cottonseed meal (D_2). The low protein basal ration was intended to be below the requirement for growing lambs, thereby inducing a need for additional nitrogen.

Table 1 shows the proximate analysis and gross energy content of the rations. The normal protein, low protein, and nitrogen-enriched meals contained 44.6, 36.7 and 42.4% crude protein respectively on a 92% dry matter basis. The usual standard for cottonseed oil meal is 41% crude protein; therefore, the normal protein and nitrogen-enriched cottonseed meals were mixed with ground cottonseed hulls to bring each to a calculated 41.3% crude protein level.

Each lamb within a four-pen group was fed a single ration for the duration of one period (a period consisted of seven days of preliminary feeding and seven days of total urine and feces collection). Thus, over the four periods, each lamb received all four rations. Three or four days were allowed between periods for the lambs to adjust to their new ration. The lambs differed in their acceptance of the rations, causing variations in consumption of dry matter and, therefore, of crude protein. To obtain a clearer comparison of the meals, a covariance analysis was used to adjust nitrogen retention data to equivalent dry matter intakes.

The results (table 2) indicate that the basal ration was deficient in protein (as planned), since the addition of any of the cottonseed meals caused a significant increase in nitrogen retention. The addition of 14% meal resulted in even greater retention than did addition of 8% meal.

TABLE 3. DIGESTIBILITY OF NITROGEN AND ENERGY FROM ADDED COTTONSEED MEAL

Item	Kind of meal			Means
	Normal	Low protein	Nitrogen enriched	
	8% meal			
Nitrogen intake, g. per day	4.03	3.89	4.04	
Nitrogen digested, g. per day	3.83	3.34	3.82	
Digestibility of nitrogen, %	95	86	95	92
	14% meal			
Nitrogen intake, g. per day	8.38	7.89	8.59	
Nitrogen digested, g. per day	5.94	5.61	6.71	
Digestibility of nitrogen, %	71	71	78	73
	8% meal			
Energy intake, kcal. per day	248	244	253	
Energy digested, kcal. per day	286	207	258	
Digestibility of energy, %	115	85	102	101
	14% meal			
Energy intake, kcal. per day	534	537	547	
Energy digested, kcal. per day	268	279	351	
Digestibility of energy, %	50	52	64	55

TABLE 4. DIGESTIBLE PROTEIN AND DIGESTIBLE ENERGY CONTENT OF THE THREE MEALS

Item	Kind of meal		
	Normal	Low protein	Nitrogen enriched
Heat of combustion, kcal. per g. dry matter	4.50	4.36	4.48
Digestion coefficient, %	50	52	64
Digestible energy, kcal. per g. dry matter	2.25	2.27	2.87
Crude protein content, % of dry matter	44.9	39.9	44.9
Digestion coefficient, %	71	71	78
Digestible crude protein, % of dry matter	31.9	28.3	35.0

There were no significant differences among the three types of cotton seed meal but each increased nitrogen retention over the basal ration. Data from the two levels of protein can be combined since there was no significant interaction between kinds of meal and protein level. Apparent differences in nitrogen retention between meals, when the low and high levels are considered separately, did not prove to be statistically significant. There are obviously no significant differences when both levels are combined.

Nitrogen digestibility (table 3) was measured by determining the digestibility of the nitrogen in the basal ration, adding the meals to the basal ration and again determining nitrogen digestibility of the combined feeds. The digestibility of the respective meals was determined by differences shown. Using this method, the digestion coefficients determined at the higher intake of meal were probably more accurate since the inherent errors were reduced as the proportion of the experimental feed was increased in the ration. The digestible energy values were determined in the same manner as the nitrogen digestibility. A value greater than 100 indicated the amount by which the meal enhanced the digestibility of the basal ingredients.

Table 4 shows the digestible protein and digestible energy content of the three meals calculated from the digestion coefficients, as determined at the 14% level of feeding.

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HIGH *on* *in*

THE IMPERIAL VALLEY includes approximately 430,000 cultivated acres of fertile land located adjacent to the U. S.-Mexican border. Its climate is characterized by high summer temperatures and relatively mild, sunny winters. About 55,000 acres of this land is in sugar beet production and, because of the unique climate and processing requirements, seed must be planted between August and October. During this period when dry soil temperatures at ½-inch depth may reach 70°C, growers have difficulties establishing a satisfactory stand of sugar beets, especially in the late-August to early-September period. The problem decreases in plantings made during the period from mid-September through October—leading to the theory that high temperature might be the cause of the problem.

These experiments were conducted to explore the possibility of overcoming the temperature problem by use of chemicals. The assumption was made that it might be possible to increase germination at elevated temperatures by leaching out some inhibitor or adding some stimulant which might allow germination to proceed.

