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"Bulletin (Alaska Agricultural Experiment Stations (U.S.))"

BETTER FORAGE

for Alaska's dairy industry

*with particular reference
to the Matanuska Valley*

W. J. SWEETMAN
A. L. BRUNDAGE

assisted by

W. M. LAUGHLIN
R. L. TAYLOR
C. I. BRANTON

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- Dairy farming is well adapted to Alaska's environment. Continued expansion of dairying supplements other primary economic growth and development.
- High quality grass hay and grass and oat-pea silage can be efficiently grown in Alaska's Matanuska and Tanana Valleys and in other favorable sites. These roughages, supplemented by locally grown grain, can supply most nutrients needed by Alaska's dairy industry.
- Much skill is needed to grow good roughage. This report summarizes the results of forage research conducted in Alaska since 1948, and interprets them in terms of farm practices.

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This publication summarizes forage studies conducted in Alaska since 1948. Major responsibility for interpretation is assumed by the dairy husbandry authors. Other staff members contributed information from their subject matter specialties.

An effort was made to incorporate material from other sources that might be helpful to Alaska's farmers. Chief among these are certain findings from the U.S.D.A. Research Center at Beltsville, Maryland.

BETTER FORAGE FOR ALASKA'S DAIRY INDUSTRY

DAIRYING is Alaska's largest agricultural industry. It is the only kind of a farm enterprise in the new State making full use of family labor throughout the year. Milk receipts accounted for 50 per cent of all commercial farm sales in 1959. In that year Alaska's dairymen were paid \$1,771,076 for nearly 16 million pounds of fresh fluid milk*, or about \$11.20 per hundredweight.

Alaska's climate favors dairying. Roughage and grains can be grown in the Matanuska and Tanana Valleys, close to Anchorage and Fairbanks and nearby military installations, the State's major consumer markets. Alaska's general economic situation justifies continued expansion of dairying which has proved efficient enough to grow without any increase in retail prices since 1948.

Consumers prefer fresh fluid milk to manufactured substitutes providing their prices are not too different. Local fresh milk represses retail prices of imported substitutes and helps keep down family living costs. Since military markets are no longer arbitrarily withheld from Alaska's dairy industry, an ever stronger agricultural economy may develop. This will benefit Alaska's consuming population by providing a better milk supply and by decreasing Alaska's present over-reliance on long vulnerable supply lines to the Pacific Northwest. Dairymen with efficient management systems will benefit most from this opportunity.

Production efficiency can be improved by stepping up acre yields of roughage through more intensive land use. Adapted crops, well prepared seed beds, wisely utilizing manures and commercial fertilizers, possibly irrigating favored sites, good harvesting and preserving practices, judicious weed control and rotating systems—all help farmers cut costs and improve farm living.

Roughage is the foundation of all dairy rations. The volume of milk produced by a dairy herd largely depends on the dairyman's skill in providing high quality roughage throughout the year.

Alaska's dairymen are striving to grow all of their roughage. Of 24,000 cropland acres in Alaska in 1959, an estimated 12,500 acres were in seeded grass, oat-pea mixtures and other roughage crops. Of this acreage, nearly 9,500 were in the Matanuska Valley where they supported 2,659 dairy animals.

In 1954, 28 dairy farms in the Matanuska Valley reported an average of 35 acres per farm in hay, 29 acres in silage crops, and 21 acres in

seeded pasture. Another 49 acres of native pasture or woodland was being grazed on these typical dairy farms. Only 5 per cent of their cropland was in other than forage crops, compared to 19 per cent in 1949. Acres in seeded pasture went up from 19 to 26 per cent during this same period. In addition some second growth brome-grass was pastured in late summer. Cereals were planted mostly for bedding straw rather than for grain.**

During the past decade most dairymen have been steadily improving their feed growing systems as they cleared more land, or by purchasing or renting cleared land. Additional cropland has generally been planted to forages. About four acres of roughage for each animal seems to be the goal of most dairymen.

ROUGHAGE CROPS

Oat-pea (and oat-pea-vetch) mixtures are the most important forages now being grown. Both oats and peas are well adapted to cool temperatures and long days. While hardy legumes may someday reduce their relative importance, oat-pea mixtures will probably continue as a major forage resource, as they have in Canada and the northern states. In 1953 about 40 per cent of the cropland on dairy farms in the Matanuska Valley was planted to oat-pea mixtures†.

Smooth brome-grass is popular on many dairy farms. Under favorable conditions brome-grass produces a dense vigorous growth with an abundance of wide long leaves. Properly managed it is nutritious and palatable in the form of hay,

*Farm Production Alaska, 1959. Mimeo report, Alaska Department of Agriculture May 1960.

**Andrews, R. H. and H. A. Johnson, Farming in Alaska, Alaska Agricultural Experiment Station Bulletin 20, October 1956.

†Andrews, R. A., Matanuska Valley Dairy Farms, 1953, Alaska Agricultural Experiment Station Mimeo Circular 8, 1954.

Chemical analysis of some native forage plants from the Matanuska Valley are listed in the table below. Native plants were not fertilized. Samples of cultivated forages were from fields of average productivity, fertilized according to current recommendations, and harvested at the stage indicated.

| Forage & growth stage | Dry Matter | Crude protein | Fat | Nitrogen | | Ash |
|---------------------------------------|------------|------------------------|-----|-------------|--------------|------|
| | | | | Crude fiber | free extract | |
| Blue joint (<i>Calamagrostis</i> sp) | Per cent | Per cent of dry matter | | | | |
| Just before flowering | 33.7 | 17.5 | 1.9 | 27.6 | 36.4 | 12.0 |
| In flower | 42.3 | 4.6 | 1.0 | 42.9 | 40.4 | 3.9 |
| Sedge, just before flowering | 37.8 | 10.3 | 2.1 | 25.7 | 45.3 | 10.6 |
| Fireweed, just before flowering | 28.7 | 19.4 | 1.8 | 14.9 | 50.1 | 8.1 |
| Horsetail (<i>equisetum</i>) | 39.0 | 9.2 | 1.6 | 16.5 | 39.4 | 27.5 |
| Bluegrass, just before flowering | 31.1 | 8.2 | 2.8 | 29.8 | 42.1 | 6.5 |
| Timothy, just before flowering | 29.0 | 9.2 | 2.7 | 27.4 | 42.7 | 6.5 |
| Bromegrass, just before flowering | 26.1 | 12.2 | 2.1 | 28.4 | 39.5 | 8.2 |
| Oats & peas, oats in late milk stage | 25.3 | 12.1 | 2.9 | 27.2 | 39.1 | 7.8 |

silage or pasture. Interlaced roots form a dense sod resisting erosion and trampling, and keeping down most weeds. Bromgrass can be pastured by late May. If adequately fertilized, it usually maintains a lush growth until early September.

Poor hay-making weather in late summer has forced most dairymen to ensile oats-and-peas and second cuttings of bromegrass. First cuttings of bromegrass, harvested in late June or early July, can usually be dried in windrows for hay.

Bromegrass has certain advantages over oat-pea mixtures. Perennial in growth habit, bromegrass is reseeded only once every four or five years. Bromegrass thus requires considerably less spring labor than oats-and-peas. This advantage is offset to some extent by the greater fertilizer needs of bromegrass. Bromegrass needs four or five times more fertilizer than most annual forage crops.

The first bromegrass cut for hay in any quantity in Alaska was reported in 1951. Since that time farmers have reported first cutting hay yields of 1 to 2 tons per acre, as compared to about 1½ tons of oat-pea hay. From late July to early September bromegrass usually yields an additional ton of dry matter for pasture or silage. Bromegrass thus yields about the same amount of feed as oat-pea mixtures. Oats-and-peas require less management skill and are less subject to setbacks because of dry spring weather.

