The Use of Molasses to Increase the Utilization of Rank, Dry Forage and Molasses-Urea as a Supplement for Weaner Calves

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At times forage grows very rank on some California annual ranges. As it matures and dries, palatability decreases to the point where cattle, especially younger animals, largely reject it. The accumulation of excessive litter decreases the quality of next year's vegetation by shading out some of the more valuable species (Talbot *et al.*, 1939).

Spraying molasses on coarse roughage to increase palatability is an old practice. Besides testing this use of molasses, urea was mixed with the molasses to see if it would replace a portion of the animal's protein requirements when on deficient forage. Other studies have indicated that about one-third of the animal's protein requirements could be supplied by urea. This study was conducted at the San Joaquin Experimental Range, O'Neals, California (Hutchinson and Kotok, 1942).

The annual foothill vegetation varies considerably, both in quantity and quality, from year to year and season to season. It is composed of a mixture of grasses, broad-leafed herbs and grass-like plants, usually about two-thirds soft chess *(Bromus mollis)*, broad-leaf filarees *(Erodium botrys* and *E. obtusiplicatum)*, and foxtail fescue *(Festuca megalura)*. There are appreciable amounts of true clovers *(Trifolium spp.)*, but little of the more valuable bur clover *(Medicago hispida)* and red-stem filaree *(E. cicutarium)* (Talbot and Biswell, 1942; Bentley and Talbot, 1951). Analyses of the dry, mature herbage have shown that crude protein runs 5 percent or less (Wagnon *et al.*, 1942). Total digestible nutrients were estimated to be about 40 percent and digestible protein about 2 percent. Thus, 12 to 14 pounds of such dry herbage would provide weaner calves less than one-third of their daily digestible protein requirement (Guilbert *et al.*, 1945).

Procedure

The experiments were conducted through the dry forage period, early July until the onset of fall rains in October or November, in 1947, 1951, 1952, and 1953. Because winter rainfall for 1946-47 was below normal, the 1947 forage crop was too thin to spray without losing most of the molasses-urea mixture on the ground. Therefore, in 1947 a group of heifers was self-fed molasses-urea as a check, and another group received daily supplements of cottonseed pellets. Further study was delayed until better range conditions occurred.

A 1951 test concerned two groups of heifers, one on dry, rank forage sprayed with a molasses-urea mixture, the other on untreated range with a 30-70 percent salt-cottonseed meal mixture available free choice. The objective was to see if the natural protein content of the forage plus protein synthesized from the urea would promote weight gains comparable to those on untreated forage plus cottonseed meal. In 1952 three groups had free access to the salt-cottonseed meal mixture. In each case the water source was about 100

