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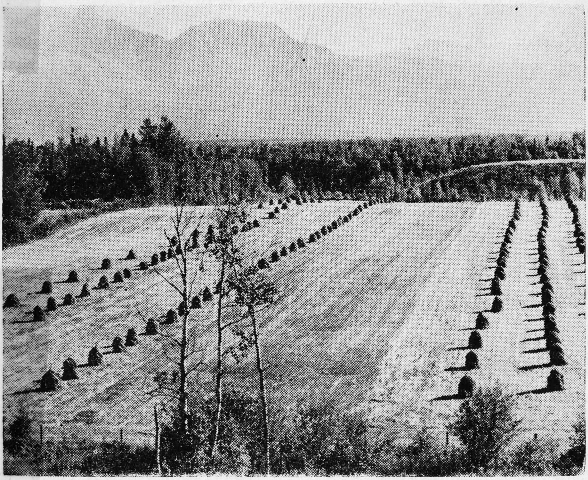

Part of the 1949 harvesting trials at the Matanuska Experiment Station. Field curing oat-pea forage on stakes produced an expensive, low quality roughage.

BETTER FORAGE FOR ALASKA

A PROGRESS REPORT

University of Alaska
DON L. IRWIN, Director
AGRICULTURAL EXPERIMENT STATIONS
PALMER, ALASKA
In cooperation with the
United States Department of Agriculture
Agricultural Research Administration

In Alaska--

Oats-and-peas make better silage than hay

Silage and silos pay

Field-choppers cut labor costs

Smooth bromegrass is an excellent forage

Alsike clover and Hubam sweetclover
make good annuals

Better forage means bigger profits

This snow-covered field was "bull-dozed" in mid-winter in an attempt to get the frozen oat-pea hay under cover. Such expensive practices produce only low grade roughage. Matanuska Valley, January 1950.

Better Forage for Alaska

*William J. Sweetman, H. J. Hodgson, and A. H. Mick**

Dairying and small-scale beef enterprises provide a fairly stable basis for the expansion of Alaska's agriculture. Both climate and market conditions favor local development of these enterprises. Feeding problems are the chief handicap. Alaskan dairymen and beef growers know that imported concentrates are expensive and hard to get. Their locally grown feed consists mostly of oat-pea mixtures. While these mixtures produce satisfactory yields, unfavorable weather conditions during harvest often make curing difficult or impossible. Some farmers mow their oats-and-peas and stack the green forage on stakes to dry. Others cut oats-and-peas with a binder as though it were grain, leaving the shocks in the field until they are fed. These shocks may "freeze dry," but more often they mold because of rainy weather during harvest. Left in the field, shocks are generally covered by heavy winter snow. Axes and sometimes bulldozers are used to loosen frozen shocks before they can be moved. In spite of the great efforts involved, these expensive practices produce only low grade roughage.

Better forage management can increase the dairyman's profits. In the following pages are described some recent Alaskan studies in this field.

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*Respective heads of Animal Industry, Agronomy, and Soil Science Departments, Alaska Agricultural Experiment Station, Palmer, Alaska.

A good field of oats-and-peas at the Matanuska Station in 1949. A bushel of peas to a bushel of oats was used in seeding this field, which received the equivalent of 100 pounds per acre of a 10-20-10 fertilizer.

OATS-AND-PEAS MAKE BETTER SILAGE THAN HAY

Oat-pea mixtures probably will remain an important Alaskan forage. A great disadvantage of this crop is encountered during harvest when wet weather usually prevents satisfactory field-curing. Even in wet weather, however, oat-pea hay can be barn-dried with warm, forced air. A much cheaper and convenient method of preserving oat-pea mixtures is to make them into silage.

Don't waste your forage—make silage. In 1948 and 1949, a uniform field of oats-and-peas was divided into three portions, one being handled as field-cured hay, the second as barn-dried hay, and the third as silage. In 1948, the entire field was cut at the same time. That part to be field-cured was raked and the crop placed on stakes where it remained for 17 days. It was put in the barn on September 13. Because little rain fell during the curing period, this hay probably was as good as can be made by field-curing in Alaska. It was much better than average oat-pea hay. Forage to be barn-dried lay in the field until rain threatened the day after cutting. It was then picked up with a hay-loader, hauled to the barn, and spread on a mow-drier. The material for silage was picked up with a hay-loader and hauled to the silo filler 2 to 4 hours after cutting. Green forage weights were obtained for each of these three lots. Moisture samples were oven-dried so that the amounts of dry matter processed by each method could be calculated.

