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Bighorn sheep once roamed the Western deserts and mountains in great numbers, but the range needs of livestock, the diseases of domestic sheep, and wanton killing have driven them to the few remaining areas of relative wilderness. The rugged canyon country of southeastern Utah still harbors some of the most prized game animals in North America. Quickened interest of sportsmen and conservationists has resulted in efforts to expand their numbers in the southeastern Utah area (see the June 1968 issue of **Utah Science**) and reintroduce them to their former habitat in the Wasatch Mountains. The efforts of Utah Fish and Game Personnel to stock the bighorns in the mountains near Brigham City, Utah are briefly described in this issue of **Utah Science.**

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UTAH SCIENCE

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Bloat on dry alfalfa hay and legume pasture

C. R. ACORD, J. E. BUTCHER, and D. W. THOMAS

Bloat, disorder of sheep, goats, and cattle, is characterized by an abnormal distention of the rumen by gas produced by rumen micro-organisms and impairment of the eructation (belching) mechanism.

Of all diseases effecting these farm animals, bloat is perhaps one of the most perplexing. It is a single manifestation of a condition usually caused by interactions between ruminant physiological pecularities and certain feed components.

Frothy bloat, caused by feeding alfalfa, creates considerable financial loss to Utah livestockmen each year. It often occurs in the spring and fall on green alfalfa pasture. In certain areas of Utah, however, bloat even occurs when cattle are fed dry alfalfa hay.

WHAT CAUSES BLOAT

Legume plants, high in nitrogen, cause much more bloat than non-legume plants. Bartley & Bassett (1961) from their analyses of alfalfa bloat foams reported that the foaming constituent is primarily proteinaceous. McArthur & Miltimore (1964) have isolated from alfalfa leaves a protein with physical and chemical properties that make it an ideal bloat promoting agent. McClay & Thompson (1955) demonstrated that plants producing bloat have a higher content of saponins than plants with few or no bloat promoting properties. Studies of Bartley & Yadava (1961) found saliva, and more specifically mucin in the saliva, to be an effective antifoaming agent. Van Horn & Bartley (1961) added saliva to incubated frothing rumen contents and found that the additional saliva permitted greater quantities of gas to escape.

The purpose of this study was to determine if: (1) bloat can be controlled in ruminants by feeding poloxalene (an anti-bloat compound) in the block form when cattle are fed alfalfa hay, and (2) bloat can be controlled on pasture by feeding poloxalene in block form or as a top dressing on grain.

ALFALFA HAY STUDY

Four cooperators contributed a total of 346 calves, averaging about 364 pounds each. Each cooperator had experienced bloat problems with their stock. The calves were divided

Figure 1. This Hereford steer is suffering from a severe case of bloat.

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into a control and treated group on each cooperator's ranch. Control calves numbered 138 and 208 calves were treated. All calves were given, *ad libitum,* alfalfa hay and 1 pound of rolled barley per head per day.

The treated calves were offered a salt-molasses block containing 30 grams of poloxalene per 1 pound of block. The control calves received a salt-molasses block without poloxalene. The salt-molasses blocks were placed in the pens at the rate of one block per five head of calves. When the block was approximately 50 percent consumed, another block was added. Weekly consumption records were kept. Cattle were checked daily for severity and incidence of bloat, as well as death. The cattle were adjusted to the respective salt-molasses blocks for a week prior to the test. Severity of bloat was assigned scores according to Johnson *et. al.* (1958).

Note: This research was partially supported by Smith, Kline and French of Philadelphia, Pa., and A. E. Staley, Co., Decatur, Illinois.

Note: The authors wish to acknowledge the assistance of Keith J. Chapman and Wallace Sjoblom, USU Extension Agents, in helping check cattle and weigh the salt-molasses block.

RESULTS AND DISCUSSION

Average daily consumption of the respective salt-molasses block by treated and untreated groups is shown on each ranch in table 1. The daily average daily consumption of the untreated groups was .22 pound and .244 pound for the treated group.

The incidence of bloat at each ranch is indicated in table 2.

Ten calves in the untreated group bloated (7.2 percent), but only three calves in the treated group bloated (1.9 percent). The difference of bloat between the treated and untreated was 5.4 percent and was significant ($P < .05$). The test suggests that the poloxalene helped reduce the incidence of bloat in these trials.

Table 1. Average consumption of salt-molasses block on dry alfalfa hay

		Untreated group				Treated group			
			Avg daily consumption block/head-lb				Avg daily consumption block/head-lb		
Rancher	Days on trial	Number cattle	High	Low	Avg	Number cattle	High	Low	Avg
A	30	41	.30	.08	.20	62	.264	.132	.180
B	26	33	.508	.172	.254	55	.362	.154	.180
C	30	39	.244	.218	.226	21	.536	.236	.354
D	55	25	.136	.244	.16	70	.344	.2	.262
Total cattle		138				208			
Avg Consumption			.30	.180	.22		.372	.180	.244

Table 2. Summary of bloat on dry alfalfa hay

	Untreated group		Treated group	
Rancher	Number cattle	Bloat incidence	Number cattle	Bloat incidence
A	41	0	62	0
B	33	3	55	1
C	39	1	21	1
D	25	6	70	1
Percent of calves bloating		7.2%		1.9%

SUMMER PASTURE STUDY

During the summer of 1967 a rancher cooperated in a test for bloat control on irrigated pasture. The 6.2 acre pasture was planted with a mixture of 8 pounds orchard grass and 3 pounds Ranger alfalfa.

