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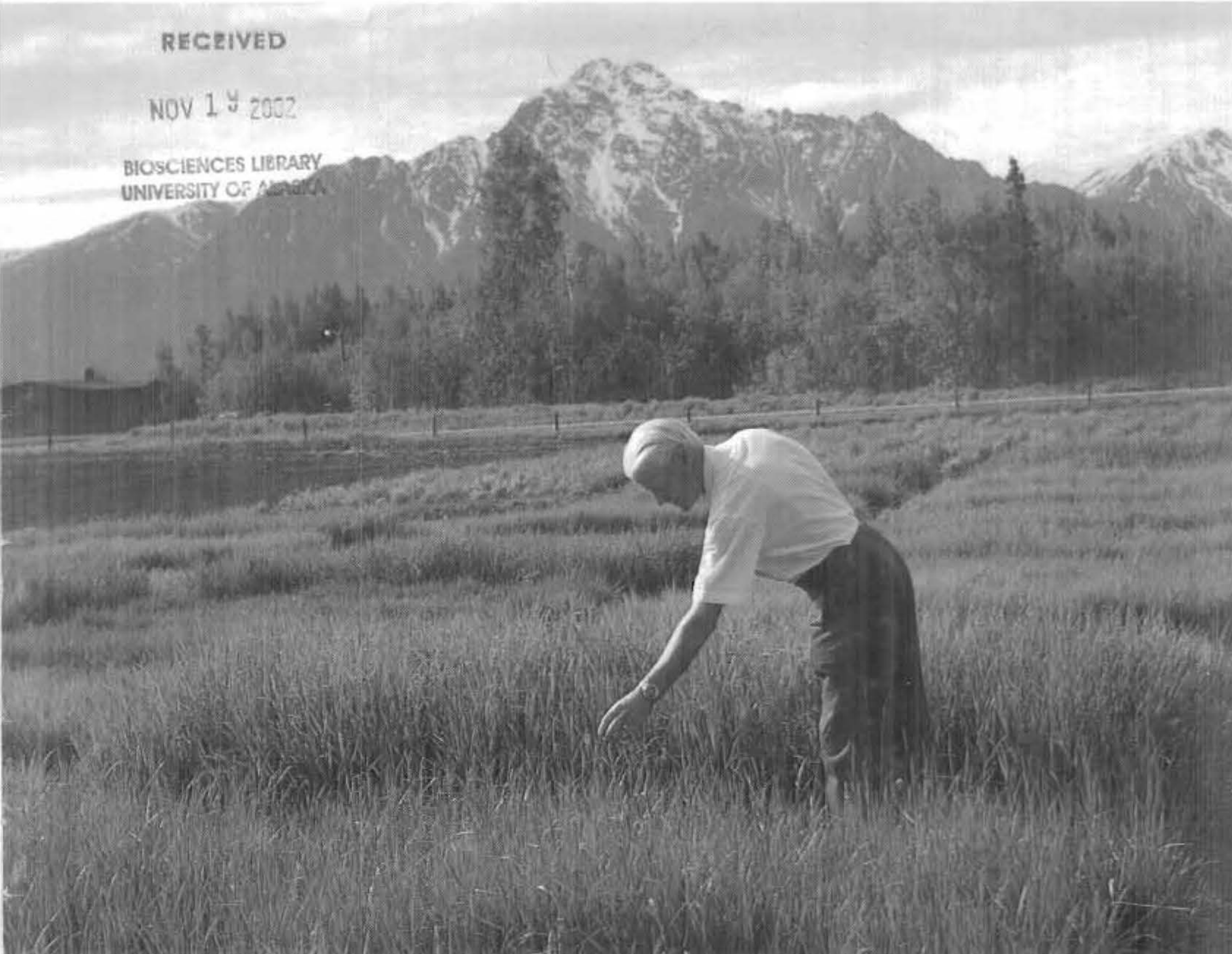

Institute of Agricultural Sciences
University of Alaska

A Review of Some Research in Progress

From The Director's Desk

Dr. Horace F. Drury, Director of the University of Alaska Institute of Agricultural Sciences retires June 30, 1975, after 8 years' service to the University and to the agricultural community of the State.

Formerly Director of the Aeromed Lab at Ft. Wainwright, Dr. Drury was given the task of taking over from the joint federal-state experiment station program and establishing a University Experiment Station program similar to that of each of the other states. Under his leadership a new program was established, new construction at Fairbanks, Palmer, Matanuska, Homer, and Kodiak was initiated, and a much broader view of Alaskan agriculture has emerged.

Following his retirement, he and Mrs. Drury will pursue their other many interests in gardening, music, flying, scuba diving, and their new-found interest in exploring the wilderness by kayaking through Alaska's myriad waterways. Adventure plus for a modern-day frontiersman!

You regular readers of ***Agroborealis*** will wonder why this column for this issue is not written by Dr. Drury, as he has done since this magazine was started. Well, the answer is simple. He decided there were a number of other things he wanted to do, so he is retiring. As a pilot flying his own Navion, he had seen most of Alaska from the air. Now, he and Mrs. Drury plan to see these remote areas traveling by kayak. Perhaps in the future, we can persuade him to write an article for ***Agroborealis*** about his kayak trips and the agricultural possibilities he finds out in the bush.

Most of the early travel in Alaska during the summer was by boat up and down the many large rivers. The first Experiment Station Director, C. C. Georgeson, who came to the Sitka Station about 1898 or 1899, apparently saw much of Alaska in this fashion. On the basis of what he saw, he estimated that Alaska had 40 million acres of agricultural lands, a figure that was widely quoted for at least 50 years. Using much more sophisticated soil sampling techniques, aerial and satellite imagery, and helicopter support, the Soil Conservation Service survey has identified over the past 25 years, approximately 17.5 million acres of tillable lands plus 10 million acres of grazing lands. These are large blocks of land, and do not include the hundreds of small parcels of less than a township in size which should also be classified as agricultural. Before long we may corroborate, with years of scientific efforts, Georgeson's "river-boat estimates" of 75 years ago. There is nothing like being on the ground to know what reality is.

We are now getting on the ground in many of the remote areas of Alaska. We have established a phenological net to give us estimates of climate in these various areas, and have established grain and vegetable test plots in quite a number of locations along the Yukon and Kuskokwim rivers. Our revegetation studies along the 800-mile oil pipeline route have provided a great deal of information on grass varieties and fertility over a complete transect of the state.

In these times, when we see a growing awareness of the serious, worldwide food situation, the identification of new agricultural lands and their food-producing potential is as exciting as the discovery of gold in 1898 or the discovery of North Slope oil in 1969. Alaska's potential as a source of both fossil-fuel energy and food, two of the world's most immediate and pressing problems, is forcing the world to take a new look at this most northern State. I believe the following articles on some of our research in progress reflect this growing excitement.

C. E. Logsdon, Associate Director

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Director H. F. Drury inspects a trial of forage grasses at the Palmer Research Center. Once a dairyman, Dr. Drury maintains considerable interest in the forage potential of Alaska. A hybrid bromegrass, directly behind Dr. Drury was one of the better producers in the trial. Some expermental native grasses showed considerable promise.

photo by W.W. Mitchel

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A Look at Forage Research in the Soviet Union: Alaska's Interests

L. J. KLEBESADEL*

On June 19, 1973, a U.S.-U.S.S.R. Agreement on Agricultural Cooperation was signed by then-U. S. President Nixon and Mr. Brezhnev of the Soviet Union. This was one of eleven bilateral agreements confirmed at summit meetings during 1972-74 as part of the U. S. Government's policy of détente with the U.S.S.R. The other agreements provide for cooperation in health, outer space, housing, energy, forestry, transportation, science and technology, atomic energy, maritime matters, and environmental protection.

Within the Agreement on Agricultural Cooperation there are two broad Working Groups — (a) Agricultural Economic Research and Information, and (b) Agricultural Research and Technological Development. The latter includes four Project Areas: Plant Science, Soil Science, Animal Science, and Mechanization.

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Primary U. S. objectives in the area of Research and Technology are to establish contacts with a wide range of Soviet institutions and individuals, and to undertake mutually beneficial research projects in various areas of the agricultural sciences. Objectives are to be achieved through exchange of research materials, including publications, seeds and seed lists, and other items; through short-term exchange visits of scientists and specialists to establish areas for mutual cooperation; and through exchange of scientists for longer-term study in universities and laboratories.

The U.S.-U.S.S.R. Agreement on Agricultural Cooperation has a term of five years, to be renewed for successive five-year periods thereafter, unless terminated unilaterally or by mutual agreement.

The author was invited to be a member of the U. S. Forage Crops Team, one of this country's first scientific exchange groups in plant science to visit the Soviet Union under terms of the Agreement.

Historically, many ties have existed between Alaska and Russia. It is generally agreed that the first humans to reach Alaska came from eastern Asia across an isthmus that joined these lands. Animals and plants also traveled via that land bridge. A Russian expedition in 1741 led to the discovery of Alaska by white men, and our present state was known as Russian America until its purchase by the U. S. in 1867.

Though the land bridge is now submerged, U.S.S.R. and U. S. lands still virtually touch in the Bering Straits where Big Diomede Island (U.S.S.R.) and Little Diomede Island (U. S.) stand 2½ miles apart. And within Alaska today, the Russian influence lives on in many ways that include geographic place names, Indians with Russian surnames, and Russian Orthodox churches. Though these many connections have existed between Alaska and the U.S.S.R. in the past, three decades of broken ties at the national level following World War II have chilled relationships. Only recently have active communications and cooperative agreements started to bridge the gaps that had developed.

Figure 1. U. S. Forage Crop Exchange Team at U.S.S.R. Ministry of Agriculture headquarters in Moscow. Front row L to R: The author, Dr. R. P. Murphy, Cornell University; Nina Agapitova, Interpreter; Team Leader Dr. G. W. Burton, ARS-USDA, Tifton, Ga.; Guide B. P. Mikhailichenko. Rear L to R: Dr. M. B. Tesar, Michigan State University; Dr. R. W. VanKeuren, Ohio State University; Dr. I. J. Johnson, Cal-West Seeds, Woodland, Calif.; and Dr. R. R. Smith, ARS-USDA, Madison, Wis.

