Agroborealis

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Institute of Agricultural Sciences
University of Alaska

A Review of Research in Progress

from the

Director's Desk . . .

Notice anything different about our cover? That's right! The old and honorable name by which we have been known for over 70 years is gone. On January 1 we became the seventh Research Institute of the University of Alaska. Why the change? Had our mission suddenly become more grandiose? Or were our hat bands perhaps getting a little too tight for our heads? What was the matter with the good old designation, "Agricultural Experiment Station" that has served similar institutions the world over for more than a century?

The truth is, despite a well known horticultural observation to the contrary, that there really is something in a name. To quote an even older observation, "By their names shall ye know them." *We* have not changed but our constituency has, and unless we can make ourselves better known to our new public, we can hardly expect its whole-hearted support.

Director Horace F. Drury

We have always felt, and still do, that we work for all Alaskans -- at least for all of them who eat or who believe that their environment can be made still more pleasant by the cultivation of living things. While our efforts have gone unnoticed by some, up to fairly recently this really has not made too much difference. Alaska may have been short on full-time farmers, but it had a high proportion of homesteaders and farmers-at-heart and most of these knew what an Experiment Station was. Even though the term no longer adequately described the full scope of our activities, they knew what to expect of us. But now, farm oriented people are far outnumbered by city people. Many of these have little conception of the sophisticated nature of modern farming and few seem to realize that agriculture, "the sciences and art of cultivating the soil - - -," is also concerned with lawns, vegetables, flowers, shrubbery, and the revegetation of scarred earth. Even the better informed tend to believe that an Experiment Station is merely a place where experiments are performed with various kinds of seeds and fertilizers. It is time for us to try to paint a new picture for them, not only of ourselves, but of agriculture as a whole.

Probably few of our readers understand that even the smallest commercial farm, a one-family operation, involves an investment of well over $100,000 - indeed, that some of our Alaskan farmers are already managing half-million dollar businesses. That's a bit more than "Old McDonald" had at stake and the "Farmers Almanac" is no longer adequate as a handbook. As a matter of fact, it never was. Top notch farmers have never been content to use last year's varieties, fertilizers, machinery, livestock and methods to meet this year's needs. They have always sought and used the very latest information obtainable - even when they had to generate their own. Many, like Thomas Jefferson, have done work of professional quality. But today, investments are so big, competition is so fierce, and there is so much to be investigated in so many scientific specialities, that no farmer can hope to do all his own research. That is what we are here for.

It is our mission to provide a constant stream of new knowledge and new materials to help keep our farmers a step ahead of the competition and to improve the quality of life for our gardeners, homeowners - in fact, for all our citizens. This is a big order and the Institute of Agricultural Sciences is still a very small organization, in need of the help and understanding of all Alaskans and hopefully of outside agencies and research foundations as well. Now that we have taken off our boots and come into the parlor with the rest of the folks, we hope that we will be in a better position to make our story heard.

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Editor
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ABOUT THE COVER . . .

Pictured on the cover of this issue of Agroborealis is an experimental revegetation project along the Glenn Highway at Mile 167. From left are Gerald W. Zamber of the Bureau of Land Management, R.B. Schwendinger and J.C. Stover of Alyeska Pipeline Service Company. In foreground is a plot of creeping foxtail and at left a plot of Kentucky bluegrass.

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Ecology, Environment and Agriculture

Wm. W. MITCHELL
Associate Professor, Agronomy

A mounting concern over environmental matters has engaged Alaska in a national discussion. This attention has centered mainly on the susceptibility of Alaska's environment to damage and on the preservation of Alaska's wilderness. Activities now underway necessarily are leading to decisions on land uses and designations. For this purpose, knowledge derived from research and experience in land husbandry is invaluable for (i) maintaining a proper ecological relationship with the land, (ii) adapting land to multiple use functions, and (iii) directing Alaska's food-producing role for a growing population.

Much of the concern over the impact of development has been on the ability to heal and stabilize disturbed ground. This has prompted various investigations in revegetation, for which agricultural experience and research have provided an important base. Trial efforts at revegetation in the Copper River Valley portion of the proposed oil pipeline route have produced encouraging, first-year results. Adequate stands were obtained this past summer of a number of grasses and cereals that showed healthy responses to fertilizer treatments. This research is continuing in order to obtain further information on winterhardiness and longevity and to establish more extensive tests, particularly in areas where agriculture hasn't been attempted.

Requests from throughout Alaska for information and materials to grow for beautification and stabilization are increasing. Many come from areas of severe climate where there is no prior, recorded experience to use as a guide. Research in assessing the agronomic character of native and introduced plants at the Institute of Agricultural Sciences has established a base for tackling these tougher problems.[1]

Concern over the environment is having a salutary effect on how we treat our habitat. However, discussions over the susceptible nature of Alaska's environment may have brought into question the potential of the land for productive settlement. Some discussions may even have conveyed the notion that all of Alaska is a tundra much too fragile for occupancy. This, of course, is not true; much of Alaska is in the boreal forest, a region that is utilized for agricultural and other purposes in similar latitudes around the world.

Alaska's productive potential, in fact, has been demonstrated to be considerable in those areas now being farmed. The fabled and factual big cabbages of Alaska are not the only evidence of this potential. Forage production, though not equalling that of the better fields in the Corn Belt and the South, equals and exceeds that of many other farming areas of the U.S. Yields of 4 to 5 tons of dry matter per acre are attainable in the Matanuska and Tanana Valleys. Other areas of Alaska have the same potential. Under reasonable management 2 to 3 tons of dry forage are readily obtainable, and this exceeds the national average.

Probably of more concern to a number of persons is the natural productivity of the land and its capacity to regenerate a cover after removal of the native growth. When the removal is accomplished in keeping with good principles of land husbandry, the productive potential of the land may be only slightly impaired, and regeneration of a natural cover can be relatively rapid. Native hay fields have been produced by careful, timely removal of the forest cover. With the elimination of the dominant woody competitors, herbaceous species can develop and increase rapidly. Repeated burns that destroy a forest cover in southcentral Alaska can produce a lush herbaceous cover, which, on sufficiently deep soils, may yield 2 to 2.5 tons of dry matter per acre. Production on native, undisturbed grasslands that occur above timberline also may be high, equalling 2 tons or more.

Research in gathering and assessing native and introduced plants at the Institute of Agricultural Sciences is providing a base for solving some of our environmental problems.

In some situations, fires may result in a diversity that affords a more desirable use than the original cover. For instance, some of the most extensive blueberry patches occur on burned-over woodlands, as do some of the best moose pastures. Mechanical clearings also afford similar opportunities. Wild raspberry picking is best along berms formed in clearings and on artificial cuts. Browse plants for moose multiply along the edges of clearings and in abandoned fallow ground. The dissection of woods, creating openings and borders, provides a variety of habitats that sustain a greater diversity of growth, thus supporting a greater variety of life and satisfying more interests. In the Interior, areas with permafrost often can be made more useful through clearing and cultivation. With deeper thawing of the permafrost, the soils become warmer and more productive.

Managed ecosystems not only may

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[1]It is interesting to note, in commenting on the role of plants in environmental applications, that turfs can aid in reducing air pollution in cities. Furthermore, buffer zones of trees and shrubs can reduce noise levels.

Natural grasslands occurring above timberline may yield over 2 tons of dry forage per acre. This grassland is part of a ranch on the Kenai Peninsula east of Anchor Point.

serve more useful functions, they also may be aesthetically more pleasing. For instance, a Cook Inlet tidal flat area that has provided enjoyment for thousands with its floral display, subsequent to the 1964 earthquake, has become increasingly infested with willows. A diligent effort at control of this natural, shrubby incursion could preserve a portion of the area for its annual show of shooting stars, iris, and Kamchatka lilies.

An appreciation of nature may be realized in many ways. A more compelling desire to live with nature oftentimes manifests itself in an agricultural venture. Generally the desire of a farmer or rancher to live on the land goes beyond a mere desire to profit from the land (staying power sometimes outruns profitability). Here, in the give and take of dealing with nature, man gains an insight into the limits and responses (ecological forces) that shape our environment. Utilization of our land need not be at the expense of the land. Good land husbandry aims at an economic relationship with the land wherein profitable yields are sustained over the long term, which means that the land is maintained in a productive state without depletion. The object of research in land husbandry, which actually is applied ecology, is to determine the means for achieving this balance. Through increased research and experience in land husbandry we will obtain needed information on how to manage our northern ecosystems.

It is well that there are efforts to preserve areas of Alaska to be viewed in their largely unmodified, pristine condition. But sufficient tracts of land can and should be employed or designated for productive purposes. Alaska has a capacity for supplying its own food requirements that is far beyond that being utilized at the present.

We are a big importer of foodstuffs from other parts of the nation -- this in face of growing demands and shrinking agricultural lands in the rest of the nation. James Horsfall, Director of the Connecticut Agricultural Experiment Station, tells us that we have about 50 to 70 million acres of reserve agricultural land in the United States, much of it of the poorer type. However, at the current rate of occupancy of land by various developments -- about 1 million acres per year, of which two thirds may be considered farmland --

--Please Turn to Page 25

An experimental revegatation plot on a black spruce muskeg site near Glennallen. Good growth was obtained with a number of grasses.

Fermented, High-Moisture Barley

Harvesting Barley in the Matanuska Valley

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Barley production and harvest are subject to the exigencies of weather, as are other agricultural endeavors in Alaska. Cool, damp weather and moisture levels often higher than 20% in the grain at harvest preclude storage in conventional structures without supplemental drying.

The obvious approach is to dry the grain to 13-14% moisture prior to storage. Drying implies alternatives which may not be acceptable to the producer, however. One is to dehydrate by artificial means, but this requires energy which is expensive and adds to the cost of production. Another is to bind the grain and store in the shock to permit field drying prior to threshing. Somehow the vista of shocked grain standing neatly in the field, row on row, loses its appeal to the grower in the accomplishment. A third alternative is to delay harvest until the standing grain has ripened and dried more completely. This becomes a calculated risk each year in the gamble of weighting field maturity against possible losses due to lodging and shattering during late summer and fall winds and rain, plus the final indignity of having the crop buried under improvidently early snowfalls.

Is it possible to store barley in unconventional structures without supplemental drying? Research results from the "South 48" with high-moisture corn suggested this as a very real possibility. We initiated research studies in Alaska in 1962 to evaluate the storage of barley as fermented, high-moisture grain. Our research has focused on two main points of interest – problems of storage and problems of utilization in livestock rations, especially those of lactating dairy cows.

We found that preservation was excellent in prefabricated storage units of 500-bushel capacity, as long as the contents remained sealed from the air. After exposure to the air, however, the fermented grain deteriorated rapidly. This mixed success suggested the use of plastic bags, holding about a ton of grain and supported within 4x4x4-foot pallet boxes. Preservation was also excellent in these units and the contents could be used within a few weeks, before appreciable spoilage could take place. The optimum size of these simple storage units was dictated by the rate of use once the contents were exposed to the air. Technological developments to exclude air during both storage and use of the grain would permit larger storage units independent of rate of use.

Success with fermented, high-moisture barley is dependent, not only on storage, but also on satisfactory utilization. Our utilization research was directed primarily toward incorporation of barley into rations for lactating dairy cows. In the initial feeding trials, barley was fed as a component of the roughage portion of the ration by adding it to standard rations of silage, fed free choice, and blended concentrates fed according to milk production. Although the addition of barley depressed silage intake, it increased total dry matter intake. Use of whole, unprocessed barley depressed milk production while either grinding or rolling the grain enhanced production in comparison with the standard. Barley could replace some of the roughage in the ration, but it should be processed prior to feeding.

The importance of processing was demonstrated also in digestion trials. The apparent dry matter digestibility of whole barley was 75%, higher than one would expect from the appearance of grain in the feces. High-moisture barley is soft and much of the nutritive content can be extracted from the grain during passage through the gut. Grinding or rolling prior to feeding increased digestibility to 85-90%.

Barley is a concentrated energy source, however. In more recent studies we compared the feeding of silage and static levels of barley, balanced with protein supplements, to standard rations of silage, fed free choice, and blended concentrates fed according to production requirements. In these trials, barley was fed at either 7.5 or 15 pounds per day (dry matter basis) throughout a 105-day feeding trial, regardless of production levels.

Combined data from three years of research showed little difference between the standard ration and 15 pounds of barley; however, significantly less milk was produced when 7.5 pounds of barley was fed. The data must be evaluated on the basis of the progressively increasing potential for milk production expressed by the cows used in the trials during this time. In the first two years, milk production ranged from 35 to 39 pounds per day and was higher on the barley regimen. In the third year, however, milk production ranged from 42 to 47 pounds per day and was highest on the standard ration.

Results from our research show that barley can be successfully stored as high-moisture, fermented grain in sealed storage of simple design. Barley was used successfully as a component of either the roughage or concentrate portion of the diet. Increased potential for milk production of individual animals will require continued reassessment of feeding programs to attain that potential.

Apples in Alaska

CURTIS H. DEARBORN
Research Horticulturist

Apples are not native to Alaska even though there are areas along the coast with milder weather conditions than those where apples are grown in other regions of the world. Oregon crabapple (*Malus fusca*) of southeastern Alaska is the only member of the *Malus* genus indigenous to Alaska.

Early settlers in Alaska were eager to have apples in their new environment and efforts were made at the Sitka Agricultural Experiment Station in 1902 and 1903 to grow and propagate apple varieties of that era. By 1906 about 30 varieties, constituting 2716 apple trees, had been distributed to settlers to learn if they would be productive in their new locations. Crabapples were also studied and found to be hardy and productive. Inadequate transportation made it difficult to spread the material beyond communities accessible by water. As a result of this early work, a few fruits of Yellow Transparent, McIntosh, Jonathan, Northern Spy and other more recent varieties are grown in the Panhandle Region of Alaska, notably at Haines. Heavy rainfall and high humidity of this coastal region favor fungi that attack apple leaves and trunks so that fruit production there is not without its problems.