Sixty calves, both steers and heifers, averaging 475 pounds per animal, were weighed in on the pasture on May 6, 1967. They were divided at random into three lots of 20 each. The three lots were all eartagged and kept separate during the summer. Lot 1 was the control and received a salt-molasses block without poloxalene. Lot 2 received poloxalene in the salt-molasses block. Lot 3 received the poloxalene on .226 pound of rolled barley per animal fed twice daily. The calves receiving the poloxalene top dressing were limited to 1.5 grams of poloxalene premix per 100 pounds body weight per head per day. The calves were weighed every 28 days for gains, and were checked four or five times daily for bloat.

RESULTS OF PASTURE TEST

Average consumption of the salt-molasses block for lots 1 and 2 was .418 pound and .390 pound per head per day, respectively, for the 125 days on pasture.

Bloat incidence on the pasture is shown in tables 3 and 4.

All untreated calves (lot 1) bloated once during the 125-day test, two severly. Three calves or 15 percent of those receiving poloxalene in block form showed mild bloat (lot 2). There was no bloat of any degree among those fed the top dressing with poloxalene premix (lot 3). Tests were significant ($P < .05$). When bloat was controlled, alfalfa pasture produced as high an economic return per acre as any other field crop in Utah.

SUMMARY

Three hundred forty-six calves, weighing approximately 364 pounds each were fed alfalfa hay, *ad libitum,* and 1 pound of rolled barley per head per day. Two hundred eight were offered a salt-molasses block containing

30 grams of poloxalene. Bloat incidence was 1.9 percent. The other 138 calves (controls) were given a salt-molasses block without poloxalene. Bloat incidence was 7.3 percent.

Sixty calves, weighing 475 pounds, were randomly divided into three lots and grazed for 125 days on an alfalfa-orchard grass pasture. Lot 1 received a salt-molasses block without poloxalene; lot 2, a salt-molasses block with 30 grams of poloxalene per 1 pound of block; and lot 3, a poloxalene premix top dressing of 1.5 grams per 100 pounds of body weight with .226 pound of rolled barley twice daily. Lots 1, 2, and 3 had a bloat incidence of 27, 3, and 0, respectively.

Alfalfa forage is of prime importance for livestock, and it often causes bloat in ruminants. If bloat can be controlled, as these tests indicate, then ranchers can realize increased animal units per acre, decreased hazard of livestock losses, increased net return, and can obtain full utilization of alfalfa for pasture.

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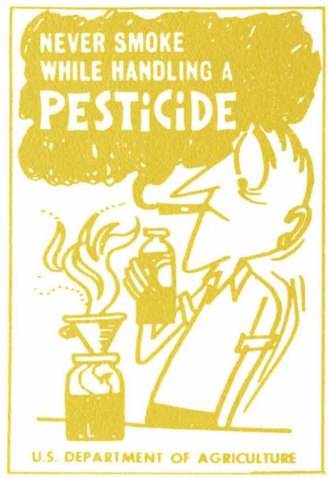

Table 3. Results of bloat on irrigated pasture

Date	Bloat incidence *		
	Untreated group	Treated group (block)	Treated group (top dressing)
6/16	7	0	0
7/10	3	0	0
7/14	3	1	0
7/28	0	2	0
8/6	6	0	0
8/11	2	0	0
8/19	3	0	0
8/27	3	0	0
Total	27	3	0

* Significant ($P < .05$)

Table 4. Summary of bloat incidence in 60 beef animals receiving different bloat prevention treatments while on irrigated pastures — 1967

Untreated*			Treated (medicated block)**			Treated (top dressing)		
Number calves	Incidence of bloating		Number calves	Incidence of bloating		Number calves	Incidence of bloating	
	Number	%		Number	%		Number	%
20	27	135	20	3	15	20	0	0

* Bloat in two calves was classified as severe. Others experienced moderate to slight cases of bloat.
** Bloat was classified as slight in three calves.

UTAH'S TOO SALTY EARTH

LOIS M. COX

Salty popcorn is great. Salty soil is trouble. And Utah has 11 million acres of so-called salt desert land. This amounts to about 21 percent of the state. Most of Utah's salt desert is publicly (government) owned. Which means that all of us have a stake in what happens to it. An element of self-interest thus helped motivate scientists in USU's Ecology Center to try to find out more about the nature of these lands.

One project, led by Dr. Neil West, has centered in Curlew Valley, an area about 20 miles southwest of Snowville, Utah. The saltiness of the soil there is caused primarily by the presence of large quantities (several thousand parts per million) of sodium, potassium and calcium chlorides, sulfates, carbonates, and bicarbonates. The main plants growing in the bottom of Curlew Valley are shadscale, greasewood, saltsage, gray molly, winterfat, and halogeton.

Figure 1. Greasewood discourages grazing.

The ecologists and graduate students working in Curlew Valley have about decided that nature is playing one of her practical jokes on man with her salt desert plants. Those such as winterfat and gray molly, which are nutritious and well-liked by domestic and wild animals, are least able to compete. By contrast, the less desirable plants such as halogeton and greasewood, which are actually poisonous, seem to enjoy more than a fair share of nature's favors.

For example, winterfat seeds must germinate within a year, or have a slim chance of ever germinating at all. Germination has to occur in the spring, immediately after the snow melt has removed much of the salt from the top few inches of soil. If the salt isn't removed, the seedling will die because its salt tolerance is very low for 3 to 4 months.

On the other hand, halogeton may produce either or both of two kinds of seed at the rate of 75 seeds/inch of stem. One, black in color, appears late in the growing season. These seeds have the same time requirements (within 1 year) for germinating as do the winterfat seeds. But many halogeton plants insure their propagation by developing a second seed crop. These are brown and remain viable almost indefinitely (as least 10 years). They thus can germinate in whichever year provides favorable conditions.

The anatomy and physiology of the mature plants show the same pattern. Winterfat and gray molly are gradually being crowded out of the salt deserts because all of their growth is soft and palatable. Shadscale and greasewood, however, are spiny enough to prevent better than one-half of each year's new growth from being grazed. In addition, halogeton as well as greasewood not only survive on unusually salty soil, they prosper most when the salt concentration is 5800 parts per million, or higher.