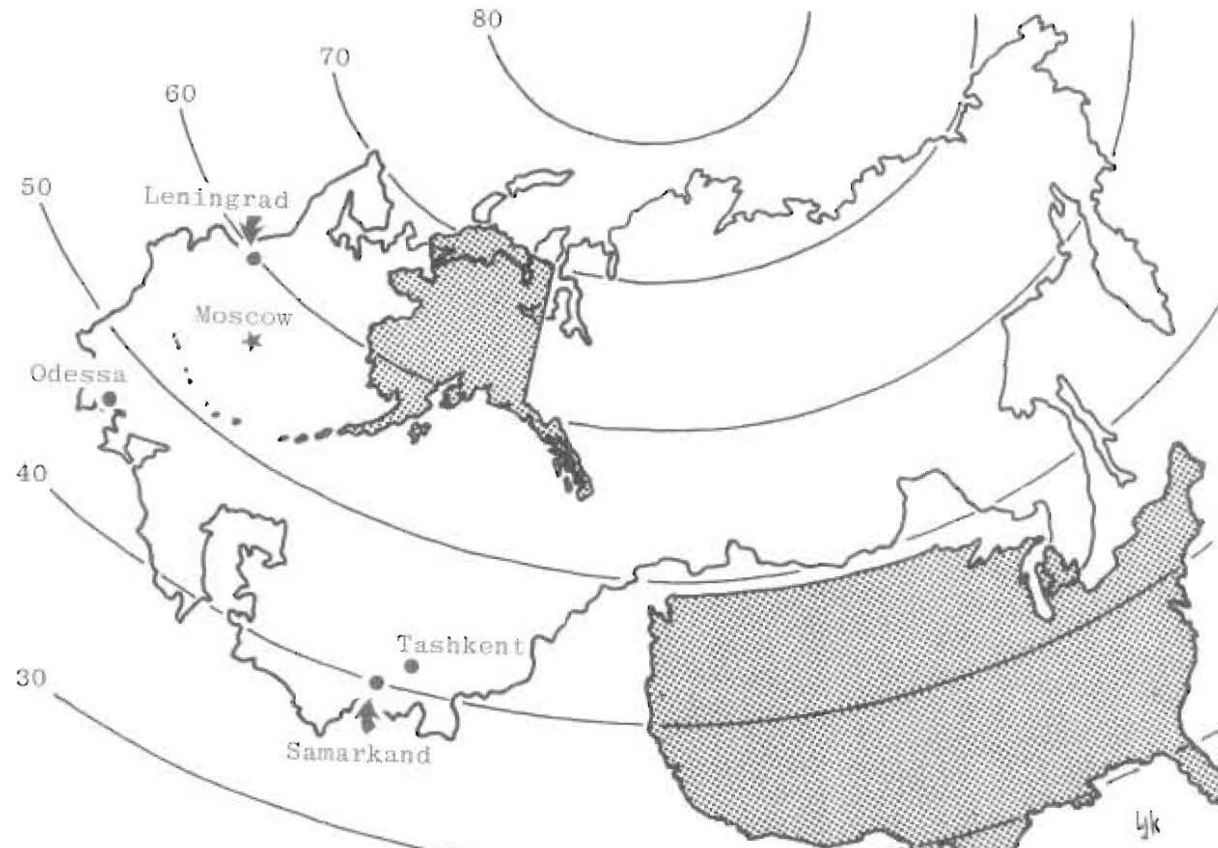
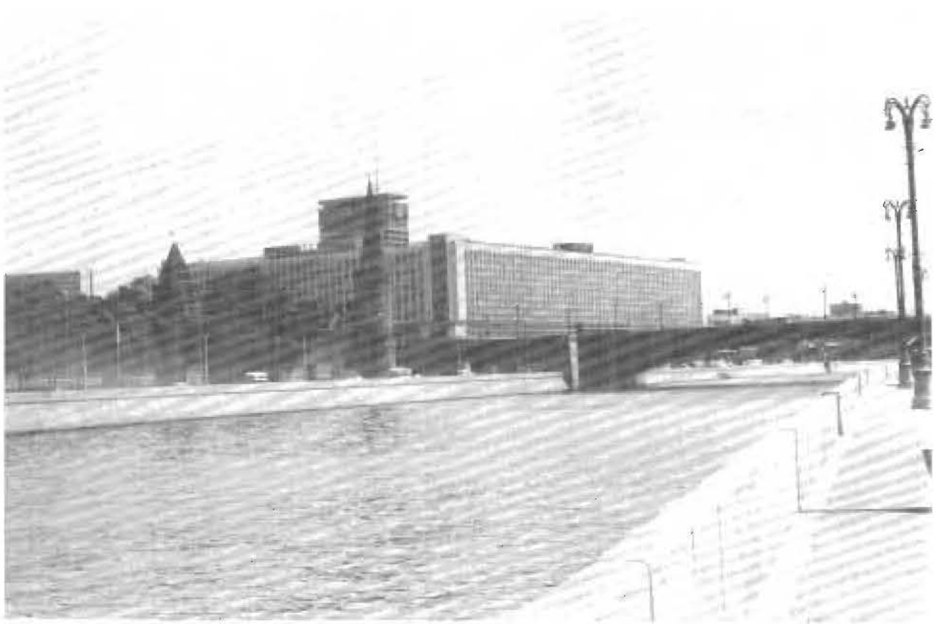


Figure 2. Comparative size and latitudinal positions occupied by the U.S.S.R. (outline map) and the conterminous U. S. and Alaska (stippled areas); the five locations in the U.S.S.R. visited by U. S. Forage Crops Exchange Team are identified.

A major natural contrast between U.S.S.R. and U. S. farmlands is seen in the relative abundance of precipitation. Only about 1% of the arable land in the U.S.S.R. lies in areas that receive 28 inches or more of annual precipitation, while in the U. S., 60% of arable lands are so favored. Most of the Soviet Union lies above 50° north latitude, while the U. S. (excluding Alaska) is below that latitude (Figure 2).

According to U. S. Department of Agriculture statistics (1), roughly one-third of the Soviet labor force (which is about 50% larger than ours) is engaged in agriculture; in the U. S. only 4% of the labor force is similarly occupied. One U.S.S.R. farm worker produces enough to feed only 7 others; one U. S. farmer's production feeds 46 others. Total U.S.S.R. agricultural output is about 80% of U. S. production. These figures are indicative of our substantial-



Modern Rossia Hotel in Moscow was home for U. S. Exchange Team during Grassland Congress and Moscow portion of tour. Kremlin Wall and towers at left, Moscow River in foreground.

Headquarters of the N. I. Vavilov All-Union Institute of Plant Industry in Leningrad.

As an Alaskan for 18 years, it was therefore with genuine interest that I welcomed the opportunity to visit and travel within the Soviet Union for a month in 1974. After attending the Twelfth International Grassland Congress in Moscow, during June 10-20, I joined a seven-member U. S. Exchange Team of forage crop specialists (Figure 1). From June 21 to July 11, we visited several research institutes and collective farms at five locations in the western area of the U.S.S.R. (Figure 2).

Some Comparisons

It is appropriate first to make some comparisons and note certain contrasts between our two countries to provide a background for more specific remarks concerning our visit. The Soviet Union is the largest nation in the world, about 2½ times larger than the U. S., and comprising over one-sixth of the earth's land surface. It is made up of 15 republics that vary greatly in size. Population of the Soviet Union is 250 million versus 210 million in the U. S.

Following the Russian revolution of 1917, most farm lands within the U.S.S.R. were "collectivized." Lands became the property of the State; individual farms were joined together into large units. These large farms exist in two categories. Collective farms (approximately 31,600 nationwide) average approximately 15,500 acres, and the larger State farms (15,744) average 49,200 acres. In contrast to their 47,344 farms, the U. S. has about 2,800,000 farms averaging about 390 acres in size. The Soviets have 1.5 billion acres of farmland to our 1.2 billion acres; they cultivate 555 million acres compared to our 385 million acres. Decisions on agricultural activities in the U.S.S.R. are highly centralized, while in the U. S. each individual farmer is a decision-maker.

ly more efficient agriculture with greater inputs of capital, fertilizers, and farm machinery. The U. S. traditionally is a net exporter of agricultural products; the Soviet Union is a net importer.

Relative emphasis on crops differs for the two nations; the Soviets raise twice as much wheat as we do, three times more barley, 14 times more rye, nearly six times as many potatoes, and more sunflowerseed (an oil and meal crop). The U.S.S.R. also produces more oats, buckwheat, sugar beets, and fiber flax than any other nation. On the other hand, U. S. farmers produce 12 times more corn, almost twice as much meat and eggs, and much more fruit and soybeans than do their U.S.S.R. counterparts.

Most of the 40 million cows in the Soviet Union are dual purpose—used both for dairy and beef. In contrast, cattle in the U. S. include 13 million for milk production and over 40 million for beef. Although U.S.S.R. milk production per cow is about half of ours, they produce 50% more milk and twice as much butter as our annual output. Conversely, the Soviets produce only half as much meat per capita as the U. S.

Small, privately operated plots, usually less than half an acre in size, are an interesting anomaly in the Soviet Union. These are tilled mostly by collective and state farm members in their spare time. Although these small plots in the aggregate occupy only about 3% of the sown acreage in the U.S.S.R., they account for an amazing productivity of certain agricultural commodities—in 1971, 37% of the nation's vegetables, and 63% of the potatoes. Of livestock products, they produced meat 35%, milk 35%, eggs 50%, and wool 20%; however, these operators obtain feed inputs for livestock from public-sector farms because the private sector plots are too small to support this production.

Areas Visited

During our tour, we visited forage research centers near the northern and southern extremes of major agricultural research in the U.S.S.R. Our northernmost stop, at Leningrad, was at 60° north latitude. A location of similar latitude in North America would be near Anchorage, Alaska (or over 1,000 miles due north of Minneapolis, Minnesota). Our southernmost visits were in the Tashkent-Samarkand area of the Uzbek Republic, these are on a latitudinal par with Salt Lake City, Utah, and Denver, Colorado. We also visited the Moscow area in the Russian Republic, and Odessa in the Ukrainian Republic, locales intermediate in latitude and climate (Figure 2).

Dr. R. W. VanKeuren photographs experimental facilities for studies of photoperiodic responses in plants at the Pushkin Laboratories east of Leningrad.

Moscow Area

During the International Grassland Congress that preceded our forage exchange tour, we stayed near the city center of Moscow, capital of the U.S.S.R. and a city of about 8,000,000 inhabitants. At the outset of our forage team tour, we visited the Moscow offices of the U. S. Agricultural Attache, and the U.S.S.R. Ministry of Agriculture. An itinerary and schedule were agreed upon in their Ministry offices.

The V. R. Williams All-Union Fodder Research Institute at Lugovaya, 19 miles northwest of Moscow, was visited first. This modern institute's programs are devoted to improvement and management of forage crops; the major species utilized in fertilization, breeding, irrigation, and grazing studies are smooth bromegrass, timothy, orchardgrass, tall fescue, meadow fescue, alfalfa, and red clover. Mechanization, seed growing and cleaning, and control of weeds and diseases are other major interests. This "All-Union" institute coordinates the activities of numerous other research institutions throughout the U.S.S.R.; it also trains researchers and grants advanced degrees.

Of possible significance to Alaska is a new variety of alfalfa called "Northern Hybrid," developed at the Williams Institute. A request for seed of this very winterhardy alfalfa has been forwarded.

Earlier, during the Grassland Congress, we had visited the Lenin State Farm on the southern outskirts of Moscow. Primary emphasis is on production of milk and meat, as well as fruits and berries. This 6,900-acre farm has 1,900 head of livestock, including 900 milk cows. About 2,000 acres are irrigated;

At Pavlovsk Experiment Station east of Leningrad, Dr. P. A. Lubenets (second from left), Leader of the Division of Forage Crops, discusses clovers with U. S. team members through interpreter N. Krasheninnik, second from right.

Dr. R. P. Murphy (left) and Dr. I. J. Johnson of the U. S. forage team examine selections of reed canarygrass (left) and smooth bromegrass (right) at the Pavlovsk Experiment Station east of Leningrad.

some irrigated pastures were seen. Irrigation was supplied by a single nozzle with an extremely long throw, operated by a power-take-off pump mounted on the rear of a crawler tractor. Annual precipitation in the Moscow area is about 25 inches.

Leningrad Area

Of all points visited, this northernmost area was most like southcentral Alaska. Leningrad is about as far north as Anchorage, and Leningrad is directly across the north pole from Anchorage. Leningrad was the capital of Russia for 206 years, and was the national capital of Alaska for longer (126 years) than Washington, D. C. (108 years). Our stay in Leningrad coincided with the summer solstice; this event is celebrated there as the "White Nights" with late-night singing, dancing, fireworks, boat-whistle tooting, and general revelry.

There we visited the Vavilov All-Union Institute of Plant Industry which supervises 18 experiment stations and 9 experiment farms; most are located in the western half of the U.S.S.R. This Institute is roughly equivalent in plant acquisition functions to our Regional Plant Introduction Stations and the U.S.D.A. Germplasm Resources Laboratory. In addition, however, it evaluates plant collections in various geographic areas (through its network of stations and farms) and selects superior materials as is done nationwide at our state experiment stations.

At the city's edge is a large greenhouse complex that produces vegetables for Leningrad. About 20 miles east of Leningrad we toured the Institute's Pushkin Laboratories, met staff, and saw facilities devoted to physiological and analytical studies with a number of crops. A few miles farther east we saw many forages of interest at the Institute's Pavlovsk Experiment Station.

Considerable work was underway on evaluation of grasses and legumes, including some U. S. varieties, as well as work with small grains and potatoes. Major grasses seen were smooth bromegrass, orchardgrass, timothy, reed canarygrass, red fescue, Kentucky bluegrass, and redtop. Legumes included several clovers: red, alsike, white and kura. An impressive-looking nursery of purportedly very winterhardy wild clovers from northern sources in the U.S.S.R. was seen; these are of interest to Alaska and requests have been made for seed of these materials.

Of further interest to Alaska is the fact that this Institute operates a Polar Experiment Station at about 68°N. near Kirovsk on the Kola Peninsula. It is

Three of U. S. team stand with Russian hosts before alfalfa plots at Dachniya Research Farm in the Ukraine near Odessa. Fourth from left is Dr. L. K. Zechniak, Director of the All-Union Scientific Breeding and Genetics Institute.

hoped that we can learn more of research aims and progress at that station and at other northern locations.

Odessa Area

Odessa, a city of 900,000, is about 900 miles south of Leningrad and is the capital of the Ukrainian Republic. Located on the northwest shore of the Black Sea, it is an industrial and educational center, a rail terminus, and an important seaport for foreign trade. The mild climate and broad plains of the Ukraine make this a major agricultural area.

About 10 miles north of Odessa we visited the All-Union Scientific Breeding and Genetics Institute which coordinates agricultural crops research for the Ukraine. The Institute is concerned with improvement of many crops including corn, sunflower, winter and spring wheat, winter and spring barley, sorghum, peas, alfalfa, and grasses. A new phytotron (controlled-environment plant-growth facility) was under construction there.

