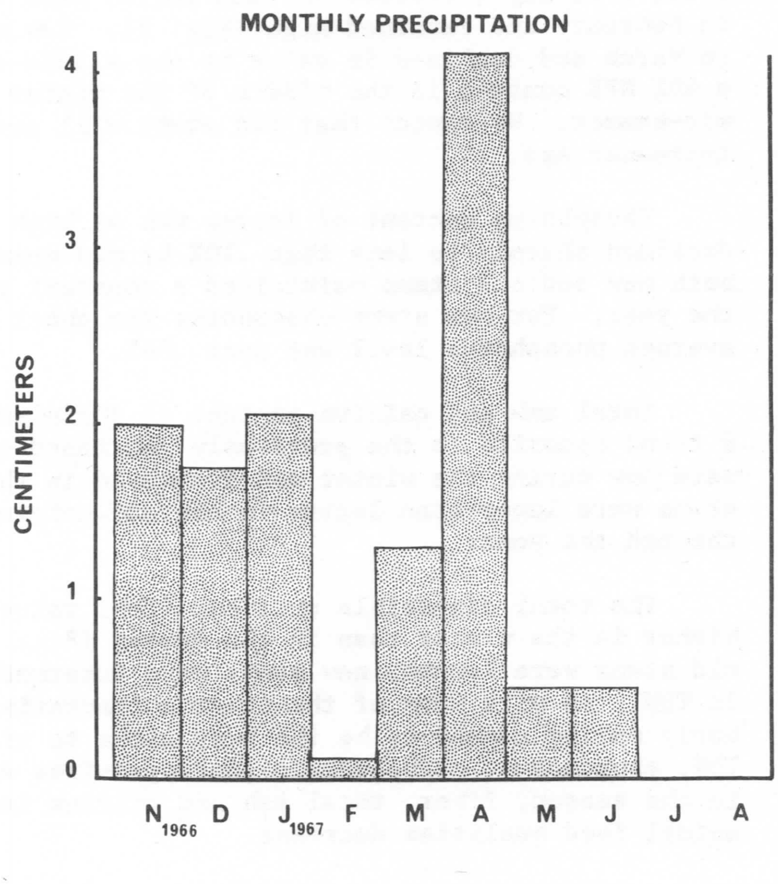


Figure 3.



Precipitation during the year of the field study was about average except for the month of April (Fig. 3). Rain occurring this late, particularly after a long dry period in February, was not as useful for plant growth as it would have been earlier in the season. High temperatures apparently caused a high evaporation loss because there is only slight evidence of any increase in soil moisture content in April.

Daytime temperatures during the sampling period were always within the favorable range for growth (Fig. 4). Minimum temperatures dipped below 40°F, the figure often given as a limit to active growth, during the months of December, January and February. These were also the months when soil moisture was in the available range at the one-foot depth.

Protein content was highest in the new leaves throughout the year (Fig. 5). The protein percentage decreased from a high of 20% in January to a low of 15% in August. New stems were about 2.5% higher in protein than the old stems throughout the entire year. Old stems decreased in protein content from 10% in November to a low of 6.5% in May. From an animal nutrition standpoint, the highest forage value of *Atriplex* is in the winter months.

Fiber content of the old stems increased from 40 to about 50% during the year, but there was no significant trend in the new stems which consisted of about 30% fiber (Fig. 6). Leaves had a fiber content of around 10% during most of the year.

Nitrogen-free extract, a characteristic used as an index of carbohydrate content, increased in the leaves from 45% in November to near 50% in February and remained high (Fig. 7). New stems had their peak NFE value in March and declined in value by the middle of the summer. Old stems had a 40% NFE content in the middle of the winter and declined to around 36% by mid-summer. We expect that old stems will continue to decline in NFE with increased age.

Phosphorus content of leaves was as high as .20% during the winter but declined sharply to less than .10% by mid-summer (Fig. 8). In contrast, both new and old stems maintained a constant phosphorus content throughout the year. For new stems phosphorus was about .10% and for old stems the average phosphorus level was near .06%.

Total ash and calcium content of *Atriplex* samples (Fig. 9, 10) showed a trend opposite to the previously mentioned characteristics in that they were low during the winter and increased in the spring months. New and old stems were lower than leaves in ash and calcium but showed little change through the year.

The total digestible nutrient (TDN) values for *Atriplex* samples were higher in the winter than in the summer (Fig. 11). As might be expected, old stems were lowest, new stems were intermediate and leaves were highest in TDN. As with many of the other characteristics reported, winter and early spring appear to be the best times to utilize *Atriplex* for maximum TDN, phosphorus, carbohydrate (nitrogen-free extract) and protein. Later in the season, fiber, total ash and calcium increase and the more desirable animal feed qualities decrease.

Figure 4.