Halogeton has a further advantage because its seedlings can tolerate salt levels that would be fatal to most other young plants. Even when dead, halogeton contributes to continued success. The dead plants return large quantities of sodium to upper soil levels. The area's low precipitation levels then allow most of this salt to accumulate year by year until seeds from other plants simply can't germinate.

USU's ecological studies of Utah's salt deserts are giving new insights into the precarious balance that exists between such land and its plants. They are also calling attention to the major disruption of that balance that could follow any relatively minor changes in precipitation patterns, such as are expected from weather modification activities.

Figure 2. Halogeton sucks salt from the soil.

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A PROFITABLE ALTERNATIVE . . .

Beef production on irrigated pastures

CLAIR R. ACORD

In addition to facing high costs and low profit margins in raising beef calves, farmers and ranchers in some areas of Utah are experiencing increased feed costs and decreased numbers of grazing units on public lands. Others are finding a decreased demand for cash crops, even to the extent of some cash crop factories being discontinued. Confronted with such situations, many are having to look to other alternatives for maintaining a living.

ALTERNATIVES

As alternatives they may: (1) sell out and seek other employment; (2) strive to improve their position through greater integration with feeders and retailers; or (3) undertake more efficient use and management of land resources at hand to produce more meat per unit of land and thus offset increased capital and current expenses. The latter alternative focuses attention on the possibility of more efficient use of irrigated pastures as a means of bolstering farm income.

The idea of grazing beef cattle on irrigated pastures is not new. In an Experiment Station Field Day Report given at Pleasant Grove, Utah, in August 1959, Lorin E. Harris *et. al.* indicated that from 1,249 to 1,705 pounds of beef gain per acre could be obtained on such pastures in a growing season. They had found that the amount of production depended largely on the treatment of the pasture and management of the cattle.

To produce large gains required pastures with a high legume content, however, which also presented serious bloat problems. For example, in 1966 eight head of cattle were lost in 2 days on a 6.2-acre test pasture in the Palmyra area of Utah County. The pasture had been seeded at 8 pounds orchard grass and 3 pounds alfalfa per acre. In 1967 a study was begun on this pasture to investigate the bloat problem and pasture production. How the bloat problem was corrected by treating with poloxalene is discussed in another circle, "Bloat on Dry Alfalfa Hays and Legume Pasture", in this issue of *Utah Science*. The present article aims to show the kinds of gains and returns one might expect from beef cattle grazing properly managed irrigated pastures.

GAIN STUDY

The 6.2-acre Palmyra pasture was designated as pasture A. It was treated with 66 pounds of available nitrogen in 1967 and irrigations were scheduled every 14 to 21 days depending on when water was available. On May 6, 60 steers and heifers, weighing an average of 475 pounds, were put on the pasture. It was divided into three sections with 20 head of cattle per section. Each section was then subdivided to provide intensive grazing. The cattle stayed on a subsection no longer than 5 or 6 days.

Table 1. Average gains of 60 beef cattle (steers and heifers) on 6.2-acre irrigated pasture at Palmyra, Utah County, during summer 1967*

Item	Grazing period 5/6-6/17	6/18-7/14	7/15-8/14	8/15-9/9	Total
Days in period	42	26	39	25	123
Avg wt/animal (lbs)	555.2	587.8	612.8	640.0	
Avg gain/animal (lbs)	80.2	32.6	25.0	27.2	165.0
Avg Daily gain/ animals (lbs)	1.90	1.25	0.83	1.04	1.23

* (Avg initial weight — 475 pounds)

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Each subsection was allowed to rest for 25 to 30 days before regrazing.

Gains were checked every month until the study was concluded on September 8. The results are shown in table 1. During the 123 days that the 60 steers and heifers were on the 6.2-acre pasture, they gained a total of 9,915 pounds or 1,599 pounds of beef per acre. If we estimate the value of beef produced at $25 cwt, each acre of pasture grossed a return of $399.75. Significantly, the 9.8 steers per acre were grazed for the 123-day period with no loss from bloat. The cattle treated with poloxalene did not bloat.

IMPLANTATION GAINS

In 1968 the pasture study, employing similar rotation and irrigation practices, was expanded to test the added advantage of diethylstilbesterol implants. The steers and heifers were also pastured separately. Thirty-four steers, averaging 380 pounds, grazed a 7-acre pasture in Heber Valley, Wasatch County. This 7-acre piece was designated pasture B. It contained a mixture of grasses seeded at 10 to 11 pounds per acre and alfalfa at 3 pounds. Sixty-nine heifers, averaging 520 pounds, grazed pasture A which had been expanded to 8.7 acres.

One third each of the steers and heifers on these improved pastures received different treatments: control, 15 mg, and 30 mg. The steers received the implants June 27 at the beginning of the study and the effects were checked at intervals during the 123-day grazing period. The heifers were implanted on July 17 and had the benefits of the implants for a 76-day period.

The over-all gains obtained may be seen in tables 2 and 3. The steers gained an average of 287.5 pounds each or a total of 9.775 pounds in 123 days. That amounts to a production of 1,369 pounds of beef or $342.25 gross per acre (at $25 cwt). The heifers gained an average of 219 pounds of 15,111 pounds total in 151 days of grazing, making 1,736 pounds of beef or a gross return of $434 per acre for the season. It should be noted, however, that during the test period these heifers also were fed daily 2 pounds of rolled barley with poloxalene at 1.5 grams per 100 pounds of body weight to control bloat.