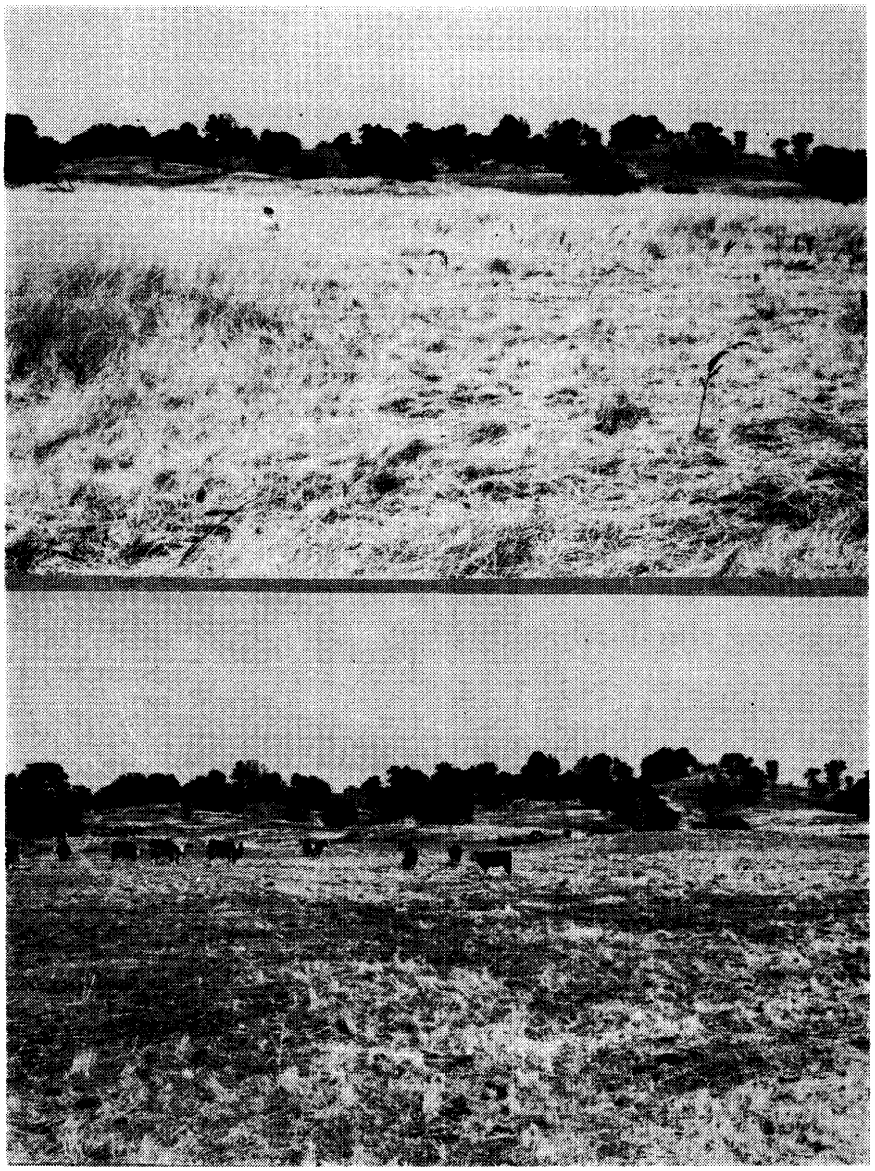

FIGURE 1. *Upper*: Rank growth of slender wild oats with understory of other annual forage plants. Rank growth of grass-like plants and grasses in swale in foreground.

Below: Same area as above showing good utilization of the poor quality forage after it had been sprayed with molasses-urea mixtures.

yards from the self-feeder and judged to be of equal convenience. One group was on dry, rank forage sprayed with molasses-urea mixture, the second on dry, rank forage sprayed only with molasses, and the third on untreated dry range. The group with only molasses sprayed on the forage was added to see if differences in gain might be due to greater net energy intake rather than to protein alone. The purpose of the 1953 test was to see if one-third of the protein requirements could be supplied by urea. Two groups of steers were used that received their supplement of cottonseed pellets hand fed to obtain better control of the intake of this feed. The group on range sprayed with molasses-urea received one pound of cottonseed pellets per head daily, whereas the second group on untreated range received one and one-half pounds, the objective being to promote daily gains of about a pound per head. Each year there was a control group on natural dry range without supplements.

Cane molasses was used throughout. The molasses-urea mixture had a crude protein equivalent of 30 percent[1]. Before spraying, the molasses and the mixture were diluted one-fourth to one-third with water, depending on consistency as affected by temperature. To minimize losses of material, only thick stands of dry grasses or grass-like plants were sprayed (Figure 1). The spraying was done by hand with a 50-gallon spray rig mounted in a pickup.

Weekly applications of 14 pounds of molasses or molasses-urea mixture per animal were made on areas selected to provide about 12 pounds of herbage per animal day. Spraying was done along area margins to prevent excessive trampling. The cottonseed pellets and meal had a 41 percent crude protein content. It was estimated that when cottonseed meal was mixed with salt and fed free choice, daily intake of at least one pound of meal per head would result.

To secure information on losses of urea through weathering a protected patch of rank, dry grass was sprayed July 26, 1951, with the molasses-urea mixture diluted with an equal volume of water. This sprayed herbage was sampled for chemical analysis the day following spraying and at frequent intervals until after the first fall rains.

The calves were grade Herefords produced at the station. Initial experimental weights were the July weaning weights. Periodic weights were taken at about monthly intervals after an overnight shrink in dry lot. Ten or more animals were in each lot

[1]*The Pacific Molasses Company furnished molasses and molasses-urea mixture used in these experiments.*

Table 1. Chemical analyses of grasses sprayed with molasses-urea mixture and exposed to weather July 26 to November 19, 1951 (Average 10 samples)

Date of collection	July 27	Aug. 7	Aug. 17	Sept. 7	Sept. 28[3]	Nov. 19[1]
Days after spraying	1	12	22	43	64	114
				Percent		
Solids extracted by hot water	32.2	28.9	28.4	30.0	27.8	6.3
Crude protein (N x 6.25) extracted by hot water	8.2	7.6	8.2	8.1	6.6	1.3
Insoluble solids	67.8	71.1	71.6	70.0	72.2	93.7
Grass equivalent[2]	79	83	82	82	84	—
Molasses residue	21	17	18	18	16	—

[1]25 days after 0.72 inches rain; most of urea-molasses leached out.