Another important roughage available to some dairy farmers is native bluejoint (*Calamagrostis*). It provides excellent summer pasture for young stock, dry stock and dairy steers. Although *Calamagrostis* cannot be intensively grazed, large near-by native grass areas should not be overlooked in planning a good dairy management program. If free summer range is readily accessible, it supplements a cultivated feed base and helps maintain a profitable operation. A cooperating farm group has for several years satisfactorily pastured herd replacements and dairy steers in a small valley in the Talkeetna Mountains north of Palmer.

Opportunities for making hay or silage from *Calamagrostis* are rare because of difficulty in mowing due to rough land. Where cutting is possible, good preserved feed can be obtained if the grass is harvested while fairly young. Over 2,000 acres were cut for hay and silage in Alaska during 1959.

In most of Alaska, *Calamagrostis* is ready in mid-June when about a tenth of its panicles have emerged. Although larger yields are obtained later in the season, its quality is inferior. Late cutting also damages the stand because the grass does not have time to recover for the winter and may be killed. Then the stand is taken over by less valuable plants and weeds.

Some farmers successfully feed sedges and associated native plants growing on tide flats and coastal meadows. These wet areas are usually

difficult to graze or cut. Some sites may be improved by surface ditching. Sedges make fair feed when harvested before vegetative maturity.

Clovers planted alone in early spring on weed-free fields sometimes give good yields of excellent silage the year they are planted. In some years they germinate slowly because of dry spring conditions. They do not over-winter in interior Alaska or on the Aleution Chain. Best are Alsike clover, Hubam sweetclover and Red clover. Although dry spring weather retards early growth, they grow rapidly in August and are ready to ensile by mid-September.

OAT-PEA MIXTURES

Although oat-pea mixtures were at one time harvested almost entirely as hay, this crop is best preserved as silage. Probably the chief reason for attempting to feed oat-pea hay in the Matanuska Valley is that all Colony farmsteads were originally equipped with hay-mow barns rather than silos. This forced many new dairy farmers into making hay which proved difficult during wet cool harvest seasons. Because mature oat-pea mixtures are coarse and stemmy, good field cured oat-pea hay requires field staking, a laborious time-consuming job. High power costs and large capital investments for remodelling barns generally rule out mow drying at the present time.

Planting.—Plowing is unnecessary except where manure is to be turned under or where oat-and-peas follow sod. Good stands can be grown on some newly cleared fields prepared only by disking, if a clean shearing job has been done. Occasional surface roots are not a handicap, providing they are not a later hazard in mowing or chopping.

Fields must be well disked—perhaps two or three times over—so that the smooth surface is easier to mow. Plant immediately after disking to conserve moisture which usually is in short supply during May and June.

Old fields need less preparation, although they must be disked sufficiently to knock down trash. All trash need not be turned under.

A good general seeding rate is 50 pounds of peas and 50 pounds of oats per acre. Comparative studies over a period of three years have showed no advantage from seeding more than 100 pounds per acre. Of this 100 pounds as little as 30 pounds may be peas, which gives silage with high dry matter and a little less protein at harvest time. When 60 per cent peas are planted, the dry matter content is reduced slightly and the protein level is raised. A disadvantage of planting 60 or 70 pounds of peas with only 30 or 40 pounds of oats is that a wet season causes excessive lodging, which makes the crop hard to harvest. Year in, year out, a 50-50 mixture is entirely satisfactory. Planting more seed does not give greater yields. Less seed may reduce yields, especially in seasons when tillering is not normal.*

*Hodgson, H. J., Effects of Seeding Rates and Time of Harvest on Yield and Quality of Oat-Pea Forage, *Agronomy Journal*, 48:87-90, 1956.

The composition and digestibility of oat-pea and bromegrass hay and silage grown on well-fertilized fields at the Matanuska Experiment Station Farm are summarized below. This hay was of good quality, having

| Item | Bromegrass | | Oats-&-peas | |
|-------------------------------|------------|--------|-------------|--------|
| | Hay | Silage | Hay | Silage |
| CONSTITUENTS | | | | |
| | Per cent | | | |
| Crude protein | 13.0 | 13.1 | 9.2 | 10.4 |
| Ether extract | 2.4 | 3.2 | 1.6 | 2.6 |
| Crude fiber | 29.6 | 33.0 | 36.0 | 30.5 |
| Nitrogen-free extract | 46.6 | 40.1 | 44.6 | 43.3 |
| Ash | 8.4 | 10.6 | 8.6 | 13.2 |
| Calcium | 0.4 | 0.5 | 0.4 | 0.6 |
| Phosphorus | 0.4 | 0.5 | 0.4 | 0.4 |
| DIGESTION COEFFICIENTS | | | | |
| Crude protein | 62.9 | 45.9 | 59.6 | 51.9 |
| Ether extract | 47.1 | 62.2 | 52.4 | 69.1 |
| Crude fiber | 68.0 | 64.3 | 61.2 | 52.6 |
| Nitrogen-free extract | 73.2 | 61.0 | 64.1 | 62.7 |
| Total digestible nutrients | 64.9 | 56.3 | 57.9 | 52.7 |

been partially dried in the field and then force dried in the barn. It was of better quality than many farmers can make unless they have expensive drying facilities. The silage was also of top quality, and can easily be matched by most dairymen in Alaska.

Varieties.—Adapted forage oat varieties are Golden Rain, Victory, Nip, and Swedish Select. Gopher oats, while maturing earlier, yield less roughage than the others.

Seed of Victory and Swedish Select oats is usually plentiful, being imported from the States. Golden Rain seed is sometimes difficult to obtain because it is grown locally and demand has been insufficient to insure steady supply year after year.

Diseases—Oats are susceptible to both covered and loose smut. Both of these fungus diseases are distributed world-wide. They have been seen in all agricultural areas of Alaska.

The loose smut fungus replaces the florets of the infected plant with its own black powdery spore masses. This is the main distinguishing symptom of this disease. These spore masses are held together by a very thin membrane as the head emerges, but the membrane ruptures very shortly afterwards releasing the spores.

Unlike the loose smut of wheat and barley, loose smut of oats does not infect the healthy flowers, so the fungus is not carried overwinter within the seed. It overwinters outside of the seed and gets into the plant by infecting the seedling before it emerges from the soil. It then grows inside the plant as the plant grows, and converts the flower parts into spore masses.

Covered smut differs from loose smut in that the membrane enclosing covered smut spores normally remains intact at least until the end of the season, although it may on occasion break earlier to release the spores. Spores form in the head of the oat plant where the fungus replaces floral tissue.

The spore balls are broken open as the grain matures or when it is threshed. Spores liberated at this time infest all seeds. They survive the winter on the outside of the seed. When infested seeds are planted, the fungus spores germinate and infect the seedling. The fungus then grows up with the plant and again replaces the floral part of the plant with spore masses.

Chemical treatment of oat seed controls both loose and covered smut. Volatile organic mercury compounds are the most effective material for treating seed. The vapor of these volatile com-

pounds gives effective coverage without actually coming in contact with every seed.

Some of these Mercury compounds are Ceresan M, Panogen, Agrox, Mergamma, and Setrete. They are almost equally effective in Alaska. Some are dusts and some are liquid. Ceresan M, for example, is a dust used at the rate of a half ounce per bushel of seed. A good rule is to read and follow the manufacturer's labels.

The best and safest method of mixing the seed and the treating material is to use either a Minnesota type gravity treater or a barrel treater.

MERCURY COMPOUNDS ARE EXTREMELY POISONOUS. Do not inhale these materials nor allow them to accumulate on the skin. Grain must not be treated indoors. Do not feed treated grain to livestock, and do not store with feed.