Comparison of the results obtained from these different methods of handling shows that making oats-and-peas into silage saves more material than either of the other two methods (see table 1). From the standpoint of losses, barn-drying is less efficient than processing oats-and-peas into silage. It is more efficient, however, than field-curing. Of the three methods, field-curing is most wasteful. The different rates of loss recorded in table 1 are due to shattering and to moisture

TABLE 1.—*Acre yields of oat-pea forage and comparison of dry matter losses per acre from three different methods of handling. Matanuska Station, Palmer, Alaska,* 1948-49.

COMPARISON	KIND OF OAT-PEA ROUGHAGE					
	1948			1949		
	Field-cured hay	Barn-dried hay	Silage	Field-cured hay	Barn-dried hay	Silage
When cut:						
Green weight* .... tons	5.7	5.6	5.7	10.0	9.9	9.9
Dry matter .... pounds	3,029	3,011	3,060	4,678	4,409	4,373
Moisture content .... percent	73	73	73	77	78	78
When placed in barn or silo:						
Weight of crop* .... tons	1.8	3.7	5.5	2.1	6.5	7.1
Dry matter .... pounds	2,590	2,947	3,029	3,700	3,983	4,178
Moisture content .... percent	30	60	72	13	69	70
Lost in handling:†						
Dry matter .... pounds	439	64	31	978	426	195
Rate .... percent	14.5	2.1	1.0	20.9	9.6	4.5
Loss of dry matter from 10-acre field at these rates .... pounds	4,390	640	310	9,780	4,260	1,950

*Green weights and weight of crop are included to give an idea of actual bulks handled and hauled.
†Greater losses in 1949 were caused by vigorous growth and more lodging than in 1948.

differences in the forage when it is picked up. Field-cured hay is dry when loaded and hauled to the barn; a forkful left behind is nearly all dry matter. On the other hand, a forkful of wilted silage left in the field contains only one-third as much dry matter as it would if dried out like hay. When "field-cured" shocks are picked up in mid-winter, as much as one-third of the total yield may be left in the field. Not only is the hay lost, but the farmer's time and labor have been expended for nothing in return.

Preserve your feed—make silage! In addition to relatively large handling losses, field-cured hay deteriorates in feeding value while exposed to weather. These losses in feeding value are not seen in yields. They are discovered only when roughage is fed to cows and their milk production is measured. Feeding tests of this nature were made on the 1948 crop. The results, summarized in table 2, show that an acre of oat-

TABLE 2.—*Relative feeding value of oat-pea forage preserved as field-cured hay, barn-dried hay, and silage. Matanuska Station, Palmer, Alaska,* 1948.

COMPARISON	KIND OF OAT-PEA ROUGHAGE		
	Field-cured hay	Barn-dried hay	Silage
Cows in test ....number..	2	2	2
Feeding period ....days..	90	90	90
Average cow weight ....pounds..	1,065	1,064	1,076
Fat produced ....pounds..	159	161	166
Milk produced* ....pounds	3,728	3,806	3,822
These cows consumed, while on test:			
Total roughage ....tons..	2.24	2.23	**5.18
Roughage per pound of milk produced......pounds..	1.20	1.17	2.71
TDN† ....pounds..	2,943	2,955	2,861
Milk yield per—			
Pound of TDN ....pounds..	1.27	1.29	1.34
Pound of TDN above maintenance requirements ....pounds..	2.61	2.69	2.89
Pound of roughage ....pounds..	0.83	0.85	0.37
Acre ....pounds..	3,148	3,110	4,056
Decline in milk production during 30-day period ....per cent..	7.45	9.64	4.94

*Corrected for 4 percent fat content.

**While on silage, these cows received no hay. Cows on hay received no silage. Each roughage was supplemented by grain in the ratio of 1 pound of grain to 3½ pounds of milk produced.

†TDN means "total digestible nutrients". These values include TDN in grain and roughage.

pea silage produced more milk than an acre of either field-cured or barn-dried hay. In 1948, an acre of silage produced 4,056 pounds of milk. An acre of the same forage, cured in the field as hay, produced only 3,148 pounds of milk. Utilizing forage as silage thus increased milk production 908 pounds per acre, or about 29 percent, over field-curing. These feeds had the same potential value when cut. Furthermore, because of good drying weather in 1948, the field-cured hay was much better than that put up under more normal conditions. Even less milk can therefore be expected from the average filed-cured hay made in the Matanuska Valley. During the 90-day test period, each cow ate the equivalent of 0.6 acres of hay as compared to 0.45 acres of silage. Milk production was maintained better on the silage diet than on either kind of hay. From the standpoints of convenience in harvesting and value of the preserved forage, feeding tests have thus proved that oat-pea mixtures make much better silage than hay.