In the Auke Bay area, an old orchard of Yellow Transparent trees with trunks 6 to 10 inches in diameter was observed in the early "50's" heavily laden with moss growth typical of that found on forest trees of that region.

At Hope, on the south shore of Turnagain Arm where the climate is tempered considerably by the water and winds of Cook Inlet, apples have been fruiting for over 30 years. Anoka and Haralson were recognizable but these were destroyed by high tide-water following the 1964 earthquake.

Settlers on the Kenai Peninsula at Seward, Sterling, Kenai, Ninilchik, and Homer have attempted to grow apples. Trees of Wealthy and Yellow Transparent fruited once in the Sterling area and were subsequently destroyed by moose browsing. Apple trees set in the other communities have grown poorly. None have matured a crop of fruit and most trees have succumbed to unfavorable growing conditions including destruction by moose browsing, or girdling by mice and rabbits.

Figure 1
Chinese Golden Early

In the vicinity of 3rd Avenue and Christensen Drive in Anchorage, an apple and 2 crabapple trees have been growing and fruiting for over 30 years. The fruit spurs and the bark of the apple closely resemble that of Yellow Transparent; however, the fruits are not typical of this variety as it grows in other apple producing regions. The tree could be a seedling of Yellow Transparent developed during the early work at Sitka.

Further up Cook Inlet, at the Matanuska Research Center, testing of apple trees has been in progress since the early "20's." Apple trees have been set in other locations of Alaska, including the College Research Center; however, survival of the plantings and production of mature fruit have been rare. An extensive planting at the Matanuska Research Center in the early "30's" was doomed to failure at setting because the root systems had become very dry during the long period in transit from nurseries in the lower latitudes.

In 1949, 39 named and numbered varieties of apples were set at the Matanuska Research Center in 5-tree plots to determine their response to this environment. Tops of about 25 percent were still alive and showing weak growth characteristics in June of 1952. Not one group showed vigorous growth among the groups of 5 trees set of each variety. It was not apparent why the apples had died or declined in vigor, so cultural practices that might influence tree survival were tested. The first method was to provide good soil drainage. Trees were set over an area of well-drained soil, where drainage was assured by excavating to a depth of 2-1/2 feet, filling with a foot of small stones, covering with top soil, and setting the trees conventionally in these prepared holes.

The second method was to evaluate tree response to exposure in the open versus against a solid fence of inch boards nailed to a height of 6 feet on wood fence posts. Four posts were set at the corners of a 12' x 12' soil plot oriented so that the east and west board walls ran parallel to magnetic north. Apple trees were set inside the square against each wall and outside the square against each wall giving all possible directions of exposures to, and protections from, the elements. The third method was to set trees into a steep soil bank and mound soil over the excavated area, leaving their trunks protruding and in a horizontal position. Envelopes of 1/4 inch mesh hardware cloth were used to protect the tops from rodents. The varieties Red Duchess and Yellow Transparent were used for these 3 studies.

These newly set trees grew normally in 1952, their first season. Buds broke irregularly in the spring of 1953 and all trees of both varieties were dead by mid-August. The answer to over-wintering apple trees had not been found through employing these protective practices. Twelve other new varieties were also set in 1952 in the conventional manner. Their growth was very disappointing in 1953 and all were dead at the close of the 1954 growing season.

With the passing of time, it has been observed that rootstocks of some trees, whose tops had winterkilled in earlier years, had regenerated a new top. When this material was traced to its origin, it was learned that the rootstocks in use by the propagators were from hardy stocks such as Columbia crabapple, or ornamental types, *M. baccata* and *M. Sieboldii.*

In 1960, the major emphasis was changed from testing the survival of nursery "whips" of commercial apple varieties to grafting scionwood onto sprouts of surviving rootstocks. Although it was recognized that USDA plant exploration excursions to other countries had brought new apples to the Plant Introduction Station at Glen Dale, Maryland, use of this new wood in Alaska was limited by a lack of trees in which grafts could be set. Each year the list of available accessions from Glen Dale was scanned for possible new varieties that might be expected to survive in the Cook Inlet environment. Since 1960, wood of 8 apples from Glen Dale has been grafted to available rootstocks. A few grew normally and developed a shoot 6 to 24 inches long.

Only a few scions have remained on the rootstocks long enough to produce fruit. Some winterkilled in the winter following setting, several succumbed during the second winter, and some were broken at the graft union by wind or carelessness in culture.

Three varieties with quite acceptable fruits are among the survivors that fruited for the first time in 1970. Chinese Golden Early (Figure 1), a yellow apple type, was grafted 25 May 1967 to *M. baccata* and it made a shoot 24 inches long during that growing season. In 1970 the tree was 7 feet tall and produced a profusion of large white flowers and 37 good fruits.

Yephorys Chernogous scionwood was grafted 3 June 1966 to *M. baccata.* It made excellent growth and form each year. Over 50 fruits set in 1970 from a profusion of light pink flowers. The fruits developed a dull red cheek and were of fair size as shown in Figure 2. The flavor and aroma resembled those of Gravenstein.

Laxton's Early Crimson was grafted 3 June 1966 to *M. Sieboldii.* Its first pink flowers were sparse and only 4 fruits developed. Three of these were damaged by magpies as the fruits began to color. The fruits were somewhat elongated, medium in size, and splashed with crimson on the side exposed to the sun. The flesh was white, crisp, juicy and had a pleasant flavor.

Each of these apples, new to Alaska, adds a new dimension to apple production in the Cook Inlet region where recognized varieties of apples are scarce. Several seasons of culture and fruiting will be required to learn if these varieties can survive in this climate following a season of fruiting. It is believed that they possess the necessary resistance to cold to survive, as the budwood came from the cold regions of fruit production in the USSR. Fungicidal and insecticidal treatments have not been needed regularly thus far in the culture of apples. Occasionally, aphids on terminal shoots were numerous enough to warrant using a malathion spray several times in a season.

One of the limitations to expanding these or any other apples or crabapples in Alaska has been the scarcity of stocks on which new varieties can be budded or grafted. Oregon crabapple of southeastern Alaska was used at Sitka in early propagation work but was not a very satisfactory rootstock because of its prostrate habit of growth and small stem. When this crabapple is grown as far north as the Matanuska Valley its stems are even smaller and it assumes a thick shrub form. Mountain-Ash has been used as a rootstock for apple and this plant is native to the Cook Inlet region. Even so, the Mountain-Ash is a slow-growing, small-stemmed tree with a rather weak root system. Bearing apple trees in Alaska need a rootstock with sufficient stem to support a rapidly growing trunk above the graft unless provided with support. Mountain-Ash is believed to lack an adequately vigorous root system to nourish a good crop of fruit. Native plant materials suitable for apple rootstocks apparently are lacking in this region.

If the trees at Matanuska continue to grow as they have in the last 4 years, budwood soon will be available for more extensive trials. Persons with hardy rootstock material soon may have the opportunity to graft or bud some of these new varieties into their trees. Another alternative is to contract with a nurseryman to bud a few Columbia or ornamental apple rootstocks with one of these new varieties.

There are still many varieties of apples in other regions and at Glen Dale, Maryland that have not been tried in Alaska. It seems likely that even better apple varieties are available for Alaska. The small investment made so far has demonstrated clearly that good eating apples can be grown in some favorable locations in Alaska. Additional financial support will be necessary if the remaining untested apple stocks in other regions are to be evaluated systematically in Alaska.

Figure 2
Yephorys Chernogous

Figure 1. Plants of *Astragalus adsurgens tananaicus* are seen here as pioneering vegetation on abandoned, gravelly streambed in the Alaska Mountain Range.

Native Alaskan Legumes Studied

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Research Agronomist

On a worldwide basis, two major families of plants -- grasses and legumes -- serve as the principal sources of pasture and harvested forage for livestock. Moreover, grasses and legumes are also important for erosion control, as ornamentals, and for many other uses. Considerable progress has been made in surveying and evaluating Alaska's native grasses for various avenues of utilization; this report discusses some studies and advances in our knowledge of Alaska's native legumes.

Worldwide, the legume family of plants includes well over 12,000 species. This large botanical group includes both woody plants (some are very large trees in the tropics) and herbaceous types (non-woody types such as the clovers). The one characteristic common to all leguminous species is the fruiting structure, called a pod or legume, in which the seeds are borne. Within the legume family are some of the world's most important crop plants -- alfalfa, soybeans, lespedeza, peas, beans, trefoils, peanuts, lupines, vetches, and clovers, -- to name a few.

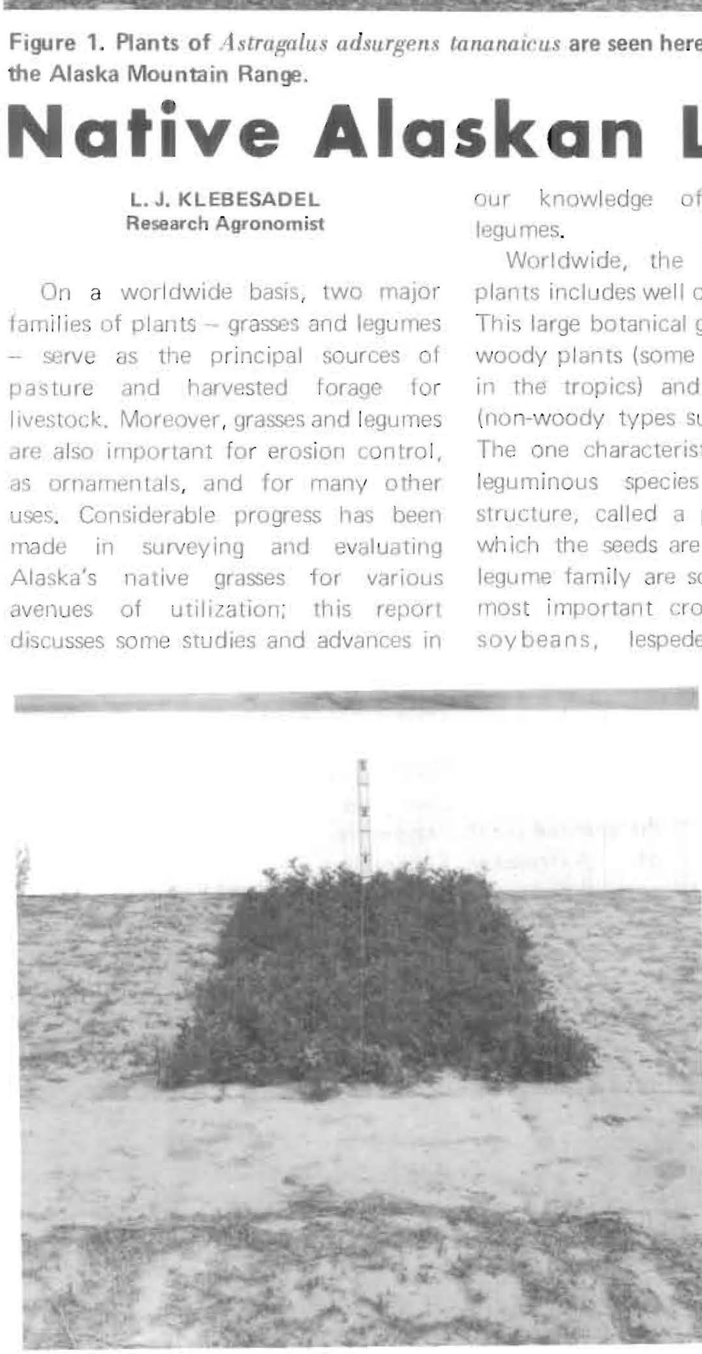

Figure 2. Broadcast-seeded field plot of *Hedysarum Alpinum* ssp. *americanum* that survived winter 100%. Adjacent plots that winterkilled completely include sainfoin, red clover, alsike clover, strawberry clover, birdsfoot trefoil, and crownvetch.

Agricultural Value

Legumes are important to agriculture largely because of two valuable characteristics: (1) their high feeding value, due primarily to relatively high levels of protein, vitamins, and mineral elements, especially phosphorus and calcium, and (2) their contribution of nitrogen to associated non-leguminous plants and to the soil, through the symbiotic assimilation and fixation of nitrogen by specialized bacteria contained in small outgrowths on the legume plant's roots.

The unique mechanism by which leguminous plants and these bacteria, operating together to their mutual benefit, can take up atmospheric nitrogen and "fix" it into forms available to plants has been understood for little more than 80 years. However, the fact that legumes contributed "something of value" to other plants has been known for near 2000 years. Pliny the Elder (23-79 A.D.) wrote .... *"Meadow land will grow old in time, and it requires to be renovated every now and then, by sowing upon it a crop of beans . . . ."*

Alaskan Legumes

In addition to use as forages, legumes have been widely used in agriculture as "plow-down" or "green-manure" crops.

As such, they are valued both for the nitrogen as well as the organic matter incorporated into the soil.

Legumes are most abundant in the equatorial zone; toward the poles their numbers decrease. Although near 2,000 species are considered native to the conterminous 48 states, only 40 to 50 are native in Alaska. These are found in 6 genera, namely, ***Astragalus*** (milkvetches), ***Oxytropis*** (oxytropes), ***Lupinus*** (lupines), ***Vicia*** (vetches), ***Lathyrus*** (vetchling or wild peas), and ***Hedysarum*** (eskimo potato or hedysarum).

All of the native Alaskan legumes are herbaceous perennials. They range in size from very small, tufted plants less that one inch tall ***(Oxytropis nigrescens, O. huddlesonii)*** to robust species 2 to 3 feet in height ***(Astragalus americanus, Lupinus nootkatensis)***. Geographically, the native legumes occur over the entire state, from the southeast panhandle to the farthest Aleutians (2400 miles east-west) and from southern Alaska to near Point Barrow (near 1400 miles north-south). Leguminous species are present in most plant communities from coastal beaches to rocky, windswept mountain-tops.