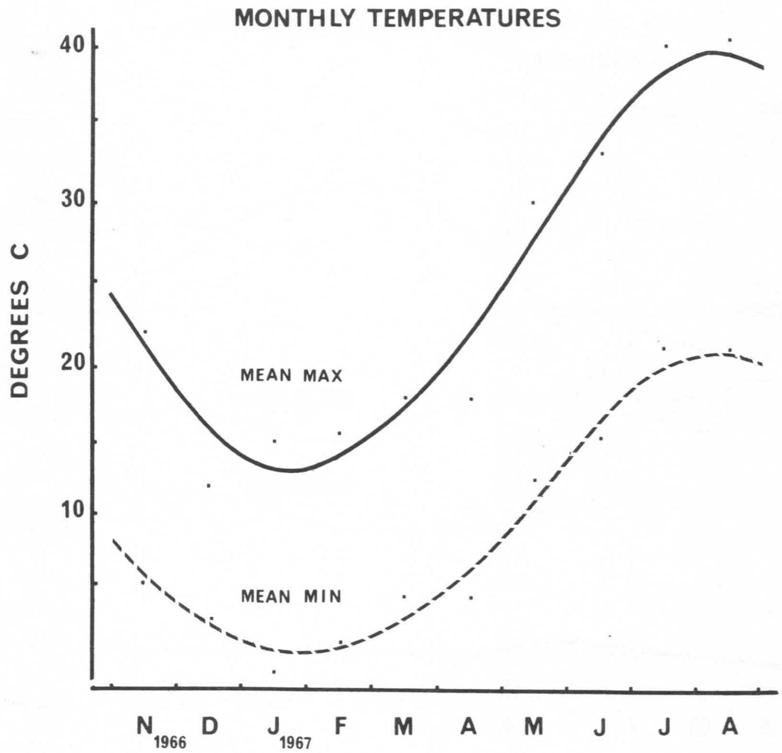
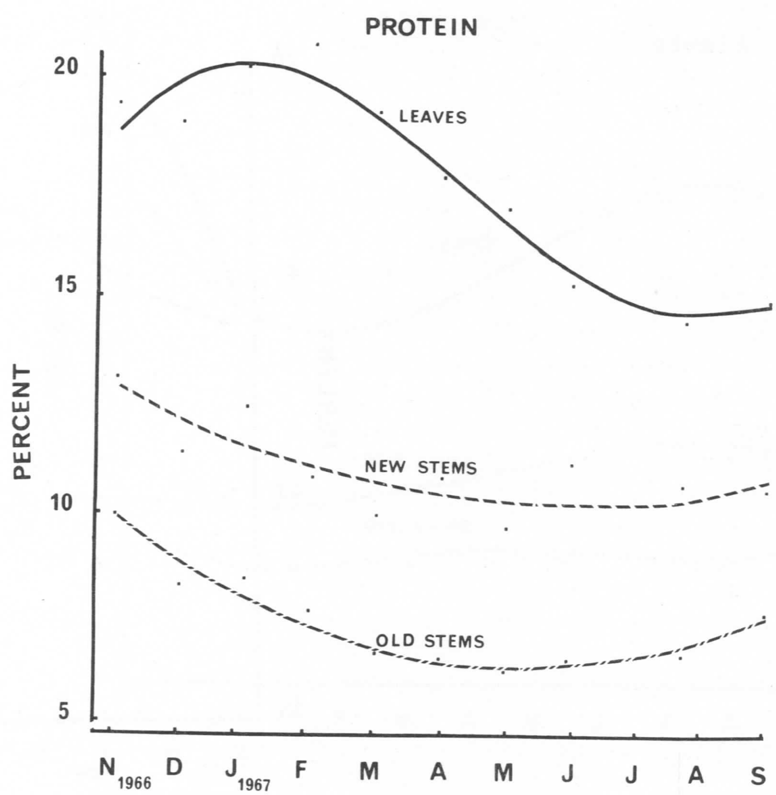


Figure 5.