This Institute operates two research farms, one 10 miles distant that we visited, and another 100 miles away. At the 6,600-acre farm visited, called Dachniya, we saw emphasis on alfalfa breeding and evaluation in field plots. A large, modern seed-cleaning facility was under construction at the farm. These farms are used for research and for growing the "elite" class of crop seeds.

During travels in this area we saw large fields of corn, sunflowers, and winter cereals. Climate there is similar to that of eastern South Dakota and central Nebraska. Mean annual precipitation is 14 to 15 inches. The somewhat limited rainfall received near Dachniya undoubtedly accounts for the relatively low plant densities noted in cornfields there.

Tashkent – Samarkand Area

After an all-night flight from Odessa, with a wee-hour stop at Mineralny-Vody, our Ilyushin-18 aircraft descended across the Kyzyl Kum Desert, approaching Tashkent, just as the sun's morning rays reached across this great empty tableau. The eerie, smooth-sculptured vastness of the desert-scape, seen through bloodshot eyes, created an unforgettable impression akin to what might be seen during a rocketship descent on Mars. Rules there forbid photography from aircraft so no photo record can be shown of this and other memorable aerial scenes.

Tashkent and Samarkand are located in arid central Asia, just west of the foothills at the western end of the Himalayan Range. As we neared civilization, and agricultural lands appeared, the miraculous influence of water in this arid area could be appreciated. Most of the agriculture in the broad valley we visited was irrigated – we were told that some irrigation has been practiced in that region since the time of Christ. Annual precipitation there is 8 to 10 inches.

Tashkent is the capital of the Uzbek Republic, an area with a hot, dry summer climate. Most days during our stay in Uzbekistan the temperature neared or exceeded 100°F. Samarkand is a 2,500-year-old city with a rich history woven of trade caravans and terrible conquests. The tides of time that washed over these lands brought occupations by Alexander the Great, Genghis Khan, and Tamerlane. The Uzbek Republic produces 70% of the Soviet Union's cotton and one-half of its rice. It is the world center for karakul sheep production and only China and Japan produce more silk than Uzbekistan. The woman in charge of one collective farm visited said they produced 37 tons of silkworm cocoons in 1973.

Our team members' chief interest there was in the alfalfa grown in rotation with cotton – six to seven years of cotton are alternated with three years of alfalfa. Beyond its use as a forage crop, alfalfa is valued for its beneficial effects on soil structure and fertility. Approximately 600,000 acres of alfalfa are grown in Uzbekistan, both for seed and forage. All alfalfa is irrigated; when utilized as forage, it is cut four to eight times per year, depending upon conditions in various districts. U.S. varieties of alfalfa reportedly perform poorly there.

General Observations

We observed that alfalfa was a major forage crop in the Ukraine and in Uzbekistan; however, it assumed lesser importance in the Moscow area, and still less in the farther-north Leningrad area. This pattern is similar to western Europe and North America, where the relative importance of alfalfa as a forage legume is less in northern areas; there dominance is assumed by clovers (***Trifolium*** spp.), especially red clover. Where alfalfa predominated in southern areas of Russia, clovers were less evident.

There is an obviously major thrust in U.S.S.R. agricultural planning to increase production of livestock products, especially milk and meat. It is equally apparent that Soviet livestock are fed less grain and consume relatively more forage than is true of U.S. livestock. Therefore, forages occupy an important and increasingly vital niche in U.S.S.R. agriculture.

A forage dehydrator at a collective farm near Tashkent dries alfalfa which is bagged as pellets and as meal in background.

Another obvious aim of U.S.S.R. agriculture communicated in several of our meetings with Russian researchers is their desire to incorporate greater mechanization in all phases of forage production and utilization, including tillage and establishment, harvesting, and in transport, storage, and feeding.

Interpreter Nina Agapitova translates questions directed at Uzbek farmers selling produce in open-air bazaar in Tashkent.

Because agricultural productivity is almost universally limited in the U.S.S.R. by insufficient precipitation, there is much emphasis on irrigation. Another area of major interest is in forage crop preservation — ensiling, drying methods, and the making of haylage. Large-scale structures, handling, and feeding techniques and equipment are being given high priority.

We observed relatively less concern for forage-quality determination than prevails currently in the U.S. Their emphasis seemed to be more toward increased total forage production; however, certain investigators expressed an interest in recent U.S. innovations and techniques for measuring forage quality.

Alaska's Interests

Of all circumpolar nations, the Soviet Union's northern agricultural development and germplasm resources hold the most interest for Alaska. There is little agriculture in Canada and none in Greenland on a latitudinal par with Alaska's mainland. Although Scandinavia is of similar latitude, winters in Norway, Sweden, and Finland are milder and less restrictive to agriculture than in Alaska. Several major forage crops now grown in North America, such as alfalfa, Russian wildrye, and crested, Siberian and intermediate wheatgrasses, had their origins in the U.S.S.R. In fact, Central Asia, including much of central U.S.S.R., is recognized as a major world center of origin of many plant species.

For good performance in Alaska, especially winterhardiness, it has been learned that plants (forage crops, ornamentals, etc.) must be adapted to the high-latitude environment of the state (5,6). Crops brought to Alaska from mid-temperate latitudes, such as the conterminous 48 states, often perform poorly here while those from other high-latitude areas of the world are better adapted to the unique photoperiodic pattern and other climatic influences prevalent in Alaska (2,4). The most winterhardy alfalfa in Alaska's forage research program, and Alaskland red clover (3), a variety released by the Institute of Agricultural Sciences, trace directly to introductions from the U.S.S.R. Because of its great botanical diversity, and the fact that a vast land area of the U.S.S.R. is similar in latitude to Alaska (Figure 2), it is believed that the Soviet Union can be the source of many significant future contributions to Alaskan agriculture.

In the past, many crops introduced to the U.S. from the Soviet Union were evaluated, and sometimes varieties were selected from them, at latitudes and under climatic conditions very unlike Alaska's. It is not surprising that those crop varieties, selected from a broad gene base of imported materials and tailored for ideal adaptation to specific areas within the conterminous U.S., are unsuited for use in Alaska. The artificial and natural selection process in mid-temperate latitudes obviously discards genotypes suited to Alaska's subarctic environment. Therefore, for maximum utility in Alaska, crop germplasm should be sought from other northern regions of the world, including northern U.S.S.R., and brought directly to Alaska for evaluation.

For this reason, we are anxious to expand direct exchanges of northern-adapted crops and potential crop species between Alaska and northern areas in the U.S.S.R. Personal contacts made during the exchange trip reported here, and familiarization gained with U.S.S.R. research centers, their locations and administrative alignments, should assist materially in this program. □

U.S. Team members examine a wild alfalfa in the courtyard of an ancient mosque in Samarkand.

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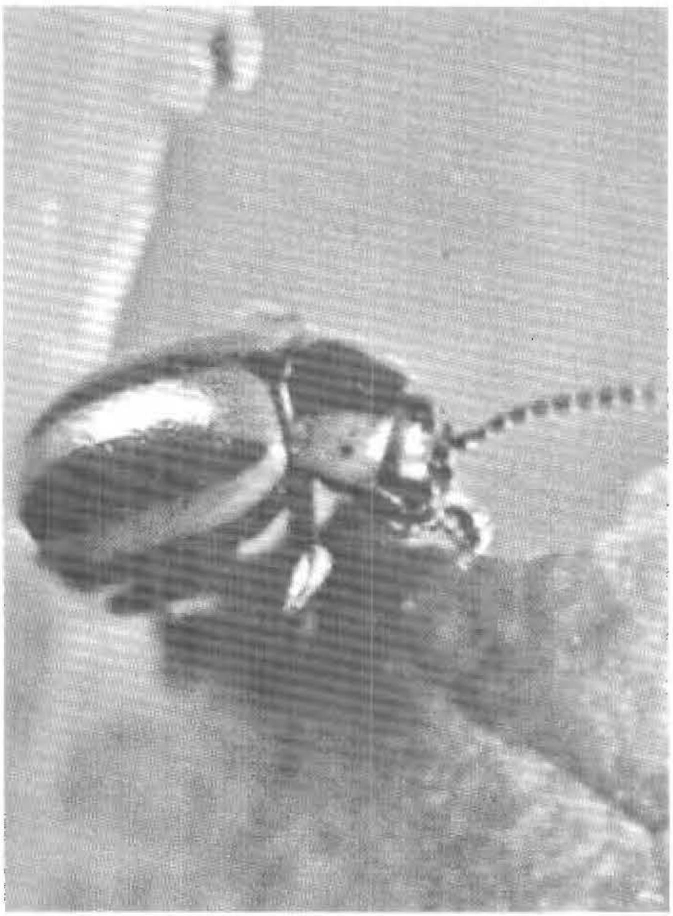
RED TURNIP BEETLE

RICHARD H. WASHBURN*

Red turnip beetle occurs from the Matanuska Valley in southcentral Alaska to Rampart on the Yukon River. The largest population and the most severe infestations have been found in the Copper River Valley in the Kenny Lake area. This leaf-feeding beetle of the family ***Chrysomelidae*** has the scientific name of ***Entomoscelis americana*** Brown. It is sometimes reported as the Colorado potato beetle, ***Leptinotarsa decemlineata*** (Say), by some who have forgotten what a potato beetle really looks like during their years in Alaska.



Red Turnip Beetle

The adult red turnip beetle, which is the most obvious stage, is a rather attractive bright red, has three black stripes down the back, and a black patch behind the head. The eggs are brown-orange, 1/8 by 1/16 inch, about the same dimensions as the eggs of the root maggots, order ***Diptera***, family ***Anthomyiidae***, that are familiar to Alaskans. The beetle eggs are laid on the ground in loose clusters and are sheltered by debris and soil lumps. Larvae are rough-skinned, dark brown above and yellowish underneath, with a few short hairs. The beetles are about ½ inch long when they are ready to pupate. They pupate on or just below the soil surface. After about 10 days in this resting stage they emerge as adults. The pupa is predominately orange and the same size as the adult.

Both adults and larvae of the red turnip beetle have been found feeding on members of the cabbage family; indeed, the insect appears to be entirely restricted to that group of plants. Observations thus far indicate that populations fluctuate greatly. For example, when trial plots were set out in areas where the beetle had completely destroyed the crop the preceding year, only a few beetles were found.

When the red turnip beetle population is relatively small, the turnip appears to be the favorite host plant. When populations are large, all members of the cabbage family commonly grown in Alaska are severely injured.

In Canada, the red turnip beetle is a serious pest of rape, especially in the prairie provinces (1), and of commercially grown mustard, a close relative of rape. It has also been destructive in part of British Columbia though it is not a problem in the coastal areas of that province or in eastern Canada. It is not considered a pest in the conterminous United States.

The larval stage of the red turnip beetle is seldom a pest to cultivated crops because it is present early in the spring and feeds on weeds such as mustards, shepherdspurse, and peppergrass. Thus, in Copper River Valley, the most common native host plant is the tansy mustard group of the genus ***Descurainia***, which is frequently found on roadsides and other disturbed areas.

The brightly-colored adults are first noted in late June or early July when enormous numbers may invade gardens and prefer cultivated crops of the mustard family (turnips, cabbage, cauliflower, radishes, etc.). Although the insects travel relatively great distances, they apparently remain on the ground. The wings appear functional, but the adults never seem to fly. If thrown into the air, they drop to the ground and then get up and walk away.

After this first several weeks of feeding, the bulk of the population usually disappears. The beetles are still there but have dug into the soil several inches and become inactive in a condition known as aestivation or summer hibernation. Some gardeners may think the problem is over, but in a few weeks, the beetles may reappear from the resting sites and begin feeding again. Feeding continues, and mating and egg laying occur in late August. The frosts kill the adults, and the damage ceases.

Fortunately the red turnip beetle is easily controlled by application of diazinon or malathion, insecticides used against aphids and root maggots. Also, cultural practices that reduce or eliminate weedy hosts, especially the tansy mustard, will help to alleviate the problem. In one case, the only beetles found along the roadsides were on mustard, and the heaviest infestations were on a nearby cultivated crop. Moreover, the mustard showed evidence of heavy feeding by the beetles before they moved to the crop.

All of the people interviewed reported that their gardens were seriously damaged by the red turnip beetle only during years in which tansy mustard was abundant. □

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In experimental plot trials yields of bromegrass (plot directly behind Director H. F. Drury) have compared favorably with some of the better yields reported for bromegrass in our rich farmlands of the Midwest. Certain native grasses entered in the above trial have shown considerable promise.