Data indicating advantages of the implants are shown in tables 4 and 5. Note that the 15 mg and 30 mg implants increased the daily gains of the steers over the controls by 10.6 and 21.8 percent respectively. This treat-

Note: The author acknowledges and expresses thanks to Paul Daniels, County Agent; Marion Sorenson and Lloyd Lawton for their help in furnishing cattle, pastures and weighing of cattle; to Dr. D. W. Thomas for arranging for stilbesterol implants; and Hess & Clark, Ashland, Ohio, for furnishing the stilbesterol implants.

Table 2. Average gains of 24 beef steers on 7-acre irrigated pasture at Palmyra, Utah County, during summer 1968*

Item	Grazing period 5/27-7/12	7/13-8/25	8/26-9/27	Total
Days in period	47	43	33	123
Avg wt/steer (lbs)	508	575.9	667.5	
Avg wt gain/steer (lbs)	128.0	67.9	91.6	287.5
Avg daily gain/steer (lbs)	2.72	1.57	2.77	2.35

*(Avg initial weight — 480 pounds)

Table 3. Average gains of 69 heifers on 8.7-acre irrigated pasture at Palmyra, Utah County, during summer 1968*

Item	Grazing period 5/3-7/17	7/18-10/2	Total
Days in period	75	76	151
Avg weight/heifer (lbs)	634	749	
Avg gain/heifer (lbs)	104	115	219
Avg daily gain/heifer (lbs)	1.38	1.50	1.44

*(Avg initial weight — 530 pounds)

Table 4. Average increases in gains and dollar value for 123-day period from use of Stilbesterol implants on 34 steers grazing 7-acre irrigated pasture at Heber Valley, Wasatch County, Utah during summer 1968

	Treatment Control	15mg	30mg
Avg lbs gained/steer	253.2	290.5	315.5
Avg daily gain	2.15	2.38	2.57
Percent daily gain increase over control		10.6	21.8
Avg gain over control/steer (lbs)		37.3	63.3
Dollar value over control @ 25¢/lb/steer		$9.33	$15.83
Effect of stilbesterol on avg daily gain (lbs)		0.303	0.514

ment produced 37.3 and 63.3 more pounds of beef per animal respectively, or cash returns above the control group of $9.33 and $15.33 per animal (at 25 cents a pound), respectively.

Because of the shorter implant period, the treated heifers did not increase so much in dollar value as the steers. However, they did show a notable increase in gains and dollar value resulting from the implants.

SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

Table 6 summarizes the beef production obtained during 1967 and 1968 on two different improved irrigated pastures under intensive rotation grazing. The emphasis was on the total pounds of beef produced per acre and the gross return per acre from the pastures. Although differences in areas, years, grazing periods and grazing intensities preclude meaningful comparisons between the pastures, we concluded that properly managed improved irrigated pastures can bring a gross return of $350 to $400 per acre in beef production. To obtain such returns, the pastures should be: (1) grazed in rotation; (2) grazed intensely for 4 or 5 days; (3) allowed to grow for 25 to 30 days before grazing again; and (4) irrigated according to plant needs—usually every 14 to 21 days.

To obtain high beef production from irrigated pastures containing high levels of alfalfa, stilbesterol implants are economically feasible and bloat prevention treatment is essential. In addition, we recommend: (1) winter the cattle to hold gains at not more than 1 pound per day before going on the pasture; (2) have them weigh approximately 450 to 550 pounds when they are turned onto the pasture in the spring; and (3) treat them for flies periodically during the grazing season. The increased efficiency gained from the recommended practices makes beef production on irrigated pastures a profitable, income-enhancing alternative for farmers and ranchers.

Table 5. Average increase in gains and dollar value for 76-day period from use of Stilbesterol implants on 69 heifers grazing on 8.7-acre irrigated pasture at Palmyra, Utah County, during summer 1968.

	Treatment		
	Control	15 mg	30 mg
Avg initial weight (lbs)	640	630	625
Avg gain/heifer (lbs)	105	119	113
Avg daily gain/heifer (lbs)	1.38	1.57	1.49
Percent daily gain increase over control		13.7	8.0
Avg gain over control/heifer (lbs)		14	8
Dollar value over co ntrol @ 25¢/lb/heifer		$3.50	$2.00
Effect of stilbesterol on avg daily gain (lbs)		0.18	0.105

Table 6. Summary of pasture production study.

	Pasture		
	A 1967	A 1968	B 1968
Total number cattle	60	69	34
Total acreage	6.2	8.7	7
Total grazing days	123	151	123
Avg initial wt	475	530	380
Avg final wt	640	749	667.5
Avg total gain/animal	165	219	287.5
Avg daily gain/animal	1.23	1.50	2.35
Total lbs beef	9,915	15,111	9,775
Total lbs beef/acre	1,599	1,736	1,369
Gross return/acre @ 25¢ lb	$ 399.75	$ 434.00	$ 342.25

SOIL CEMENT LININGS FOR CANALS

C. W. LAURITZEN

Soil-cement has possibilities in some sandy-soil areas for lining canals and reservoirs. To determine the adaptability of soil-cement for canal lining, a series of laboratory and field tests were undertaken.[1] The Eden Project in the vicinity of Farson, Wyoming was selected for the field tests, because the soils in that area are generally sandy and canals there have heavy seepage losses. This seepage has contributed to high groundwater tables and salinity conditions. Furthermore, the absence of good concrete aggregate and the marginal character of the agriculture in the area limited the expenditure justified to control seepage. The lack of suitable aggregate also influenced the type of lining economically feasible.

FIELD STUDIES

The ditch selected for the field installations paralled the west side lateral and served as the supply ditch on one of the development farms. The field tests were designed primarily for the evaluation of standard soil-cement linings, but plans included some plastic soil-cement; and, as the work progressed, some sand concrete linings were placed.