Soil-borne diseases—When oat and pea seed first germinate, a host of soil organisms are ready to attack their tender tissues. In damp cold seedbeds, many seedlings are killed before or immediately after they emerge.

Treating oat and pea seed with fungicides like those listed above helps suppress soil-borne diseases, protects the young seedlings and often improves stands. The economic advantages of improved stands are often hard to judge. If commercially treated seed is available at a small price premium, its use is justified.

Inoculating peas—Most fields that have been farmed for sometime in Alaska produce excellent field peas even though the seed is not inoculated. On newly cleared land inoculation is recommended. This insures that nitrogen fixing bacteria are introduced into the new soil.

Pea inoculant is available in Alaska. It is applied as a seed treatment. The label on the can tells how.

The only other important disease of oats is a nutritional malady called "gray speck". On some alkaline fields in the Matanuska Valley oat yields have been cut considerably by "gray speck". This is caused by failure to assimilate or utilize soil manganese. Applications of manganese to the soil are expensive and of doubtful value. It is

best to avoid planting oats where gray speck has been a serious problem. Golden Rain oats seem to be more tolerant and displays less damage from "grey speck" than other varieties.*

Canadian field pea seed is plentiful. This variety is well adapted to most of Alaska, although it will not ripen seed except in extremely favorable seasons. Seed is usually imported. The Alaska variety of peas is also good but seed is difficult to obtain. No important diseases have been observed in field peas.

Fertilizer.**—A good general rule is to apply 30 pounds of nitrogen, 60 pounds of phosphate and 30 pounds of potash on each acre. This is the equivalent of 300 pounds of 10-20-10 complete fertilizer. Sometimes 300 pounds of 8-32-16 or 10-20-20 may be just as cheap, in which case they are usually just as good.

Where oats-and-peas are planted on newly cleared land, potash may be omitted for the first two or three years. A combination of 100 pounds of ammonium nitrate mixed with 100 pounds of treblesuperphosphate may save as much as \$5 an acre in out-of-pocket cash costs. An even cheaper home-mix combination for new land is 100 pounds of ammonium phosphate (11-48) and 50 to 60 pounds of ammonium nitrate. All of these materials must be mixed on the farm. Whether cash savings offset the labor needed to mix them depends on each farmer's situation at planting time.

Oats-and-peas may follow sod. This sequence affords an excellent chance to plow down manure. On some farms it is the only chance to spread manure during the winter. Some accumulated manure can be spread on the sod after the fall freeze-up, before or after snow arrives. It is often better to spread manure in the snow than to let it accumulate in a stock pile that must later be distributed during the busy planting season.

*Logsdon, C. E., Diseases of Economic Crops in Alaska, Alaska Extension Bulletin 800, 1956.

**See current issue of Fertilizers for Alaska, General Recommendations, Alaska Cooperative Extension Circular 515.

Best yields and best quality of oat-pea silage is obtained when oats are in late milk stage. Values in this table were from a good crop grown on a productive well-

| Maturity when harvested | Dry Crude | | Yield per acre | |
|---|-----------|---------|----------------|---------|
| | matter | protein | Silage | Protein |
| | Per cent | | Tons | Pounds |
| Oats in early milk stage, lower pea pods half-filled | 27.8 | 8.2 | 7.7 | 353 |
| Oats in milk stage, lower pea pods well-filled | 26.9 | 7.7 | 8.7 | 361 |
| Oats in late milk stage, middle pea pods well-filled | 28.1 | 7.4 | 8.9 | 371 |
| Oats in dough stage, upper pea pods well filled | 33.7 | 7.1 | 7.4 | 335 |
| Oats in late dough stage, peas filled and turning yellow | 35.5 | 6.8 | 7.0 | 336 |

fertilized field at the Matanuska Experiment Station Farm. Planting rate was 50 pounds of oats and 50 pounds of peas. The crop was harvested at five different stages of maturity.

Reduced yields of protein as the crop ages is due to weathering, and shattering of lower leaves.

Where oats-and-peas are planted on heavily manured land, 50 pounds of ammonium nitrate and 100 pounds of treblesuper-phosphate usually insures a good silage crop. A good ready-mix fertilizer to use with manure is 8-32-16, at the rate of 200 pounds per acre.

Commercial fertilizer is most efficiently applied with a fertilizer attachment on the grain drill. Fertilizer should be placed about an inch under the seed. If a drill is not available, a broadcast spreader can be used, and the fertilizer disked in before planting. Once over with the disk is adequate.

Weeds.—Most weeds pose no special mechanical problems in making silage, although fireweed, lambsquarter, chickweed, and mustard compete with oats and peas to reduce their growth. Many weeds are overly mature at harvest time and detract from silage quality. Mustard creates off-flavor problems in milk. But for the most part, common weeds are not sufficiently detrimental to justify large cash expenditures to control them in fields exclusively devoted to oat-pea production.

Other considerations, however, make it advisable to eliminate or keep weeds down in oat-pea

A field study of how best to store oat-pea forage compared field-cured hay, barn-dried hay and silage. A uniform oat-pea field at the Matanuska Experiment Station was divided into three parts and the forage from each part was put up in each of these three ways. The results are summarized in the table below.

The point here is that field-curing caused large losses of dry matter. This season was much better for haying than are most years and the field cured hay was in good storage condition when picked up. By this time, however, many of the nutritious leaves had shattered

| Content | | How stored or preserved | | |
|--------------------------------|-------------|-------------------------|----------------|--------|
| | | Field-cured hay | Barn-dried hay | Silage |
| Dry matter content when cut | tons/acres | 2.33 | 2.20 | 2.18 |
| Dry matter stored | tons/acre | 1.85 | 1.94 | 2.08 |
| Dry matter lost | pounds/acre | 978 | 426 | 195 |
| | per cent | 21 | 10 | 5 |
| Crude protein content when fed | per cent | 8.2 | 8.8 | 8.5 |

from raking, loading and unloading. Over a fifth of the dry matter in the crop was lost, worth about \$40 an acre.

Barn dried hay was moist when picked up and losses were therefore much less. Drying costs were, however, beyond the means of most farmers. Picking up silage gave very little loss, amounting to no more than \$10 worth of feed per acre.

fields. Mustard roots, for example, serve as hosts for root maggots which infest other crops to the detriment of the farm, the neighbors, and the community. Mustard drops mature seed before silage is harvested, making more severe weed competition for following grain crops. Lambsquarter and chickweed also drop viable seed before and after silage is harvested. If the roughage field is rotated to grain or row-crops, weed control is a necessity.

Weed competition may sometimes be reduced by allowing weeds to germinate and then disking them under before planting.

Pre-emergence weed control sprays generally give better results with less crop injury than post-emergence sprays. Pre-emergence sprays cost more than post-emergence sprays, because more chemical is needed. Since better weed control is often obtained with less crop injury if weather is favorable, greater crop yields sometimes more than offset initial costs of pre-emergence sprays. Pre-emergence sprays are especially effective on heavily manured fields which usually contain a lot of weed seed. Good timing is very important because the ground surface must be damp and the oat-and-pea should not yet have emerged. There are usually few opportunities to

apply pre-emergence sprays during Alaska's dry spring weather.

Growth regulators like a 2-4,D cannot be used after the crop comes up because they damage peas. Chickweed is not killed during cool weather.

Dinitro compounds control most common weeds like lambsquarter, chickweed, shepherds purse, and mustard. Wild buckwheat and quackgrass are killed. Dinitro chemicals are sold under several tradenames and are now available through many Alaskan dealers. Concentrated forms containing 50 per cent or more active ingredient are cheaper than less concentrated forms.