Climate Reversals and Alaska's Grasslands

WM. W. MITCHELL*

Possible changes in worldwide climates may require Alaska to become more self-reliant in food production and also promote the use of its cool season grasses in other areas. Climatic trends over the ages, and in the recent past, provide evidence for an imminent deterioration in climate (4, 13). In a recent report, the National Academy of Sciences expressed concern over the effects of future climatic events on mankind, pointing to the abnormal nature, from a historical basis, of this century's warm climate (8). Colder weather and the onset of another major drought are considered distinct possibilities.

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The recent failures of the monsoon rains to penetrate into West Africa and India as far as customary, thus expanding subtropical deserts, and the more unsettled seasons in our own Midwest are reminiscent of less favorable climatic periods that have occurred in the past. In 1974, crops in the Midwest were diminished significantly by a cold, wet spring and droughty summer conditions. A continuation of unfavorable growing years would greatly reduce projected production increases for the U. S.; indeed, it could become difficult to sustain past yields. Unfortunately, the current balance between food supplies and population levels renders us increasingly sensitive to small shifts in food supplies.

Improved technology and research findings have contributed to the high productivity of the American farmer. However, between 1945 and 1970 the kilocalorie return per unit of energy input has dropped from 3.70 to 2.82 (22). With transportation and processing requirements included, 10 calories of energy were expended for every calorie of food consumed in 1970, compared with a ratio of 7 to 1 in 1940 (7). Thus our increased productivity has depended upon a higher expenditure of energy; furthermore, it has occurred during a favorable climatic period and on the most productive croplands of the U. S.

A buildup of food surpluses in the 1950's and 1960's resulted in the less productive land being retired in "soil banks." Now the food surpluses are gone and the demand is for all-out crop production to (a) satisfy our own needs, (b) meet our foreign trade markets—transactions that are vital to our economic health, and (c) help feed hungry and starving people in the world. However, all-out crop production means bringing less fertile and marginal land into cultivation. Thus, continued increases in per acre yields, as has been predicted, may be difficult to attain, even without a deterioration in climate.

The forecast of adverse climatic conditions, of course, is problematical, though climatic events throughout the world tend to support the thesis. However, an increased demand for food by a growing worldwide population is a fact. Unfortunately, that many of these people will die for a lack of food also appears to be a fact.

These facts augur important changes in farm land use. Because of the rising demand for grain for human consumption, less grain will be available for finishing livestock. Moreover, cropland formerly devoted to livestock pasture will be diverted to lucrative grain production. The dean of the College of Natural Resources of Utah State University predicts that while the demand for red meat will increase, the land available to produce meat will decrease (3). Red meat, he claims, "will become a luxury product with high costs and be mostly produced from rangelands." Thus, the nation's grasslands will become ever more valuable for livestock production.

Productive Potential of Alaska's Grasslands

How productive are Alaska's grasslands? A U. S. Department of Agriculture task group, whose investigations in the Territory preceded the commitment of a U.S.D.A. research staff here, recognized Alaska's high potential for grass production. Their report (23) stated, "The grasses grow surprisingly fast, tall, and vigorously on nearly all open areas of well-drained or partially drained soils . . ." Natural grasslands occur above and beyond timberline in Alaska's mountain slopes and coastal regions. In forested areas grasslands develop on clearings created by fires or mechanical means. These grasslands compare in productivity to some of the better rangelands of the midwestern tallgrass prairie. Yields of 1.5 to almost 3 tons per acre have been obtained on native, undisturbed grasslands in Alaska (16, 21, unpublished data) compared, for example, with a yield of about 2.5 tons per acre for excellent range in Nebraska (24).

How well do the Alaskan soils respond when cultivated and converted to stands of managed grasses? Again, yields compare favorably with those reported for other states. Smooth bromegrass *(Bromus inermis)* is the most commonly used forage grass in Alaska and is a popular forage across the northern states of the Midwest and Northwest. Some of the better yields of bromegrass reported in such states as Wisconsin (17), Iowa (25), Illinois (12), and Pennsylvania (2) have equalled about 4.5 to 5.5 tons per acre with applications of 150 to 240 lbs of nitrogen (N) per acre. Yields of 3.5 to over 5 tons per acre have been attained in Alaska with less than 200 lbs of N applied (26, unpublished data).

Other grasses native to Alaska also offer potential. In a comparison between native arcticgrass *(Arctagrostis latifolia)* and the commercial varieties Polar bromegrass and Engmo timothy, Klebesadel (15) obtained higher yields with unselected material of arcticgrass. The arcticgrass also exceeded the other two varieties in crude protein content. Doubtlessly a screening and selection program would produce superior types with higher yielding capacity. Such a program is underway.

Some exceptionally high yields have been obtained with a selection of indigenous Bering hairgrass *(Deschampsia beringensis)*. In work currently in progress over 6 tons of oven-dry matter per acre (over 7 tons of 12% moisture hay) have been achieved with 2 cuts in one season; however, injury under this harvest system has led to reduced yields in the subsequent year. Individual types are being selected that may sustain high yields under harvest pressure.

It is more difficult to obtain high yields in areas of Alaska with strongly acidic soils using available commercial grasses. But native grasses growing on some of these sites are valuable forage grasses and lend themselves to improved yields under proper management. Bluejoint reedgrass *(Calamagrostis canadensis)* is the principal native grass harvested in place at this time. Yields of 1 to 2.5 tons per acre have been reported (14, 18), but up to 4 tons (hay basis) have been obtained using 150 to 190 lbs of N per acre in experimental work still in progress.

The research now underway with native Alaskan grasses would become even more valuable should the predictions of a deterioration in climate materialize. These grasses have experienced times of glacial stress, and today some occupy habitats of a periglacial nature. Such species contain genetic types preadapted to situations colder than the norm. The vigor with which some of these grasses grow in subalpine to alpine situations, where climates are cooler and growing seasons shorter than in the agricultural valleys, is witness to this fact.

Rangelands Assume Greater Importance in Struggle for Food

Arguments are increasing that the conversion of plant tissue into meat products is a wasteful use of energy. Dr. George Borgstrom of Michigan State University is quoted as saying, "The livestock of the rich world is in direct competition with the humans of the poor world" (5). Soybeans, at about 37 percent protein, can produce substantially more protein per unit of energy invested than can grain-fed beef, at about 17 percent protein, or other meat animals (10).

Nevertheless, there will be a continued demand for meat products (11), both because of their desirability as food items and because of land use considerations. Lands poorly suited for tillage are best left in grass or other vegetative cover. Animals can harvest the energy contained in this forage and render it available to humans. Otherwise much of this food energy would be lost to man.

The grasslands of Alaska represent a tremendous range resource (1, 19, 20). Little information is available, however, on animal gains achieved under grazing systems. Respectable gains up to 1.6 lbs per day were reported for animals in a mixed herd of holstein and red dane cattle grazing for a 90-day period on a subalpine rangeland in southcentral Alaska (6). Grazing periods of 4 to 6 months are possible on mainland Alaska, and year-round grazing is the practice on islands of the Aleutian Chain utilized for sheep and cattle raising. Unlike grasslands in many of the temperate and more southern regions that experience a midsummer, dry-dormant period, grazed grasslands in Alaska can remain green throughout the growing season until fall dormancy sets in. Diversification with established pasture can improve upon grazing potential and lengthen the grazing season.

Unused Energy — A Waste

The productivity of Alaska's grasslands and croplands represents a means of utilizing energy and materials that otherwise would be wasted. Currently, fuel and fertilizer are exported, and energy is expended in their transport, for the production of food elsewhere; more energy is required to ship some of that food back to Alaska.

Other conditions also encourage agricultural use of this state's resources. Agriculture requires large quantities of water — it is the largest consumer of water in the United States. The growing needs of this nation dictate that our water resources be managed most efficiently. Alaska is a profligate of water resources in an unusual sense. A writer and analyst on political and agricultural affairs recently commented (9), "... Alaska receives almost half as much precipitation as all the mainland states combined, and that constitutes the largest amount of unused water in the country." We can couple the waste of this valuable resource with that of the many calories of radiant energy that also go unharvested during the long days of summer.

Conservation can be defined as the wise use of our resources. Alaska's heavy reliance on outside food production that depletes Alaska-derived fuel energy, while allowing energy and materials to be wasted, must be questioned. It is time for a major assessment of Alaska's resources for agricultural production. □

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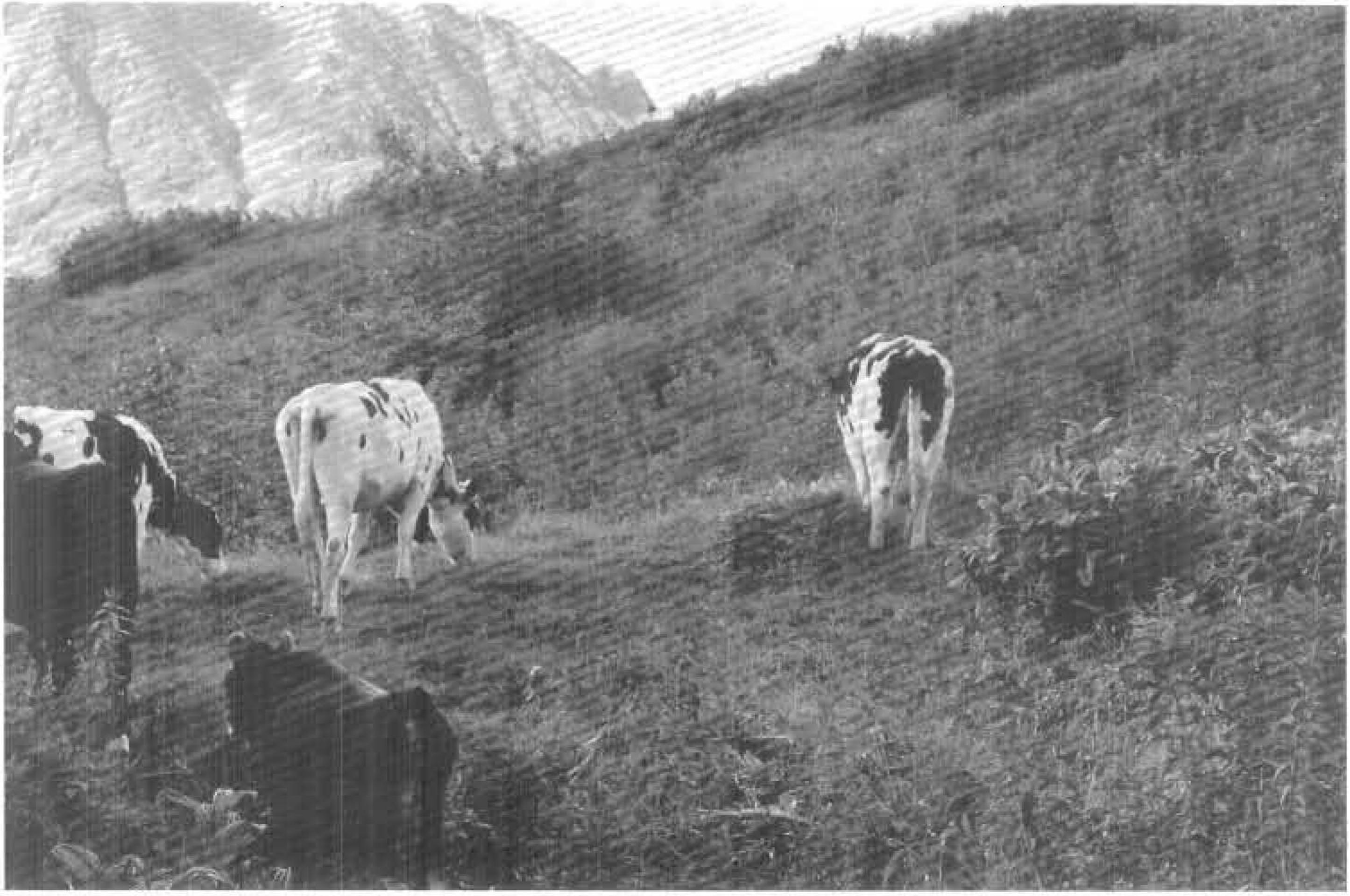
A collection of arcticgrass *(Arctagrostis latifolia)* originating from an Alaskan tundra site. The stake in the foreground is about 10 inches in length. The collection demonstrates unusually robust growth for material that has developed under the cool, short season conditions typical of tundra locations. *Arctagrostis* is strictly northern latitude in its area of occurrence and includes forms adapted to arctic, subarctic and boreal forested conditions.



Cattle graze a mountain rangeland in the Talkeetnas north of Palmer. This range has received considerable use by cattle since 1953 and consists of a rich mixture of grasses and forbs. The plants attain a lush growth by midseason.