The standard tests required for the design of soil-cement were not made, but the short-cut method[2] indicated that satisfactory soil-cement could be obtained by using 7 percent cement

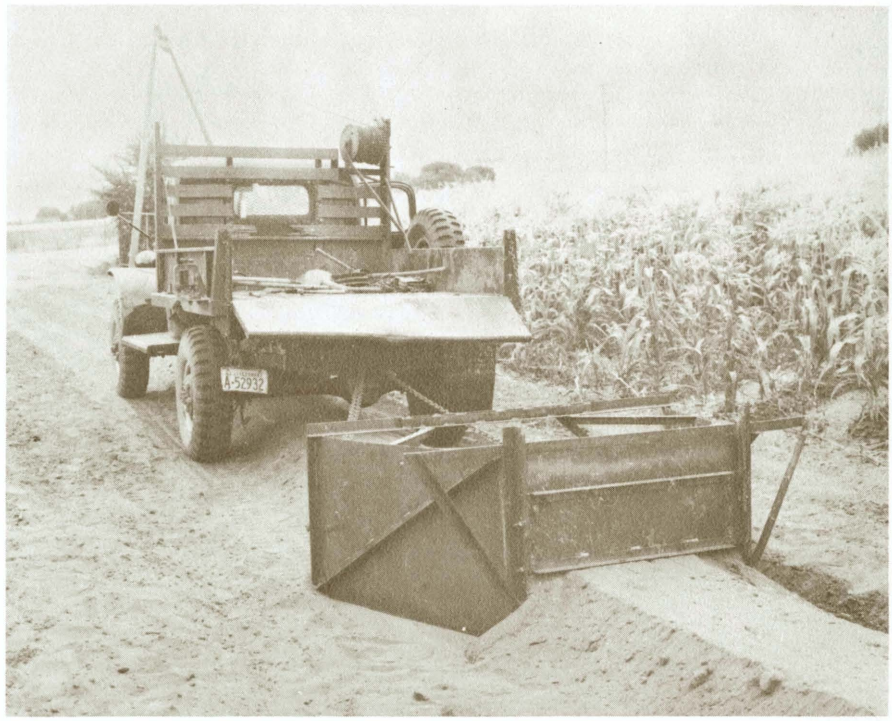

Figure 1. Windrow proportioner which formed windrow prior to lining ditch.

Figure 2. Cement bags spotted on windrow at proper spacing before being spread.

[1] These tests were conducted in cooperation with the Portland Cement Association and Region 4 of the U.S. Bureau of Reclamation. Mr. M. L. Burgener and Mr. L. Norling were present and assisted with the field installations.

[2] Short-cut Soil-cement Testing Procedures for Sandy Soils. Published by Soil-cement Bureau, Portland Cement Association.

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by volume. Exposed installations generally require additional cement; so the minimum figure was arbitrarily increased to 9 percent. Because of the high sulphate content of the Eden soils, Type 5 cement was used.

The soil was bladed into a windrow on the berm of the ditch with a grader patrol. The size of the windrow was properly adjusted with a windrow proportioner (figure 1) which provided the quantity of soil required per foot of ditch lining. Then bags of cement were spotted at the calculated spacing on the windrow to provide the amount of cement specified in the mix design (figure 2). The bags were then opened, and the cement was spread uniformly on the windrow. The soil and cement were mixed with a modified Wood Roadmixer (figure 3).

Figure 3. Wood Roadmixer assembly and spreader box mixing and placing soil-cement.

Just before the lining was placed, the ditch subgrade was dampened by sprinkling with water. The soil and cement were picked up from the windrow by the mixer as it moved forward. Water was added as a spray to the mix in the pugmill to raise the moisture content of the mix to that required for optimum compaction as determined by the Proctor Method,[3] and the mix was placed as a lining in the ditch in one continuous operation (figures 4 and 5). Shortly after the mix was in place, it was compacted with a Jackson plate vibrator, (figure