Dinitro sprays must be applied when weeds are small, or better still, as they are germinating or emerging. Most weeds in oat-pea fields are controlled with 4½ pounds of active dinitro chemical in 50 gallons of water per acre, applied as a pre-emergence spray before the grain begins to show through the ground. The best time is about four days after the grain is planted, providing the ground surface is damp.

If the soil surface is dusty dry, pre-emergence sprays are not very effective. Spray droplets roll up into dust-covered balls, leaving most of the surface without a protective film. Weeds grow through these unprotected spaces.

When cows of equal milk producing ability were fed all they would eat of field-cured oat-pea hay, barn-dried hay, or silage, silage proved the best of the three roughages. It gave nearly a third more milk per acre than hay. Calculated on the basis of the amount of roughage needed for a hundredweight of milk, silage proved cheaper than hay, as shown by the figures in this table. (All cows in the trial were fed the same amounts of grain.)

| Comparison | | Field-cured hay | Barn-dried hay | Silage |
|--|--------|-----------------|----------------|--------|
| Roughage consumed by 2 cows in 90 days | pounds | 4,486 | 4,473 | 10,379 |
| Daily intake of dry matter per cow | pounds | 19.4 | 19.3 | 15.8 |
| Milk produced per pound of dry matter | pounds | 1.07 | 1.08 | 1.34 |
| Milk per acre | pounds | 3,148 | 3,110 | 4,056 |
| Cost of roughage per cwt of milk* | | \$3.61 | \$3.53 | \$2.72 |

*\$60 a ton for hay and \$20 a ton for silage

When post-emergence treatments of dinitro are used, not more than two pounds of active ingredient, diluted in 50 to 100 gallons of water, is needed for each acre. The spray must be applied before the grain is six inches tall, and before the weeds have more than four leaves. The foliage must be dry to avoid excessive burning of the crop leaves.

Harvesting.—Oat-pea silage harvests usually start when the oats reach milk stage. Before harvest is completed, some oats will have passed through the early dough stage which is still satisfactory. If oats become more mature than this their tissues are too dry for good silage. The more mature a crop becomes, the poorer it is for feed.

Ensiling must therefore start early enough so that the entire crop can be cut and stored before the oats pass through their early dough stage. By this time the lower and middle pea pods are well filled. Lower pods have started to turn light green. Topmost pods are beginning to fill or may

be half-filled. If harvest is delayed until the upper pods are completely filled (middle pods turning light green, lower pods turning yellow), the oats are too mature and make only inferior silage.

When harvest begins, the first silage will keep better if it is slightly wilted to reduce its moisture content. With a little practice a farmer can tell when wilted material is ready for ensiling. A slightly wilted crop appears a little lighter in color. Its leaves and stems are limp but not dry curled. Twisting a handful brings moisture to the surface but no free moisture drips off.

The time needed for wilting depends on maturity and on weather. Two to four hours is usually sufficient to wilt a windrow during clear weather in late August or early September. If not rained on, oats-and-peas will wilt enough in this time to make good silage. To avoid over-wilting it is best to cut no more than can be ensiled in half a day. More can be cut if a binder is used because a bundle does not wilt as rapidly as a windrow.

The merits of feeding oat-pea hay or silage separately or together was explored at the Matanuska Farm. Based on the performance of six cows on each ration for 90 days during two years, this trial again demonstrated the superiority of silage, chiefly because more dry matter can be collected from each acre when the roughage is preserved in this manner.

| Comparison | | Barn-dried hay | Silage | Hay & silage |
|--|--------|----------------|--------|--------------|
| Roughage consumed by 6 cows in 90 days | pounds | 10,906 | 33,194 | 22,798 |
| Daily intake of dry matter per cow | pounds | 15.1 | 17.1 | 16.5 |
| Milk produced per pound of dry matter | pounds | 1.75 | 1.61 | 1.65 |
| Milk per acre | pounds | 6,015 | 6,346 | 6,142 |

A 6-year feeding trial at the Matanuska Farm compared oat-pea silage and oat-pea barn-dried hay. In this study the responses of 43 milk cows on each feed were measured for 30 days each year. These cows consumed more dry matter when they were eating

| Comparison | | Hay | Silage |
|---|--------|--------|--------|
| Roughage consumed by 43 cows in 30 days | pounds | 27,798 | 76,110 |
| Daily intake of dry matter per cow | pounds | 18.5 | 17.4 |
| Milk produced per pound of dry matter | pounds | 1.16 | 1.26 |
| Milk per acre | pounds | 4,641 | 5,238 |

roughage preserved as hay. But since more dry matter was actually removed from an acre when it was harvested as silage, silage gave more milk per acre. Less acres are therefore needed to feed a dairy herd when the roughage is harvested and stored as silage.

If some of the crop becomes too dry, fresh green forage should be cut and run in with the wilted material. This can be done by hauling mixed loads or by alternating loads of wilted and unwilted material.

As the oats reach late milk or early dough stage, silage can be harvested by a direct-cut forage chopper and hauled directly to the silo without wilting. If handled in this manner some excess moisture can be expected. Suitable drainage in the silo allows this excess moisture to escape and prevents sour silage.

Chopping silage as finely as possible is important. Fine material packs quickly and more solidly, eliminating air pockets and subsequent molding. The degree of fineness generally depends on the equipment and power available. Most choppers should be set for a $\frac{1}{4}$ -inch cut. Cutter knives must be changed frequently. The cutter bar against which the knives operate must be turned or replaced when its edges wear off.

Ensiling.—Preservatives or additives like molasses are usually not needed to make good silage in Alaska. No benefits are expected from metabisulfite compounds widely advertised in the States. Although the green color may be retained by using additives of this kind, they do not improve the feeding value of the silage grown in Alaska enough to pay for their cost and the labor involved. A possible exception may be in putting up excessively wet silage.

The silo must be inspected and repaired before filling. Steel hoops on wood stave cylinders

should be tightened. Concrete structures showing pitted walls should be painted with thin cement. Doors and cracks must be lined with heavy paper, roll roofing or plastic materials. Care in closing cracks and in smoothing walls prevents mold growth where air pockets form as the silage settles. When filling the silo, paper liners must be smoothed across all cracks to seal out air.

When filling cylindrical silos one man inside tramps the material around the walls and levels off the silage as it enters. It is especially important to distribute the silage evenly and tramp it thoroughly in the upper third of an upright silo. The top 4 to 6 feet should be filled with green wet material. This heavy layer helps force air out all the way down. The drier the main crop, the deeper this heavy layer should be.

If filling is interrupted for a week, remove any spoilage from the surface before continuing. If filling is resumed within a day or so, spoilage usually is insignificant.

After an interruption in filling a cylindrical silo, caution should be observed in re-entering because the structure may contain dangerous concentrations of toxic gases. Doors must be opened to provide ventilation and permit gases to escape. Let the blower run several minutes before entering.

During settling keep the silage well packed in both the center and against the walls. When filling is completed, tramp the silage each day, making sure it is packed tightly against the walls. Continue packing against the wall until settling has stopped, usually after a week or so.

Trench or bunker silos built of planks or rough lumber should be lined with heavy waterproof paper or plastic materials to exclude all air.

The liner must be fastened so it will not tear or sag as the silage settle along the walls.

Trench silos require more packing than upright silos. Packing can be done by filling the structure in layers and driving truck or tractor over each layer. Special attention is given the sides to insure complete packing. Tramping along the walls is usually necessary.

Heap the trench as full as possible so that, after settling the middle is still higher than the walls. This helps shed rain away from the center towards the walls. Cover the filled trench with paper or plastic and about six inches of dirt or sawdust to completely seal out air. The weight of the dirt helps pack the silage. Depressions made by additional settling are filled with more dirt. If some means to keep the dirt fairly dry can be arranged, it will not freeze so hard and the job of winter removal is made easier.