Boost your profits—use silage! Farmers often say that making silage is a lot of work. Because forage is handled when succulent, they point out that more material must be hauled to the barn than when it is left in the field to dry. Table 1 shows that these observations are

TABLE 3.—*Harvesting and processing cost per ton of oat-pea roughage handled as field-cured hay, barn-dried hay, and silage. Matanuska Station, Palmer, Alaska,* 1948-49.

COMPARISON	KIND OF OAT-PEA ROUGHAGE					
	1948			1949		
	Field-cured hay	Barn-dried hay	Silage	Field-cured hay	Barn-dried hay	Silage
Roughage obtained ________________tons	3.54	3.76	15.32	3.56	7.74	15.29
Moisture content when fed ______percent	21	19	72	13	20	70
OPERATION COSTS PER TON						
Tractor	$ .88	$ .81	$ .26	$ .39	$ 1.08	$ .18
Truck	1.41	.79	.77	2.49	1.41	.57
Mower	.53	.49	.11	.18	.28	.09
Rake	.31	--	--	.13	.17	.08
Hayloader	--	.79	.26	NOT USED		
Silo filler	--	--	.26	NOT USED		
Field-chopper	NOT USED			--	.83	.43
Blower	NOT USED			--	.49	.13
Barn-drier fan @ $ .06 per kwh	--	8.24	--	--	8.64	--
Man labor @ $1.50 per hour	13.78	10.21	2.86	15.15	4.15	1.69
TOTAL per ton of roughage	$16.91	$21.33	$ 4.52	$18.34	$17.05	$ 3.17

true. From 2½ to 3½ times more material had to be hauled for silage than for hay. Moreover, cows eat more silage than hay, as table 2 reveals. These comparisons are one-sided, however, since the great labor requirements necessary to dry oats-and-peas in the field have not yet been considered.

In order to find out how much hay and silage cost, records were kept on all phases of harvesting and processing. In 1949, a field-chopper was obtained. Costs of forage processed by this modern machine were compared with those of the older, hay-loader method used in 1948. The records summarized in table 3 include all special costs involved in the three methods of getting oat-pea forage into the barn or silo. In the discussion that follows, it is assumed that (1) a silo is available, or (2) suitable hay storage facilities are available, or (3) a barn already equipped with a mow-drier is available. In other words, the initial cost of storage and processing equipment is not taken into account. Table 3 comparisons are thus limited to actual operation and labor charges.

In 1948, green oats-and-peas for barn-drying were picked up with a loader and unloaded at the barn with a mow fork. Both operations required a lot of manual work, reflected in labor costs that exceeded

$10 per ton of dry roughage. Even more labor was used in staking field-cured hay. On the other hand, high electricity costs for the drying fan made barn-drying more expensive than field-curing. In 1949, field-cured hay was more expensive because labor costs for making barn-dried hay were greatly reduced by using a field chopper. In this season, cost of hand-staking oat-pea forage exceeded the cost of operating the mow-drier fan. Although lower electric rates will reduce barn-drying costs still more, there is little chance of making cheaper field-cured hay from oats-and-peas because of the usual wet harvest seasons.

Of the three processing methods, making silage proved cheapest. Even when picked up with a hayloader, silage was least expensive because field-staking, hand-forking, and artificial drying costs were avoided. In 1949, use of the field-chopper with self-dumping trucks and a blower-elevator further reduced the labor costs in making silage.

SILAGE AND SILOS

Silage at $3 to $5 a ton certainly appears a better bargain than hay at $15 to $20 a ton. "That may be right," some dairymen say, "but our cows eat more silage than hay. Don't they eat up all those savings?" Table 2 contains the answer to this question. A little figuring reveals that 2.26 tons of silage produced just as much milk in 1948 as 1 ton of field-cured hay. In terms of dollars and cents, $10.20* worth of silage gave as much milk as $16.90 worth of field-cured hay in 1948. In 1949, $7.16 worth of even less expensive silage appeared just as good as $18.34 worth of hay. These savings are great enough to justify serious thinking about building a silo. In fact, this is probably one reason why many new silos have recently been built in the Matanuska Valley.