[3] ASTM D558

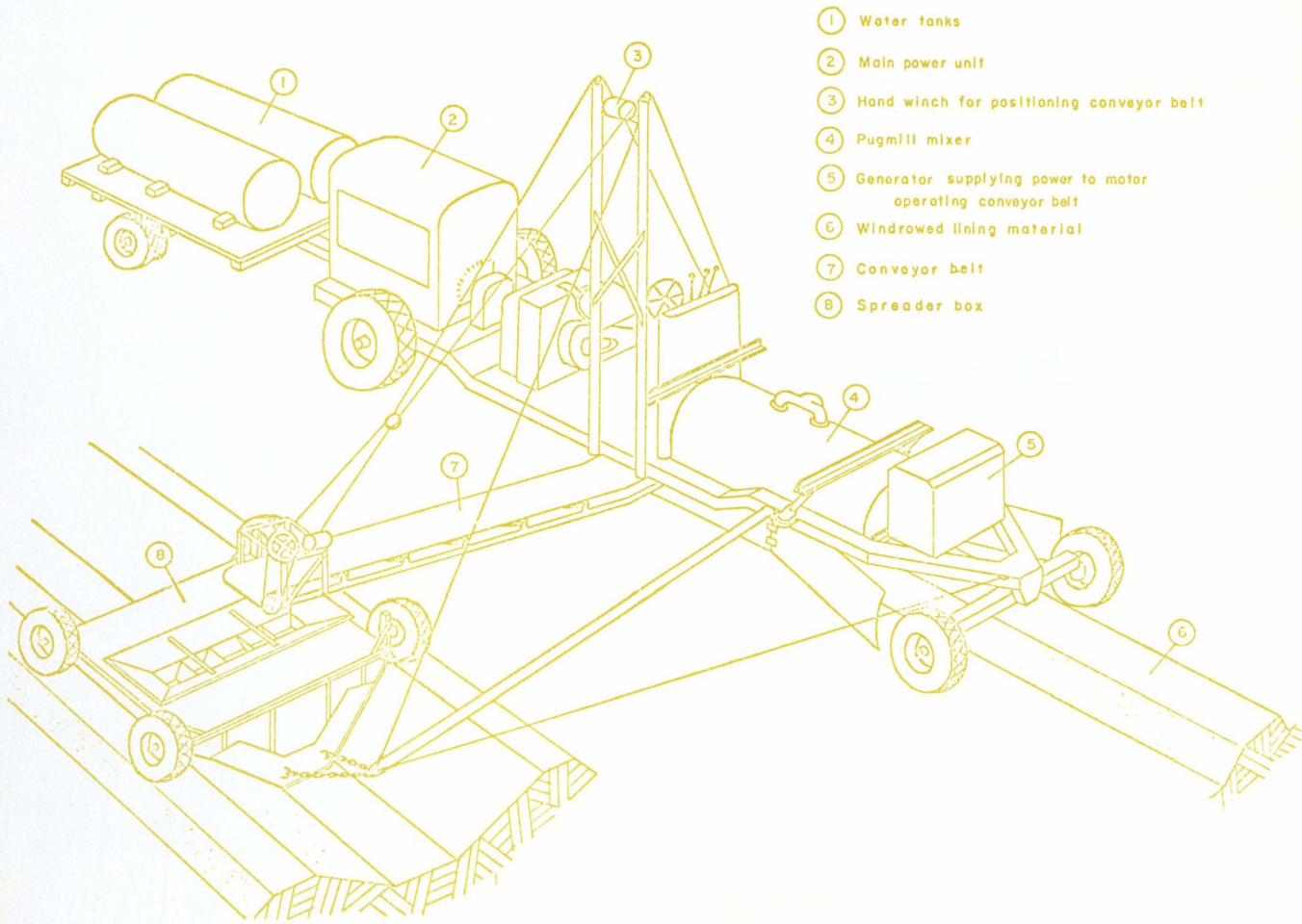

Figure 4. Perspective view of mixing equipment used in soil-cement ditch lining tests.

6). Three passes with this vibrator were made on each section of ditch. After compaction, the soil-cement lining was sprayed with a white pigmented concrete curing compound.

Cores were taken after the lining had cured to determine the quality of the lining structure. These cores were 2 inches in diameter and taken with a core bit powered with an electric drill. One core was taken in the bottom and one on each side in the middle of the slope of each ponded ditch reach. Sampling was limited to reaches that appeared to represent the best quality soil-cement for each given treatment. In addition to bulk density measurement, the cores were analyzed for the actual cement percentage according to ASTM method D806.

RESULTS AND DISCUSSION

Difficulty was experienced in coordinating the multiple operation of mixing, placing, and compacting the soil-cement linings. In most cases, the percentage of cement was less than the plan design. This is especially true of 9 and 12-percent cement mixes where the actual cement content for the two 9-percent sections was 5.3 and 5.8 and the 12-percent was 6.5 percent.

The actual cement content as determined from the analyses of core samples and the bulk density are given in table 1. Although the number of samples taken were not sufficient to fully determine the average compaction, the results indicate that the field density approached the laboratory density of 125 pounds per cubic foot.

It was intended to investigate plastic soil-cement. This differs from the standard soil-cement in that the mix has a higher moisture content giving it the consistency of morter. This plan was abandoned because of the difficulty encountered with the mix sticking to the conveyor belt. To determine if aggregate with a lower percentage of fines would present less of a problem, three concrete mixes using a sandy aggregate with 4.5, 5.5, and 7.0 bags of portland cement per cubic yard respectively were substituted. It was intended to place the mixture at about a 2-inch slump, but the nozzle capacities in the pugmill were not regulated to supply enough water, and the resulting mix had a slump of about 1 inch. DAREX, an air-entraining agent, was added to the mixing water to increase the workability of the concrete and its resistance to frost action. After the mix was placed, the reach was sprayed with asphalt emulsion as a curing compound.

Like plastic soil-cement, concrete did not lend itself to placement with the equipment assembled. The concrete mixes were too dry, and the resulting lining had an open porous structure with a bulk density of about 125 pounds per cubic foot, compared to 150 pounds per cubic foot for good concrete. Seepage through the concrete-lined reaches, table 2, was about as much as from the unlined reaches. The porous nature of the linings could have been corrected if some method of compaction had been used following placement. Although too dry for slipformed concrete, the mixes were too wet for compaction with the vibrator used on the standard soil-cement linings.

The condition of the standard soil-cement linings on September 24, 1967 —11 years after installation—is indicated in figure 7 and figure 8. As

Figure 5. Spreader box consisting of a hopper and screed mounted on an adjustable frame carried on rubber-tired wheels.

Figure 6. Jackson vibrator compacting soil-cement lining placed by spreader box.

Table 1. Cement content and bulk density of concrete and soil-cement linings

Station sampled	Position	Type	Designed cement %	Actual cement by wt %	Cement by vol %	Bulk density lbs/cu ft 1958	Notes at time lining sampleted for bulk density measurements
0 + 85	bottom side	concrete	17	11.2	13.8	121	Good, hard, no crumbling
				10.0	11.5	128	Good, hard, slight crumbling
1 + 50	bottom side	concrete	20	17.1	17.5	124	Good, not too hard, no crumbling
				17.1	17.0	125	Good, not too hard, no crumbling
2 + 00	bottom side	concrete	26	28.7	25.0	123	Good, hard, no crumbling
				29.0	28.2	124	Good, hard, texture like cinder block
2 + 50		s/c plastic	16	10.3	13.8	122	Very hard, dense
2 + 85	bottom side	s/c	16	20.9	23.5	128	Good, hard, no crumbling
				20.9	18.6	125	Good, fairly hard, crumbles
3 + 40	bottom side	s/c	9	5.4	6.5	128	Good, fairly hard
				5.1	6.4	118	Good, fairly hard, slight crumbling
4 + 50	bottom side	s/c	9	5.9	7.5	132	Good, hard, no crumbling
				5.7	5.9	125	Good, hard, no crumbling
5 + 50	bottom side	s/c	12	6.1	8.0	120	Good, fairly hard, slight crumbling
				6.8	7.1	127	Fair, not too hard, very easily crumbled
6 + 50	bottom side	s/c	12	10.3	12.2		Good, hard, no crumbling
				8.6	10.2		Good, fairly hard, crumbles
7 + 50	bottom side	s/c	15	14.6	17.9	127	Good, very hard, no crumbling
				13.4	14.1	126	Good, fairly hard, some crumbling
8 + 50	bottom side	s/c	9	11.4	13.8		Good, hard, does not crumble
				11.9	13.0		Good, fairly hard, some crumbling