Plastic covers are making low-cost, time and labor-saving horizontal silos more popular than ever among dairy farmers. Covers of polyethylene vinyl, or neoprene-coated nylon provide an airtight seal over the silage and greatly reduce surface spoilage. Plastic covers have cut total storage losses in horizontal silos.

Greater spoilage due to relatively large exposed surfaces has been a major disadvantage of horizontal bunker, trench, and stack type silos as compared with the older upright cylinders. Even this big disadvantage does not completely offset their lower initial cost, ease of filling and ready accessibility, either for self-feeding or mechanical feeding.

Deciding what cover is best suited for a particular silo depends upon the individual's use and comparative annual costs. Neoprene-coated nylon (10-ounce weight) is more durable than vinyl plastic and polyethylene films. Nylon-neoprene sheeting is not easily damaged accidentally by punctures or by the weighting material. Although nylon sheeting is more expensive than vinyl plastic or polyethylene, its life is much longer—probably 5 to 10 years if carefully handled.

Less durable and less expensive films of polyethylene or vinyl plastic are satisfactory for not more than three years. Vinyl film is less subject

to puncture than polyethylene and can be patched readily. The life of these materials depends on how carefully they are handled. Their cost ranges from 2 to 5 cents a square foot per year.

BROMEGRASS

Smooth brome grass is an excellent forage especially suited to interior Alaska's cool weather and dry springs. It is a drought resistant, winter-hardy, sod-forming, long-lived perennial. Properly managed brome grass gives excellent yields of good quality hay, silage or pasture. It is recommended for long rotations or permanent pasture on well drained soils. It is among the first of the grasses to start spring growth.

Brome grass is one of the most palatable of forage grasses and is thought to retain both its palatability and nutritive value at much later stages of growth than most grasses.

Brome grass offers Alaska's dairymen about their only chance of making grass hay during late June and early July when there is an opportunity for field-curing. Bluegrass, commercial timothy, meadow foxtail, and red fescue are all inferior, although a new timothy strain (Engmo) displays some promise.

In Alaska lack of cleared land limits the expansion of many dairy farms. It is therefore important for the dairyman to keep his land in production. Brome grass can be seeded with a grain companion crop which can be harvested early in the fall, and the grass will be ready the next summer. Where irrigated, an early brome grass seeding can be cropped the same year.

Planting.—A good seed bed is the first step in getting a good grass stand. For this reason newly cleared fields should not be planted to grass.

Because plowing is usually required, this affords an opportunity to turn under manure. Manure can be spread the previous fall or during the winter if weather permits. After plowing, disk and harrow the surface until fairly fine. In the Matanuska Valley a seedbed rapidly becomes dry and powdery. It should be planted as soon as possible after plowing. Preparing the seed

An old bromegrass stand at the Matanuska Experiment Station Farm responded as outlined in the table below to different nitrogen treatments. Beginning in 1949 and continuing for a total of three years, all plots were topdressed with the same amounts of phosphate and potash in early spring (80 pounds of P₂O₅ and 40 pounds of K₂O per acre). Some plots were not topdressed with any nitrogen while others were treated with 16 pounds, 32 pounds and so

| Pounds of N per acre per year | Crude protein in crop | | Dry matter | Approximate yield of- | |
|-------------------------------------|--------------------------|----------|---------------|--------------------------|--------|
| | Per cent | Lbs/acre | Lbs/acre | Hay | Silage |
| None | 11.2 | 100 | 878 | 0.5 | 1.5 |
| 16 | 11.4 | 132 | 1,158 | 0.7 | 2.2 |
| 32 | 12.4 | 182 | 1,467 | 1.0 | 3.0 |
| 64 | 14.6 | 324 | 2,213 | 1.7 | 4.5 |
| 128 | 18.3 | 636 | 3,480 | 2.3 | 7.0 |

forth up to 128 pounds of N per acre (about 400 pounds of ammonium nitrate). No midsummer topdressing was applied.

All plots were clipped three times each year. The green clippings were weighed. A sample was dried, and crude protein content was measured. All values in the table are averages for the three years.

Heavy nitrogen applications improved the protein content of the grass and yields. Heavily fertilized grass yielded six times more protein and over four times more forage than untreated grass. The heaviest treatment cost about \$55 an acre for fertilizer and labor to spread it. Improvement in forage yields in terms of dollar values of an equivalent amount of hay or silage went up from perhaps \$30 an acre where no fertilizer was used to around \$150 an acre, assuming good hay is worth \$70 a ton and good silage \$20 a ton.

The first 64 pounds of nitrogen cost \$27 a year. It returned about \$60 or \$70 worth of additional feed over unfertilized grass. The money spent on fertilizer was thus more than doubled. The next 64 pounds of nitrogen cost another \$27. It returned an additional \$50 worth of feed, or about double the investment in additional fertilizer. Unless bromegrass is irrigated there is little chance of again doubling the money needed to spread a third 64-pound increment of nitrogen.

Larger yields might have been obtained from younger stands of bromegrass. Younger stands have responded in a similar manner although yields are sometimes nearly double those reported in this study.

bed, planting, and packing must be done in the shortest possible time to conserve moisture and promote germination.

New seedings need moderate quantities of commercial fertilizer. About 200 pounds of 10-20-10 per acre gives a good companion crop and gets the grass off to a good start. An application of 250 pounds of 8-32-16 is even better for most fields. Fertilizer can be broadcast and lightly disked in. It may also be applied with a drill attachment when sowing the companion crop.

Wheat, oats or barley are suitable companion crops. Barley is best because it can be harvested earlier. Drill in grain and fertilizer first, then seed grass with a cultipacker seeder. Grass seed can also be broadcast by hand or with a cyclone seeder after drilling in the grain. Cultipacking the field is sufficient to work in a hand seeding.

A more common and less laborious method of seeding is to mix grass seed with grain, drilling in both at the same time. In this method the seeding must be shallow, not over an inch deep.

The chief advantage of a companion crop is that some grain can be obtained the same year the grass stand is established. A companion crop also helps keep down weeds. Sometimes, however, grain offers too much competition so that only a poor grass stand develops. If the companion crop seems in August to be more vigorous than expected, it can be mowed down and made into silage, or it can be grazed off. This practice sacrifices a grain crop for a better grass stand.

Mixtures of bromegrass and timothy have been successful on some farms and may be worth trying. Grass and Siberian alfalfa also shows some promise.

Another bromegrass study started in 1949 and continued through 1951 compared the value of (1) spreading all of the nitrogen in the spring with (2) spreading half in the spring and half in early summer. All plots were topdressed with equal amounts of phosphate and potash in early spring (80 pounds of P₂O₅ and 40 pounds potash per acre).

At the same time the phosphate and potash were spread, a fourth of the plots were topdressed with 64 pounds of nitrogen (about 200 pounds of ammonium nitrate) while another fourth were topdressed with double this amount. Still another fourth of the plots were topdressed with only 32 pounds of nitrogen per acre, and another 32 pounds was saved and spread after hay was cut in early summer. The remaining fourth was topdressed with 64 pounds of nitrogen in the spring and again with another 64 pounds of nitrogen in early summer.