[2]Grass equivalent calculated from insoluble solids by dividing by 0.86. Molasses residue is a measure of the partly dried molasses-urea mixture remaining on the grass. The original dry grass before spraying with urea-molasses contained 14 percent solids soluble in hot water and 0.84 percent hot water soluble crude protein.

[3]Few light dews between September 7-28.

except in 1947 when the control group consisted of nine heifers.

Results

Under prevailing high temperatures and low humidities the molasses and molasses-urea mixtures, even though diluted with water, "candied" quickly when sprayed on the dry forage. There was no loss of urea nitrogen or molasses solids until light dews occurred between 43 and 63 days after the initial spraying (Table 1). These dews diluted the molasses-urea mixture so that some material ran down the plant stems, causing a small loss. Practically all molasses-urea mixture was washed from the forage by 0.72 inch of rain received 90 days after the initial spraying.

Self-feeding Molasses-urea

Group 1, self-fed the molasses-urea without additional natural protein, and group 3, subsisting entirely on native forage, did not make worthwhile gains during the first 66 days (Table 2). However, group 2, fed 0.88 pound of cottonseed pellets per head daily, gained 0.65 pound per head daily. The responses of groups 2 and 3 were similar to those of groups similarly treated in previous experiments (Wagnon *et al.*, 1959). Group 1 took about as much molasses-urea per head (2.10 pounds daily) as later groups consumed when the mixture was sprayed on the dry forage. Under these conditions molasses-urea was not an effective supplement.

By September 5, deterioration of the dry forage warranted increasing supplements to group 2 to 1½ pounds cottonseed pellets per animal. At the same time, group 1 was given one pound of cottonseed pellets per head daily. During this period consumption of molasses-urea increased markedly. Group 1 made average daily gains of 1.22 pounds, group 2 gained 0.91 pound, and group 3 lost 0.47 pound per day. It seems likely that there were benefits from the urea; however, the greater gains of group 1 may have been due to greater digestible nutrient intake.

Molasses-urea Sprayed on Forage

The use of salt, mixed with cottonseed meal, to regulate intake of that supplement self-fed, was not too successful in 1951 and 1952 as daily consumption was below the desired levels both years (Tables 3 and 4). Furthermore, the drying-up of the water source near the self-feeder, in mid-period of 1951, resulted in a further marked decrease in consumption. Daily consumption of cottonseed meal in the 1952 experiments was not equal in supplemented groups, even though the water sources were near the self-feeders.

The average gain of 24 pounds for the group of 4 calves in the first period in 1951, compared with 28 pounds for group 5, indicates that the urea promoted weight gains similar to those produced by a 0.7 pound daily intake of cottonseed meal per animal. The average gain of 5 pounds for control group 6 indi-

Table 2. Growth of weaner heifers and feed consumed on dry range with a free choice molasses-urea supplement with cottonseed pellets; and with no supplement.

	July 1 to Sept. 5, 1947 (66 days)			Sept. 5 to Oct. 7, 1947 (32 days)		
	Group 1	Group 2	Group 3	Group 1	Group 2	Group 3
	Range and molasses-urea mixture	Range and cotton-seed cake	Range only	Range and molasses-urea mixture	Range and cotton-seed cake	Range only
Number of heifers	10	10	9	10	10	9
			(Pounds)			
Initial weight	412	413	400	414	456	402
Final weight	414	456	402	453	485	387
Gain or loss	+2	+43	+2	+39	+29	—15
Daily gain or loss	+0.03	+0.65	+0.03	+1.22	+0.91	—0.47
Cottonseed cake fed daily	None	0.88	None	0.97	1.48	None
Molasses-urea fed daily[1]	2.10	None	None	3.48	None	None

[1]30 percent protein equivalent.

Table 3. Growth of weaner heifers on dry range plus molasses and urea; cottonseed meal-salt supplement and with no supplement.

	July 7 to Sept. 6, 1951 (63 days)			Sept. 6 to Nov. 3, 1951 (58 days)		
	Group 4	Group 5[3]	Group 6	Group 4	Group 5[3]	Group 6
	Range and molasses urea mixture	Range plus salt-cotton-seed meal	Range only	Range plus molasses urea mixture	Range plus salt-cotton-seed meal	Range only
Number of heifers	23	12	10	23	12	10
	(Pounds)					
Average initial weight	487	479	526	511	507	531
Average final weight	511	507	531	550	505	487
Average gain or loss	+24	+28	+5	+39	—2	—44
Average daily gain or loss	+0.38	+0.44	+0.08	+0.67	—0.03	—0.76
Cottonseed meal-salt mix daily	None	1.01	None	None	0.64	None
Cottonseed meal daily	None	0.71	None	None	0.45	None
Salt Daily[1]	None	0.30	None	None	0.19	None
Molasses-urea fed daily[2]	1.81	None	None	1.94	None	None
Cottonseed cake fed daily	None	None	None	1.00	None	None

[1]Does not include salt provided in salt licks.
[2]Protein equivalent 30 percent.
[3]Included two steers.

cates the nutritional qualities of the forage were similar to those of the first period in 1947.