Role in Nature

Many of the native legumes play a pioneering role in nature; that is, they are "colonizers," the first plants to invade and grow in barren areas created by glacial retreat, altered stream courses, frost action, etc. (Figure 1).

Legume characteristics that make possible this pioneering role are several. Nitrogen fixation permits legumes to grow in relatively infertile soil materials. After legumes have grown for several years in sterile gravels, nutrient levels accumulate to where other plants can invade and thrive.

For legumes to function as pioneer species, ability to grow in infertile soils is not enough; they also must have the opportunity to invade such areas. Winged seed pods on the hedysarums, and the light, papery nature of ripe seed pods dropped from species such as blackish oxytrope and reflex-podded oxytrope, provide an effective conveyance means for seed transport by the wind.

Hard seed coats permit some seeds to be transported to new sites while they pass through animal and bird digestive tracts without damage; moreover, our studies have shown that passage through the digestive tract renders hard seeds more germinable. A further advantage to seeds transported and deposited in this manner is the benefit derived from nutrients in the feces.

Three species of native lupines have considerable ranges within Alaska. Although lupine pods remain attached to the stem, they possess a novel feature for seed dispersal. Upon ripening, the pods snap open with such force that seeds can be propelled several feet. Over many years, this process can be an effective contributor to plant migration.

Collections

To evaluate native legumes for potential cultivated uses, seeds and vegetative transplants have been

Figure 3. Formerly denuded roadisde area that has become revegetated through natural invasion of *Hedysarum alpinum* ssp. *americanum*.

collected throughout Alaska and grown in experimental nurseries for observation. Research grant funds from The Rockefeller Foundation made possible extensive collection trips and field evaluations that would not have been feasible within the limitations of regular budgetary support. Conducted over about a 10-year period, these plant explorations via road vehicles, light aircraft, and river boats were under the overall coordination of Research Agronomist R. L. Taylor.

In addition to providing plants for study purposes, these collection trips have made other contributions to our knowledge of native legumes in Alaska. The known natural ranges occupied by several of the species have been expanded considerably by our finding plants growing in areas where they were previously not known to be; moreover, we have found legumes previously not known to occur in Alaska.

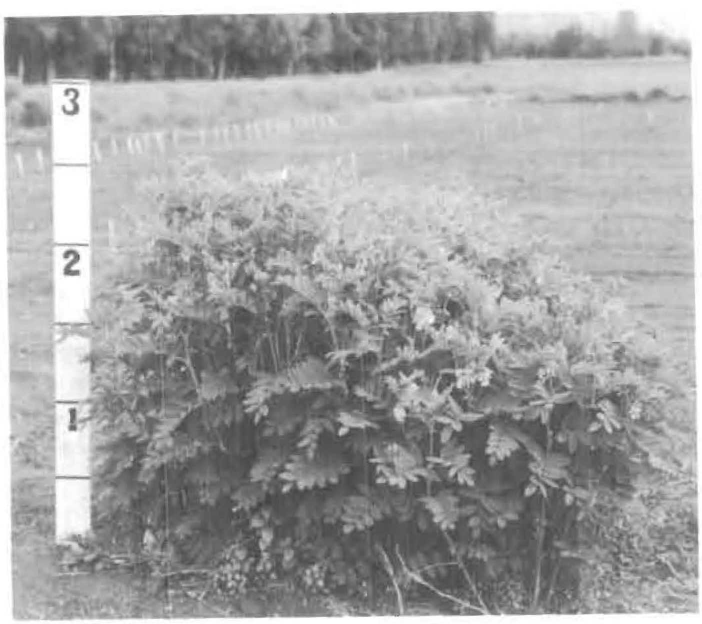

Figure 4. Six-year-old plant of *Astragalus americanus* in experimental nursery. Numbers on stake indicate height in feet. Note how plant has spread laterally by growth of rhizomes (underground stems).

Seeds and Seedlings

Many legumes, including both "wild" and cultivated species, possess a characteristic known as "hard seeds." This term refers to an unusually hard seed coat, impervious to water, that prevents germination. For commercially used crop species possessing this property, seeds are "scarified" mechanically to scratch the seed coat, thereby permitting uptake of water upon planting.

The "hard seed" property is very common in native Alaskan legumes. In some of the milkvetches and oxytropes, virtually 100 percent of the seeds are of this nature. None will germinate until scarified, or until such factors as weathering gradually break down the hard seed coats in the soil. We have found that mechanical treatment with abrasive or brief immersion in concentrated sulfuric acid are effectual scarification aids. Acid scarification, although more time-consuming than mechanical treatment, provides effective surface sterilization of seeds eliminating seed-borne pathogens that are undesirable in germination tests and sometimes lethal to young seedlings.

In the course of many different plantings over several years, poor seedling vigor and slow establishment has been a uniform disadvantage in virtually all native legumes evaluated. This shortcoming can be offset somewhat by planting as early in the growing season as possible.

Winter Hardiness

Owing to eons of residence in the Alaskan environment, native Alaskan plants are naturally better adapted to subarctic climatic patterns than crop plants brought here from areas with different climates. One of the most striking characteristics in which native legumes have excelled in field tests is their extreme winter hardiness (Fig. 2). This should be qualified, however, to relate that native legumes accustomed to natural persistence in exposed habitats survive winters better in wind-swept field nurseries than species normally resident in woodland and similarly protected sites where insulating snow cover remains in place all winter. To illustrate, in one field test where winter stress was quite severe, *Lupinus polyphyllus* (which occupies relatively protected habitats in nature) winterkilled 100 percent while other native legumes that persist well in more exposed sites survived as follows: *Astragalus harringtonii* 97 percent, *A. williamsii* 70 percent, *Oxytropis foliolosa* 83 percent, *Hedysarum mackenzii* 64 percent, and *H. alpinum americanum* 100 percent. In the same test, 4 varieties of alfalfa averaged 5 percent survival, 2 sweetclovers averaged 9 percent, and 4 red clovers winterkilled completely.

Seed Production

To be used commercially, legumes must produce harvestable seed crops in quantities sufficient to provide profitable returns to growers. Virtually no data have been obtained on seed yields that might be expected from the various native legumes. Most species, however, produce seed in fair abundance and this requirement should present few problems except with the lupines. The lupines are poorly suited for mechanized seed harvest because of uneven ripening times for the total crop of seed pods; the lower ones on the flowering stalk ripen, split open, and release seeds, while those at the top are yet green and succulent.

Conservation Uses

The successful pioneering role of several native Alaskan legumes, (Figures 1,3), and the broad range of habitats to which various species are suited, suggests that some may be useful for revegetation purposes. Where construction activities disturb or denude soil materials, reestablishment of an adapted, perennial plant cover usually is necessary. A good vegetative cover prevents wind and water erosion, improves appearances, protects streams and lakes from sediments, etc. The showy flowers of many of the native legumes should be considered an asset for beautification.

Forage Potential

Absence of dependably winterhardy, productive cultivated legumes in Alaska directs attention toward the native legumes as potentially useful species. Chemical analyses of herbage, and wild animal utilization, indicate that they should provide satisfactory forage. Moreover, some species are impressive as to stature and leafiness (Figure 4).

Results of many experimental trials to date, however, provide little optimism for considering native Alaskan legumes as high-yielding forage crops. Despite their vastly superior winter hardiness over introduced forage legumes, the native species possess other agronomic deficiencies that limit their potential as cropland forages.

In addition to poor seedling vigor, most of the native legumes evaluated regrow poorly after cutting. Many require two to three years after planting to achieve full stature -- even then, most do not grow tall enough to meet the requirements of a useful crop (Figure 5). Some flower extremely early, and some go dormant quite early in the growing season; both characteristics limit their utility as forages.

Studies are continuing, however, to determine more precisely which of the native legumes are best suited for commercial utilization, and to define specific opportunities and limitations for their use.

Figure 5. Plants of *Oxytropis deflexa* showing short stature and near-basal origin of all leaves characteristic of the oxytropes. Tallest flowering scapes here are about 12 inches in height.

Two Sources of Nitrogen for Bromegrass

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Research Soil Scientist
PAUL F. MARTIN
Research Soil Scientist
and
GLENN R. SMITH
Laboratory Technician

Smooth bromegrass is the principal and most dependable perennial forage crop grown in Alaska. It requires high nitrogen (N) rates for the most profitable production. Naturally the most efficient source of nitrogen is desired. This study was conducted to evaluate response to the proposed use of liquid fertilizers as topdressing for grass.

Two nitrogen sources (aqua ammonia and ammonium nitrate) were applied at the rate of 200 lb N per acre with and without potassium sulfate as a spring topdressing to an established stand of Canadian bromegrass. Potassium sulfate supplied 200 pounds K_2O per acre. In addition, each treatment received a

Table 1. Effect of N source and K on dry matter and crude protein content of bromegrass (averages of 8 measurements)

Nitrogen source	Lb K_2O /A	% dry matter 1st cut	% dry matter 2nd cut	% crude protein 1st cut	% crude protein 2nd cut
Aqua ammonia	0	27.9	33.3	12.1	9.0
Ammonium nitrate	0	23.2	28.9	20.8	17.0
Aqua ammonia	200	26.9	29.5	8.9	8.6
Ammonium nitrate	200	18.7	30.2	18.7	9.3

Low Temperature Fungi

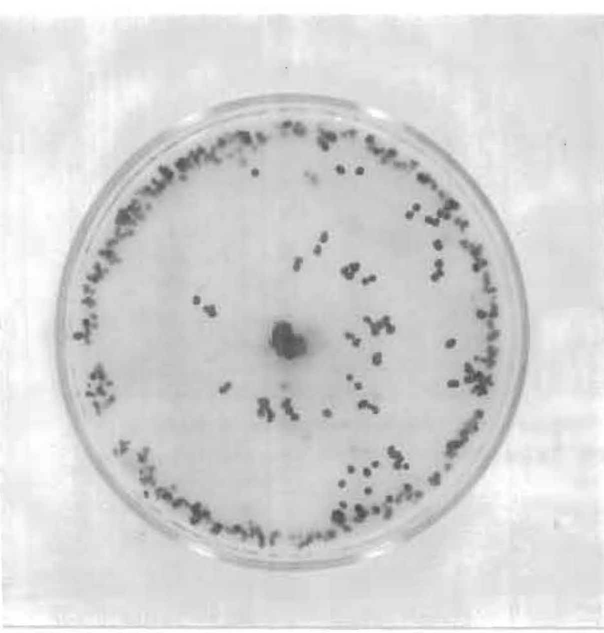
C.E. LOGSDON
Professor, Plant Pathology

Most people associate fungus growth with warm-humid conditions. Bread left out in a warm room will develop beautiful green or black mold growth if not allowed to dry. Clothes in a warm, damp closet will mildew. Yeast with which we make bread or beer or wine is a fungus which makes very rapid growth in warm, moist conditions. Much of our association with the fungi has been under conditions of warmth and high humidity.

It may come as some surprise then to realize that many fungi will flourish under very cool conditions; and in fact, there are species that grow very well at or near freezing.

There are many fungi that will attack plants and cause disease during the growing season. There are others, some very low-temperature-loving fungi, that do not attack growing plants during the summer, but will attack and even kill perennial plants during the winter under the snow. These are referred to as a group by the name "snowmolds," but there are actually a number of different species of snowmold fungi. Snowmold fungi are by no means restricted to Alaska and other high-latitude countries. In North America, some species occur as far south as areas where prolonged snow cover extends in the states. In Europe this is as far south as middle Germany.

The most southerly occurring snowmold species seems to be one called *Fusarium nivale.* This is not known to be present in Alaska. Overlapping the range of *Fusarium nivale,* and apparently extending farther north, are at least two species of a fungus called *Typhula.* This fungus would be expected to be found in Alaska, but it has not yet been identified here. *Typhula* is a snowmold problem in northern Japan and Scandinavia, as well as in Canada and some of the northern states. A third snowmold that appears to be adapted even farther north is *Sclerotinia borealis.* This fungus is well known and widely distributed in Alaska. It also occurs in Canada and Scandinavia and is an occasional problem in the winter wheat areas of Washington state.



Sclerotinia borealis In Culture

Other low-temperature fungi known to be of commercial concern are those causing breakdown and rot of stored vegetables and fruits. The most important storage fungi noted so far in Alaska are species of *Botrytis* and *Sclerotinia.* These are especially important storage pathogens on lettuce and carrots.

The Institute of Agricultural Sciences has begun a new project this year to determine the nature and importance of low-temperature plant diseases in Alaska. The fungi causing these diseases will be isolated, identified, and studied to develop control measures especially suited to Alaska.

uniform application of 100 pounds P_2O_5 per acre to make certain that growth was not limited by inadequate phosphorus. Fertilizers were applied April 25, 1968. Treatments were replicated 8 times on a Knik silt loam at the Matanuska Research Center.

Aqua ammonia is a 20% to 38% nitrogen solution prepared by dissolving anhydrous ammonia in water. Because of its volatile nature, aqua ammonia is usually incorporated into the soil to minimize loss into the atmosphere. The higher the temperature, the greater the loss of ammonia by volatilization. In this investigation, a 38% nitrogen solution of aqua ammonia was diluted by half with water and applied with a sprinkling can held one foot or less from the soil surface. Temperature at the time of application was 47° F.

Bromegrass on the individual fertilizer plots was harvested twice in 1968 (June 18 and August 8). Green weights were recorded and a sample from each plot taken for determination of moisture and nitrogen. Soil from each plot was sampled after the second cutting.

Ammonium nitrate was much superior to aqua ammonia in both cuttings when potassium sulfate was applied and in the second cutting without potassium sulfate (Figure 1).