Four varieties of sugar beets, all of which are grown commercially in the Imperial Valley, were used in the experiments: HH3, US 75, and HC-1 (multigerm varieties); and HH4, a monogerm variety which is somewhat slower to germinate. Germination percentages for the four varieties at various temperatures are shown in graph 1. Preliminary to the chemical tests, optimum conditions for temperature, moisture, and leaching were established and these conditions were followed throughout the experimental procedure.

Seeds were germinated on Kimpak germinating paper, enclosed in plastic germinating dishes, and placed in a Mangelsdorf germinator. Approximately 60 ml of water or germinating solution provided the free moisture necessary for germination.

For the purpose of establishing germination percentage, only normal healthy

TEMPERATURE EFFECTS

sugar beet germination

Imperial Valley

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radicles more than 1 mm in length were counted. In accordance with standard seedling interpretation, more than one seedling developing from a seed ball was considered as only one count. Size of the seed was 7½ to 9½ sixty-fourths of an inch.

Official methods for testing sugar beet germination call for washing the seed in running water for two hours prior to germinating by alternating temperatures of 20° and 30°C. Tests conducted here showed no evidence that leaching in this manner improved germination, and a constant 20°C temperature was found to be superior to the recommended alternating temperature.

Oxalic acid, reported to be an endogenous inhibitor in sugar beets, failed to inhibit germination when tested at concentrations ranging from 0.001% to 1.0%.

Although rate and uniformity of rice seed germination is improved on a commercial basis by soaking the seed for 24 hours in a 0.05% NaOCl solution, a similar treatment with sugar beet seed reduced germination slightly at 20° C, and failed to promote germination at 45° C.

Gibberellin, reported to stimulate germination of many seeds, failed to stimulate sugar beet seed at optimum or elevated temperatures. Similarly, KNO_3 and thiourea failed to produce a stimulatory effect at 20° or 45° C. These experiments gave no evidence that sugar beet seed contains an active inhibitor at concentrations sufficient to prevent germination.

When no chemical treatment was found that would leach an inhibitor or act as a stimulant, field methods of reducing soil temperature at the ½-inch planting depth were attempted.

During September, 1963, maximum soil temperatures were measured for six soil conditions to determine what might be expected in reducing temperatures. Temperatures were measured at the ½-inch depth on a dry bed sloping south, a flat dry bed, a dry bed sloping north, a wet bed sloping south, a wet bed covered with $CaCO_3$ on a north slope, and a wet bed covered with white paper on a north slope. As expected, all wet soil was markedly cooler than dry soil, and north-facing slopes with reflective covering were approximately 10° C cooler than a wet, south-facing slope (graph 2).

Two possible causes of poor germination include (a) excessive daytime soil temperature as a primary consideration; and (b) excessive nighttime temperature as a primary consideration. Recent experiments conducted elsewhere indicate that the latter may be the case. If excessive daytime temperatures were the cause, considerable improvement in field stands of sugar beets could be achieved by proper bed orientation and covering. However, if excessive nighttime temperature is the cause, we may have to look for new temperature-problem solutions.

Under field conditions, salinity may also play a leading role in rate and degree of germination. Future studies will concentrate on the relationship of salt-tolerance to moisture and temperature.

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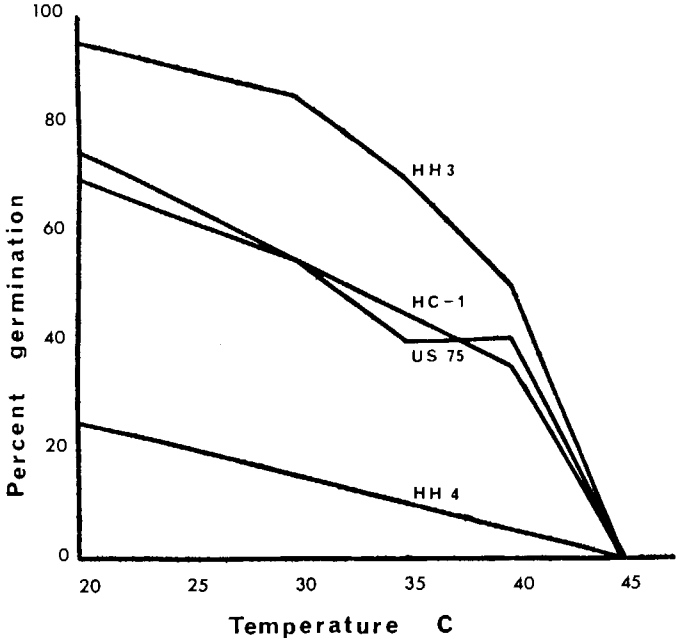
Graph 1. Germination of four varieties of sugar beets as influenced by temperature.



Graph 2. Daily maximum soil temperature at ½-inch depth (Imperial Valley Field Station): (a) dry bed, sloping south; (b) dry bed, flat; (c) dry bed, sloping north; (d) moist bed, sloping south; (e) moist bed, sloping north with $CaCO_3$; (f) moist bed, sloping north with white paper.