previously noted, the cement content determined by analysis deviated widely in some instances from the designed quantity. Also, in many instances, construction difficulties involving moisture control and compaction were encountered. Where the actual cement content equaled or bettered the designed value, and satisfactory compaction and curing were achieved, the resultant lining remained in reasonably good condition after 11 years of service. An example is one section in which one-half had a cement content of 9 percent and the other half about 14 percent. Notes at the time the lining was constructed indicate that the operation was well controlled and that good quality soil-cement should result.

It would appear, therefore, that construction of quality standard soil-cement linings with the equipment used is possible. It is doubtful, however, that the method is practical, in view of the control required and the

Table 2. Seepage rates for soil-cement and concrete linings.

Pond no.	Lining type	Ponded reach	Seepage $ft^3/ft^2/24$ hr 1957	Seepage $ft^3/ft^2/24$ hr 1958	Cement content by wt
Unlined			1.92		
2	l/c†	0 + 69 – 1 + 09	1.19	2.02	10.6
3	l/c	1 + 09 – 1 + 61	1.09	3.90	17.1
4	l/c	1 + 61 – 2 + 23	5.92	1.91	28.8
5	s/c‡	2 + 68 – 3 + 13	0.98	0.57	20.9
6	s/c	3 + 30 – 4 + 10	0.60	0.76	5.2
7	s/c	4 + 30 – 4 + 98	0.38	0.75	5.8
8	s/c	5 + 53 – 6 + 22	0.58	1.41	6.4
9	s/c	7 + 05 – 7 + 64	0.25	0.44	9.4

† s/c Standard soil cement

‡ l/c Low slump concrete

number of operations that must be coordinated, unless long reaches of canal are to be lined.

The condition of the sand-concrete linings is shown in figures 8 to 10. These, it will be noted, show less sign of degradation and are in better condition than the standard soil-cement linings.

Only a very short reach of the canal, as mentioned, was lined with plastic soil-cement, and it was finished in part by hand troweling. In appearance it was similar to slipformed concrete. The structure was hard and showed little degradation due to weathering, indicating that plastic soil-cement, batched and mixed similar to concrete and placed with the conventional concrete slipform, should be considered in sites such as the Eden area. The shortness of lined section did not permit a seepage-loss measurement, however.

Seepage measurement of the soil-cement linings were taken in 1957 and again in 1958. Ponds were constructed by installing plastic dams at the ends of each reach in which seepage was to be measured; then, the ditch between the dams was filled with water pumped from the canal. The seepage rate was calculated by the drop in the water-surface. The seepage rate of the linings is given in table 2.

It will be noted in table 2 that the seepage was greater in 1958 than in 1957 in all but two reaches. In this interval, transverse cracks had developed on 4- to 5-foot centers in the linings which probably accounts—in part at least—for the larger seepage rate in 1958.

The rate of seepage through the standard soil-cement was less than through the low-slump concrete linings but higher than considered allowable for lined ditches—1 to 1/4 cubic feet per day per square foot. The losses from reaches in which the soil-cement was rated better were not always lower than for reaches that were in a more advanced state of deterioration when inspected in 1967.

In field ditches in this area, ditch stability is the chief function and justification for a lining. Seepage losses, associated with intermittent use, seldom justify lining field ditches on the basis of the value of the water saved in this or other areas. Ditch stability may be all that should be sought. If this is assumed, soil-cement—even that of poor quality—has been reasonably effective for a period of over 10 years.

Figure 7. Condition of standard soil-cement lining with cement content of 5.2 percent on September 24, 1967—11years after installation.

Figure 8. Condition of standard soil-cement lining with cement content of 14 percent on September 24, 1967—11 years after installation.

BIGHORNS ALONG THE WASATCH

LOIS M. COX

About 130 years ago, mountain sheep were abundant all along the Wasatch. In his "Journal of a Trapper", Osborine Russell often refers to seeing "thousands of mountain sheep". On one occasion, while hunting south of the Salt Lake, he killed 4 of a band of 100 rams. Another time he describes "sheep rock" (Soda Point, Idaho) as being frequented by mountain sheep all year.

The situation changed quickly, however, as white settlers followed the trail-blazing trappers such as Russell. The mountain sheep, along with much of the other wildlife, were killed or they moved to less accessible areas. Some of the sheep persisted in Utah in the Uinta Mountains, but they disappeared along the Wasatch.

The "never-satisfied" nature of man, though, made it inevitable that someday, someone would want to reintroduce mountain sheep to their former home grounds. Wildlife managers and researchers, whether on a university campus or with state or federal agencies, are especially susceptible to that kind of day dreaming.

In 1960, with personnel of the Utah Division of Fish and Game taking the lead, the hope finally began to move toward reality. Letters were written and contacts made with likely sources of bighorn sheep. By 1965, possible areas around Wellsville and Brigham City were being evaluated for paddock construction in anticipation of taking delivery on bighorns from Wyoming and Canada.