Table 2. Effect of N source and K on the pH, total N and available NO_3-N, P_2O_5 and K_2O August 8.

Nitrogen source	Lb K_2O /A	pH (water)	% total N in soil	Pounds per acre available NO_3-N	P_2O_5	K_2O
Aqua ammonia	0	6.38	0.18	1.7	73	67
Ammonium nitrate	0	6.04	0.18	23.4	64	70
Aqua ammonia	200	6.20	0.17	1.0	71	254
Ammonium nitrate	200	6.03	0.19	2.3	64	170

Potassium sulfate doubled brome yields when ammonium nitrate was used. When aqua ammonia was the N source, potassium sulfate application had no effect on the yield. First cutting yields did not differ between the two nitrogen sources when no potassium was used.

Table 1 shows dry matter and crude protein contents in bromegrass herbage. In the first cutting, brome that received ammonium nitrate was more succulent (lower dry matter content) than that receiving aqua ammonia. Potassium application further reduced the percent dry matter in the first cutting where ammonium nitrate was the N source. These reductions indicate better and more luxurious growth. Second-cutting dry matter content was relatively constant with the various fertilizer treatments, although percent dry matter in brome topdressed with aqua ammonia and without potassium was significantly greater than the other treatments.

Crude protein content of forage decreased from the first to the second cutting indicating less nitrogen available for plant use. Bromegrass topdressed with ammonium nitrate contained a higher level of crude protein in the first cutting than where aqua ammonia was the N source. Second cutting brome protein content was increased only by ammonium nitrate applied without potassium fertilizer.

Nitrogen uptake by the grass crop

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FIG. 1. EFFECT OF N SOURCE AND K ON BROME YIELD.

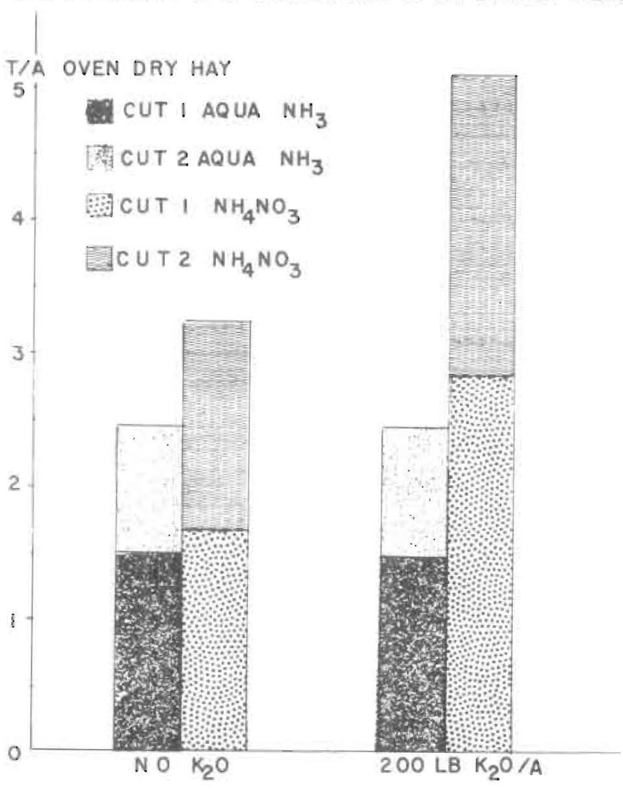
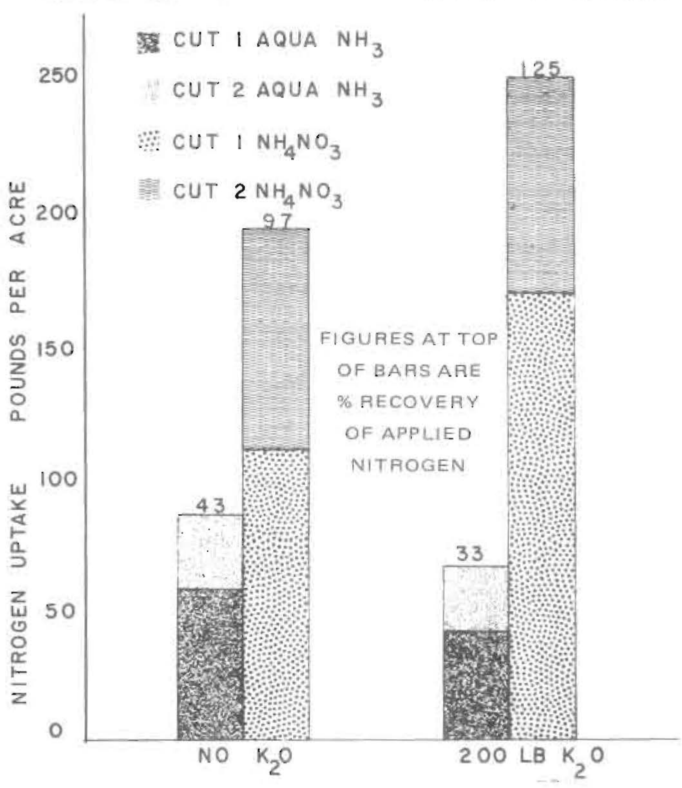


FIG. 2. EFFECT OF N SOURCE AND K ON N UPTAKE.



Time of Planting Critical for Alaska Grass Seed Growers

L. J. KLEBESADEL
Research Agronomist

". . . The farmer . . . must not only think about planting, but he must do it." - Cato, 95-46, B.C.

When it comes to planting grasses for seed production in Alaska, the above advice to Romans from Marcus Cato the Younger remains applicable 2000 years later. Here, on the opposite side of the world, recent field tests have demonstrated that to delay planting while he "thinks about" it, can lead to a grass seed grower's economic disaster; time-of-planting a grass in one growing season in Alaska can very well determine whether the seed crop the following year will be abundant or non-existent.

In earlier years of agricultural development in Alaska, seed dealers imported seed of forage grasses chiefly from Canada or "The Old Country" (the conterminous 48 states). At that time, those were the best grasses available. However, times have changed. Frequent bouts of serious winter injury (and sometimes complete winterkill) of imported grasses spurred Alaskan agronomists to find or develop more hardy, better adapted grasses.

Bromegrass and timothy are the dominant forage grasses used on Alaskan farms. Within both of these grass species, however, individual varieties developed in various areas of the world differ greatly in performance here. Engmo timothy imported from northernmost Norway, was found to surpass other timothies in Alaska in winterhardiness and in other desirable characteristics. And within this Institute's plant breeding program, directed at different times by Research Agronomist, R. L. Taylor, and former Alaskan agronomists H. J. Hodgson and A. C. Wilton, the new, very winterhardy Polar variety of bromegrass was developed.

Polar and Engmo have so far not been adopted for use elsewhere in North America. Accordingly, Alaskans must contract with seed growers elsewhere, or initiate production within this state, for needed seed supplies of these grass varieties. Regardless of where the certified class of seed is produced, the earlier generations (breeder and foundation classes) must be produced locally. Therefore, a new agricultural pursuit for Alaska -- grass seed production -- must be undertaken to supply current and future needs of these and other new grass varieties as they become available.

Just as one robin doesn't make a summer, a few isolated grass seed heads don't make a worthwhile seed crop. We had numerous clues, from a wide variety of experimental plantings, that heading of grasses in Alaska was influenced by many factors, most of which could be manipulated artifically. For one thing, we thought we saw evidence indicating that the time of planting within the growing season affected considerably the amount of heading the following year (perennial grasses don't produce a seed crop here in the year that they are planted).

On the basis of this strong suspicion concerning grass behavior, a detailed experiment was designed to ferret out the truth of the matter.

We chose for the investigation both of our major forage grasses, bromegrass and timothy. To add breadth to the study (and to explore further our limited clues that more southern-adapted grasses headed poorly here) we included four different bromegrasses and three timothy varieties. The four bromes were: (1) native Alaskan, (2) the new Alaskan variety, Polar, (3) Manchar, a variety from the Pacific Northwest, and (4) Achenbach, a variety of still more southern adaptation in the Great Plains. The timothies were: (1) Engmo from northern Norway, (2) Climax from Canada, and (3) Clair from Kentucky. Each grass was planted at 10-day intervals from May 20 to mid-September in two different years. The different grasses and the various planting dates were evaluated in both tests the year after planting in terms of (1) winter survival, (2) heading, and (3) seed production.

Our suspicions were confirmed. The two adapted bromes, Polar and native, wintered well and produced highest seed yields with earliest planting; yields from rows planted June 20 were only about 1/2 those from the May 20 rows, and rows planted later than July 20 did not produce heads the following year. Although Manchar survived the winters well, seed yields of this more southern-adapted variety were only about 1/3 those of Polar. Achenbach brome sustained severe winter injury and produced little seed regardless of planting dates.

Different planting dates prior to

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Figure 1. Photo June 1 of timothy rows planted on various dates during the previous year. Following a winter of moderate stress, Climax (foreground) sustained severe injury and produced no seed, Clair (middle) winterkilled completely, and Engmo (rear) survived well with virtually all planting dates.

Freeze-Branding Cattle

DON C TOMLIN
Assistant Professor, Animal Science

The first requirement for any beef cattle improvement program is a means of marking the individual animals so that they can be easily and quickly identified on the range or in the corral. Freeze-branding, a relatively new technique, appears to be an effective way to identify cattle.

Freeze-branding was introduced in 1965 by Dr. Keith Farrell, a U.S. Department of Agriculture scientist stationed at Pullman, Washington. It has since been tried at other agricultural experiment stations, and by ranchers, with varying results. The branding iron, instead of being heated, is supercooled in liquid nitrogen or a mixture of dry ice and alcohol. When properly applied the brand destroys the pigment cells in the hair follicle and skin without damaging the skin, so that subsequent hair grows out white. If the cold iron is applied too long, it also destroys the hair follicles similar to hot-iron branding. Obviously one requirement for the freeze-brand is that it be applied on an area where the hair and skin are colored, so that the white of the brand will stand out in contrast.

Jim and Bill Burton, who run cattle at Narrow Cape on Kodiak Island, wanted to identify their cows for artificial insemination and production recording. They discussed the possibility of freeze-branding with Dr. A. L. Brundage during his field trip to Kodiak Island last spring. Dr. Brundage, a dairy scientist by training and the only animal scientist with the Institute of Agricultural Sciences at that time, agreed to set up a freeze branding experiment with the Burtons during the fall roundup. By that time, Dr. D. C Tomlin had joined the Institute as the meat-animal specialist and took part in the freeze-branding.

The branding was done at the Burtons' ranch in early December. A set of heavy copper brands four inches high, in numbers from 0 to 9 were used. Liquid nitrogen and dry ice in methyl alcohol were compared as coolants. The cattle were Hereford or Angus, from yearling to ten years in age. It has been reported that the brands "take" better on young cattle. Two different types of hair clippers were used; one cutting closer to the skin than the other. Branding times varied from 10 to 30 seconds with liquid nitrogen and 30 to 60 seconds with dry ice-alcohol.

Results will not be available until the cattle start growing new hair in the spring. All of the brands will be graded then for effect. However, observations made during the branding can be reported. First, liquid nitrogen was easier to use, but it boiled away too quickly in the ice-chest where the irons were cooled. A special, heavily-insulated, covered chest that would hold each iron separately should be built of sheet metal for this freeze-branding. The handles on the irons should be changed from steel rods to wood, with a maximum length of ten inches, and fastened more securely to the irons. Brands placed on the rump were the easiest to spot from horseback or in the corrals.

Dr. Tomlin getting irons out of liquid nitrogen to brand.

It was interesting to note the animals' reactions to branding. There was a lag time of about 5 seconds before responding, and the physical objections to the cold metal usually lasted only another five to ten seconds. Apparently the cold had an anesthetic effect. When the branding iron was lifted, we could feel the frozen depression in the skin.

It is quite likely that some animals were under-branded and some were over-branded. When the brands are graded in the spring, the best combination of treatments will be determined for routine use. From this, the Burtons, and other ranchers as well, will be able to use the technique to improve beef production in their herds.

Dr. Tomlin branding, Jim Burton timing.

Dr. Don C Tomlin joined the University of Alaska as Assistant Professor of Animal Science with the Institute of Agricultural Sciences during November last year. This appointment climaxed recruitment for this position which was initiated last summer in conjunction with the new start in red meat research approved by the Board of Regents and the legislature. Dr. Tomlin brings ten years of research in animal science to this program, including three years at the Prince George Experimental Farm in British Columbia and three years at the U.S. Sheep Experiment Station in Dubois, Idaho, his place of employment prior to coming to Alaska. He holds a Ph. D. degree and a M.Sc. degree from the University of Florida and the B.Sc. degree from California State Polytechnic College.

Dr. Tomlin joins Dr. Brundage in the Animal Science department of the Institute and will have major responsibility for the initiation and development of a research program in beef, swine, and sheep. Although he will be stationed at the College Research Center of the Institute, it is expected that he will become a familiar figure throughout the state wherever animal industries are developing.

Dr. Tomlin was accompanied to Alaska by his wife, Yvonna, and their daughter, Marie.

Energy Measurements In a Sub-Polar Environment

C.I. BRANTON
Research Agricultural Engineer

Whatever theories one may have concerning the origin or creation of the earth and the solar system it must be admitted that there are some complex inter-relating natural phenomena providing environmental conditions which are suitable at times for luxuriant plant growth in the Subarctic. Without the annual tilting of the axis of the earth in relation to the sun, it is doubtful whether areas as far from the equator as 60° north latitude would support any kind of plant life. Tilting of the earth provides for the receipt of vital energy in the summer time, for dramatic changes in seasons, for rapid change in day length, and for the increased probability of occasional low temperatures when compared to areas nearer the equator.