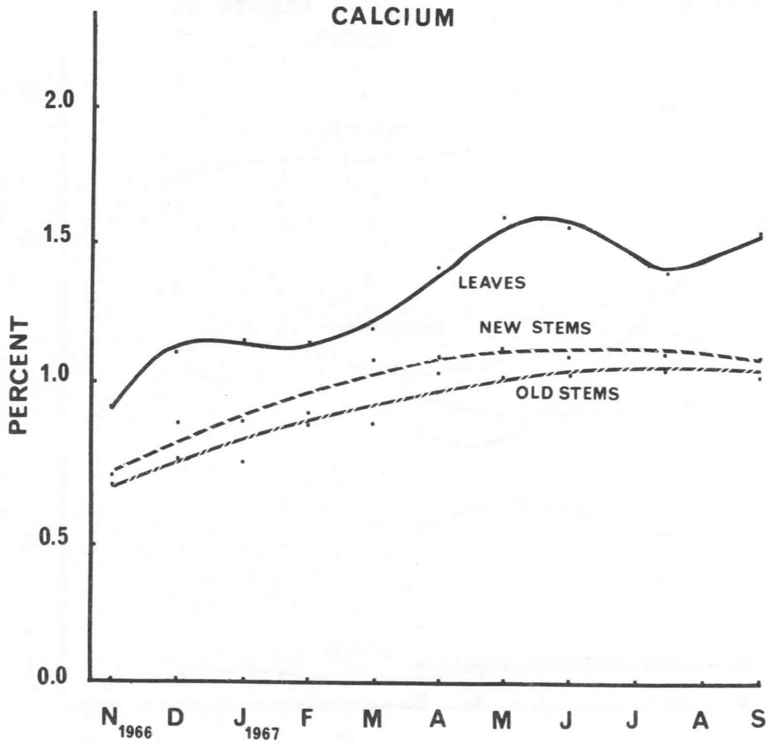
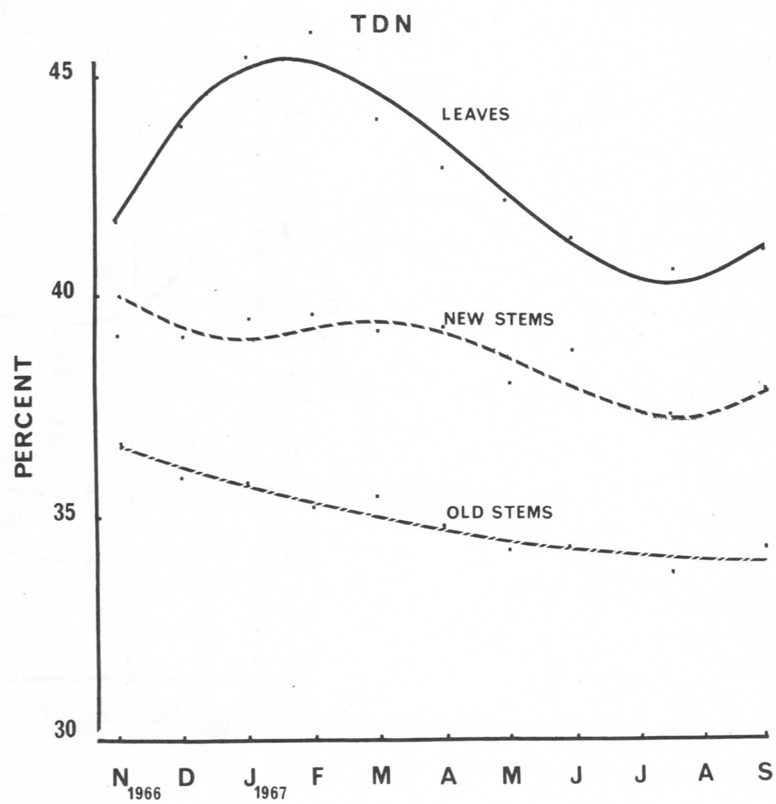


Figure 10.

Figure 11.



III. PHYSIOLOGY OF SALT ADAPTATION IN *Atriplex*

From the dissertation of Mr. Ahmad Mozafar we have new information concerning the mechanism of salt tolerance in saltbushes. *Atriplex halimus* L. was grown in saline solutions of increasing salt concentration. Low levels of salinity greatly stimulated the growth and protein content of the plants, but the maximum growth did not occur at the same level of salt concentration of different kinds of salts. Moreover, the extent of growth inhibition by higher levels of salinity was quite different in various solutions. Therefore, it was concluded that the depression of growth by different salts with the same concentration, which has been cited as evidence for the inhibition of growth, may not hold true in all cases. Furthermore, it was concluded that the stimulation or inhibition of growth under saline conditions can be greatly modified by the kind of mineral elements present in the solution or in the soil.

The content of sodium, potassium, chloride, oxalate, and enzyme activity in the leaves of the plants grown on different saline solutions was measured. It was found that sodium uptake by *Atriplex* was not inhibited by the presence of excess potassium in the culture solution. However, potassium absorption was strongly inhibited as a result of excess sodium. Therefore, the presence of a highly specified site for the uptake of sodium in *Atriplex* roots, which cannot be inhibited by potassium, was postulated. The oxalic acid content of leaves (a substance in *Atriplex* species) did not increase in response to excess sodium or potassium uptake by the plant.

The salt concentration of *Atriplex* leaves did not change parallel to that of the culture solution, but the osmotic potential of the vesiculated hairs present on the surface of the leaves increased drastically as a result of salinity treatments. The increase in the salt concentration of vesiculated hairs appears to be an important means by which saltbush plants are able to tolerate high levels of salinity.

IV. RANGE FERTILIZATION

A small demonstration of range fertilization was established at Elkhorn in November 1968. Four replications of the following treatments were applied: control, N_{40}, N_{80}, N_{120}. The fertilizer material used was ammonium phosphate sulfate [16% nitrogen (N), 20% available phosphoric acid (P), and 20% sulfur (S)].

Forage samples were harvested to ground level and oven dried to obtain the following yield data:

Treatment	Lbs/Acre Dry Weight
Control	1,090 a*
N_{40}	2,420 b
N_{80}	4,020 c
N_{120}	3,910 c

* Values followed by the same letter are not significantly different at the .05 level of probability.

It is important to remember that these results were obtained under conditions of much better than average rainfall.

At Temblor Rock a fertilizer plot was established in the fall of 1967 to investigate responses to zinc and sulfur. Earlier greenhouse tests had shown this soil to be deficient in these elements. However there was no increase in forage yield due to any of these treatments. Average yield was 4,300 lbs/acre.