Bluejoint grassland *(Calamagrostis canadensis)* affords good grazing in early summer on the lower Kenai Peninsula. Extensive areas are dominated by this cool-season, northern-adapted grass in southcentral and southwestern Alaska. Yields of over 2 tons of dry matter per acre have been estimated in native undisturbed stands.

THE MODERN DAIRY COW...

an enigma in our time

A. L. BRUNDAGE*

The modern dairy cow is a prime example of man's unceasing urge to improve on nature to serve his egocentric needs. Originally, as do most other mammals, the cow provided milk for her young until they could subsist on an adult diet. There was no reason to produce milk in excess of the appetite of the suckling calf; in fact, milk production beyond the immediate need of the young might be deleterious to the health and well-being of the mother.

Man, however, discovered that milk from the dairy cow was one of the more perfect foods available for human nutrition — for adults and adolescents as well as for children. The cow acquired unique importance in the affairs of man; provision of food for her young became secondary in importance to her ability to provide dairy products for an ever-expanding human appetite. Because of her new status, the dairy cow has been subjected to directed selection for milk production far in excess of that required under a wild, pastoral existence. Dairy cattle breeding and selection for ever-increasing levels of milk production must be tempered with recognition and concern for the physical and physiological limitations in her ability to consume feed and to transform feed into milk.

Seeking Answers

One might raise the question; if the dairy cow can be bred and selected for ever-higher levels of milk production, can she also consume sufficient nutrients to meet the requirements predicated by her genetic potential for milk secretion? Seeking answers, we placed one of the University Holstein cows, Alaska Inka Actor Atlas, under continuous feed intake surveillance from 4 October 1972 through 20 September 1973. She was 7½ years old on 4 December 1972 when she gave birth to her fifth calf. Producing eight tons of milk testing 3.8 percent milk fat during the ensuing 285 days, she gave birth to her sixth calf on 21 November.

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Prior to calving, Atlas received a daily allowance of four pounds of blended concentrates; after calving, she was fed concentrates according to her level of milk production. Roughage was provided free choice as silage and/or hay throughout the time she was under surveillance.

Milk production was weighed and recorded twice daily and sampled each week for determination of percent milk fat and solids-not-fat. Roughage and concentrate intakes were recorded daily and sampled twice weekly for laboratory analyses.

Laboratory analyses included dry matter, crude protein, cell walls, acid detergent fiber, lignin (72% H_2SO_4 method), and in vitro dry matter disappearance. Digestibility of feed samples was estimated with Van Soest's summative equation (3) using data for cell walls, acid detergent fiber, and lignin. The digestibility of crude protein was assumed to be 55 percent for the roughages and 80 percent for the concentrate fed. Digestible and metabolizable energy were estimated in megacalories per kilogram of feed from calculated dry matter digestibility according to equations suggested by J. T. Reid (2):

$$\text{Digestible energy} = \frac{49.0\ \text{DMD}(\%) - 360}{1000}$$

$$\text{Metabolizable energy} = \frac{34.2\ \text{DMD}(\%) + 45}{1000}$$

The protein, digestible protein, digestible energy and metabolizable energy necessary to meet daily requirements for body maintenance and milk production were determined from the National Academy of Sciences Nutrient Requirements of Dairy Cattle (1).

What We Learned

Some of the more important information obtained in this study is illustrated in Figure 1 for nine weeks prior to freshening and the 42 weeks of lactation. Daily milk production peaked at 74.1 pounds by the 10th week and declined progressively thereafter. Atlas weighed about 1,700 pounds prior to parturition. The precipitant drop in weight to about 1,400 pounds at the start of lactation can be attributed to the birth of her calf and the expulsion of the fetal membranes. Her

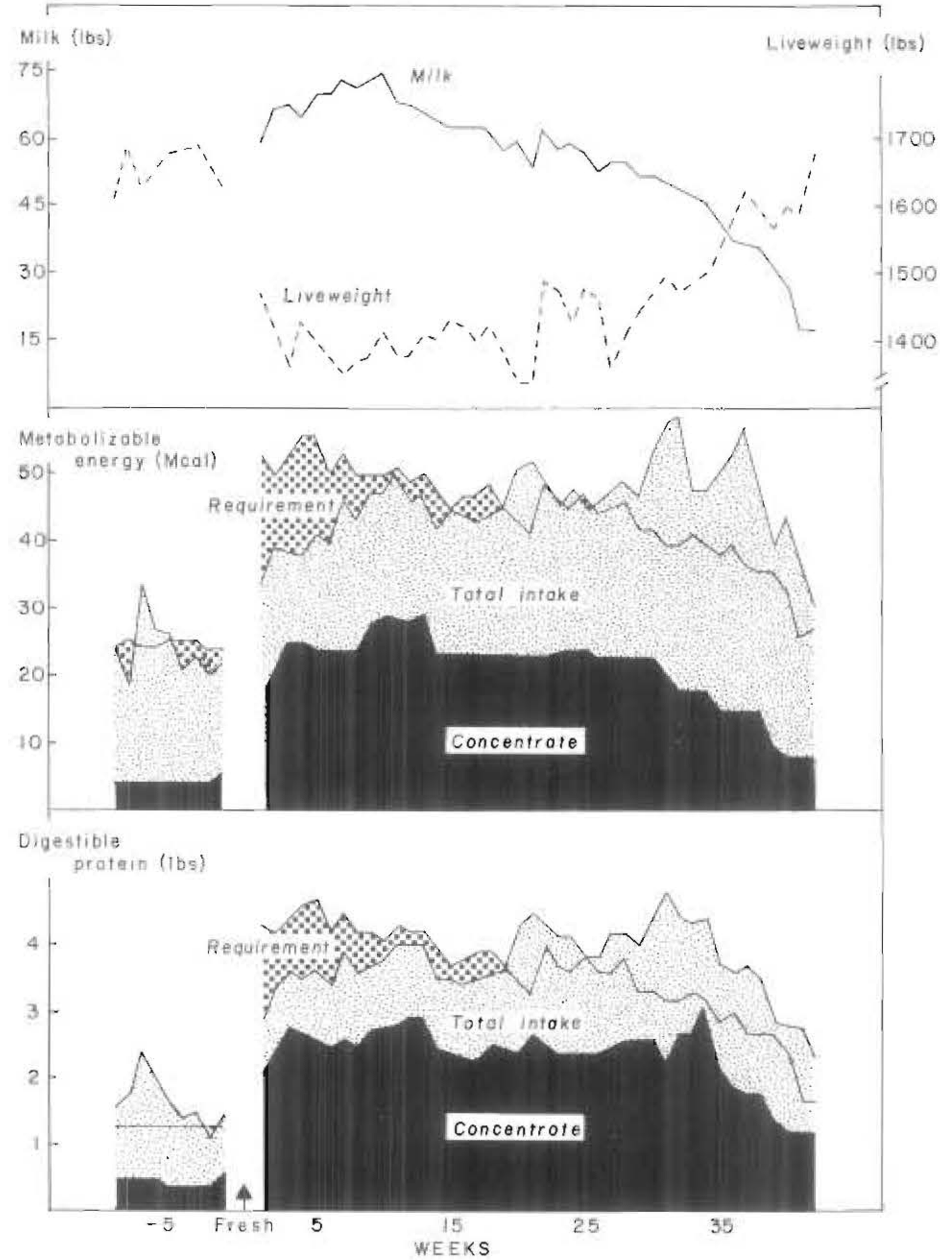

Figure 1. Average daily liveweight, milk production, metabolizable energy (ME) and digestible protein (DP) requirements, and ME and DP intakes from the total ration and from concentrates fed during nine weeks prior to freshening and for 42 weeks thereafter.

Table 1. Total Nutrient Intakes and Requirements.

	Nutrient Intakes				Nutrient Requirements		
	Hay	Silage	Concentrates	Total	Maintenance	Milk	Total
Protein (lbs)	388	472	899	1547	649	1250	1898
Digestible protein (lbs)	213	260	721	1194	317	813	1131
Digestible energy (Mcal)	4741	5647	8136	18524	7627	10559	18186
Metabolizable energy (Mcal)	3802	4565	6480	14847	6247	8222	14469

weight remained at about 1,400 pounds until the 24th week of production and then increased steadily to 1,675 pounds by the end of the study.

Total daily requirements and intakes of metabolizable energy and digestible protein are also illustrated in Figure 1, including the contribution of the concentrate portion of the diet. Estimated requirements for both energy and protein exceeded intake through the first 18 weeks after calving; intakes exceeded requirements thereafter.

Total intakes of protein, digestible protein, digestible energy, and metabolizable energy from hay, silage and concentrates are listed in Table 1 with total requirements of these nutrients for body maintenance and milk production. Although the total protein requirement exceeded the total intake, the total requirements for digestible protein, digestible energy and metabolizable energy were less than total intakes.

How Does She Do It?

Although these data are limited to one dairy cow producing milk at a moderate level, they do focus on some of the fundamental problems in providing a cow with sufficient nutrients to meet her genetic potential for milk production. Atlas theoretically consumed insufficient feed for her needs during the early weeks of lactation, even though over half of her nutrient intake was being provided by the concentrate portion of her diet. One must assume that she was drawing on body reserves of nutrients to fully meet her requirements during this time.

By the 19th week of lactation, however, Atlas was eating more feed than she theoretically required to maintain body-weight and produce milk. Presumably she then was able to provide for the developing fetus and the replenishment of body reserves previously used. Total nutrient intake for the entire period of surveillance, which included both negative and positive nutrient balance, was equal to the total expenditure of nutrients.

However, one must question the efficiency of storing excess feed nutrients in body tissues for use during early lactation when nutrient requirements exceed intake. The net energy value of most feeds for bodyweight gain is one-half to two-thirds the net energy value for milk synthesis and body maintenance (1). □

Acknowledgments

The author expresses his appreciation to Ms. A. J. Wright for her assistance in compiling the data, to Mr. G. R. Smith for crude protein determination, to Ms. V. L. Burton for the other laboratory analyses, and to the dairy personnel for sampling the feeds used, and providing intake and other data.

Data presented in this report are from a project contributing to the objectives of North Central Regional Project: NC-115 Nutrition of High-Producing Dairy Cows.

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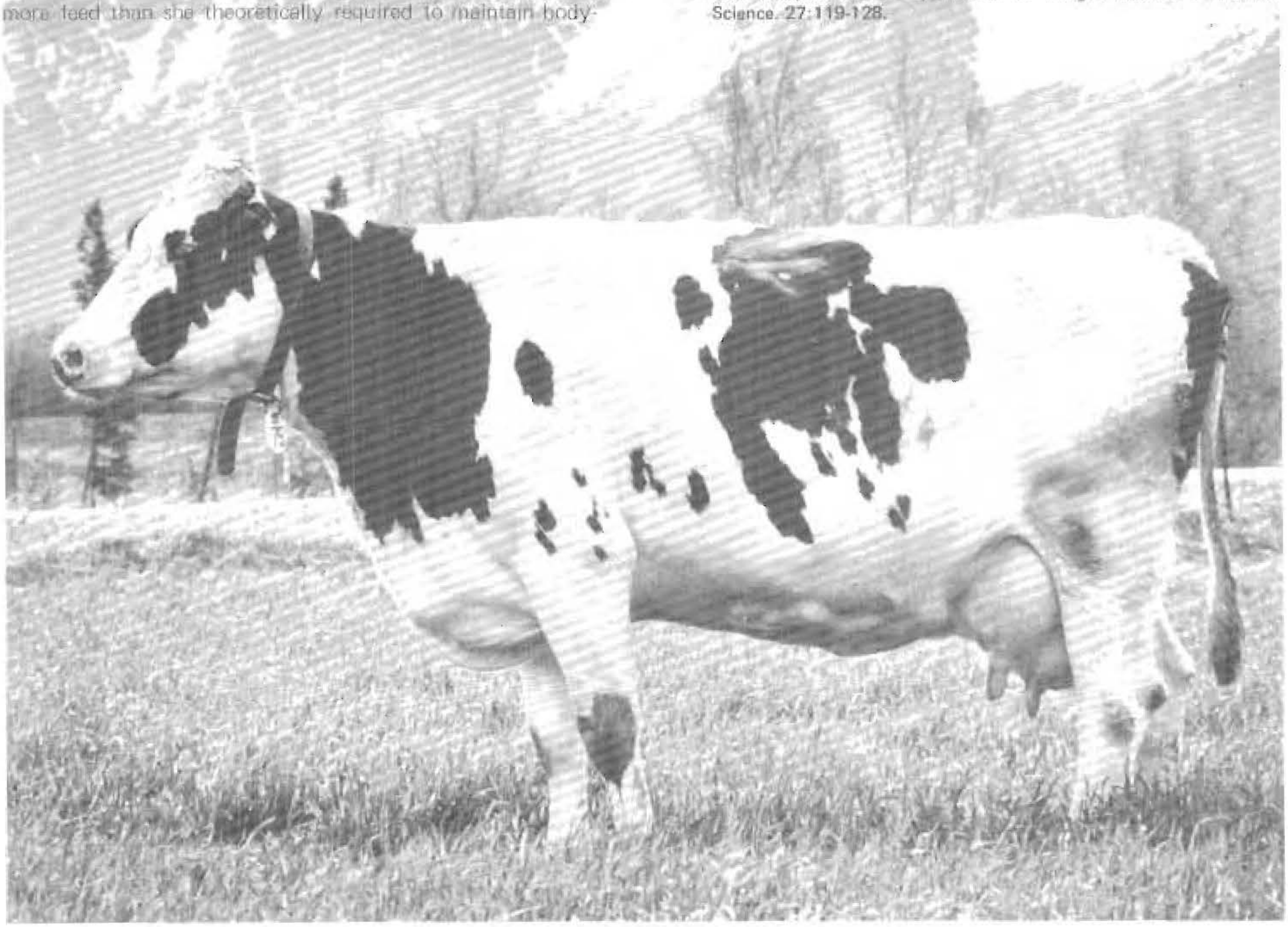

REPORT ON THE WESTERN GOVERNORS' CONFERENCE

CHARLES E. LOGSDON*

The 1975 Western Governors' Conference on Agriculture met in Billings, Montana, April 1, 2, and 3 to consider the dual issues of energy development and agricultural production. Delegations from the 16 western states included representatives of state and national farm organizations, personnel from energy industries and transportation companies, farmers, ranchers, university people, and representatives of various state and federal agencies.