During the second phase of the experiment, group 4 made an average 39-pound gain, whereas group 5 lost 2 pounds and control group 6 lost 44 pounds. These differences can be explained by the 0.72 inch of rain which fell October 24. Unpublished studies have shown a sudden change in cattle grazing habits immediately following the first substantial fall rain. The cattle commence to graze the newly germinated forage plants, rejecting the old, leached forage as much as possible, which results in a weight loss due to a marked reduction in ruminal fill. In this instance group 4 continued to eat the old forage that had been sprayed with molasses-urea mixture.

Over the 113-day period in 1952 group 7, receiving the molasses-urea mixture on forage and consuming 0.27 pound of cottonseed meal per head daily, made weight gains comparable to group 9 (74 and 70 pounds, respectively) that subsisted on natural forage and 0.66 pound of cottonseed meal per head daily. Further evidence that the urea was effective in supplying part of the calves' protein requirements lies in the data from group 8 (Table 4). This group with its forage sprayed with molasses and an average daily consumption of 0.49-pound cottonseed meal only made an average 45 pounds gain. These data also indicate that under these forage conditions available protein is a more restrictive factor in weight gains than total energy intake.

Data from the 1953 study show that urea effectively supplied one-third of the needed protein supplements to promote average daily weight gains of about a pound daily (Table 5). Over the 100-day experimental period groups 11 and 12 made similar daily gains (1.09 and 1.07 pounds, respectively).

Spraying the coarse dry forage with molasses-urea mixture or molasses resulted in its complete utilization even though more desirable fine-stemmed forage was abundant (Figure 2).

Table 4. Growth of weaner heifers and feed consumed on annual type range with molasses-urea plus cottonseed meal-salt, molasses plus meal-salt, meal-salt and without any supplement.

	July 8 to October 29, 1952 (113 days)			
	Group 7	Group 8	Group 9	Group 10
	Molasses-urea plus meal-salt	Molasses plus meal-salt	Meal-salt	Range only
Number of heifers	15	15	10	10
	(Pounds)			
Average initial weight	461	459	488	457
Average final weight	535	504	558	444
Average gain or loss	+74	+45	+70	—13
Average daily gain or loss	+0.64	+0.39	+0.61	—0.11
Cottonseed meal-salt mix daily	0.38	0.70	0.94	None
Cottonseed meal daily	0.27	0.49	0.66	None
Salt daily[1]	0.11	0.21	0.28	None
Molasses-urea fed daily[2]	1.86	None	None	None
Cane molasses fed daily	None	1.86	None	None

[1]Does not include salt provided in salt licks.
[2]Protein equivalent 30 percent.

Table 5. Growth of weaner calves and feed consumed on dry range plus cottonseed pellets, with molasses-urea and cottonseed pellets, and without supplements.

	June 25 to October 3, 1953 — 100 days		
	Group 11	**Group 12**	**Group 13**
	Range plus cottonseed pellets	Range plus molasses-urea and cottonseed pellets	Range only
Number of animals	10 steers	10 steers	10 heifers
	Pounds		
Average initial weight	514	522	485
Average final weight	623	629	492
Average gain or loss	+109	+107	+7
Average daily gain	+1.09	+1.07	+0.07
Cottonseed pellets daily	1.36	0.91	None
Molasses-urea daily	None	1.82	None

Summary

Under range conditions there was no loss of molasses solids or urea nitrogen until light dews commenced about 50 days after spraying. A 0.72-inch rain washed the mixture from the forage.

Rank, dry forage of low palatability was completely utilized by weaned calves after spraying with cane molasses or a cane molasses-urea mixture. Similar unsprayed forage was mostly left ungrazed.

The molasses-urea mixture self-fed to weaner heifers on dry protein-deficient range was an ineffective supplement. When sprayed on dry forage the urea furnished some of the required protein. When weaner steers were supplemented to promote average daily gains of a pound, the urea replaced a third of the cottonseed pellets.

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