Pin-point clover (*Trifolium gracilentum*) was observed to be abundant along the crest of the Temblor Range this spring. This legume appeared particularly productive on an abandoned experiment at the Temblor Rock site which had received single super phosphate at 500 lbs/acre in the fall of 1966. Clover yields were measured by clipping ten square feet from the centers of clover colonies on the fertilized area and ten outside. Clover yields were 4,700 lbs/acre where fertilized and 2,100 lbs/acre where not fertilized. It is not known if this was due to the sulfur remaining from 1966 or if this was a phosphorus response.

V. SPECIES ADAPTATION

A. 1966-67 Trials

Perhaps the most promising range improvement practive to appear from experimental results to date is the seeding of annual legumes. Results of a trial seeded in the fall of 1966 show five varieties of rose clover, two subclover varieties, and two medics which show promise in the third year. This means that they set seed in both of the previous two years with precipitation of about 11 inches and 6.6 inches respectively.

In the unusually late spring of 1969 all varieties which were still present succeeded in setting seed. Ratings for stand and vigor appear in Table No. 1. A few plants remain of three perennial grasses - hardinggrass, Palestine orchardgrass, and Davis slender wheatgrass.

B. 1967-68 Trials

Ninety-three forage varieties were planted in the fall of 1967 at both Elkhorn and Temblor Rock. The following spring was exceedingly dry. Because of the lack of moisture and poor weed control few accessions became established. A complete list of accessions planted appears on pages 14-18 of the Temblor Range Research Annual Report of 1967-68. Table No. 2 lists only the grass accessions which became established to some degree. None of the legumes or shrubs became established. Transplants of *Prosopis tamaruga* to Temblor Rock were killed by cold weather.

VI. SEEDING TECHNIQUES ON CHEMICAL FALLOW SEEDBEDS

Last year this report described a method of using herbicides in a one-year fallow program. The herbicide atrazine at rates of 1 to 2 lbs/acre showed the most promise with some establishment of Luna wheatgrass in the very dry spring of 1968.

Table No. 1

Plant introductions is 1966-67 species adaptation trials at Elkhorn and Temblor Rock - third growing season.

	ELKHORN April 9, 1969		TEMBLOR ROCK April 9, 1969	
	Stand	Vigor	Stand	Vigor
SUBCLOVER VARIETIES (*Trifolium subterraneum*)				
Tallarook	0	-	0	-
Mt. Barker	0	-	0	-
Bacchus Marsh	0	-	0	-
Woogenellup	1	5	0	-
Clare	1	5	1	3
Yarloop	3	4	0	1
Dwalganup	6	7	5	5
Geraldton	8	6	8	8
Dinninup	2	2	1	3
ROSE CLOVER VARIETIES (*Trifolium hirtum*)				
Wilton (Calif. Cert.)	3	$5^{\dagger}$	2	$5^{\dagger}$
P.I. 170821	3	$6^{\dagger}$	4	$5^{\dagger}$
Kondinin	4	4	7	8
Cyprus	3	4	7	7
Hykon	6	7	4	7
Olympus	5	5	7	6
Sirint	3	5	6	6
Th 52	4	$5^{\dagger}$	6	$7^{\dagger}$
S-6	4	$6^{\dagger}$	6	$7^{\dagger}$
MEDICS (*Medicago* spp.)				
Bur clover (*M. polymorpha*)	2	5	1	4
Black medic (*M. lupulina*)	0	-	0	-
173 barrel medic (*M. tribuloides*)	4	6	1	4
Cyprus barrel medic (*M. tribuloides*)	4	6	6	7
MISCELLANEOUS LEGUMES				
Dixie crimson clover (*T. incarnatum*)	0	-	0	-
Purple clover (*T. purpureum*)	0	-	0	-
Beenong cup clover (*T. cherleri*)	3	3	2	3
Yamina cup clover (*T. cherleri*)	1	4	2	4
Hairy canary clover (*Dorycnium hirsutum*)	0	-	0	-
Lana woollypod vetch (*Vicia dasycarpa*)	2	$3^{\dagger}$	4	$4^{\dagger}$
Auburn wollypod vetch (*Vicia dasycarpa*)	2	$3^{\dagger}$	2	$3^{\dagger}$

Table No. 1 (cont'd)

	ELKHORN April 9, 1969 Stand	Vigor	TEMBLOR ROCK April 9, 1969 Stand	Vigor
ANNUAL GRASSES				
Gaudin ryegrass (*Lolium gaudini*)	0	-	0	-
PERENNIAL GRASSES				
Hardinggrass (*Phalaris tuberosa* var. *stenoptera*)	4 plants/12 ft.		7 plants/12 ft.	
Palestine orchardgrass (*Dactylis glomerata*)	1 plant/12 ft.		4 plants/12 ft.	
Davis slender wheatgrass (*Agropyron trachycaulum*)	2 plants/12 ft.		4 plants/12 ft.	
Kangaroo Valley ryegrass (*Lolium perenne*)	0	-	0	-

* Stand and vigor were rated on a 1-10 basis, 1 being poor and 10 excellent. Data are means of three applications.