Three days were spent in intensive study and discourse. Nine workshop reports, containing numerous recommendations for political action, were prepared and presented to the western governors. Reams of testimony were provided for the U. S. Senate and House Agricultural and Interior Committees.

There was a general consensus throughout the conference that:

1. A national policy of energy self-sufficiency would require a major energy-resource development effort in the western states.
2. An all-out energy development effort in the western United States would seriously impact agricultural production through competition for land and especially for water resources.
3. The most serious effect of massive energy development would be on the quality of life for people in western areas.
4. The concepts of "total resource management" and "land-use planning" must gain broader acceptance.

It should be noted that the interaction between energy development and agricultural production in Alaska might differ from that in most of the other western states. Energy development should enhance agricultural development through increased population, availability of cheaper energy, and possibilities for local fertilizer production. However, this has not been the case in Alaska. Effects of energy development are already proving detrimental to Alaska's agricultural future.

The rapid increase in population resulting from all facets of Alaska's energy developments, has placed heavy demands on the small portion of land in private ownership. The resulting prices of several thousand dollars per acre virtually preclude the continued use of such lands in the Anchorage and Fairbanks areas for agricultural production. Alaska has millions of other acres which are potentially tillable, but these lands are not available and great pressure is being exerted to lock them up in perpetuity. Paradoxically, the very areas of the United States, with high population density and high energy use, that are forcing development of Alaska's energy resources, are in turn exerting their political influence to allocate Alaska's latent agricultural soils for single-use purposes which preclude agricultural development or production.

It is particularly interesting to note that the United States continues to exert this colonial attitude towards Alaska at a time when we are celebrating the 200th anniversary of escape from colonialism.

In order to emphasize the need for Congress to understand the effects of their energy policies on Alaska's future, and to bring to their attention some positive and necessary alternative actions which they could and should undertake, I presented the following testimony to the Congressional hearings held in conjunction with the Western Governors' Conference on April 3, 1975.

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It is easy to anticipate that the Western States, including Alaska, will be, in the immediate years ahead, the major supplier of America's energy resources to the rest of the United States. And it is equally obvious that America will come to depend more and more on these same western states to provide greater quantities of food, both for domestic consumption and for export to other nations of the world.

Let me make the State of Alaska's position clear in regard to energy development. Certainly, Alaska hopes to benefit from these fossil fuel reserves that are presently being tapped in the state, but we believe the benefits from this development will accrue more to the rest of the nation than it will to Alaska itself, unless we can convert non-renewable resource income into renewable resource systems on a long-term basis.

Alaska represents a case study of the unfavorable social impacts from massive development thrusts. Our inflation rate far exceeds that of the nation as a whole. Although a great number of new jobs have been created in this development effort, our unemployment percentage still remains at an almost critical 11%, due to the influx of a greater number of job seekers than new jobs. The added social costs of welfare, new school construction, crime suppression, and the whole range of other social services, plus the added cost of competing with inflated construction wages in order to maintain normal government services, has almost bankrupted the state two years prior to anticipated revenue flow from royalty returns. The critical push by the federal government to develop outer continental shelf resources without adequate compensation for the additional onshore impacts would be irresponsible fiscal enslavement of the State of Alaska.

Rape of the colonies is an anachronism, and no longer acceptable in this enlightened age. Covert colonialism is, however, a continuing reality which should be recognized and discouraged.

Alaskans do not mind that the energy development in Alaska benefits the rest of the country first. After all, we are a part of the community of states, and are willing to share both our bounty and our misery with our brothers. We refuse, however, to retain the status of second-class citizens, and we will continue to fight for the right to self-determination so that we do not become a burden on the rest of the states, nor allow the rest of the states to become a burden on us. For this reason, we conceive that Alaska's future economic base, its life style, its establishment of permanent settlements, and its social development will depend on an emphasis on renewable resource development including agriculture.

Congress is well aware of Alaska's potential contribution to the nation's energy resources, but they are not as well-informed that Alaska has one of the largest undeveloped, uncommitted blocks of potential agricultural land in the world; a large portion of which the Department of Interior would commit to uses other than agriculture without adequate land-use study, and without consideration of the recommendations of the joint Federal-State Land Use Planning Commission. Proposals from the Secretary of Interior for inclusion of these lands in single-use categories, which would preclude their use for agricultural purposes, are before the Congress now. Other proposals for dedication of lands in Alaska which are equally laudable as to intent, are also equally lacking in an informational base on which to make land-use decisions. Painting federal reserves, for whatever purpose, in permanent ink, with a broad brush, on a small scale map, is the worst kind of land-use or conservation planning. We need information for planning. You, as owners of the largest share of Alaska, need information for planning. I would urge you to inventory resources on your lands, the soils, the water, the minerals, the wildlife, the forests. Only then can you determine alternative costs for dedicated use.

It is the general consensus of those Alaskans who have examined the issue, that agricultural development of the 4% of Alaska's lands that are tillable must be of a high priority, and that this need is being forced very rapidly as a result of the social impact of energy development in Alaska.

America and the world may need Alaska's food production capability by the year 2000. Alaska needs it now. We import 95% of the food we consume, and will continue to pay dearly for these imports until we reach a level of self-sufficiency. Above this self-sufficient level, we would be glad to share with the rest of the states and the rest of the world.

Yes, we pay dearly. When the Secretary of Agriculture said Americans would never pay $1.00 a loaf for bread, citizens of some of our communities were already paying in excess of $1.00 a loaf.

We, as a state, are committed by statute to support renewable resource development with revenue obtained from non-renewable resources. We expect to develop agriculture on State-owned lands, and we anticipate that agriculture will develop on privately owned lands. Initial inventories by the Soil Conservation Service indicate that almost 75% of the tillable lands in Alaska are now in and will continue to remain in, federal ownership after settlement of the Native Claims and after transfer of lands to the State under the Statehood Act. I would suggest the need for Congress to take action to determine the extent and productive capability of these lands as a hedge against future national needs. These tillable lands probably do not exceed 10 million acres of the more than 200 million acres that will remain in federal ownership. They could be dedicated to agricultural purposes and hardly impinge on other land-use needs.

In summary, I should like to recommend to the Congress through this Committee:

1. The federal government should inventory the resources on federal lands in Alaska so that land-use planning and area dedication can be based on a solid foundation of firm data.
2. Tillable lands with agricultural potential in Alaska under federal ownership be dedicated to agricultural purposes or to other purposes that are compatible with future agricultural production on those lands, and federal land-management agencies in Alaska be so instructed.
3. Congress should provide for generous returns of revenues from Outer Continental Shelf development, to the coastal states affected, to help offset the negative impacts from associated onshore developments. □

VOLCANIC-ASH-AFFECTED SOILS OF SOUTHCENTRAL ALASKA: SOME CHEMICAL AND MINERALOGICAL PROPERTIES

GEORGE A. MITCHELL AND
JAY D. McKENDRICK*

For some time agriculturalists have known that Alaskan soils are usually low in available phosphorus, and require frequent and substantial fertilization in order to produce satisfactory crop yields. Recently, phosphorus fixation was discovered in soils of the lower Kenai Peninsula (9). That discovery was not unexpected since in such acidic soils phosphorus commonly combines with iron and aluminum forming insoluble compounds. More recent investigations, however, suggest that phosphorus fixation was probably due to the presence of allophane, an amorphous gel of silica and aluminum hydrous oxides ($Al_2O_3 . SiO_2 . nH_2O$) which carries both negative and positive charges.

Since the phosphate ion is negatively charged, it is believed to be attracted to the positively charged sites on the allophane particle thus becoming unavailable to plants. Other negatively-charged, essential plant nutrients may be similarly attracted to allophane (including nitrate, chloride, sulfate, boron, and molybdate); however, phosphate fixation has been studied more than fixation of other nutrients. Problems with the phenomenon have been reported in several areas on the Pacific Rim, including Chile, New Zealand, Japan, and Hawaii.

Allophane in Alaskan Soils

Reports of volcanic ash deposits in certain Alaskan soils were given by Capps (2) and Kellogg and Nygard (7). Simonson and Rieger (12) identified volcanic ash deposits in profile descriptions of Kachemak silt loam, Kodiak silt loam and Island very fine sandy loam soils. They also indicated that allophane was a predominant clay-sized mineral in the island soil and suspected that the same was true for the Kodiak and Kachemak series.

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Our own laboratory evidence suggests that allophane affects phosphorus availability in the Kachemak series. Table 1 shows the effects of phosphorus adsorption on the cation exchange capacity (CEC) of the Kachemak series under four different types of vegetation. As phosphorus applications increased, CEC and adsorbed P also increased. Since CEC is a measure of the net negative charge on soil particles and this increased with the adsorption of negatively charged phosphorus ions, it was concluded that phosphorus ions were effectively cancelling positively charged sites on the allophane particles.

These findings agree with those of Mekura and Vehara (8) in Hawaii and those of Schalscha, *et al.* (11) in Chile. In both of those reports, scientists were studying soil formed from volcanic parent materials. For the Kachemak soils, each millimole of phosphate adsorbed increased the CEC an average of 0.91 milliequivalents compared to 0.8 and 0.6 for the Hawaiian and Chilean soils, respectively. Translated to field conditions, that would indicate that for each 100 lbs of P adsorbed by the Kachemak soil there would be a corresponding increase in that soil's capacity to hold either 114 lbs of potassium ($K+$) or 39 lbs of ammonium (NH_4+) on the cation exchange complex.

Measuring Allophane Content of Soils

Precise measures for allophane content in soil are not presently available. However, deVilliers (5) reported a qualitative estimation method based on observations that amorphous aluminum and silica are more soluble in an alkaline solution (0.5 M NaOH) than their

Table 1. The effect of phosphorus adsorption on cation exchange capacity in Kachemak silt loam under four vegetation types.