Along with the tilt of the earth is the "greenhouse effect," another ingenious phenomenon. Energy from the sun reaches the earth in the form of electromagnetic radiation in certain ranges of wave lengths that penetrate moisture vapor and carbon dioxide with relatively little loss. The major part of the energy received from the sun is reradiated by the earth at much longer wave lengths much of it being absorbed by water vapor and carbon dioxide in the atmosphere, raising its temperature.

In Alaska, this "greenhouse effect" is especially applicable during summer because of long days with a relatively small night-time temperature depression, permitting the level of water vapor in the atmosphere to remain high. Moisture is often removed by condensation during nights, leaving only the amount that can be held by air at the minimum night temperature. During the summer, when energy received from the sun is at its highest level, the moisture vapor in the air is also at the maximum for the year, trapping long wave heat energy in the atmosphere which would be lost if moisture vapor were not present.

When winter comes with its lower temperatures, long nights, and short days, moisture vapor in the air is greatly reduced. This situation tends to "open a window" to the cold of outer space. Without the buffering effect of the moisture vapor in the air, the heat loss from the earth to outer space can be extremely rapid. Space remains a constant "cold sink" to which heat is radiated from the earth's surface and from plants and animals on it.

Measurements of the rate of energy loss from the earth made at Palmer, Alaska, show large daily variations in both incoming solar radiation and net radiation losses. The greatest daily net energy loss recorded in December of 1970, was 154 Langleys. This is equivalent to the energy required to freeze 3.94 pounds of water per square foot of ground area. The average daily energy loss for the month was 52 Langleys, about one third of the maximum.

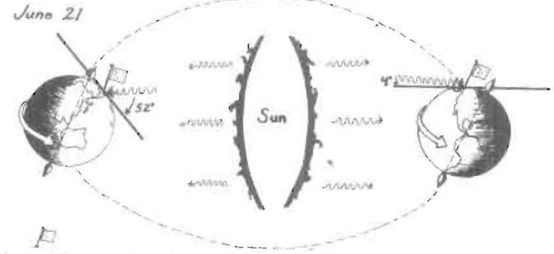

Figure 1. Maximum and minimum angles at which mid-day sunshine intercepts a plane parallel to the earth's surface at Palmer.

Energy is received from the sun at a relatively constant rate and the difference in distance between different earth positions to the sun has only a small effect. Great differences do occur in the amount retained at the earth's surfaces, however, because of differences in angular relationships between it and the direction of incoming sunlight. As the angle at which sunshine strikes decreases, as in the polar regions, the distance that the short wave energy must travel through the atmosphere is increased.

At Palmer on December 21, the angle of the sun's rays with a line horizontal to the surface at noon is about 4°-10'. On June 21, at noon this angle is nearly 51°-45'. Figure 1 portrays these

Figure 2. Sixty-three percent of incoming solar radiation was reflected with this snow cover.

Figure 3. Eighteen percent of incoming solar radiation was reflected from the turf.

situations where minimum and maximum insolation is available.

The amount of energy retained on the surface is influenced not only by the angle at which the sun's rays strike but by the type of surface. A term called "albedo" has been applied to describe the ratio between the short wave energy reflected skyward and that retained.

A series of albedo measurements were made at Palmer in the winter of 1966. At 8:30 A.M. on April 12, with clear skies and fresh snow, it was found that 75 percent of the incoming global hemispherical short wave energy was reflected skyward. Figure 2 shows the situation at 11:45 A.M. when 63 percent of the solar insolation was reflected. By six o'clock, surface conditions had changed sufficiently so that 55 percent was being reflected. By noon, April 14, (Figure 3) all the snow had melted exposing a short grass turf, and only 18 percent of the incoming energy was being reflected.

In mid-winter, when the tilt of the earth's axis causes northern areas to move into an unfavorable position, the amount of energy striking a horizontal surface is small. In December of 1970, at Palmer, an average of 14 Langleys were received per day, whereas in June, 1970, when the axis is tilted toward the sun, an average of 348 Langleys were received. That atmospheric conditions radically affect the amounts of energy in sunshine is demonstrated by the fact that, although the average for June was 348 Langleys, the maximum received on a single day was 644, nearly double the monthly average.

Figure 5. Clyde Hornal adjusts the height of the shade ring to shield the pyranometer from direct sunshine.

Two of the major energy fluxes have been monitored continuously at Palmer since 1960. Global hemispherical radiation, which is the short wave incoming flux from the sun, is recorded on an Eppley pyranometer. This instrument records the energy received on a horizontal surface. The other energy flux measured is the net energy balance, which is obtained with a "Funk" ventilated type net radiometer. Its sensor responds to both short and long wave radiation in the bands which are primarily responsible for heat transfer to and from the earth. An additional instrumentation system recently placed in operation, permits the partitioning of the global short wave radiation into that which is received as a direct beam and that which is received as scattered radiation. (Figure 4 shows a pyranometer with a shading device.) The scattered radiation is likely to be relatively higher in polar regions, as the thickness of the atmospheric envelope through which the rays must pass is greater.

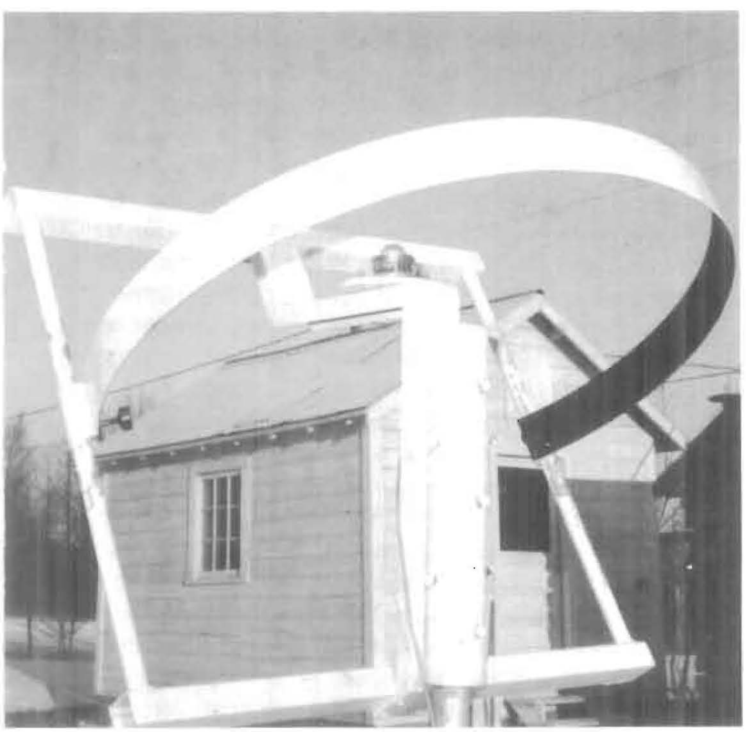

Figure 4. A "Shade Ring" to prevent direct sunshine from affecting the output of a pyranometer.

The shading device was built by Mr. Clyde Hornal at the Palmer Research Center from plans provided by Professor H. B. Schultz of the Agricultural Engineering Department of the University of California. (Figure 5) It provides shade for the bulb from direct rays of the sun, but leaves an unobscured exposure to the diffused short wave radiation.

The amount and quality of solar radiation received is often critical to plant growth in polar latitudes. It is important to scientists concerned with the productive capacity of any environment to know the range of energy fluxes received. Because of the low sun angles and great temperature ranges experienced at this latitude, greater variability from day to day can be anticipated than at most locations where these data have been recorded. It is planned to continue the observations now made at Palmer, and to improve the instrumentation as funds and staffing permit.

Frozen French Fries for Alaska

By CHARLES E. LOGSDON
Professor, Plant Pathology
and
C. IVAN BRANTON
Research Agricultural Engineer

Alaska potatoes are excellent for frozen french fries, frozen whole small potatoes and hash browns, according to preliminary studies of potato processing now underway at the Institute of Agricultural Sciences' Palmer Research Center. It is believed that these studies will open the door to new outlets for present production and will give a boost to the whole industry.

An estimated 6.5 to 7 million pounds of frozen potato products are imported into the state each year. This market presently is closed to local growers due to lack of processing facilities. In addition, the fresh potato market is reduced in direct proportion to the amount of the market satisfied by imported products. National trends show that processed potatoes have increased steadily in volume over the past 15 years as the fresh market volume has decreased. The volume of processed potatoes marketed will exceed 50% of the total market in 1970-71 according to national estimates.

Several varieties presently grown in Alaska are suitable for french frying. These include Bake King, Alaska Russet, Kennebec, and the seedling AK90. Other varieties will be included in future tests. Green Mountain does not make a commercially acceptable french fry.

U.S.D.A. grades established for frozen french fries consider color and texture as most important. Secondarily, they consider uniformity of size and cut, and freedom from defect. Flavor is of little consideration, with the exception that they should not have an objectionable flavor.

Alaska french fries can easily meet U.S.D.A. standards and have a very pleasing flavor in addition.

The color of french fries is determined by the amount of reducing sugars in the surface layers of the potato pieces. Although it is desirable to start with a potato variety high in starch and low in reducing sugars, the amount of sugar in the surface layers can be controlled by water blanching prior to oil blanching. Water blanching also improves the texture of the finished product. The time and temperature of the water blanch will control the color of the final product.

Another potato product for which we have a small amount of data is frozen whole potatoes. Although the market for these is limited, it would provide an outlet for potatoes now often discarded or fed to livestock. Small, whole Bake King potatoes were water-blanched and packaged with other frozen vegetables in a "stew pack." When subsequently prepared for the

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Oat Varieties for Forage

R.L. TAYLOR
Research Agronomist

Oats are utilized in Alaska as an annual forage crop as well as for grain production. For forage, oats may be seeded alone or as a component of mixtures. In some cases, oats originally intended for grain may be harvested for forage. However, varieties are not equally suited for both forage and grain production. Oat seed imported for forage use may be of a variety too late in maturity for dependable grain production in Alaska. Unfortunately, many varieties which are readily available for importation may not be suited for either forage or grain in this environment.

This report concerns the results of one season of testing commonly available and potential oat varieties for forage purposes. Three imported varieties, Victory, Park and Cayuse, were obtained from local commercial sources. Golden Rain and Nip are recommended as grain varieties in Alaska. The two numbered strains included, 6111-55-19-95-15 and 5511-51-7-185, are under consideration as new grain varieties.

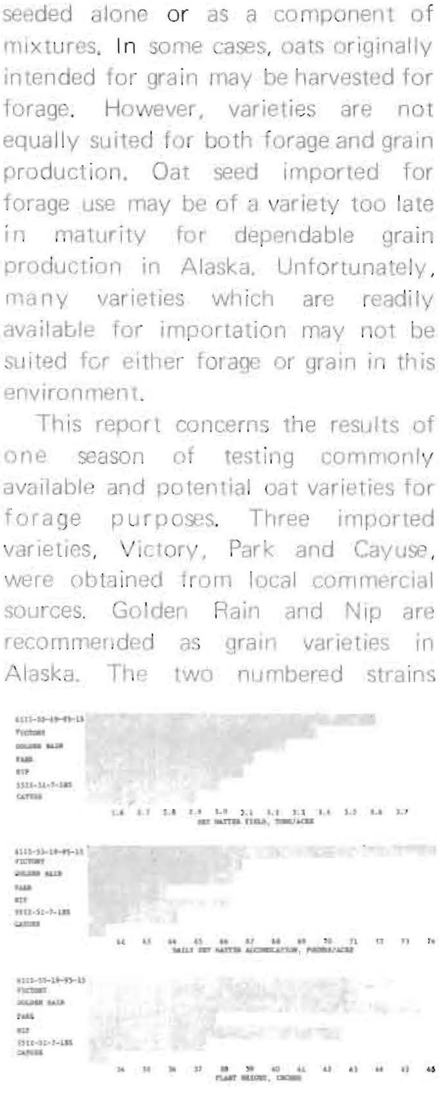

Figure 1. Average performance of seven oat varieties harvested for forage as each variety reached the early dough and late dough stages of development.

The oats were sown in drilled rows, 6 inches apart, on May 14, 1970, at 100 pounds seed per acre. The field area utilized was watered with a pre-plow irrigation of approximately 4 inches in early May, and moisture was not a limiting factor in crop growth during the season. Fertilizer was applied, on the basis of soil test results, at a rate of 12-115-24 (N-P_2O_5-K_2O) pounds per acre, at the time of seeding. Weeds were controlled with herbicide treatment, supplemented by hand weeding. Different plots of each variety were harvested at several specified stages of development. Varietal performance reported here is the average of two harvests, at the early dough and late dough stages. Most of the oat forage acreage in Alaska is harvested at a comparable stage of development.

Dry matter yield, daily dry matter accumulation and plant height of the oat varieties are presented in Figure 1. There is a considerable range in dry matter yields, an indication that some varieties performed better than others. Consideration of daily dry matter accumulation may modify somewhat the picture given by dry matter yield results. This average dry matter accumulation from planting to harvest takes into account the variable harvest date, when varieties of different maturities were harvested at specified growth stages. Victory, Golden Rain and Nip accumulated dry matter at nearly the same rate, with differences in dry matter yield related to the variable harvest date. This agrees with the results of other forage trials in which these

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Alaskan Veal for the Alaskan Consumer

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L. E. CAVASOS
Formerly Farm Manager, College

The human stomach is finite in size, even that of the teenager, and the ultimate choice of what to put into it, and why, is an interesting facet of studies in consumer psychology. It is also the focus of continued attack by Madison Avenue in their attempt to create a demand for one more food, or non-food. Although the virtues of veal are seldom included in the hyperbole of advertising rhetoric, there are people in Alaska who want veal and who buy it when it is available in the local supermarket. Many consumers prefer fresh to frozen veal. Fresh veal is a perishable product, however, and is usually shipped to Alaska via air freight from the "Lower 48" at a cost of up to 17 cents per pound.