† Stand is probably the result of hard seed from original planting or first year as none was set in 1968.

Table No. 2

TEMBLOR RANGE FORAGE VARIETY TRIAL

Planted Fall, 1967

		Stand* June, 1969	
		Elkhorn	Temblor Rock
Avena sterilis T.O. 3722		9	4.5
Agropyron desertorum	Nordan crested wheatgrass	0	1
" " A-13043		7	0
" " 2 clone synthetic 114x117 - from Mandan, S.D.		1	0
Agropyron desertorum 117x114 from Mandan, S.D.		1	1
Agropyron elongatum	Alkar tall wheatgrass	1.5	1
" "	Jose tall wheatgrass	2	1
" "	Largo tall wheatgrass	7.5	3.5
Agropyron intermedium	Amur intermediate wheatgrass	1.5	0
" "	Greenar intermediate wheatgrass	1	0
Agropyron tricophorum	Luna pubescent wheatgrass	5	4
" "	Topar pubescent wheatgrass	4.5	0
" "	Trigo pubescent wheatgrass	4	2
Bromus carinatus	Cucamonga brome	9.8	7.5
Bromus mollis	Blando brome	10	10
Bromus scoparius T.O. 3546		8	1.5
Bromus severtzovii T.O. 4012		10	8
Dactylis glomerata	Palestine orchardgrass	1	0
Elymus cinereus P-5797	Basin wildrye	1.5	0
Elymus triticoides - Clones from Pleasanton PMC	Beardless wildrye - PI-249-50 Firebaugh, California	10	1
Lolium gaudini T.O. 3023	Gaudin ryegrass	8	0
Lolium rigidum	Wimmera ryegrass 62	8	1
Orozopsis holciformis T.O. 3904		1.5	0
Poa bulbosa P-4874	Bulbous bluegrass	10	2

*Stand was rated on a 1-10 basis, 1 being poor and 10 excellent. Data are means of 4 replications at Elkhorn and 2 replications at Temblor Rock.

This experiment was repeated with modifications. Soil moisture was measured at 12, 18, 24, and 30 inches throughout the year using gypsum electrical resistence blocks. Atrazine was applied at rates of 1, 2 and 3 lbs/acre one year before seeding and results compared with spring cultivation and no seedbed preparation. Seeding in deep furrows (6 inches wide by 5 inches deep) was compared with planting 1 inch deep without furrows.

Soil moisture was increased in the fallow year by 2 and 3 lbs atrazine. One lb increased moisture, but not above the permanent wilting point (PWP). The check was never wet at 12 inches in this very dry year (6.58 inches). Heavy rains in January of 1969 raised the moisture to field capacity at all depths, thus eliminating any beneficial effect of fallowed moisture. However weed control persisted at varying degrees in the different treatments.

The check treatment was dry at 12 and 18 inches within 3 to 7 days after the last rain (Fig. 12). The cultivated treatment was above PWP at 12 and 18 inches for 17 to 20 days after the last rain. One and 2 lb/acre atrazine were wet for 18-22 and 80-109 days after rain respectively. Three lbs/acre was above PWP for 130 to 140 days. Soil moisture reached PWP at 30 inches at 21, 25, 130, and 153 days after the last rain for the cultivated, 1, 2, and 3 lb atrazine treatments respectively. The check was above PWP at 24 and 36 inches through September 4 because the resident grasses apparently do not root to that depth. However if filaree was present soil moisture was exhausted at all depths within 23 days after the final rain.

One pound of atrazine is reported to be sufficient to fallow moisture in studies in Northern Nevada. However on the Temblor Range 2 lbs/acre was required.

Seeding was on November 12, 1968. At this date partial germination had taken place from the early October rains. Paraquat was applied to the spring cultivation and spring paraquat treatments because it was obvious that weed control was nil in spite of the destruction of one year's seed crop. The soil was moist in the newly made furrows.

Four forage plants were seeded in separate rows - two perennial grasses and two annual legumes - Luna and Topar pubescent wheatgrasses and Hykon rose clover and Bur clover. The wheatgrasses were tolerant of atrazine of up to 2 lbs/acre, but stands were severely reduced by 3 lbs/acre (Table 3). Bur clover and Hykon rose clover were killed by the residue from the 1 lb/acre rate in the surface seeding, but not reduced by 2 lbs in the furrow seeding (Table 4). Both legumes were severely reduced by 3 lb/acre.

The residue from granular atrazine (G) is greater than the wettable powder (WP) as determined by weed control in the second growing season after application and by tolerance of the seeded species. One and 2 lbs/acre of atrazine granular are equivalent to 2 and 3 lbs respectively of wettable powder.

Several conclusions about growing perennial grasses may be drawn from the first two years of this series of trials. Seeding in the bottom of furrows is much superior to surface seeding and weed control in the seeding year is necessary both in dry and wet years. In addition fallow moisture is probably necessary for successful seeding in dry years. Luna wheatgrass is superior to Topar at this site.