Organic matter %	Soil pH	P Added	P Adsorbed	CEC	Change in CEC	Change in CEC/ P adsorbed
		(mmole/100 g)		(meq/100 g)		(meq/mmole)
			Alder			
27	[illegible]	0		24.8		
		10	4.9	30.4	5.6	1.14
		20	9.3	32.8	8.0	0.86
		40	13.2	40.4	15.6	1.18
			Spruce			
[illegible]	4.55	0		23.2		
		10	7.4	29.6	6.4	0.86
		20	13.2	31.6	8.4	0.64
		40	18.2	37.2	14.0	0.77
			Fireweed			
21	[illegible]	0		19.6		
		10	6.5	27.2	5.6	0.86
		20	11.9	28.2	8.6	0.72
		40	16.6	30.4	10.8	0.65
			Bluejoint			
[illegible]	5.10	0		14.0		
		10	5.7	23.6	9.6	1.47
		20	9.6	26.8	12.8	1.08
		40	12.7	26.0	12.0	.72
				Overall Average		0.91

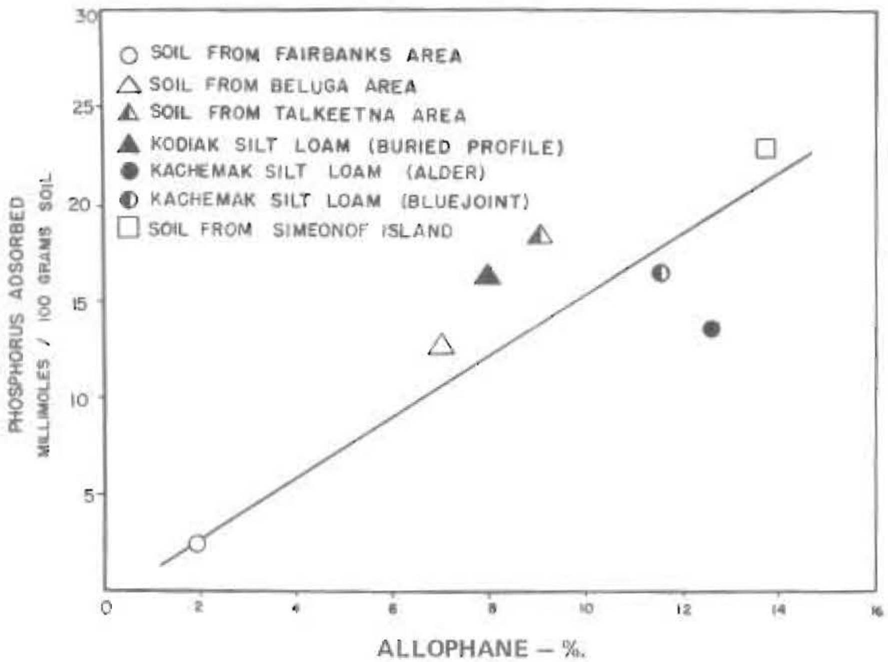


Figure 1. The relationship between the estimated allophane content and the amount of phosphorus adsorbed by seven Alaskan soils.

crystalline counterparts. Figure 1 shows the relationship between the estimated allophane and the amount of phosphorus adsorbed by seven Alaskan soils. These data indicate that generally the highest phosphorus fixation occurred among the allophanic soils.

Soils of southcentral Alaska (Figures 2 and 3), the Alaska Peninsula and the Aleutian Islands (3) have been affected variously by volcanic activity. Also, in about 100-600 A.D. a rather extensive ash fall covered a sizeable area of eastern Alaska and adjacent Yukon territory, (Capps 2 and Fernald 6). There are much older ash layers which are usually buried in soil profiles of the Interior, such as in the Fairbanks area (10). Thus, the surface soil at Fairbanks (Figure 1) had a low allophanic content and an insignificant phosphorus fixation capacity. A number of soils were tested from various locations in Alaska for phosphorus adsorption capacity. Curiously, a soil sample from the most recent ash fall on Kodiak Island had a relatively low phosphorus adsorption response in this test (Figure 4). It may be that either weathering or accumulations of organic matter contribute significantly to the phosphorus fixation capacity of volcanic ash.

If the relative adsorption capacities of those soils (Figure 4) are reasonable indexes to their phosphorus fertility requirements, it is possible that phosphate fertilizer costs could vary severalfold among Alaskan soils. And that may be one of the major considerations when evaluating Alaska's potential agricultural areas which were recently estimated to be about 21,110 square miles (1). □

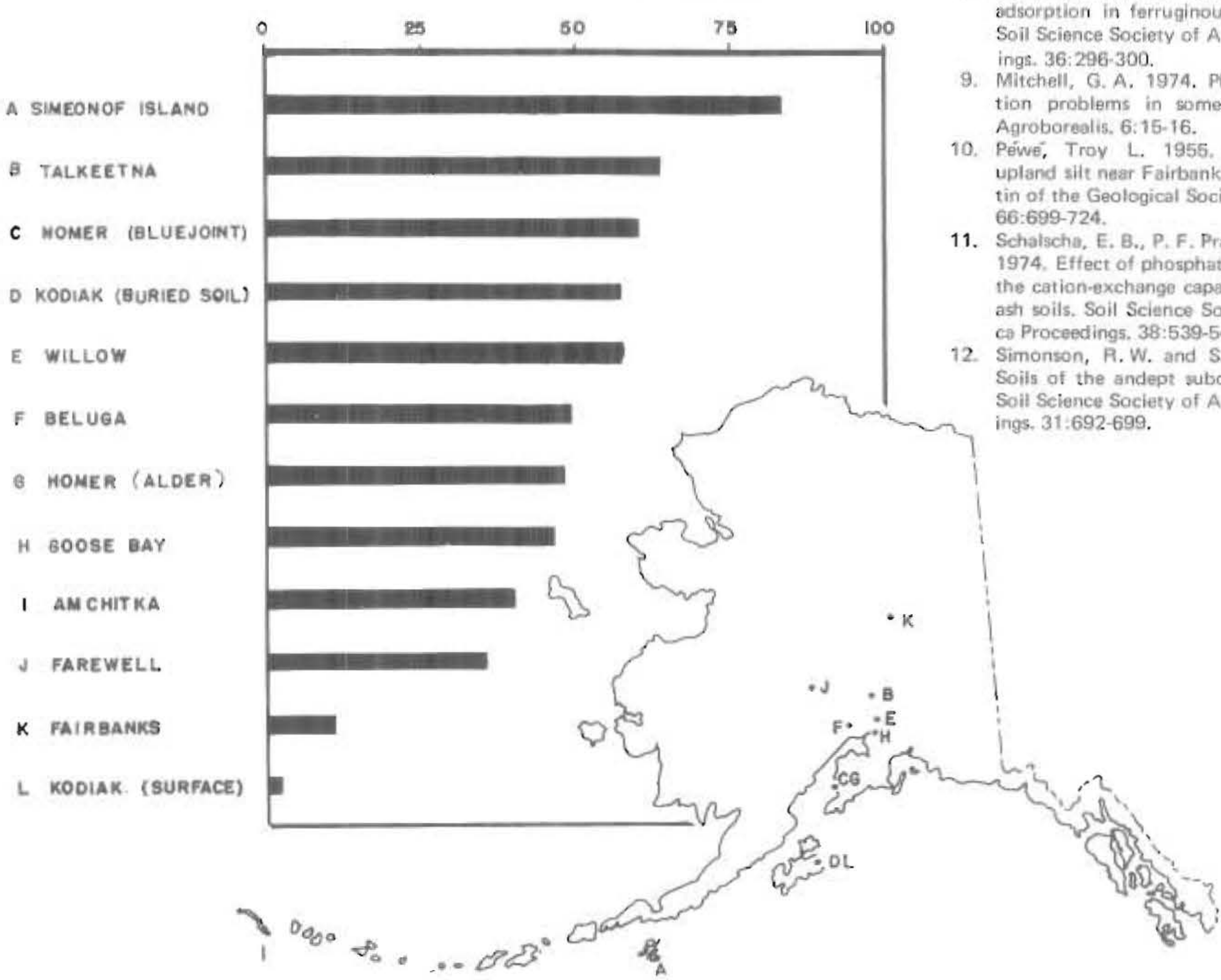
Figure 2. Examining an exposed ash layer in an Alaskan soil profile.

Acknowledgments

The authors express their gratitude to L. J. Klebesadel for providing photos for this article, to personnel in the U. S. Geological Survey's Public Inquiries Office (Anchorage), and to Troy L. Péwé for providing information on the occurrences of volcanic ash falls in Alaska.

Figure 3. White volcanic ash in a recently plowed field on Kodiak Island.

Figure 4.
RELATIVE PHOSPHORUS ADSORPTION CAPACITY



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PRODUCTION TIPS: CAULIFLOWER, SWISS CHARD, BEET, SPINACH, CUCUMBER, POTATO, SUMMER SQUASH

CURTIS H. DEARBORN*

New varieties of vegetables are released by breeders because they are better in some way than other varieties on the market. When a grower tries new varieties, he expects them to be better than those he has been growing. First-year production of new varieties should always be made in comparison with main crop varieties to assure that differences can be accounted for and new varieties not discarded because of meteorological limitations of that particular season.

Figure 1. Cauliflower tied with string or rubber band to prevent sun-induced discoloration of the head.

Cauliflower

Cauliflower, one of Alaska's specialty crops, has been given considerable attention by plant breeders in other states and countries. Some have recognized the need for developing a variety that does not require the gathering together and tying of the large leaves to shield the head from direct sunlight (Figure 1). Cauliflower heads exposed to strong light develop a creamy surface color or purple pigmentation depending upon their genetic composition. Michigan State University's variety Self-Blanche was released because its heart leaf coverage of the head was good. These young leaves form a rather tight spiral cover over the expanding head. In this environment, Self-Blanche does not remain tightly curled. Instead, the whorl opens much the same as other varieties, allowing the snowy white head to become exposed to light. Growers who plant Self-Blanche on the premise that tying the wrapper leaves is unnecessary should have the usual tying material at hand and be prepared to use it when necessary. The variety forms good heads and its maturity is between that of Perfected Snowball and Igloo. Extra early cauliflower varieties form heads prematurely and seldom become large enough to justify harvesting.

Cauliflower variety trials have shown that Lawyna[1] and Snowmound are vigorous, medium-to-late-maturing varieties with excellent deep heads which have better than average leaf cover of the heads. They have withstood dry weather very well. Whitehorse is a very good variety for this region; however, the natural supply of molybdenum in soils is frequently insufficient for early growth of this variety in either the field or the greenhouse. Seedlings started indoors with inadequate molybdenum in the soil mixture invariably grow into "whiptail" plants (Figure 2). Plants so affected usually do not produce a head. If they do head, the heads will be deformed and unsightly (Figure 3). Dry weather accentuates the molybdenum shortage. Young plants develop small brown spots on the leaves. Larger plants become yellowish-green

Figure 2. Whiptail of cauliflower, a leaf deformity resulting from inadequate molybdenum in the soil.

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[1]Seed was obtained from N. Sluis of Sluis & Groot of America, Inc., P. O. Box 580, Menlo Park, California 94025.

between the veins. The veins hold a bright green color down into the network of very small veins. Leaf tissues pull apart along the midrib (Figure 4). Nearly every plant will develop deficiency symptoms that become sufficiently severe to ruin the crop (Figure 5).

Gardeners who have experienced this type of cauliflower plant growth can correct the deficiency by adding 2.5 pounds of sodium molybdate per acre to the soil or by spraying the seedlings with a molybdenum solution as early as the two-true-leaf stage of growth. If spray is to be used, the rate should be cut down to one pound per acre, or it should be rinsed off the foliage to prevent leaf burn (Figure 6). A burn is better than no treatment since without molybdenum scarcely any plants will produce marketable heads.

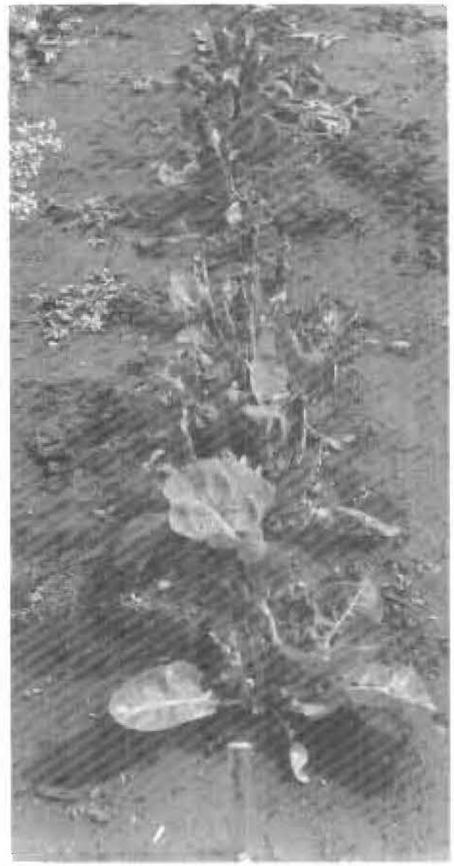


Figure 5. Cauliflower variety Whitehorse barely surviving on a molybdenum-deficient soil. Heads were never formed on these plants.

Figure 3. Typical deformed cauliflower head produced on a molybdenum-deficient plant.

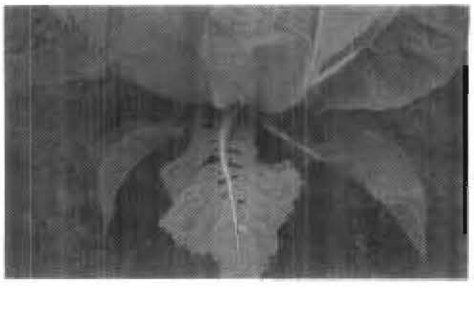


Figure 4. Cauliflower leaf pulled apart by growth stresses resulting from molybdenum deficiency.