Can you afford a silo? Let's assume, for example. that 35 tons of dry matter in the form of field-cured hay will feed 15 cows during an average winter. Table 4 (calculated from information contained in tables 2 and 3) lists the steps in figuring roughage costs for this herd. The foregoing experimental results show that feeding oat-pea silage rather than field-cured hay to a 15-cow herd might save a farmer as much as $745 in 2 years. At this rate, money for building a good silo might soon be accumulated. A word of caution, however, is necessary at this point. That $745 remains only a figure on paper until the farmer actually earns it by using his labor, saved in harvesting, to sell $745 worth of produce. This means that he must either (1) expand his herd and sell enough more milk to get $745 or (2) produce other marketable crops which he can sell for $745, or (3) "sell" his "saved labor" outside of his farm and earn $745. All of these possible actions involve eco-

*According to table 2, 2.71 pounds of silage or 1.20 pounds of field-cured hay are required to produce a pound of milk. 2.71 divided by 1.20 equals 2.26; thus, it takes 2.26 times as much silage as field-cured hay to produce a given amount of milk. Table 3 shows that harvesting cost for 1 ton of silage was $4.52; 2.26 multiplied by $4.52 gives $10.20.

TABLE 4.—*Comparison of costs of feeding oat-pea hay or silage to a 15-cow herd in a normal winter. Calculations are based on experimental studies at the Matanuska Station, Palmer, Alaska,* 1948-49.

COMPARISON	KIND OF OAT-PEA ROUGHAGE			
	1948		1949	
	Field-cured hay	Silage	Field-cured hay	Silage
Moisture content of roughage ______percent__	21	72	13	70
Estimated dry matter required by a 15-cow herd during a normal winter* ______tons__	35.0	27.7	35.0	27.7
Estimated roughage requirements† ___tons__	44.3	99.0	40.2	92.4
Cost of roughage (see table 3) ____________	$749	$447	$737	$294
Savings from feeding silage ______________	$302		$443	
Savings for 2-year period _________________	$745			

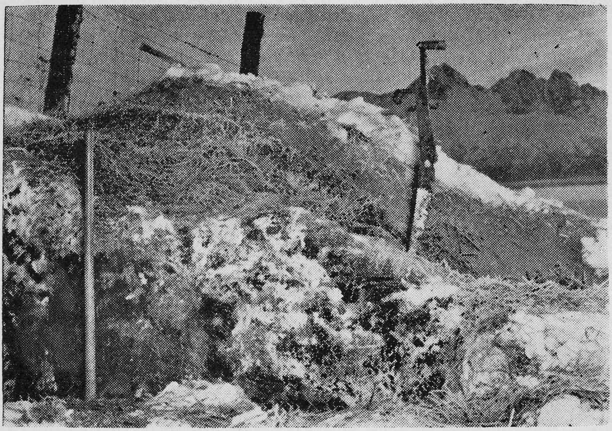
*Table 2 shows that feeding these roughages in the amounts indicated produced the same quantities of milk. Equal quantities of grain concentrates were therefore required to supplement each roughage. Calculations are based on cow weights of 1,050 to 1,100 pounds; these cows produced 20 to 25 pounds of milk per day.

†Adjusted to dry matter content obtained in 1948 and 1949 feeding trials.

nomic factors outside the scope of this report but which must be considered by the dairyman before he expands his enterprise.

Overhead construction costs and depreciation of buildings and machinery have not been considered in this discussion. This is because these fixed charges are only incidentally related to forage harvesting and processing. A farmer must, of course, think about fixed costs before he decides to use a particular method of preserving his roughage. Many farmers will have to choose between a good method of preserving roughage and making use of the buildings or machinery they have at hand. Farm experience indicates, however, that a silo can be built as cheaply as a hay storage shed or mow. Probably barn-driers will not become popular until cheaper electricity is available; a rate of about 1 cent per kilowatt hour might make barn-drying economical.

Stacked ensilage may solve your problem. An air-tight structure of either the cylindrical or pit type is needed to preserve good silage. These structures cost more than many farmers and homesteaders can afford. To avoid such financial obstacles, farmers in some northwestern states and in the Scandinavian countries have used stacked ensilage. A recent test indicates that this practice may prove satisfactory in Alaska despite long periods of sub-zero weather. In 1949, for example, 12 tons of green, unchopped alsike clover and bromegrass were piled in a stack against a steep bank. The finished stack was



Ensilage may be stacked outdoors and covered with straw and dirt. This has proved a satisfactory emergency practice in the Matanuska Valley.

about 10 feet high, 10 feet wide, and 14 feet long. It was covered with straw and then sealed with a 6-inch layer of dirt over the top and sides. Poles around the sides supported the pile and kept the dirt in place. Finished on October 14, the stack was not opened until December 13. It settled nearly 4 feet during this storage period.