The first 80-acre holding pen was built on Wasatch Mountain just above the Intermountain Indian School at Brigham City. This was one of the locations where Osborne had seen numerous sheep between 1834 and 1843. The Wyoming bighorns (5 rams, 9 ewes) were being shipped to Utah from around Dubois, Wyoming and arrived on March 8, 1966. The Canadian shipment (6 rams, 14 ewes) from Waterton Lakes National Park was delivered during April The first bighorn lamb known to be born along the Wasatch since pioneer days, arrived in May 1966.

Before the end of 1968, the mountain sheep had provided Utah's Fish and Game personnel with several interesting (and frustrating) adventures. Winter weather had taken annual tolls of fences — and rebuilding fence in mid-winter is quite a chore. Many of the bighorns that escaped the paddocks were never captured. Several lambs had been born to ewes remaining inside the fences, and a few had been glimpsed outside the fenced areas.

Overall, it looks as if the Wasatch Mountains are "home" once again for the Rocky Mountain Bighorn.

Figure 1. The bighorns arrived in Utah via truck, and were eager to get back to self-locomotion. They quickly adjusted to their new location. In their first year in Utah, the ewes produced nine lambs. The total population, in the paddock above the Intermountain Indian School at Brigham City and roaming free, is estimated to be about 44-50 despite several deaths among the original Wyoming and Canadian groups.

Figure 2. During their first winter in Utah some of the bighorns left the paddock when winds and drifting snow breached the fence. Two of them provided considerable excitement around Perry when they were chased across the highway by dogs, finally finding refuge on a barn roof. When the dogs were controlled, the sheep had to be literally hauled from the roof. They then promptly took off again and are presumed among those still running free in the mountains.

Louse-like keds cause sheepskin defects

The wingless parasitic fly known as the sheep tick, or ked, is a more costly pest than has been realized.

Sheep raisers have known that the louse-like fly (*Melophagus ovinus*) irritates animals and causes biting and scratching that damages fleeces. Recently, two Agricultural Research Service scientists found that ked bites also make the raised, pimple-like blemishes in sheepskin called cockle.

Cockle costs the leather and allied industries millions of dollars a year. The defects are of varying size and elevation and impair both the grain and flesh sides of the skin. They cannot be completely flattened out or covered with dyes and stains.

Now that the cause-effect relationship of keds and cockle is known, treating sheep to eradicate the flies becomes even more important.

Dipping in vats containing toxaphene, lindane, or rotenone, or dusting with dieldrin are among the most satisfactory of the many approved treatments for ked control. One treatment a year usually provides good control and is most effectively and economically administered shortly after shearing the ewes. If the ewes are shorn after lambing in the spring, special attention should be given to treating the lambs as well as the ewes. In preparing and using insecticides for this purpose, the directions furnished by the manufacturer should be closely followed.

The relationship between keds and cockle was established by two cooperating Agricultural Research Service scientists working nearly 2,000 miles apart: Microscopist A. L. Everett of the Eastern Utilization Research Laboratory in Philadelphia, Pennsylvania, and I. H. Roberts, veterinarian in charge of the Agricultural Research Service Animal Parasite Station in Albuquerque, New Mexico. Everett, who observed keds in many of the woolskins he examined for cockle, and Roberts, who was thoroughly familiar with this sheep parasite, inferred that the insect might be causing the skin blemishes.

The two men planned an experiment to test their theory, employing Roberts' facilities for work with live sheep. Roberts worked with a flock of about 150 sheep that had been protected since birth from external parasites. He deliberately infested half of them with keds, keeping the rest in isolation. At regular intervals he selected animals for slaughter and shipped the skins to Everett for analysis.

Extensive cockle in all skins of the infested shep and virtual absence of the defect in the skins of the animals protected from keds proved conclusively that the insect is responsible.

In later phases of the test, Roberts showed that sheep can spontaneously recover from ked bites. When animals were protected from further bites, either by shearing or by immersing in an insecticide bath, the lesions receded. (Reprinted from Agricultural Research, USDA, February 1969)

WILDLIFE NOTES

Trumpeter swans are the largest American birds in terms of weight, males sometimes reaching 30 pounds.

A single egg mass from a female Gypsy moth contains from 100 to 1,000 eggs.

Like eagles, ospreys use the same nests year after year, rebuilding them to the extent that some weigh up to 1,000 pounds.

The flight musculature of the tiny hummingbird is the strongest of any bird—one-third its weight.

When the jack rabbit shifts into high gear, it can travel at speeds up to 45 mph, and make 20-foot jumps.

The only hoofed animal having its origin in North America is the pronghorn antelope.

A worker bee can lift 24 times its weight, a horse only half its weight.

A ground mole will die in approximately 1 day if deprived of its food.

Antelope fawns are capable of running up to 25 miles an hour for short distances when only 1 or 2 days old.

FOUR KEYS TO PESTICIDE SAFETY

READ THE LABEL ON EACH PESTICIDE CONTAINER BEFORE EACH USE. Follow instructions; heed all cautions and warnings. Why read the label each time? Because the chemical nature of pesticides and their uses vary greatly. You should refresh your mind each time on the material's specific uses.

APPLY PESTICIDES ONLY AS DIRECTED. Apply them only to the crops specified, in amounts specified and at times specified in label instructions, or by your agricultural authorities.

STORE PESTICIDES IN THEIR ORIGINAL, LABELED CONTAINERS. Keep them out of the reach of children and irresponsible people. They cannot be properly identified unless they are in original labeled containers. Lock pesticides in a shed away from feed, seed, and other farm supplies.

DISPOSE OF EMPTY CONTAINERS SAFELY. It is almost impossible to remove all material from a container. "Empty" containers contain small amounts of pesticides which could harm children or animals who might get into them. It is best to dispose of empty containers by burying them at least 18 inches deep in an isolated area provided for this purpose away from water supplies.

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