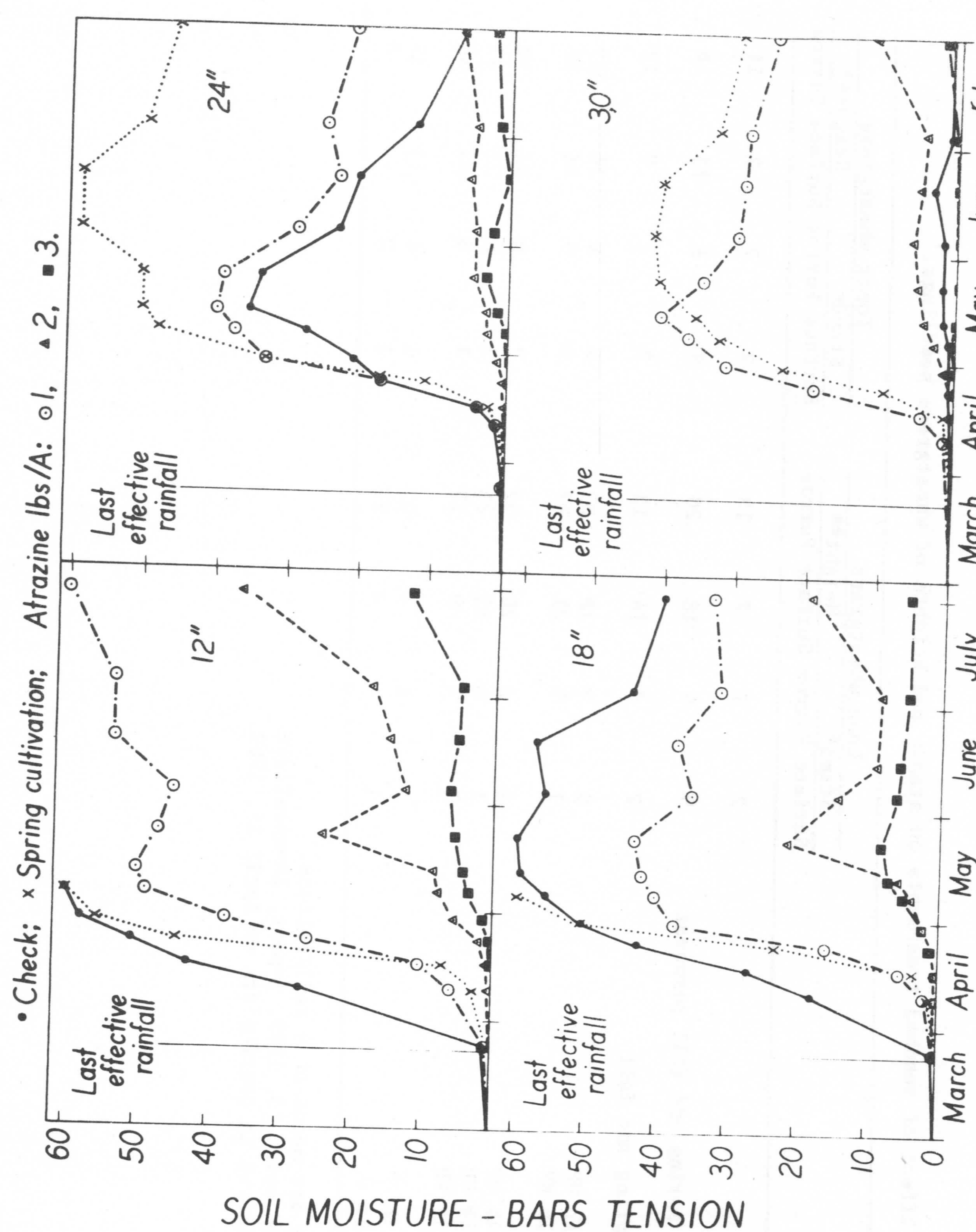


Figure 12. Soil moisture remaining in fallow treatments during the year of seedling establishment.

Table No. 3. Effect of seedbed treatments on stands and heights of wheatgrass seedlings.[†]

	Luna wheatgrass				Topar wheatgrass			
	Stand*		Height**		Stand*		Height**	
	Surface	Furrow	Surface	Furrow	Surface	Furrow	Surface	Furrow
Check	2	7	7	13	2	7	7	14
Cultivated in spring and fall paraquat	9	9	16	20	9	8	13	16
Paraquat in spring and fall	2	7	14	13	3	7	8	12
Simizine - 1 lb WP	2	7	18	28	2	8	16	25
- 2 lb WP	1	8	21	27	2	8	16	22
Atrazine - 1 lb WP	2	8	20	32	2	8	21	28
- 2 lb WP	1	8	22	23	1	8	11	22
- 3 lb WP	1	4	9	17	1	3	22	14
Atrazine - 1 lb G	1	6	-	22	1	6	11	18
- 2 lb G	1	4	-	22	1	2	-	8

† All values are means of 4 replications.
* Stand rated April 23, 1969, 1=poor, 10=excellent
** Height measured in centimeters on April 16, 1969.