When opened, about 70 pounds of spoilage were removed from a 10-foot face. Ensilage in silos was frozen around the walls, but this stacked ensilage was insulated by snow and did not freeze until exposed. Even where frozen, the ensilage was readily cut with a hay knife or axe. This ensilage was fed to steers as their sole winter ration during the winter of 1949-50. Although feeding trial results will not be available for some time, stacked ensilage appears to be a cheap and satisfactory method of preserving green forage. By using stacked ensilage, a homesteader or anyone else with a few cows or heifers can take advantage of the low costs and superior feed value of silage. Farmers owning large livestock or dairy herds might stack green forage in this manner for emergency use.

FIELD CHOPPERS CUT LABOR COSTS

A dairyman studying table 3 can see that a field-chopper reduces labor in handling forage. He may ask, "Is this saving big enough to pay for the machine and leave some over for profit?" Table 5 (calculated from information in tables 2 and 3) lists the steps in estimating total savings in putting up winter feed for 15 cows. Considerable savings were obtained by using this machine to cut and chop barn-dried hay. Somewhat smaller savings of $153 resulted from putting up silage, perhaps because silage must be chopped finer than hay. A large volume of forage must be handled when making silage; this difference in volume also reduces savings as compared to barn-dried hay.

Can you afford a field-chopper? The purchase price of this machine (together with the blower and automatic dump-beds for the trucks) is about $2,000, including freight. An annual saving of $153 would retire this purchase price in about 13 years. If the life of the machine is 20 years, the difference of 7 year's savings would have to go for main-

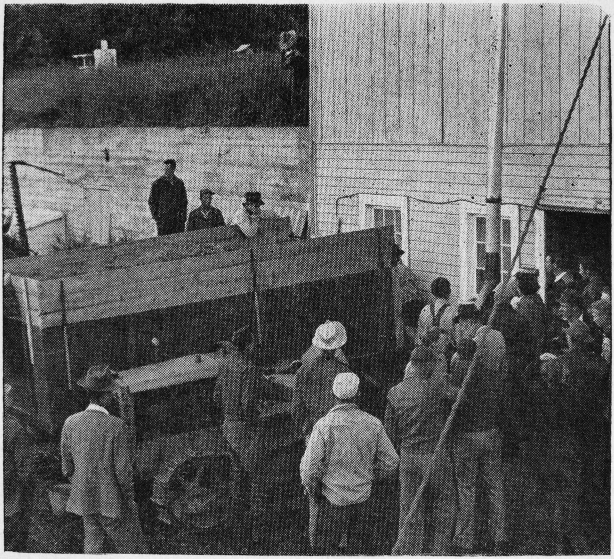
TABLE 5.—*Estimate of savings from using a field-chopper to harvest oat-pea forage. Calculations are based on experimental studies at the Matanuska Station, Palmer, Alaska,* 1948-49.

COMPARISON	KIND OF OAT-PEA ROUGHAGE			
	1948 Field-chopper not used		1949 Field-chopper used	
	Barn-dried hay	Silage	Barn-dried hay	Silage
Moisture content of roughage______percent_	19	72	20	70
Estimated dry matter required by a 15-cow herd during a normal winter* ________________tons_	35.0	27.7	35.0	27.7
Estimated roughage requirements†___tons_	43.3	99.0	43.7	92.4
Cost of roughage (see table 3)____________	$924	$447	$745	$294
Savings from using a field-chopper________			$179	$153

*Table 2 shows that feeding these roughages in hte amounts indicated produced the same quantities of milk. Equal quantities of grain concentrates were therefore required to supplement each roughage.

†Adjusted to dry matter content obtained in 1948 and 1949 feeding trials.

tenance and repairs, leaving a very dubious margin for profit. Since these estimates are based on data from a single growing season, further studies may warrant changes in the conclusions. At the present time, however, it does not appear that a 15-cow dairy enterprise can afford a field-chopper. On the other hand, speedy harvesting and reduced labor requirements are field-chopper advantages not to be overlooked. They do not offset the high initial cost, but they do suggest two practical alternatives to private ownership: (1) A 60-cow unit, representing



Demonstration at the Matanuska Experiment Station shows one method of blowing chopped hay into a drying-mow.

3 or 4 cooperating dairymen, could be served adequately and profitably by one field chopper. (2) Field-chopping on a custom basis should be profitable to both dairymen and contractor.

How to use a field-chopper. A nice feature of the field-chopper and unloader combination is that making silage is no longer hard work. Another good feature is that harvesting goes a lot faster. A field-chopper is used to best advantage where several trucks or trailers are available for hauling forage to the barn. The number required varies, of course, with the distance from field to storage facilities. Efficient use of a field-chopper requires a tractor and driver in the field, at least three trucks and drivers for long hauls, and a tractor at the blower. In the studies reported here, a truck and tractor-drawn trailer were used. Each was equipped with a motor-driven, self-dumping bed. The "unloading" features of the bed consist of a false front which is pulled toward the rear by two steel cables. These cables are wound up on a roller attached to the rear of the bed. The wind-up roller is revolved by a telescoping torque rod driven by an electric motor mounted separately near the blower.