Marie Antoinette had the answer for Alaskans who want fresh veal and cannot find it in the meat counter, "Let them eat cake." Determining not to lose our heads in this approach, we initiated research to explore the potential demand for fresh veal in Fairbanks, Alaska and the possibility of meeting that demand by production within the State. Fairbanks was selected for this study to gain information on veal consumption patterns specific for that area. The Anchorage market for veal had been evaluated previously.[1]

The project was started in 1967 to explore three basic objectives -- (a) the comparative performance of veal calves on whole milk and milk replacer rations, (b) the evaluation of consumer acceptance of veal from these rations and estimation of price levels which would permit the rapid movement of veal through the marketplace and still provide a profit incentive for the producer, and (c) projection of consumer demand for fresh veal.

Results obtained and economic realities of ration costs would temper the optimism of the consumer who wants fresh veal and the producer who would provide it. Nineteen holstein bull calves were raised on whole milk or one of two milk replacer diets. Calf performance was similar on all three rations (Fig. 1) and animals were ready for slaughter at about seven weeks of age. Nine and a half pounds of whole milk were required for each pound of veal produced; not too promising for the dairyman who can market his milk at 10.5 cents per pound. Only 1.3 pounds of dry milk replacer were required per pound of veal, however; encouraging if the basic feed price of 28 cents per pound could be reduced further by volume purchase.

As in the previous study,[1] these data do not lend support to the idea of vealing a few bull calves on the average dairy farm or the vealing of calves for home use. Failure to achieve economies in the purchase of feed and other supplies for a small number of animals would make the venture marginal at best.

The data do support the possibility of a single large operation, or at the most two moderate sized enterprises, utilizing the surplus calves from the dairy industry. And these animals are surplus; the dairyman has neither the incentive nor the time to raise his bull calves or heifer calves which he does not plan to keep for herd replacements.

The potential for success in a veal enterprise cannot be evaluated from production data alone. Economy and efficiency in production is a dream from which one is rudely awakened if a product finds little favor in the marketplace. Veal carcasses produced during the project were retailed through one of the large supermarkets in Fairbanks. Four carcasses, two from whole milk and two from milk replacer diets, were used in consumer acceptance and evaluation tests.

Trained interviewers asked purchasers their opinion about the appearance of the veal and reasons for purchase. Seventy-four families granted permission for a second interview at home to follow preparation and serving the veal.

Of the 130 families who purchased veal during the initial interview period at the meat counter, 37% had extensive and 54% had limited prior experience with veal. Only 8.5% reported no previous experience with veal.

Retail cuts were priced from $0.69 to $1.09 for the low priced cuts to $2.29 for cutlets. Most of those buying veal said they did not mind paying a high price for good, fresh veal. They didn't seem too concerned about price if veal was available. Others, who were not accustomed to eating veal, commented to interviewers that the prices were too high.

Seventy-five percent of the 130 consumers questioned indicated that they would pay 5 cents a pound more for this quality veal and 50% were willing to go 10 cents more.

Over 60% of the families interviewed at home purchased the veal because they liked veal and the veal looked good. Only 7% did so because of a desire for something different. Ninety percent of the respondents purchased the veal for a routine meal and nearly all were pleased with the appearance of the product. Data from the consumer preference study did not indicate a

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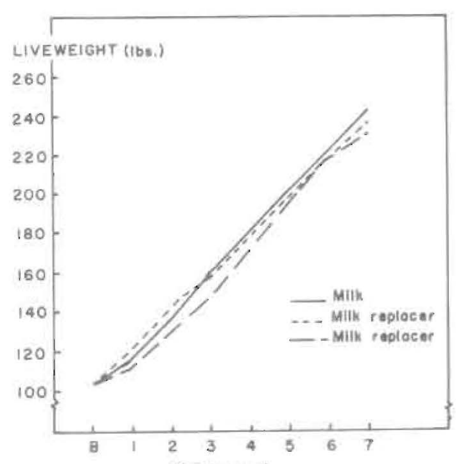

Figure 1. Growth rate (adjusted to equal birth weight) of calves fed rations of whole milk or one of two milk replacers.

[1]Brundage, A.L., J.G. Schubin and W.J. Sweetman. 1962. Veal - A market for Alaska's surplus calves. University of Alaska Agricultural Experiment Station Information Circular.

Views in Evaluating Alaskan Efforts In Range Livestock Production for the Future

By C. WAYNE COOK
Chairman, Department of Range Science
Colorado State University
Fort Collins

Dr. C. Wayne Cook, an international expert in range livestock production, spent three weeks during the summer of 1970 assessing Alaska's beef-raising efforts and problems. Dr. Cook is chairman of the Department of Range Science at Colorado State University. He has been a consultant on livestock matters in Australia, Brazil, Argentina, and Mexico. While here in Alaska he expressed a deep interest in its problems, potential and future. Following are introductory remarks in his report.

It seems logical to assume that Alaska's population will more than double within the next 15 to 20 years. Much of the increase may be only summer home residences. The western mountainous states below are rapidly becoming crowded, and better than average salaried city dwellers will be looking to Alaska for relaxation and relief from crowding. Social behavior demands this release at any cost in present day thinking.

Since much of the western range lands in the United States below are, at present, being devoted to other uses such as wilderness, recreation, suburban building, and summer or seasonal home sites for urban dwellers, it is inevitable that the western states will soon become importers of meat rather than exporters. For this reason it would seem that Alaska should plan to supply more of its domestic meat needs. Australia is now exporting 80 percent of its total beef supply to the United States, and Argentina rations meat in their country to meet their commitments to Europe and Asia. Brazil has a rather large range resource potential but it is even further behind than Alaska. Like Alaska, it must develop the land, transportation, and packing and marketing facilities.

At present, livestock meat production in Alaska does not make a substantial contribution to the state's economy but it does have a rather significant potential to do so in the future if properly developed. Home grown meat is a means of processing an otherwise wasted forage resource. This creates a new dollar in the State and also an enterprise that causes intrastate turnover of earned monies.

Development of the Alaskan livestock industry in proper perspective appears to be in dire need of financial aid and technical assistance. Financial aid is necessary to carry out research and supply solutions to the many problems confronting an undeveloped industry. It needs technical assistance in developing a plan. The plan should be preceded by an inventory of the complete agricultural resources and their importance to future growth and development of Alaska.

Since most of the range lands and potential pasture lands are owned by the State of Alaska and the Bureau of Land Management, it would seem advisable for the State Department of Natural Resources and the BLM to cooperatively undertake the task of inventorying the area of range land and the potential pasture lands that might be converted from native vegetation cover in the State of Alaska. No one can accurately evaluate the magnitude or the importance of a fully developed beef program in the State until this has been determined.

Resurgence Noted in Alaskan Cutworms

R. H. WASHBURN
Research Entomologist

1970 marked the resurgence of the cutworm as an important pest of agricultural crops in Alaska. Cutworms are the larval stages of a group of stout bodied moths of the family Phalaenidae. Their population fluctuates greatly from year to year in contrast to the more constant presence of root maggots.

A cutworm outbreak in 1943, probably the most serious that has occurred in the state, gave impetus to the beginning of agricultural entomology in Alaska. Cutworm populations in Alaska are suppressed due to great natural pressure from a complex of parasitic wasps and flies, as well as diseases incited by viruses and bacteria. In addition there are a number of predatory animals and birds. Sea gulls are one of the common indicators of cutworms in near-coastal areas; large numbers of gulls appear in fields newly planted to cereals or annual hay crops when cutworms are abundant.

One of the reasons for the fluctuations in cutworm population is host specificity of the wasp parasites. Under favorable conditions, the parasites build up in numbers so that the cutworms are practically eliminated; with decrease in available prey, the wasps die off and take longer to build up again than do the cutworms.

There are approximately 95 species of the cutworm family known to occur in the state, but fortunately there appear to be only four species of economic importance. These are the red-backed cutworm, the spotted cutworm, the w-marked cutworm, and the black army cutworm.

The red-backed cutworm is by far

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So Many Questions - So Few Answers

WAYNE E. BURTON
Associate Professor of Economics

DONALD H. DINKEL
Associate Professor of Plant Physiology

FRANK J. WOODING
Assistant Professor of Agronomy

Agriculture in Alaska has a substantial development potential which has been only partially explored and, "some combination of commercial agriculture and subsistence agriculture that is capable of evolving into commercial agriculture would seem to be indicated."[1] Historically, most of the the agricultural research in Alaska has been oriented to assist homestead development and small commercial farms. However, in December, 1969, a Memorandum of Understanding between a commercial venture, OHM, Inc., and the University of Alaska, provided the unique opportunity to study the feasibility of large-scale commercial agriculture in the Tanana Valley.

The University of Alaska's responsibility in the project was delegated to the Institute of Agricultural Sciences' College Research Center. After initial appraisal of the project, it became apparent that our primary goal should be to determine critical information and technology required for an evolving large-scale farming industry in a new lands, settlement-development area, and to provide consultant expertise and research information in the developmental process.

The University-Institute's Input

During early months of University participation in the project, activity may be characterized as interested curiosity and limited "consultant expertise." Initial emphasis was to facilitate fertilizer grants to the cooperative project. Resource and management studies were initiated by Dr. Wayne E. Burton, Project Coordinator, to generate and record scientific and economic data from successive development phases of the Delta-Clearwater farm unit. Some climatological instrumentation was installed. Regular liaison and planning dialogue were carried out between the Project Coordinator for the University and the President of OHM, Inc. (... and we talked of many things).

By midyear, focus and tempo of the Institute program had begun to change and gain momentum. Program needs mushroomed due to the rate the case-study farm was growing. Research information unique to the Delta-Clearwater area was conspicuous by its absence. Drought-induced problems accentuated agronomic and soil fertility questions. Dr. Frank J. Wooding joined the Institute research staff at College in July and was immediately involved in the cereal grains-soil fertility program. The advancing scope of questions caught up with Dr. Donald H. Dinkel in mid-October, when the "pork palace-growth factory" concept emerged. Economic studies were expanded to include marketing of pork and horticultural products. A Pandora's box of questions had been opened. The full impact of the needs for information and technology by a fast-growing, large-scale farming industry in a new lands, settlement-development area had exploded upon us. Year's end may be summarized by, "So many questions - so few answers."

The Case-Study Farm

Land was acquired early in 1969 by OHM, Inc., and a typical homestead-type operation was started with the purchase of a used dozer to clear land on weekends and available days away from a job in town. Spring barley (Edda) was roughed-in just before freeze-up to evaluate dormancy planting, a cultural practice tested at the Fairbanks Experiment Station (1914-1915), and now used in some areas of Canada. Triticale was also dormancy planted. An extensive search for information and technology applicable to interior Alaska was carried out by OHM, Inc. personnel.

During the winter of 1969-1970, development of the OHM unit was reoriented to a large-scale commercial farming endeavor. Their expressed goal was to make the unit "the most modern farm in the United States." Land clearing was accelerated by hiring a second dozer. Additional land was acquired by term lease and purchase. A "package" of farm machinery was purchased from Deere and Company. The Memorandum of Understanding was consummated to initiate the cooperative research-development Project, and dialogue was carried on with Institute personnel regarding barley varieties, minimum tillage farming systems, fertilizer use and rates of application, foundation stock for a swine enterprise, confinement housing, swine production systems, pork marketing potentials, and various firm-development strategems.

Minimum tillage with a large tandem disk and roller-packer, was used on newly cleared land. Some 90 acres of fall-plowed land was planted to compare tillage systems. Previously farmed land provided another comparison. Three varieties of barley were planted: Edda and two Canadian varieties, Galt and Conquest. Fertilizer was applied at the rate of 320 pounds of 8-32-16 per acre, based on soil analysis. Some fields were also top-dressed with urea later in the season.

A 6-inch domestic water well, two 10-inch irrigation wells and equipment adequate for 640 acres, a 40 x 80 ft. shop and storage building, four 10,000-bushel grain bins, a "Bacon Bin" hog house, and the earth and concrete work for a slaughterhouse certainly demonstrated dynamics of the unit. The air-lifting to Delta Junction of a foundation herd of certified specific pathogen-free (SPF) swine emphasized that major inputs can be brought into the development process in a matter of days. Future plans include 6,000 acres of crops, 200,000-bushel grain storage, an annual production of 14,000 marketable hogs, 10 "pork palace-growth factories," a feed mill, and a slaughter plant.

OBSERVATIONS, RESEARCH NEEDS

Land Clearing

Initial clearing was a traditional dozer operation during the winter,

[1]"Planning Guidelines for the State of Alaska," prepared for the Office of the Governor, State of Alaska, Stanford Research Institute, Project 8183, December 1969, Chapter IV, "Agriculture."

pushing materials into berm rows for burning. Clearing was carried out on partially cleared regrowth land, burned-over regrowth land, and primary forest cover. Information on other clearing procedures was reviewed, i.e., clearing firebreaks and controlled burning of standing timber, chaining down standing timber followed by controlled burning, treating with Tordon to kill vegetation with subsequent controlled burning, and use of mechanical shredders. A preliminary appraisal of various clearing systems did not indicate advantages to changing from dozer clearing. However, more research is needed on problems of land clearing to determine comparative costs and functional efficiency of alternative methods, and to evaluate relative environmental disruption.

Tillage Practices

Two tillage practices were used during the 1970 cropping season, traditional plowing and the minimum tillage system described previously. One field had been fall-plowed with a moldboard plow after clearing, turning all vegetative material under 5 to 7 inches. Some "dusting" occurred during the winter and early spring, and the soil was very dry at planting time. Moisture from light showers did little to alleviate the dryness in the top 5 inches of soil. Barley seedlings emerged slowly and unevenly. The stand was stunted and irregular until after late summer showers and top-dressing with urea. Grain maturity was late and yields were low.