Table No. 4. Effect of seedbed treatments on legume stands.*

	April 16, 1969			
	Hykon rose clover		Bur clover	
	Surface	Furrow	Surface	Furrow
Check	2	6	2	5
Cultivated in spring	4	7	3	6
Paraquat in spring	3	8	3	4
Simazine - 1 lb WP	2	8	1	7
2 lb WP	2	7	1	4
Atrazine - 1 lb WP	1	6	2	8
- 2 lb WP	1	5	1	5
- 3 lb WP	1	2	1	2
Atrazine - 1 lb G	1	4	1	2
- 2 lb G	1	2	1	2

* Stand rated April 16, 1969, 1=poor, 10=excellent.
All values are means of 4 replications.

VII. SEEDING TRIALS WHICH "HARVEST RAINFALL"

During the 1968-69 season a new acrylic material was evaluated for use in seedling establishment. The material, DCA-70, was supplied by Union Carbide Chemical Company and was of interest because of its reported ability to temporarily bind soil particles together. DCA-70 was chosen from a large number of materials for sealing the surface of helicopter landing areas in the Viet-Nam war. The proposed use was to spray a sloping area adjacent to a seeded row and seal the surface and thus "harvest rainfall" for use by the seedlings.

A wheel-tractor was equipped with a small grader blade to create an 18-inch wide slope of about 5 degrees incline. The sloped area was sprayed with a water solution of DCA-70. At the rear of the tractor a planet Jr. seeder followed along in the botton of the sprayed slope.

A series of seeding trials were carried out in the fall of 1968. A 1:10 rate of DCA-70 in water was used as a surface treatment. Three species were seeded in three replications of the following surface treatment combinations: control, sloped only, sloped plus DCA-70. Additionally, dillutions of DCA-70 of 1:5, 1:20 and 1:30 were applied on runoff plots in the Elkhorn Plains study exclosure.

Excellent weather conditions prevailed during the period of seedling establishment, and good stands of grass and clover were obtained on the sloped and on the sloped plus DCA-70 plots. Because of the failure of the DCA-70 to hold a solid soil surface during the cold winter it does not look promising as a material for surface treatments. Other materials may yet prove successful. In areas where soil disturbance is not a problem, creating a sloping area to concentrate runoff to a seed row might be used effectively. The additional advantage of eliminating seeds and seedlings of weeds is also obtained by grading.

VIII. SOIL SURVEY OF TEMBLOR EXPERIMENT SITES

The soils of the experimental sites in the Temblor Range were examined and classified by Eugene L. Begg, U.C. Dept. of Soils and Plant Nutrition, Davis during a field trip on October 1, 1969. Following is a short description of the soils at each site.

Elkhorn Site

The Elkhorn site occupies an alluvial fan, outwashed from the western slope of the Temblor Range. The soils in this site closely resemble the Lost Hills series, but differ mainly in being gravelly and having developed on mixed alluvium from sedimentary, granitic, and metamorphic rocks. For reference purposes in the project report, these soils can be designated as a Lost Hills variant.

A representative description of the Lost Hills variant soil at the Elkhorn plot is as follows:

A11	0-4"	Grayish brown (2.5Y 5/2) gravelly fine sandy loam, very dark grayish brown (2.5Y 3/2 when moist; weak massive structure; very slightly hard dry and very friable moist; mildly alkaline (pH 7.8) and slightly calcareous; clear smooth boundary.
A12	4-11"	Grayish brown (2.5Y 5/2) gravelly sandy loam, dark grayish brown (2.5Y 4/2) when moist; weak massive structure; very slightly hard and very friable moist; moderately alkaline (pH 8.0+) and moderately calcareous; clear, wavy boundary.
A3	11-18"	Light brownish gray (2.5Y 6/2) heavy gravelly sandy loam, dark grayish brown (2.5Y 4/2) when moist; few cobbles; weak massive structure; very friable, moderately alkaline (pH 8.0+) and strongly calcareous; clear, wavy boundary.
B2t	18-34"	Light yellowish brown (2.5Y 6/3-7/3) light sandy clay loam, olive brown (2.5Y 4/4) when moist; stone line at 18 to 22"; massive structure; slightly hard dry, friable moist; moderately alkaline (pH 8.0+), and strongly calcareous; mycelium lime in tubular pores; gradual, wavy boundary.
B3/C	34"+	Light yellowish brown (2.5Y 6/3-7/3) very gravelly sandy loam, olive brown (2.5Y 4/4) whem moist; weak massive structure; very slightly hard to loose, very friable; moderately alkaline and strongly calcareous.

Temblor Rock Site

The Temblor Rock site occupies a high, structurally-controlled valley, just east of the drainage divide, on the eastern slope of the Temblor Range. The soils in this test plot correlate well with the Lost Hills series. The alluvium or parent material for the soils is derived from calcareous, sedimentary rocks.