Unloading requires one man who watches the blower tractor and regulates the flow of chopped material from truck to blower. His big job is to keep the blower from choking up. When making barn-dried hay, a man is needed to spread chopped hay blown onto the mow-drier. He does this with a rope connected to the distributor and so avoids tramping and packing the damp forage. Packed spots dry slowly because air cannot circulate freely through them. To prevent excessive packing on the mow-drier, forage must be cut 3 inches or longer. For silage, on the other hand, forage must be well-packed to prevent spoilage. Packing is promoted by chopping green forage three-eighths of an inch or shorter. It is also advisable to have one man in the silo to help pack the green material as it is blown in. Freshly cut oats-and-peas usually contain lots of moisture and therefore should be wilted 2 to 4 hours before making into silage. Bromegrass contains less moisture; it should be chopped and hauled as soon as it is cut or it will be too dry. This is especially important in warm, dry weather, or bromegrass will not contain sufficient moisture to make good silage.

SMOOTH BROMEGRASS IS AN EXCELLENT FORAGE

Smooth bromegrass has been studied for several years in Alaska. It is well adapted to the Tanana and Matanuska Valleys and to the Kenai Peninsula. Its perennial nature gives it a great advantage over oats-and-peas, which must be planted each season. Bromegrass usually is not damaged by cutworms after the first year—another advantage over oats-and-peas. Smooth bromegrass starts early in the spring and grows rapidly. Fertilized bromegrass produces good hay by late June or early July. At this time of year, a farmer has a fair chance of field-curing it in windrows. Second-cuttings made during the rainy season can be used for silage.

Bromegrass has not been popular because it will not produce good yields unless fertilized. Many farmers have tried bromegrass without fertilizer and, in an attempt to get big yields, let their crop grow too mature before cutting it. When cut before it fully heads, fertilized bromegrass produces good hay and silage with less labor and expense than any other Alaskan forage. Bromegrass must be cut early because its palatability and protein content decrease rapidly after the panicles emerge. Increases in yield after one-tenth of the field has headed out are made only by sacrificing quality.

What does bromegrass roughage cost? An extensive field trial was started in 1949 on an old bromegrass field which had been abandoned as worthless several years before. Spring labor involved only spreading 200 pounds per acre of ammonium nitrate (31.5%) and fence repairs.

By June 27, the bromegrass was 25 to 40 inches high and in the one-tenth bloom stage—ready for cutting. At this time, many oat-pea crops were little more than 8 inches high; others had not emerged or had been severely damaged by cutworms. This early rapid growth of bromegrass is a great advantage since it distributes harvesting labor and permits a second cutting.

Part of the first-cutting was hauled to the barn-drier on June 30 and July 1. The remainder was field-cured until July 4 when it was hauled to the mow in good condition. Average first-cutting yields were 0.8 tons per acre of hay containing 20 percent moisture. Immediately after the first-cutting was harvested, the field was again top-dressed with 200 pounds per acre of ammonium nitrate. A second-cutting was ready by September 20. Harvested and processed by the three methods used for oat-pea forage, this second-cutting of bromegrass yielded 1.1 tons per acre, for a total of 1.9 tons of hay (20 percent moisture) per acre for the two cuttings.

Table 6 lists the costs involved in making bromegrass roughage. As with oats-and-peas, barn-curing produced an expensive feed. Its high cost is due chiefly to electrical power charges for artificial drying. If this charge of $12.04 can be reduced by cheaper electrical rates or

TABLE 6.—*Harvesting and processing cost per ton of second-cutting bromegrass forage put up as field-cured hay, barn-dried hay and silage. Matanuska Station, Palmer, Alaska,* 1949.