All plots were clipped three times each year. The green clippings were weighed and a sample was dried, giving moisture content. Then crude protein was measured. All values were averaged for the 3-year period. These averages make up the table at the right.

| Pounds of N per acre per year, and time | Crude protein in crop | | Dry matter | Approximate yield of Hay Silage | |
|---|-----------------------|----------|------------|---------------------------------|-----|
| | Per cent | Lbs/acre | Lbs/acre | Tons/acre | |
| 64 pounds per acre | | | | | |
| All in spring | 14.7 | 324 | 2,210 | 1.5 | 4.5 |
| Half in spring, half in summer | 13.3 | 300 | 2,250 | 1.5 | 4.5 |
| 128 pounds per acre | | | | | |
| All in spring | 18.3 | 636 | 3,475 | 2.3 | 7.0 |
| Half in spring, half in summer | 16.5 | 547 | 3,310 | 2.2 | 6.5 |

Total yields obtained from an acre of grass is about the same, whether all of the nitrogen is spread in early spring or whether half of it is spread in the spring and the rest in early summer. Spreading all nitrogen in the spring gave large hay yields but less grass for late pasture or silage. Saving some nitrogen for early summer gave less hay but more late pasture and silage.

Some farmers prefer to plant grass without a companion crop. Seeding without a companion crop produces more vigorous grass stands the first year, especially if supplemental water is available. Weeds must be controlled. Grass may be planted alone with a seeder-cultipacker or with a grain drill. If a drill is used, grass seed is mixed with cracked grain to keep it from "bridging" in the hopper. Sometimes a limited amount of roughage may be cut in August.

Seeding rates.—Bromegrass is seeded alone at a minimum rate of 15 pounds per acre on good clean fields where a firm seedbed can be prepared and where adequate moisture in early spring and summer promotes good stands. On most fields, a rate of 20 pounds per acre is needed with or without a companion crop.

If timothy and brome are planted together, five pounds of timothy mixed with 10 to 15 pounds of brome is sufficient for each acre. Where seeded with a legume, 8 pounds of clover or alfalfa, 2

pounds of timothy, and 10 pounds of brome is a satisfactory acre rate.

The same seeding rates apply when a companion crop is planted. Barley and oats should be seeded at the rate of 80 pounds per acre, wheat at about 60 pounds.

Varieties.—There are two types of smooth bromegrass seed—northern and southern. Only northern types are worth planting in Alaska. Southern types usually die during their first winter. Three satisfactory northern bromegrass strains are Canadian Commercial, Manchar, and Martin. Seed of these are usually in good supply, although not heavily stocked in Alaska. Orders must be placed well in advance of planting.

Edda barley and Golden Rain, Swedish Select, Nip and Victory oats are good companion crops. When seed is available, Gasser wheat is also suitable. Commercial timothy may also be mixed with bromegrass. Seed of an especially adapted strain—Engmo—is now available.

There is little point in planting bromegrass and legume mixtures unless seed of the Siberian yellow-flowered alfalfa (*Medicago falcata*) can be obtained. Small supplies of these are sometimes available through the Soil Conservation Districts on a demonstration basis.

Weed control.—Weeds must be controlled in grass seedings. Lambsquarter and chickweed compete vigorously with grass, especially where fields have been heavily manured. Pre-emergence dinitro sprays control these weeds. They are applied in the same way as on oat-pea mixtures (see page 8).

Managing established stands.—If planted without a companion crop and if a full stand develops by August, the grass can be lightly grazed throughout the month. Irrigated stands may be grazed or cut somewhat earlier.

Where planted with a companion crop, the seeding must be watched. If the companion grain offers severe competition it can be grazed off in early August. If competition is not severe, the grain can be allowed to ripen before cutting. Shocks should not remain in the field too long or the grass will smother out where they stand.

After bromegrass has been established, it can be expected to yield up to three tons of hay (or

its equivalent in silage) for the first two or three years on most Alaskan fields. Yields will begin to decline after four or five years, and the grass stand should be renovated or plowed down after five or six years.

Fertilizers.—To obtain good yields, bromegrass must be heavily fertilized. The amount of fertilizer and the timing of applications depends somewhat on how the grass is used—whether pastured, or cut for hay or silage.

During the first year after seeding, an early spring application of 60 pounds of nitrogen, 60 pounds of phosphate and 20 to 30 pounds of potash on each acre will return good profits on the dollars invested in fertilizer. This application is most cheaply purchased by buying concentrated materials and mixing them on the farm.

Six good combinations for spring application are listed below, assuming that all materials are purchased in 100 pound sacks. These values must be increased by 5/4's for 80 pound sacks. The indicated amounts are acre requirements.

- | 2 sacks of 8-32-16
- | 1½ sacks of ammonium nitrate
- | 3 sacks of 10-20-10 or 10-20-20
- | 1 sack of ammonium nitrate

Bromegrass fertilizer studies also included response to phosphate and potash. The fertilizers were spread in early spring as topdressing. Values in the summary tabulated below are averages for all nitrogen levels during the 1949 to 1951 field trials at the Matanuska Experiment Station Farm. Plots were clipped three times a year, green weights measured, and a sample collected to determine moisture and crude protein content.

| Pounds of P ₂ O ₅ , K ₂ O per acre per year | Crude protein in crop | | Dry matter | Approximate yield of- Hay Silage | |
|--|--------------------------|----------|---------------|--|-----|
| | Per cent | Lbs/acre | Lbs/acre | Tons/acre | |
| None | 14.5 | 275 | 1,900 | 1.2 | 3.7 |
| 40-20 | 13.8 | 320 | 2,320 | 1.5 | 4.5 |
| 80-40 | 13.7 | 358 | 2,601 | 1.5 | 4.5 |

This summary shows why heavy potash and phosphate treatments have not been generally recommended. Each increment of phosphate and potash costs about \$10 an acre. The first increment gave a return of about \$50 an acre, but the second produced no additional yields over a period of years. This is confirmed by many farmers who have found 11-48-0 ammophos a satisfactory grass fertilizer. Lack of moisture during a particular season may keep the grass from utilizing phosphate and potash as well as nitrogen.

Where grass is heavily fertilized with nitrogen it is good insurance to apply the extra \$10 worth of phosphate and potash so that a lack of these elements will not restrict plant growth if the season turns out to be favorable. In the Tanana Valley, vegetative symptoms recently observed indicate that potash together with phosphate must be included in grass fertilizers.

{ 3 sacks of 16-20 ammophos
 { ½ sack of ammonium nitrate
 { ½ sack of sulfate of potash

{ 1½ sacks of 11-48 ammophos
 { 1½ sacks of ammonium nitrate
 { ½ sack of sulfate of potash

{ 2 sacks of 16-32-16
 { 1 sack of ammonium nitrate

{ 2 sacks of ammonium nitrate
 { 1½ sack of treblesuperphosphate
 { ½ sack sulfate of potash

These ratios are simple enough so that the separate carriers can be poured directly into the fertilizer hopper from the original containers, and mixed with a hoe or shovel. The spreader agitators complete the mixing.

If no potash deficiencies have been observed in the field and if it has made good crops, 200 pounds of ammonium nitrate and 100 pounds of treblesuperphosphate may be adequate for the spring application. Urea is not a good spring fertilizer because the soil is too cold.

After the first harvest, either as hay or pasture, the grass must be top-dressed with another hundred pounds of ammonium nitrate. An equivalent amount of nitrogen in the form of ammonium sulfate can be used for summer top-dressing.

By the second crop year, most grass stands have developed a heavy sod. Yields during the second year and after diminish unless spring fertilizer applications are maintained. An early summer application is also needed. Some fields may return profits on applications of 120 pounds of nitrogen per acre.

It is poor economy to apply less than 60 pounds of nitrogen and 40 pounds of phosphate to bromegrass in the spring. Smaller applications do not usually pay. If cash resources are scarce it is best to fertilize fewer acres with more fertilizer, rather than spread less fertilizer on more acres.