A typical description of the Lost Hills soils in this plot is as follows:

A11	0-3"	Grayish brown (2.5Y 5/2) fine sandy loam, very dark grayish brown (2.5Y 3/2) when moist; weak massive structure; very friable, mildly alkaline (pH 7.8) and very slightly calcareous; clear smooth boundary.
A12	3-11"	Grayish brown (2.5Y 5/2-6/2) fine sandy loam, dark grayish brown (2.5Y 4/2) when moist; weak massive structure; very friable; moderately alkaline (pH 8.0+). and slightly calcareous; clear, wavy boundary.

A13	11-23"	Light brownish gray (2.5Y 6/2) fine sandy loam, dark grayish brown (2.5Y 4/2) when moist; weak massive structure; very friable moist; moderately alkaline (pH 8.0+) and slightly calcareous; clear wavy boundary.
B1	23-30"	Light brownish gray (2.5Y 6/2-6/3) light loam, dark grayish brown (2.5Y 4/2) when moist; weak massive structure; very friable; moderately alkaline (pH 8.0+) and moderately calcareous; clear, wavy boundary.
B21t	30-40"	Light yellowish brown (2.5Y 6/3) loam, olive brown (2.5Y 4/3) when moist; massive structure; slightly hard dry, slightly firm moist; moderately alkaline (pH 8.0+) and strongly calcareous; segregated lime along tubular pores; clear boundary.
B22t	40-52"+	Light yellowish brown (2.5Y 6/3) heavy loam, olive brown (2.5Y 4/3) when moist; massive structure; slightly hard dry, slightly firm, slightly sticky; moderately alkaline (pH 8.0+) and strongly calcareous; lime segregated along tubular pore walls.

Recruit Grade Pass Site

The Recruit Grade Pass site is situated on the east slope of the drainage divide of the Temblor Range. No detailed description was made of the soils of this site, but they are deep, residual soils developed from calcareous, soft shales and sandstones. The soils are light gray, loam or light clay loam, and calcareous throughout. They correlated best as a deep phase of the Shedd series.

IX. MISCELLANEOUS OBSERVATIONS

The effect of plant numbers on forage production. In the 1966-67 report it was noted that plant numbers play an important part in determining total forage production. Varying populations by applying various rates of paraquat increased forage production several fold. Forage yields from treatments of 0, 1/4 and 1/2 lb/acre paraquat were 650, 1,055, and 1,865 lbs/acre. The lower the plant population the higher the herbage yield.

The same effect was noticed this year from weed control treatments applied in the fall of 1967, spring of 1968, and fall of 1968 (Table 5). Total forage yields were increased over 6-1/2 times by the application of 1 lb of atrazine per acre the previous year. This is the effect of adjusting plant numbers and plant species. The check is a mixture of red brome, *Schismus arabicus*, and red-stem filaree with the grasses dominating. Total density was not sampled, but it was well over 100 plants per square foot. By contrast the population on the 1 lb/acre atrazine treatment filaree only at 1 to 2 plants per square foot. Yields by adjusting plant numbers were over twice as high as from applying 80 lbs of nitrogen.

Part of this increase may be due to the effect of atrazine and simazine in stimulating the nitrogen reductase activity of treated plants. Sub-herbicidal applications have been shown to increase protein and nitrate-nitrogen levels of other crops. Both protein and nitrate levels as well as yield were increased (Table 5).

Table No. 5. Effect of seedbed treatment on herbage yields and protein and nitrate nitrogen content in the year of seeding.

	Herbage yields* lb/acre	Protein-percent	Nitrate nitrogen ppm.
Check	1,360	8.71	7
Cultivated in spring	2,090	-	-
Paraquat in spring	1,180	-	-
Paraquat in fall	1,220	-	-
Simazine 1 lb/acre	3,260	9.26	642
Simazine 2 lb/acre	5,270	8.51	237
Atrazine 1 lb/acre	8,880	12.92	2,063
Atrazine 2 lb/acre	4,590	11.10	1,183
Atrazine 3 lb/acre	1,150	-	-
L.S.D. .05	830	2.63	88
.01	1,100	-	124

*Oven dry clipped to ground level on May 12, 1969. All values are means of 4 replications.

X. WORK PLAN FOR 1969-70

All promising lines of research will be continued. An area of about 4 acres at Elkhorn was sprayed with atrazine at 2 lbs/acre. Studies planned for this area in the coming year include comparison of furrow sizes, a grass and shrub nursery and further seedbed investigations.

Also at Elkhorn the series of seedbed experiments is progressing into the third season with the fourth trial to receive the herbicide treatments this fall.

Promising legumes will be seeded at three sites - Elkhorn, a new site in Recruit Grade Pass, and another new site on the East side of the Temblors near Fellows. These new sites were located with the help of Mr. Bill Bright of the Bakersfield office of BLM on October 1, 1969.

The primary purpose of the Recruit Grade Pass location is to study shrubs. Native and introduced shrubs will be planted in the winter of 1969-70. In addition a graduate student from Syria, Mr. M. Nazi Sankary, will be planting accessions of *Atriplex* from Syria to compare with similar plants collected in the Temblors.

Studies will continue on the salt and drought tolerance of *Atriplex*. Previous studies at the Temblor have shown that severe clipping and other treatments are detrimental to regenerative capacity. We will continue to look at means for survival and reproduction.