Minimum tillage left vegetative material near the surface and provided a suitable seed bed. Small brush was cut with a brush-cutter. Some fields farmed under this system appeared to yield more than twice that of the plowed field, suggesting that moisture was utilized more effectively.

Differences in production were sufficient to indicate need for management and economic research comparisons of a number of tillage practices and systems. Emphasis should be given to those systems which minimize erosion and increase humus content of this very immature soil.

Dormancy Planting

Dormancy planting involves sowing in late fall or early winter when low soil temperatures inhibit germination. It is a cultural practice that involves both advantages and disadvantages that must be weighed against each other through critical evaluations.

About 50 acres of Edda barley and 2 small test plots of triticale were included in a test by the farm operators. Emergence of barley was uneven, perhaps due to the dry, open winter and inadequate soil preparation. However, estimated yields were approximately 20% greater than spring-planted Edda. Barley-stripe damage occurred and was comparable in fall and spring-planted Edda. Although the initial attempt at dormancy planting met with only partial success, the results were sufficiently promising to warrant further investigation. About 350 acres of Galt barley were planted in late September, 1970, when soil temperatures reached approximately 32° F.

Dormancy-planting studies were initiated at College in late September, 1970. Four varieties of barley (Edda, Olli, Galt, and Conquest) were sown at the rate of 3 bushels per acre at a depth of 1 inch. These same varieties will be planted next spring, so comparisons can be made.

Research is needed to determine critical temperatures for germination, time of seeding in relation to soil temperature, depth of seeding, and seeding rates. Since weather varies considerably from year to year, several years data from at least two locations will be necessary before conclusions can be made.

Fertilizer Response

By early July, barley in some fields displayed a severe nitrogen deficiency. Soil analysis also suggested phosphorus deficiency. Urea fertilizer obtained from the Collier Carbon and Chemical Corporation was applied in late July as a top-dressing at the rate of 100 pounds per acre (45 lb N per acre). Urea was withheld from areas in one field of Conquest for comparison. Application of urea increased estimated production by approximately 50% and crude protein content of grain from 13.5% to 15.4%.

Fertility problems associated with newly cleared land can be immense, and those encountered at OHM were no exception. An intensive research program is needed on plant nutrition in newly cleared Tanana Valley soils. Of immediate concern is macronutrient requirements for various crops. In addition, a careful vigilance should be maintained for the appearance of micronutrient deficiencies. This should include both laboratory analyses and field experiments.

Spring Cereals

In 1970, three 6-rowed barley varieties were grown at OHM: 180 acres of Edda (including the fall-planted acreage), 550 acres of Galt, and 250 acres of Conquest.

Edda barley, originally an introduction from Sweden, has been recommended for Alaska since 1951. Edda performed poorly at OHM, due largely to severe infestation by barley stripe (*Helminthosporium gramineum*), a fungus disease usually controlled by seed treatment with mercurial compounds. Unless other controls can be found, the USDA ban on agricultural use of mercury may place limitations on use of Edda in Alaska.

Galt has consistently performed well in tests on dryland in Western Canada. In first-year use at the Delta-Clearwater farm, Galt out-yielded and exhibited greater drought resistance than either Edda or Conquest. Its ability to withstand drought apparently comes from extensive root development during early stages of growth. Galt is a stiff-strawed variety, possessing resistance to both lodging and shattering and showing minor susceptibility to loose smut.

Conquest, another Canadian variety, is taller-growing than Galt or Edda, but has good straw strength. Last year, Conquest yielded less than Galt, but greater than Edda. Both Galt and Edda appeared to be earlier maturing than Conquest.

The favorable response by the two Canadian varieties used by OHM suggests that even better varieties of barley might be available for interior Alaska from Canada and other sources. Better adapted spring varieties of oats and wheat also may be available, emphasizing the need for an extensive program of variety screening in several areas of the Tanana Valley. For 1971, variety trials are planned for both College and the Delta-Clearwater area. In addition to varieties currently recommended, seed of new varieties is being obtained from Alberta, Manitoba, Wyoming, Montana, and South Dakota.

Triticale

Two varieties of triticale obtained from the Jenkins Foundation for Research in Salinas, California, were tested on the Delta-Clearwater farm in 1970.

One, Fas Gro No. 204, proved to be far superior. Fas Gro No. 204 exhibited genetic uniformity, large heads, and a high degree of tillering. This variety is now available from the International Commodities Corporation, Amarillo, Texas. The other variety, a Hungarian development, had genetic variability, shriveled grain, and partial sterility. Both varieties appeared to be subject to daylength sensitivity and were slow maturing. However, mature seeds were harvested in late September. Problems may have been compounded by drought and nutritional inadequacies evident throughout the first half of the growing season.

Triticales result from a cross between two distinct species, wheat and rye. Nobel prize winner Dr. Norman Borlaug has termed triticale as "the first man-made species that shows promise of becoming a major cereal crop." Triticales have been grown under many diverse conditions. Major research programs with triticale are now being conducted in Canada, Mexico, Spain, Sweden, California, and other locations. Many varieties exhibit superior qualities as a feed grain. They have been reported to contain higher levels of protein and certain essential amino acids than other cereals. In feeding trials with cattle and swine, triticale has often been equal to or better than barley, wheat, and sorghum.

The initial results with triticale grown at OHM were sufficiently promising to justify continued research. For 1971, this will involve variety screening of seed obtained from Canada and California.

Winter Cereals

A new program was initiated last summer to screen varieties of winter cereals in the Tanana Valley. Seed was selected from winter-hardy and drought resistant varieties, most of which are grown in the Northern Great Plains and Rocky Mountain states. Nine winter wheat varieties and one winter barley variety were planted in mid-August at Delta-Clearwater and at College. Seed for six of the winter wheat varieties (Trapper, Trader, Warrior, Lancer, Scout 66, and Omaha) were obtained from the University of Nebraska. Roscoe Taylor, Research Agronomist at the Palmer Research Center, contributed seed of three winter wheat varieties (Froid, Kharkof, and Blackhawk) and one winter barley (Composite Cross). Seed of additional winter varieties of wheat and barley are being obtained from Montana State University and the University of Wyoming.

Past performance of winter cereals in the Tanana Valley has been characterized by poor winter survival. Some years, most of the varieties tested winter-killed. This may have been caused by lack of hardiness or susceptibility to snowmold. Progress is being made in breeding programs. Each year new varieties are released, some more winter-hardy than their predecessors.

The Swine Enterprise

Breeding stock for the swine project was purchased in Iowa after a concerted search by the farm operators. Specific pathogen-free animals were selected to minimize possible disease problems. Several different ages were purchased to initiate a year-round farrowing program that would maximize use of the housing facility and provide year-round distribution of pork into the market. Sows were crossbred Yorkshire x Hampshire x Spotted Poland China. Boars were purebred Yorkshire, Duroc, and Chester White. Rotational crossbreeding will be practiced and performance testing will be initiated by the farm operators.

Feeding programs are intended to maximize use of farm-produced barley. Initially, whole barley and protein supplement were fed. Grinding equipment has now been installed and is in use. Pigs are fed starter until five weeks old, then gradually changed to a barley-based ration. More refined nutritional programs will be developed as the swine enterprise progresses.

The initial swine house is two-floored, circular-shaped, 48 ft. in diameter, and insulated with 3 inches of urethane foam. Temperatures in the facility have varied less than 5 degrees above and below the 65° F standard. Constant air circulation is maintained by a modified heating-circulating fan system. Waste disposal is via a covered log-crib-type cesspool.

Review of information on waste disposal systems suggests the use of aerated lagoons, biological reduction systems that could provide protein feed supplement and a CO_2-O_2 exchange system that could be incorporated into the total operation.

The concept of a "pork palace-horticultural growth factory" emerged from evaluation of alternative uses of second-story space in large quonset-type buildings being considered for swine finishing operations. The first building of this kind is to be erected by midyear 1971. It is anticipated that hogs will be fed on the lower floor and horticultural crops produced on the upper floor. This concept stimulated an intensive search for research information and advanced technology to initiate a "first of its kind" growth factory.

The Horticulture Growth Factory

Production of crops in a completely controlled environment has been the quest of growers and hobbyists for years. Recent research applications in lighting, use of carbon dioxide enrichment, hydroponic culture, and improved varieties adapted to controlled environments suggest the feasibility of a "growth factory." Alaska, where the climate restricts growth of crops to a short season, could benefit from this kind of food production.

The Institute's horticulture research at Delta-Clearwater has been limited to a cooperative venture on the site of the OHM development, where a small "growth factory" prototype has been erected adjacent to the "Bacon Bin." Several commercial and experimental lighting systems for plant growth are being evaluated. The prototype has atmospheric interchange with the swine facility, so that results can be obtained on the possibility of utilizing excess carbon dioxide from the swine facility to enrich the atmosphere in the prototype. Oxygen-improved air is recycled back to the swine.

Related research objectives of the Institute are to test developing knowledge and advanced technology in a totally integrated automated system of production. A search for the most recent information on automated production, hydroponic systems, lighting techniques, and CO_2 enrichment procedures has been conducted.

To accomplish these objectives, present greenhouse studies at College are being expanded to be more applicable for commercial growers interested in total or supplemental lighting in greenhouses or "growth factories," and to those interested in automated growing systems. Variety tests of lettuce, tomatoes, cucumbers, radishes, turnips, green onions, and strawberries will be made to find the kinds best adapted to "growth factory" production. Present greenhouse varieties of some crops, such as tomatoes and cucumbers, may not be desirable because of certain growth characteristics. Tomato plants with a large number of fruits in the first two trusses could be limited in height to 2 to 2½ feet and would be closer to the light source during their growth.

Several commercial lighting companies are developing more efficient light sources specifically for plant growth. Better methods of reflecting light to the plant are available. Industry reports suggest that pulsing or intermittent light is more efficient than steady light for certain plants. Such new ideas and developments will be tested at the College research facilities, and the best lighting systems will be identified for particular crops.

Economic development in Alaska would be enhanced by use of locally produced growing media for a hydroponic system, so studies at College will be intensified to further evaluate the usefulness of local gravels, sands, and peats. When fully developed, the "growth factories" should bring year-round *fresh* vegetables and fruit to the inhabitants of the north and an increased dependability of production in more southern climes as well. It should enhance the quality of living in the north by also making pot plants and flowers available on a year-round basis.

Marketing

Development of the OHM farm is not yet at the stage where marketing is an urgent problem. Barley production is primarily intended for use as feed for the swine enterprise. Due to an integrated production system for pork through the slaughter phase, marketing will be at the distributor level for fresh, and possibly cured, pork. Preliminary intrastate market projections and limited exploration of possible export markets for pork have been completed. More specific studies of market infrastructures, and intrastate and export markets will soon be initiated.

Horticultural and floricultural markets are of less immediacy. However, market infrastructure studies are in process, which will provide not only market parameter estimates for such crops, but will also provide information regarding present production data and seasonal distribution patterns at the retail level. Time series data collections have been initiated for greenhouse crops.

SUMMARY

The University of Alaska-OHM, Inc. cooperative project has provided a case-study opportunity to observe and study the process of large-scale farm development, while identifying limiting problems in various enterprises as they develop, so timely expertise and research support could be staged. The project also has provided the stimulus to explore new and different concepts that may enhance production opportunities for present and potential Alaska farmers.

Sources of Nitrogen for Bromegrass

(Continued from Page 13)

from the soil was increased by potassium sulfate application only when ammonium nitrate was used (Figure 2). Ammonium nitrate resulted in consistently greater nitrogen uptake than aqua ammonia.

Less than half of the N added in the spring was recovered by the plant when aqua ammonia was used. But with ammonium nitrate, practically all applied N was recovered. Nitrogen recovery of 135% with potassium sulfate fertilization indicates removal of N already present in the soil.

Application of potassium sulfate to the soil in the spring produced an increase in the available potassium in the soil after cropping on August 8 (Table 2). The relative decrease in available potassium, when K was used with ammonium nitrate as compared to aqua ammonia, is the result of increased grass growth and removal of potassium. The soil reaction (pH) of plots receiving aqua ammonia remained relatively constant through the season as compared to the decrease in pH exhibited by those plots that received ammonium nitrate.

Available NO_3-N in the soil after the two grass harvests was extremely low except with those plots that received ammonium nitrate without potassium. Growth on these plots was limited by low potassium level and, hence, the plants were unable to utilize all the N available. Neither the available phosphorus nor the total nitrogen content of the soil after harvest was related to fertilizer treatment.

Under the conditions of this experiment, the bromegrass yields and the residual available NO_3-N in the soil, indicate ammonium nitrate is vastly superior to aqua ammonia for spring topdressing of bromegrass. The poor results with aqua ammonia indicate considerable loss of applied N. Even at the low temperature of 47°F, much of the nitrogen applied to the soil surface must have been lost to the atmosphere (volatilized as ammonia) before the ammonium ion could be adsorbed to the soil colloids.

Veal for Alaskans

(Continued from Page 19)

differential in preference between the milk and replacer fed veal.

There is a small but growing market for veal in the Fairbanks area. Per capita consumption of veal was 0.7 pounds there compared with 4 pounds for the entire United States. Low consumption appeared to be related to an inadequate supply of good quality, fresh veal. Both retailers and consumers expressed a desire for more. Assuming a more adequate supply of veal, per capita consumption could be expected to approach the U.S. average.

Ecology, Enviornment, Agriculture

(Continued from Page 5)

our agricultural reserve will be gone in only 50 years, more or less.[2]

Furthermore, the curve denoting a dramatic rise in yields over the past 30 years is showing signs of flattening. This is particularly true when relating the overall application of fertilizers to yields. In the opinion of Horsfall, it indicates that "unless we have some quantum jump in our technology to increase food production, the nationwide increase in the use of fertilizer will produce an ever lessening effect on crop production with the passing years."