COMPARISON	KIND OF BROMEGRASS ROUGHAGE		
	Field-cured hay	Barn-dried hay	Silage
Roughage obtained ______ tons	10.24	4.51	10.80
Moisture content when fed ______ percent	20	20	58
OPERATION COSTS PER TON:			
Tractor	$ .23	$ .53	$ .30
Truck	1.76	1.09	.49
Mower	.11	.56	.17
Rake	.39	.33	.15
Field-chopper	--	1.05	.60
Blower	--	1.04	.26
Barn-drier fan @ $ .06 per kwh.	--	12.04	--
Man labor @ $1.50 per hour:			
Staking	7.35	--	--
Other	$6.52	4.66	1.69
TOTAL per ton of roughage	$16.36	$21.30	$ 3.66

Smooth bromegrass on the left received 400 pounds per acre of ammonium nitrate. The plot on the right was treated with the same amount of phosphate and potash but only 1/3 as much nitrogen.

more efficient dryer designs, barn-dried hay costs might come down. Second-cutting field-cured hay was expensive because it was mowed in wet weather and had to be staked. In this trial, staking charges were recorded separately. By subtracting the $7.35 charged to staking from the total cost per ton, it is seen that windrow-cured bromegrass hay is relatively cheap. As a matter of fact, bromegrass is probably the only forage now available to Alaskan farmers that can be put up for about $10 per ton. First cuttings made in late June or early July give the Alaskan farmer a good opportunity to obtain $10-a-ton hay. It is emphasized, however, that this low cost hay can be made only when bromegrass is cut early.

Using a field-chopper, bromegrass silage can be made as cheaply as first-cutting hay. Even if 2½ times more silage than hay is required for equal milk production, 2½ tons of roughage consumed as silage can be expected to cost less than $10. As with oats-and-peas, moreover, bromegrass silage has another advantage over hay in that silage is not exposed to weather and therefore runs less chance of losing its nutritive value through leaching.

A comparison of tables 3 and 6 reveals that costs of processing second-cutting bromegrass forage are about the same as for oat-pea roughages. Second-cutting bromegrass was barn-dried later than oat-pea forage; since the air was cooler and more humid, more electricity was used than when the oat-and-peas were barn-dried. The great advantage of bromegrass over oat-pea forage lies in the fact that an early cutting of bromegrass can be field-dried in windrows rather than on stakes.

Fertilize your bromegrass. Smooth bromegrass grows best on fertile soil. This has been shown by fertilizer trials in both the Matanuska and Tanana Valleys. Research in the United States and Canada also shows that bromegrass seedings must be fertilized and that bromegrass sods used for hay or pasture are greatly stimulated by top-dressings of commercial fertilizer. The following suggestions outline good management practices for bromegrass sods:

(1) Use a complete fertilizer containing nitrogen, phosphate, and potash.

(2) Fertilizers should be spread as soon as the snow disappears and the frost has gone from the plow layer.

(3) Tentative rates of application are 80 to 100 pounds per acre of nitrogen, 60 to 80 pounds per acre of phosphoric acid, and 20 to 40 pounds per acre of potash. In terms of economical fertilizers available at local warehouses, these rates equal:

250 to 312 pounds per acre of 32% ammonium nitrate.
140 to 190 pounds per acre of 42% superphosphate.
33 to 66 pounds per acre of 60% muriate of potash.

(4) If the season is favorable and a heavy first-cutting of hay is obtained in late June or early July, top-dress immediately with another 40 pounds per acre of nitrogen. This will make a total of 120 to 140 pounds per acre of nitrogen used for top-dressing.

(5) Manure can be used on pasture. Spread manure at the rate of 6 to 8 tons per acre. As soon as the snow disappears and the frost has gone, supplement manure with a top-dressing of 20 to 50 pounds of nitrogen and 100 to 140 pounds of phosphoric acid per acre.

(6) Cut bromegrass hay when about one-tenth of the field has headed out. Growing periods for hay range from 60 to 70 days in the Matanuska Valley.

(7) Rotate pasture grazing. Allow bromegrass to recover to a height of 6 to 10 inches before grazing again. Recovery periods for pasture vary from 32 to 38 days.

Manure can be used to a good advantage when bromegrass is seeded. Plow it under at the rate of 6 to 8 tons per acre. Manure must be supplemented with about 15 pounds of phosphoric acid for every ton. Where manure is not used, fertilize bromegrass seedings with 40 to 50 pounds per acre of nitrogen, 60 to 80 pounds of phosphoric acid, and 10 to 20 pounds of potash.

ALSIKE CLOVER AND HUBAM SWEETCLOVER ARE GOOD ANNUAL LEGUMES

A long search for legumes adapted to Alaskan conditions has so far been generally unsuccessful. Of the numerous perennial legumes tried, Siberian red clover, perennial vetch, and Siberian alfalfa appear

Hubam sweetclover is a satisfactory annual legume. This 3-foot crop yielded over five tons of excellent silage per acre.

most promising*. Seed procurement is a great obstacle, however, in utilizing these crops. None of them has consistently yielded seed in important Alaskan agricultural areas. Satisfactory "Outside" sources have not yet been located or established. While the search for winter-hardy varieties continues, two legumes may find a place in the dairyman's program. These are alsike clover and Hubam sweetclover.