Where grass can be irrigated, a third application of fertilizer may pay dividends. Supplemental water probably will not give greater yields through the season unless the fertilizer is applied at intervals throughout the summer.

If there are doubts about a response to fertilizer, a portion of the field can be left untreated.

Better grass quality and better yields are obtained from heavily fertilized grass when nitrogen, phosphate and potash are all balanced. The following summary is from studies described in the previous pages.

| Pounds of N per acre per year | Total crude protein yield for the season, for the following P ₂ O ₅ & K ₂ O treatment, lbs/acre | | |
|-------------------------------|--|-------|-------|
| | None | 40-20 | 80-40 |
| | Pounds of protein per acre | | |
| None ----- | 76 | 91 | 92 |
| 32 ----- | 158 | 149 | 173 |
| 64 ----- | 273 | 291 | 300 |
| 128 ----- | 430 | 564 | 671 |

When grass was topdressed with 128 pounds of nitrogen per acre each additional \$10 worth of potash and phosphate improved crude protein yields by at least 100 pounds per acre. This is equal to nearly 700 pounds of hay (14 per cent protein, 20 per cent moisture) or a ton of silage, both worth about \$20.

An untreated strip 3 or 4 feet wide across the field will show up if the adjacent grass is responding to fertilizer. Some farmers also double back on a small strip to see if a double treatment might pay.

Bromegrass hay.—Since bromegrass now offers Alaska's dairymen about their only chance of making field cured hay, an effort should be made to use the first growth in this form whenever possible. While most cows give good milk yields on silage alone, they do crave a little hay. The TDN content of hay usually is higher than for silage. A cow can consume more feed if some is offered in the form of hay. Good drying weather usually occurs in late June.

The protein content and digestible nutrients in bromegrass both decline as the crop ages. Cutting early—when the forage approaches its peak stage of nutrient content—is the key to making good hay. Even if more tonnage can be harvested by delayed cutting, this is no advantage. The yield that counts—total digestible nutrients per acre—is much smaller from a mature crop than from the same plants cut at their nutrient prime.

During vegetative growth, grass plants accumulate stores of digestible nutrients. These reach a peak sometime in the bud or early bloom stage.

As bromegrass matures its protein content drops. Good quality hay can be cut in late June and early July, when the best chances of field drying can be expected in interior Alaska. The values in this table were from successive harvests from an old bromegrass field at the Matanuska Experiment Station Farm that had been well fertilized.

| Date and stage of growth when harvested | Crude protein | Yield per acre | |
|---|---------------|----------------|---------|
| | Per cent | Hay | Protein |
| | | Pounds | |
| May 28 3 to 6 inches of early growth | 27.4 | 1,080 | 237 |
| June 12 internodes elongating, 10 inches high | 22.1 | 1,835 | 324 |
| June 26 still growing, 27 inches high | 13.7 | 3,600 | 394 |
| July 10 all panicles emerged, in full bloom | 12.2 | 4,364 | 426 |
| Aug. 7 seeding developing | 10.2 | 5,079 | 414 |
| Aug. 28 seed ripened, leaves yellow | 5.4 | 6,030 | 259 |
| Sept. 25 leaves dry and shattering | 4.2 | 3,392 | 113 |

Thereafter, this accumulation rapidly declines as the plant uses it to form flowers and seed. Less valuable stems become a larger proportion of the total mass as leaves turn yellow and shatter.

The greater nutrient content of early cut hay has been proved by many feeding tests. Bromegrass contains the most protein and digestible nutrients when its heads are emerging and some flowers are opening. After full bloom, its fiber content rapidly increases and hay quality deteriorates. This peak nutrient stage fortunately coincides with good hay making weather in most of interior Alaska. Hay made at this time contains 11 to 13 per cent crude protein, about 7 per cent digestible protein, and 50 to 54 per cent digestible nutrients (TDN). This kind of hay needs supplementing only with local grains (which supply the extra TDN) and a small amount of protein supplement (200 pounds per ton) as a safety measure.

Weather.—Over 40 years of weather records collected at Matanuska show that for any day a farmer mows hay between June 15 and July 1, he has odds of 1 to 1 for three good days of drying weather, and odds of 3 to 1 against five days of good weather. From July 1 to July 15, the odds against good haying weather drop to 2 to 1 for three days and 4 to 1 for five days. Thereafter, chances against three days of good weather remain at about 4 to 1 for the remainder of the season. If a hay crop is not under cover by July 4, plans must be changed to make silage.

Chances of getting high quality hay under cover are greatly improved by crimping or crushing

the stems. This speeds up drying and cuts about a day off field curing time. Although crushing adds perhaps \$3 to the cost of a ton of hay, it reduces the probability of rain damage.

Keeping in touch with weather news is helpful in getting hay making off to a good start, or considering the alternative of silage making to avoid rain-damaged hay. One-day forecasts for the Matanuska Valley are improving in accuracy, although nearby mountain ranges cause local differences difficult to anticipate. While Tanana Valley forecasts are primarily for aviation needs, 1- and 2-day predictions of 85 to 90 per cent accuracy are extremely helpful to farmers.

Conserving quality.—Once cut, there is no chance to improve the nutrient content of hay. The hay-makers' big task is to conserve quality. No single set of procedures suits all hay-making situations. Whatever equipment is used and whatever the methods used, efficient haymaking aims at reducing moisture to safe storage levels with the least possible loss of greenness and leaves.

Bromegrass contains 70 to 80 per cent moisture when cut. For safe storage this must be reduced to less than 20 per cent, whether it is put up as loose hay, chopped, or baled. Chopped and baled hay must be drier than loose hay.

When properly dried, hay loses nutrients very slowly and may remain a good feed for a year or longer. Underdried hay packs tightly, and will heat and mold. Overdried hay shatters its leaves, is brittle, discolored, and even dusty. Its nutrients dwindle and its palatability is poor.

Bromegrass silage has proved better than field-cured or barn-dried grass hay. The summary below shows the results of a 90-day feeding trial conducted in 1949 and repeated in 1950. This trial involved four cows on each kind of roughage. All cows were equal in weight and possessed equal milk producing capabilities. They were offered all of the roughage they would eat.

| Comparison | Field-cured hay | Barn-dried hay | Silage |
|---|-----------------|----------------|--------|
| Roughage consumed by 4 cows in 90 days .. pounds | 10,988 | 10,032 | 17,785 |
| Milk produced per pound of dry matter ---- pounds | 0.79 | 0.90 | 1.14 |

A longer feeding trial comparing bromegrass barn-dried hay and silage confirmed these findings. The following summary gives the average production of 20 cows fed for 90 days each year over a 7-year period (1949-1954) at the Matanuska Farm. As in the above trial, the hay was generally of good quality, better than can be made on most dairy farms that do not have artificial drying facilities.

| Comparison | Hay | Silage |
|--|--------|--------|
| Roughage consumed by 20 cows in 90 days pounds | 37,747 | 81,116 |
| Milk produced per pound of dry matter --- pounds | 1.17 | 1.35 |

Similar results were obtained from still a third test comparing barn-dried bromegrass hay and silage with another ration containing equal qualities of these two roughages. Values in this summary are averages for a 2-year period.

| Comparison | Barn-dried hay | Silage | Hay & silage |
|---|----------------|--------|--------------|
| Roughage consumed by 7 cows in 90 days .. pounds | 9,105 | 19,786 | 10,352 |
| Milk produced per pound of dry mater ----- pounds | 1.73 | 1.78 | 1.77 |

As with oat-pea mixtures, a smaller acreage of bromegrass silage produces as much milk as a larger acreage harvested as hay. This is because more dry matter can be collected when the roughage is preserved as silage. Losses from shattering of leaves, leaching and bleaching in field-drying hay are avoided in making silage.