On the other hand, we at Agricultural Sciences feel that, with sufficient research effort, yields could be significantly increased in Alaska. The amount of research that has been applied to the problems of yield in Alaska is woefully small when compared with that conducted in other regions. A great deal needs to be done in the areas of finding, selecting, and breeding better adapted plants and in determining proper management procedures for particular kinds of plants under given sets of conditions. This applies to all aspects of agricultural research, and this kind of research can ensure that agriculture and other activities are conducted in keeping with good principles of environmental management.

With the improvement of the agricultural picture in Alaska, an economic base will be provided for opening up areas that are now inaccessible except to a few. Such areas can be enjoyed by the sightseer, sportsman, photographer, walker or jogger, snowmobiler, and other outdoorsmen. Thus, agriculture and the knowledge gained therefrom through practice and research can contribute a useful, pleasant, and enriching diversity to the landscape of Alaska.

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[2]The Green Revolution: Agriculture in the Face of the Population Explosion by James Horsfall, in THE ENVIRONMENTAL CRISIS, Yale University Press.

Dr. Yvonne Aitken views a plant of slender wheatgrass prior to dissecting tillers for microscopic examination of progress of growing points.

A Distinguished and Charming Visiting Scientist

During the growing season of 1970, a botanical scientist from "Down Under" studied crop plant behavior under the long, subarctic photoperiods of Alaska. Dr. Yvonne Aitken of the School of Agriculture, University of Melbourne, resided at the University of Alaska at College from June until October. Here, in cooperation with Institute of Agricultural Sciences personnel, both at College and at Palmer, she continued studies that have taken her to many parts of the globe.

In each place visited, she has grown certain carefully selected varieties of cereals, forage grasses, and legumes. Growing the same varieties at the many different locations permits Dr. Aitken to assess the influence of environmental factors on plant growth and development. These results enable her to make comparisons among the many different environments visited, as well as comparing each with her Australian homeland.

Each of the several study locations has been carefully selected for its unique characteristics that affect plant growth. Alaska was chosen for its north-latitude position where one special environmental characteristic prevails that was necessary for her studies -- long mid-summer photoperiods that affect many developmental responses in plants. Dr. Aitken brought to the Institute skills and knowledge that complemented and broadened resident scientists' programs.

Beyond her professional interests, Dr. Aitken acknowledges a strong bond to the beauties of nature everywhere but especially those which reach majestic expression in Alaska. During her stay here, she twice visited Camp Denali, a nature-lovers' retreat on the border of Mount McKinley National Park. There and elsewhere in the state she photographed, sketched, and painted Alaska's plants and vistas. A very competent water-color artist, Dr. Aitken has recorded through this medium a treasured collection of scenes from her world travels.

She interrupted her Alaskan stay in mid-summer to journey to the "Lower 48" and on to Iceland, Norway, and other European points; in Finland she visited a research station above the Arctic Circle where studies related to the International Biological Program were of special interest.

Dr. Aitken has been an active contributor to Australian scientific journals; she has published numerous professional papers from her studies dealing principally with flower initiation in various crop plants.

From Alaska she traveled to Mexico where she currently is growing another crop of test plants for assessment of their responses in the high altitude, low latitude environment at Chapingo in the Valley of Mexico.

Resurgence Noted in Alaskan Cutworms (Continued from Page 20)

the most important and has been the main destructive species in all of the Alaskan outbreaks thus far. It is also one of the most serious cutworm species in the prairie regions of Canada. Representatives of the group are widely distributed. Some have been found as far north as the tundra area around Pt. Barrow. Most species feed on native vegetation and are seldom noticed except by those specifically looking for them.

All of the economically important species overwinter as larvae. It is often possible to carefully warm those found in frozen soil or ice and have them revive, crawl around, and even resume feeding if suitable food is available.

Black light traps collect large numbers of adult cutworm moths in April to mid-May and again from late July to freezeup. Unfortunately, these traps do not attract the species of most economic importance in Alaska. In the period of maximum daylight, light traps are ineffective and that is when the adults of the red-backed cutworm and other economic species are flying. The species collected in greatest numbers over the years is ***Xylena thoracia*** Put. - Cram. which has no common name.

Cutworms are difficult to rear for experimental studies. They are cannibalistic and must be raised in individual containers. The most satisfactory method has been to place them in individual, sterilized pill boxes containing a small amount of dry sifted soil. We feed them at about 48 hour intervals on lambsquarter leaves. They usually consume a single leaf in that time span when small, but as they mature more foliage is required. After pupation it is necessary to wait about three or four weeks for the emergence of the adult moth or its parasite.

Of about 300 field collected cutworms reared in 1970, only 20 parasitic wasps emerged. About an equal number died from disease indicating a fairly healthy population and a good possibility of further trouble with cutworms in 1971.

The feeding habits of cutworms are quite characteristic. Small, succulent plants are often cut off at ground level. Larger, more mature plants may have only midrib and main stem remaining after heavy feeding; with lighter feeding only a few holes may be eaten in the leaves. Migration of feeding cutworms is usually from the edge of a plowed field toward the center. In some fields a notable preference for certain species of plants is often apparent. In fields of oats and peas, the peas are often attacked before the oats. In fields where lambsquarters are present, this weed is usually preferentially eaten from the normal mixture of weedy species.

Cutworms are more difficult to control if the soil is dry and a dust mulch is present. Use of insecticides is more effective when combined with irrigation so that the treated area can be kept moist.

The eventual phasing out through regulatory restrictions of the more persistent chlorinated hydrocarbon insecticides will make it more difficult to control cutworms. In order for diazinon to be effective it must be worked into the soil. This can be done prior to planting without much difficulty but is more of a problem after the plants are up. Carbaryl (Sevin) applied to foliage of larger plants is satisfactory but below-ground feeders are not controlled satisfactorily. Trichlorfon (Dylox) appears promising, as it is effective in other areas. However, as with other non-persistent materials this product is more expensive and will require more applications for satisfactory control.

Frozen French Fries for Alaska

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table, the color, flavor, and texture were excellent.

Other marketable frozen potato products for which Alaskan potatoes should be well suited are hash browns, potato patties, and conceivably, mashed potatoes.

Processing of frozen potato products would provide entry for Alaskan growers into a market not presently available to them. It would provide the Alaskan consumer with excellent local products and extend the marketing season to a full 12 months. It would provide a use for good potatoes not presently utilized, and would allow the marketing of an even better quality fresh potato.

Processing will undoubtedly change the whole Alaskan potato industry if the same trends occur here as in other areas when processing has gained importance.

The most important change will be in the marketing structure. Processors market not only processed, but fresh potatoes as well. Processors often contract for a total crop, establishing a price based on the percentage of U.S. #1 potatoes delivered in a given lot. The grower will no longer wash, grade, and bag his potatoes; this will be done by the processor who will take the very best for the fresh market.

We must be careful not to think of the processor as a user of waste potatoes. In some respects the processor may have stricter requirements than the fresh market. Defects in potatoes cause the processor the same kind of loss that the housewife sustains when she buys them. The better quality the processor can get, the higher his proportion of saleable product, and the more he can afford to pay the grower. Also there are certain qualities needed in potatoes to make specific products. It may be some time, for instance, before Alaskan growers can produce a consistently successful chipping potato or one

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Time of Planting Is Critical

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early July had little effect on Engmo timothy heading the following year; seed yields from the first five planting dates (May through July 8) were about equal. With later planting (mid-July through mid-September) Engmo seed yields the following year were progressively lower. The more southern-adapted timothies, Climax and Clair, winterkilled almost completely and produced no seed (see photo).

These results are of vital concern to Alaskans planning to grow seed of these grasses. Time-of-planting can influence dramatically the economic success of seed-growing here. Research is continuing on several other management procedures important to grass seed growers.

Oat Varieties for Forage

(Continued from Page 18)

three varieties produced nearly equal dry matter yields when harvested on the same date instead of by stage of growth. Plant height appeared somewhat related to dry matter yield, with Nip, the most notable exception, being almost as tall as the higher yielding varieties. Park, a late variety, produced a reasonable dry matter yield, although relatively short in height and low in daily dry matter accumulation. One selection, 5511-51-7-185, performed relatively poorly as a forage producer, although ranking above Cayuse in all aspects measured. The other selection, 6111-55-19-95-15, appears to possess an unusually favorable level of dry matter accumulation, and is an excellent forage producer.

These results illustrate the difference in performance of oat varieties for forage production; however, several years information, as well as forage quality data, are necessary to assess the desirability of a variety. Production of seed of adapted forage varieties in Alaska would lessen dependence on imported seed, some of which, as evidenced by the performance of Cayuse, is of questionable value. However, care must be exercised in utilizing locally produced seed for forage. Selection 5511-51-7-185 does not appear to be a satisfactory forage producer, although it may be released as a grain variety. We will continue to evaluate local and imported varieties, as well as new selections, to provide the best forage oat possible to Alaskan agriculture.

Frozen French Fries for Alaska

(Continued from Preceeding Page)

suitable for dehydration. Potatoes presently grown in Alaska can be used for frozen french fries and certain other frozen products, but even here, the better the raw material, the better the final product and the better the acceptability in the market.

There is another change that processing will bring. Under the present system, washing, grading, and packaging contributes very little to pollution of the environment. The housewife is the one who accumulates the waste from peeling. Her activities are scattered so the waste she accumulates in potato preparation is scarcely noticeable. If her garbage is removed by a municipal agency, then public tax money takes care of waste disposal. A processor, on the other hand, concentrates the peeling waste from tons of potatoes, and most likely will have to find private means of disposal. Until new methods of waste disposal are designed specifically for Alaska, it will be necessary to utilize technology from other areas.

Alaskan potatoes can be processed into useable frozen products to give the local producer additional outlets for his crop. A market for 6.5 to 7 million pounds of frozen potato products already exists in the Railbelt area but this market presently is served by imported potatoes. Have we been overlooking a real potential for expansion of our agricultural economy? A study of the economic feasibility should give us the answer to this important question.

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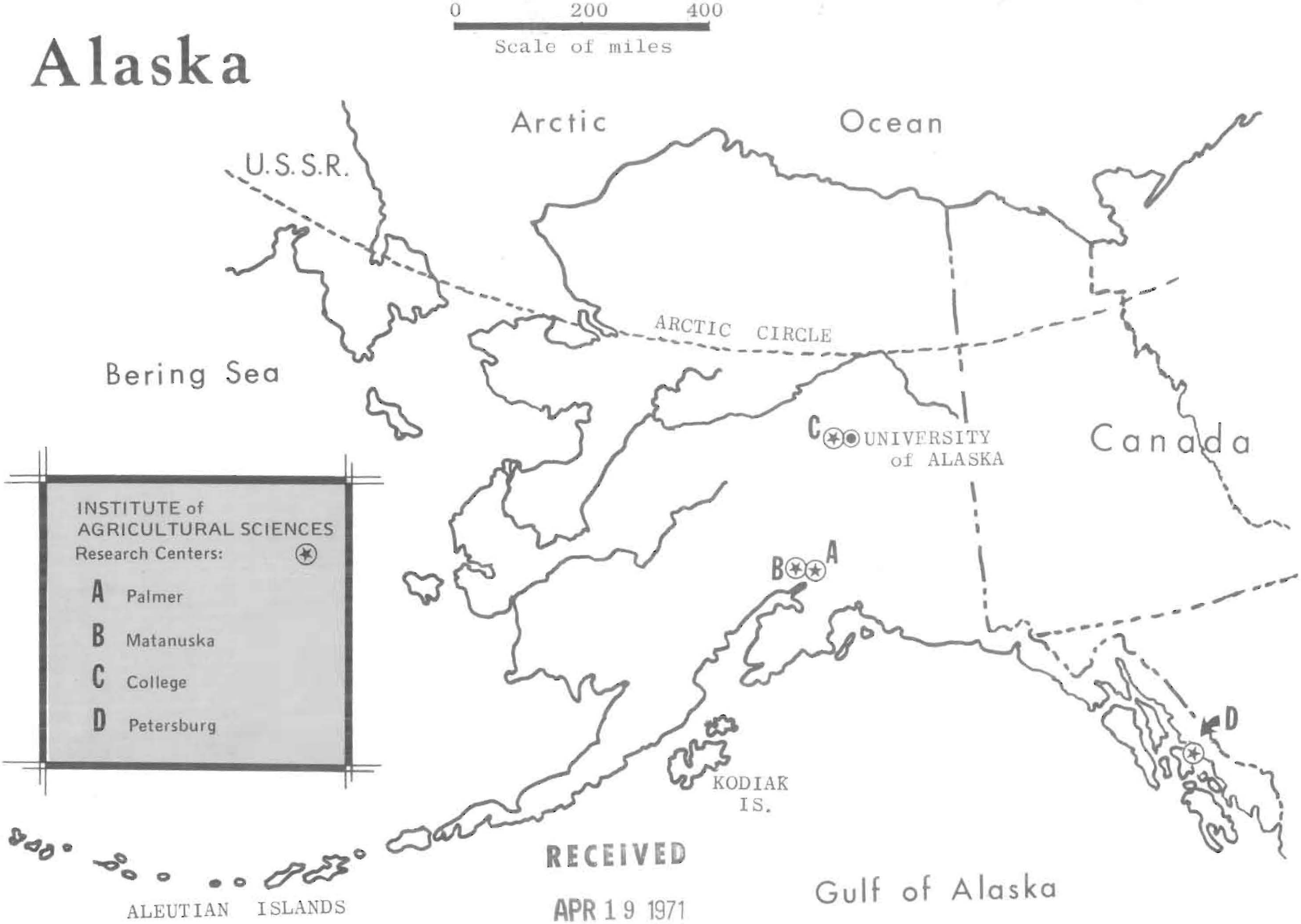
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Research Centers:
A Palmer
B Matanuska
C College
D Petersburg