Field trials of these crops in 1949 showed that first year forage yields make superior silage. These crops were planted on an old, unproductive field plowed in mid-May. Commercial fertilizer (applied at the rate of 12 pounds of nitrogen, 37 pounds of phosphate, and 26 pounds per acre of potash) was spread and then alsike clover seeded at the rate of 6 pounds per acre. Although slow to start, an excellent stand emerged. During the last week in September, this green forage was cut and chopped for ensilage. Alsike clover yields from this test field

*Although alsike clover sometimes thrives in locally protected sites, it cannot be depended on as a winterhardy legume in the important agricultural districts of Alaska.

amounted to 5½ tons per acre. From the standpoint of moisture content, late cutting proved unsatisfactory because wet weather prevented wilting.

Alsike forage is very succulent. To make good silage, part of its moisture content must be lost before it is put in the silo. When wilting is impractical, alsike forage can be mixed with bromegrass as it is blown into the silo. This practice improves both forages since bromegrass alone is often too dry. Alsike clover contains about 35 per cent more protein than grass. The alsike-grass silage is therefore higher in protein than silage made from bromegrass alone. The protein content of alsike clover-grass silage is somewhat higher than for oat-pea silage. In these field tests, oat-and-pea silage contained 3.3 percent protein whereas alsike-grass ensilage contained 5.4 percent protein. Seed costs for alsike clover-bromegrass mixtures are about the same as for oats-and-peas.

Hubam sweetclover seeded at the same time and in the same manner as alsike clover also produced large yields. This forage was cut in late August at about one-tenth bloom and when the crop was 3 to 4 feet high. After it had been wilted for 2 days, over 5 tons per acre of green forage was hauled to the silo. One disadvantage of Hubam sweetclover is that it emerges slowly in the spring. Nurse and companion crops (except bromegrass) start faster and smother the clover. With little or no competition, sweetclover grows rapidly in late summer.

Many reports from Canadian and State-side experiment stations deal with the lime requirements of legumes. The reason is that soils in those areas are relatively old and weathered. Plow layers have lost nearly all of their original calcium and magnesium. Lime loving legumes therefore grow poorly unless lime is added to fields before seeding. In contrast, even acid Matanuska and Tanana Valley soils apparently contain large quantities of calcium and magnesium. Field tests show that legumes growing on these soils do not respond to lime or marl.* Some soils in the Kenai Peninsula and elsewhere in Alaska are more deficient in calcium and magnesium. There is no evidence, however, that liming soils in these places will increase crop yields.

Recent field tests in the Matanuska Valley indicate that some soils contain so much calcium that it appears to interfere with phosphate nutrition of legumes and other crops; heavy applications of sulfur, for example, increased alsike clover yields on Knik loamy silt in 1949. Soil manganese is also relatively unavailable where large quantities of calcium are present. Although these tests are not conclusive enough to justify recommending large applications of sulfur, they do show that liming is generally unnecessary. In places, lime applications may do more harm than good. On such soils, money is better invested in nitrogen, phosphates, and potash than in liming materials.

*"Marl" is a natural deposit of calcium carbonate found near lakes and streams. Small bodies of marl near Wasilla in the Matanuska Valley indicate that some weathering of soil materials has taken place. In this region, however plow soils still appear to contain large quantities of calcium. Use of marl as a liming material is therefore not recommended at the present time.

BETTER FORAGE MEANS BIGGER PROFITS

In summary, the foregoing discussion demonstrates how Alaska's dairy producers and livestock growers can increase their net profits by better management of adapted forage crops. General conclusions and recommendations, resulting from actual field trials in Alaska, are:

(1) Use oats-and-peas chiefly for silage. Plant plenty of peas; a bushel of peas to a bushel of oats is a good rule to follow. Field-cured oats-and-peas make expensive forage, especially if left in the field during the winter.

(2) Wet harvest seasons are no obstacle to making silage. Good inexpensive silage can be made from oats-and-peas, from bromegrass, and from annual legumes.

(3) Diversify forage production to include bromegrass and annual legumes. First-cuttings of bromegrass make good, inexpensive hay. Alsike clover can be used as an annual legume. Mix alsike clover or Hubam sweetclover with bromegrass or oats-and-peas as they go into the silo.

(4) Use commercial fertilizers. Manure applications must be supplemented with phosphate. Bromegrass can be expected to yield large returns on money invested in fertilizer.

(5) Save time, labor, and money by using modern machinery where possible. Field-choppers are efficient only where large volumes of forage can be handled.

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