New ways of conserving color and leaves, particularly ways that lessen exposure time and weathering, are constantly being devised. Since leaves dry faster than stems, crushers and crimpers that break up the stem tissue promote more uniform drying in the swath. Many kinds are available, the best being those that attach to the mower. Crushing or crimping stems usually eliminates one day of exposure during good weather. The fluffing action of a tedder is of some benefit although it does not substitute for crushing or crimping.

Raking swaths into windrows at the right time saves quality. Premature raking retards the drying rate and prolongs exposure. Fastest drying is

achieved when windrowing is delayed until the moisture content is down to 50 per cent or less.

Side delivery rakes save more leaves if fitted with more bars than the old 3- and 4-bar types. Rakes with 5 or 6 bars lift the hay more gently and lessen leaf shattering.

Ensiling bromegrass. — There is usually no chance to make hay after early July in most of Alaska. A second cutting of bromegrass is best stored as silage.

Bromegrass is more difficult to ensile than oat-pea mixtures. Grass dries out faster and is harder to pack. Direct cut equipment often works best with grass, which does not need to be wilted. Except for these differences, grass silage can be

stored in cylinders, trenches and, in emergencies, in stacks like oat-pea mixtures.

Grass silage must be finely chopped and firmly packed. After completing a day's pickup, a layer of wet chopped oats-and-peas on top of the grass helps press it down and force air out.

ANNUAL LEGUMES

Alsike clover, Red clover and Hubam sweet clover are sometimes well worth growing as annual legumes. Seed is usually available and not too expensive. For farmers who depend largely on bromegrass, a few acres of annual legumes may

be useful in making grass silage. Several loads of wet legumes help pack down chopped grass in the silo. The added water may help offset lack of moisture in grass that is a little too dry.

Annual clovers start very slowly because soil moisture conditions in a normal spring are too dry to insure germination.

Irrigation speeds up germination so that full use is made of June and July sunlight. Even without irrigation clovers usually emerge by mid-July and grow rapidly during August. Yields of 5 to 6 tons of silage per acre can be expected where weed competition is not severe.

HIGH PROTEIN SUPPLEMENTS NOT NEEDED IN ALASKA

Alaska's dairy industry is based on high protein roughages. Oat-pea mixtures and bromegrass both contain considerably more crude protein and digestible protein than does corn silage, which is the primary roughage in many other states. National dairy journals and farm papers are slanted toward these corn-based milksheds. Many of their articles and much of their advertising is directed toward dairy farms where low protein corn silage is fed as a major roughage, and where dairymen usually make up protein deficiencies by including high protein supplements in their rations.

In contrast, good quality oat-pea and bromegrass roughage needs little high protein supplement. A grain mixture of local oats and barley containing in a ton 200 pounds of soybean meal, 20 pounds of salt and 20 pounds of bone meal, is all the supplement needed to supply both digestible protein and total digestible nutrients (TDN). Fed in amounts sufficient to supply a cow's TDN requirements this grain mixture also provides — together with good quality grass, or oat-pea forage—more than enough pro-

tein. The table below illustrates this point. It compares the digestible protein (DP) and the TDN requirements of a 1,300 pound dairy cow

| Comparison | DP | TDN |
|---|----------------|------|
| | Pounds per day | |
| Supplied daily by oat-pea silage | 1.84 | 13.6 |
| Supplied daily by bromegrass hay | 1.95 | 13.8 |
| Producing 20 pounds of milk per day, grain ratio 1 to 5 | | |
| Nutrients supplied by 4 pounds of grain mix .. | 0.48 | 3.0 |
| Total supplied by silage and grain ration | 2.32 | 16.6 |
| Total supplied by hay and grain ration | 2.43 | 16.8 |
| TOTAL NEEDED* | low 1.57 | 15.0 |
| | high 1.80 | 16.4 |
| Producing 40 pounds of milk per day, grain ratio 1 to 3½ | | |
| Nutrients supplied by 11½ pounds of grain mix | 1.38 | 8.6 |
| Total supplied by silage and grain ration | 3.22 | 22.2 |
| Total supplied by hay and grain ration | 3.33 | 22.4 |
| TOTAL NEEDED* | low 2.39 | 21.2 |
| | high 2.78 | 22.8 |
| Producing 60 pounds of milk per day, grain ratio 1 to 3 | | |
| Nutrients supplied by 20 pounds of grain mix .. | 2.40 | 15.0 |
| Total supplied by silage and grain ration | 4.24 | 28.6 |
| Total supplied by hay and grain ration | 4.35 | 28.8 |
| TOTAL NEEDED* | low 3.21 | 27.4 |
| | high 3.70 | 29.2 |
| Producing 80 pounds of milk per day, grain ratio 1 to 3 | | |
| Nutrients supplied by 27 pounds of grain mix .. | 3.24 | 20.3 |
| Total supplied by silage and grain ration | 5.08 | 33.9 |
| Total supplied by hay and grain ration | 5.19 | 34.1 |
| TOTAL NEEDED* | low 4.03 | 33.6 |
| | high 4.74 | 35.6 |

*Needed for body maintenance are 0.75 to 0.82 pounds of digestible protein (DP) and 8.8. to 10.0 pounds of TDN per day.

producing from 20 to 80 pounds of milk a day with the amount supplied by the suggested rations.

In calculating the above values, a digestible protein content for oat-pea silage was assumed to be 2.3 per cent, for brome-grass hay 7 per cent and for the grain mixture 12 per cent. Total digestible nutrients were assumed to be 57 per cent for silage, 53 for hay, and 75 for grain. These are conservative values, representing what can be expected in only medium quality roughage.

For every level of production, these locally grown rations supply adequate protein, providing enough grain is fed to supply the cows requirements for total digestible nutrients.

ROTATIONS

During the past decade, many Alaskan dairy farmers have planted brome-grass. In 1959 it was estimated that nearly 7,000 acres of seeded grasslands were on Alaskan farms. In the Matanuska Valley, over 5,300 acres of a total of 15,000 acres of cropland were in seeded grass, most of it planted to brome.

More recently many farmers have enlarged their grain plantings of barley and oats. Perhaps a half

of the Matanuska Valley's grain needs were grown locally in 1959, rather than being imported as in the early 1950's. These two developments mean that many dairy farms are now practicing some system of crop rotation.

Because brome-grass fields seldom remain productive for more than six years, a six-year basic rotation may be a feasible goal for many farms. Some modification of the suggested rotation diagrammed below can be adapted to many enterprises.

A three-year rotation may be more practical for some farms. On others, a half or two-thirds of the cleared acres might well be seeded to grass, the remainder being rotated from grain to oat-pea mixtures.

A rotation serves a useful purpose in laying out a long range farm plan. Many financing institutions require a schematic rotation in order to evaluate the debt carrying capacity of a proposed enterprise.

No planned rotation survives for more than a few years in its original form. A severe winter may kill a grass-stand, thus interrupting a long range plan and demanding large adjustments.

| Year | One-third of cleared acres | One-third of cleared acres | One-third of cleared acres |
|---------------|----------------------------|----------------------------|----------------------------|
| First | Oats & peas | Grass | Grain |
| Second | Oats & peas | Grass | Grain |
| Third | Oats & peas | Grass | Grain |
| Fourth | Grain | Grass | Oats & peas |
| Fifth | Grain | Grass | Oats & peas |
| Sixth | Grass seeding with grain | Grass | Oats & peas |
| Seventh | Grass | Oats & peas | Grain |

Oat-pea mixtures can be substituted for grain, or part of the grain acreage might be diverted to potatoes or truck crops. Annual legumes or timothy-clover mixtures may also be substituted for oat-pea and grain plantings.