Figure 6. Sodium molybdate spray burn on young cauliflower plants.

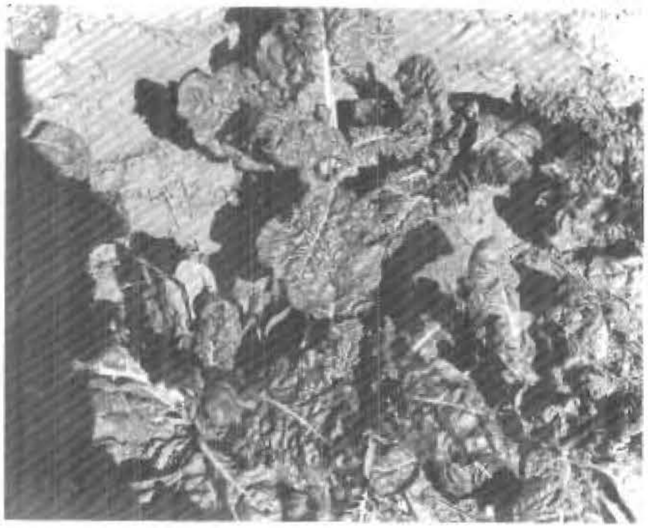


Figure 7. Swiss Chard showing small holes in leaves of plants deficient in molybdenum.

Swiss Chard

Swiss Chard, one of Alaska's best "greens," responds to molybdenum shortage in the soil much the same as does cauliflower. As the leaves expand, many buckled areas pull apart, producing perforations (Figure 7). Miniature cracks resembling those in the early stage of cauliflower leaf cracking are very common (Figure 4). Swiss Chard sprayed or fertilized with molybdenum the same as cauliflower has been free of this leaf abnormality.

Beet

Some seeds of garden beet varieties offered in Alaska produce plants that develop seed stalks. Early plantings in cold soils increase this bolting tendency. Two seasons of beet trials at Matanuska showed that the variety Boltardy[1] did not develop seedstalks even when planted early. Seedstalks developed on 20 to 50 percent of some other varieties and the roots became woody and useless except for livestock feed. Boltardy developed excellent roots of a dark uniform red color and good table quality. It is a good Detroit type (globular root with rather erect top). Alaskan growers should try Boltardy.

True Spinach

Spinach, a close relative of beet, develops a seedstalk much earlier than beet. The long daylight of high latitudes stimulates early chemical reactions in spinach that result in rapid seedstalk growth in most varieties. Usually seedstalk elongation occurs before the plant is large enough to be commercially useful. Variety trials in the early 1950's lead to recommending "New Zealand," a plant which is used as spinach, but is not a true spinach. Marathon, a new hybrid spinach variety available commercially since the late '60's, was tested and found to develop seedstalks much slower than any other variety. Marathon's production is double that of variety America, its nearest competitor (Figure 8). Marathon is a very high-quality spinach maturing July 5 to 10 from early plantings in late April or early May. Under favorable planting conditions in late fall, seeds can be sown and remain in the soil to emerge in the spring as soon as growing conditions are favorable. Persons in Alaska who dislike spinach grown in lower latitudes should try Marathon. Its flavor is superb here and quite different from spinach grown elsewhere and shipped to Alaska.

Cucumbers Without Pollination

During the past ten years, several gynoecious cucumbers have been selected by breeders and released to the public. Gynoecious means they usually produce only female flowers, in contrast to the old standard varieties that had both male and female flowers on the same vines. To effect fruit set in the greenhouse on old standard varieties, pollen from male flowers has to be transferred to the female flowers. This is a tedious and expensive hand job so greenhouse operators import honeybees to do the pollinating. Managing bee colonies from March through May, when bees are needed in early greenhouse cucumber production, is expensive. Cucumber variety trials in the greenhouse at Palmer showed that gynoecious cucumber varieties flowered as early as standard varieties and set their first five to seven fruits without pollination. Fruits developed normally (Figure 9). This first burst of flowers produced one-third of the crop as measured against the same variety whose flowers were all hand pollinated.

Although the gynoecious cucumber varieties produce scarcely any pollen, these plants need pollen for fruit set during the last two-thirds of the season. Therefore, one must grow at least one plant of a standard variety for each 10 gynoecious plants so that pollen will be available for fertilization. Gynoecious varieties Gemini and Princess, when interplanted with Challenger, Marketer or Marketmore, produce good crops with a minimum of attention to pollination. The variety Straight Eight was found to develop bitter fruits more frequently than any of 30 varieties tested.

Gynoecious varieties provide greenhouse cucumber growers several advantages over standard varieties. The first third of the crop is set without attention from the greenhouse operator. This delays the date when hand labor or bees must be brought into the operation. Also by delaying planting one can depend upon bumblebees, flies and solitary bees to pollinate cucumbers in small greenhouses. By the time the first five fruits are well grown the house can be opened nearly every day long enough

Figure 8. Marathon spinach on right showing size of plants compared to variety America. On July 17, when this photograph was taken, both spinach varieties were one week past their prime. Seedstalk elongation has occurred; however, the quality is still excellent for home use.

[1]Seed was obtained from N. Sluis of Sluis & Groot of America, Inc., P. O. Box 580, Menlo Park, California 94025.

Figure 9. Six excellent fruits of Gemini cucumber developed without pollination or use of hormone spray to set fruit.

for insects to enter, pollinate flowers, and leave the greenhouse.

The long European-type gynoecious cucumber varieties do not need pollen-producing types interplanted amongst them to produce a full crop of fruit. In fact, if the long types are pollinated and fertilization occurs, seeds will develop which is not desirable in these otherwise delicious cucumbers.

Potato Innovations

The potato variety Alaska Frostless, named in 1969 has, in addition to its frost-resistant tops, the unique characteristic of deep tuberization. Stolons of Alaska Frostless are much deeper in the soil when tuberization begins than are those of other varieties; consequently, "hilling" to keep the tubers from "greening" is not necessary. This feature permits producing the crop from seed pieces planted in shallow trenches and covered with an inch of soil. Level culture planting and no hilling is a labor saver. If one uses a chemical weed killer successfully, as has been done in Alaska for the past 23 years by commercial growers, there is no need for disturbing the soil after planting. Under these cultural conditions, distance between rows can be cut to 18 inches or to whatever is convenient for harvesting.

A new red-skinned potato to be named Alaska Red will be available in 1976. Its yield of U. S. No. 1 grade tubers is equivalent to the best "whites" grown in Alaska. Growers of Alaska Red should be able to supply local markets with a good potato that will be of much better quality than the "reds" that are being imported from lower latitudes.

Summer Squash

Summer squash, a frost-sensitive crop, produces heavily in areas where the growing season is frost-free for at least 90 days. Fruits are ready for harvesting about 60 days from planting. Fruiting continues until the vines are frosted. Newer varieties including Elite, Apollo, Greyzini, Cozini, Chiefini and Black Jack were evaluated; only Black Jack emerged from cold soils of early spring plantings (Figure 10). No other summer squash seeds germinated in cold soil. This characteristic in Black Jack could mean the difference between a crop and no crop in some areas of Alaska where the soils are slow to warm up in the spring. In seasons when all varieties germinated well, Elite and Apollo were more productive than Black Jack. □

Figure 10. Black Jack summer squash germinated in cold soils, a very desirable feature in a variety for Alaska. Other varieties of summer squash failed to germinate in the same cold soil (right).

SMALL GRAINS ON AGRICULTURAL LAND IN REMOTE AREAS OF ALASKA

FRANK J. WOODING,
JERRY L. BROSSIA,
STEPHEN D. SPARROW,
AND DAVID H. HASSINGER*

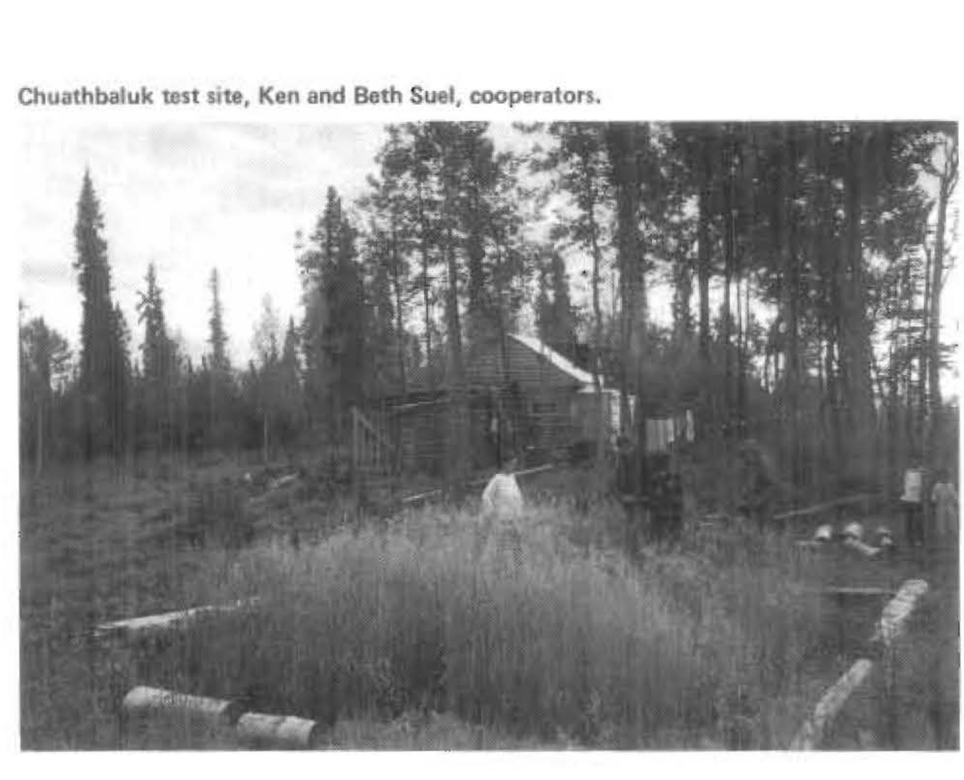
Red Devil test site, George Willis, cooperator.

Current world food shortages, population growth, and continued withdrawal of agricultural land for other uses indicate that it may be necessary as well as profitable to bring large areas of new land into production in the very near future.

This production may be of importance to Alaskans since the arctic and subarctic climatic zones contain a significant portion of the world's remaining new lands. A recent exploratory soil survey in Alaska identified approximately 16,000,000 acres of land having climate and soils suitable for agriculture (2). Much of this land is located in very remote areas, presently inaccessible by most means of ground transportation.

With the exception of a few scattered locations within this potential agricultural land, virtually no information is available with regard to types of crops which are best suited and their relative productivity. A high percentage of these lands has been included in proposed D-2 land withdrawals by the Department of Interior without consideration for their agricultural potentials. It is urgent that these potentials be demonstrated so that the land is not included in a category which would prevent agricultural development. To compile more information on these potential agricultural areas, test plantings of grain were established at selected locations in 1974.

Chuathbaluk test site, Ken and Beth Suel, cooperators.



*Assistant Professor of Agronomy, Agronomy Research Technician, and Senior Agronomy Research Assistant, respectively, University of Alaska Institute of Agricultural Sciences, Fairbanks. Hassinger is University of Alaska Cooperative Extension Service Agent, Aniak.

Description of Project and Objectives

The idea for this project came from a study conducted in western Alaska near the village of Red Devil (3). One person there was interested in growing grains in an area where virtually no agricultural information was available. With his cooperation, a grain adaptation test was conducted in 1973. The test proved highly successful and generated interest and enthusiasm among other people living in the area.

In 1974, the program was expanded to include 16 test sites encompassing a broad cross-section of potential agricultural lands in Alaska. Test plantings were established at Aniak, Chuathbaluk, Red Devil, Holy Cross, Saint Marys, Dillingham, Koliganek, Ruby, Tanana, Lake Minchumina, Delta Junction, Fairbanks, Manley Hot Springs, Nenana, and Fort Yukon (2 sites). Utilization of many of the test sites would not have been possible without the cooperation of interested individuals living in these areas.

The purpose of the study was to determine grain types and varieties within grain types which will grow to maturity, and to estimate their productivity at remote locations. The test consisted of 6 varieties each of barley (Lidal, Edda, Galt, Rovaniemi Sel.70-B, Weal, and Olli), oats (Nip, Ceal, Pendek, Rodney, Cayuse, and Toral) and wheat (Gasser, Rovaniemi Sel.70-W, Park, Saunders, Thatcher, and Pitic 62). Varieties were selected with a range in maturity from early to late.

Results

Of the 16 test sites established, 13 were harvested for barley and wheat yield determinations and 12 for oat yield determinations. The site near Lake Minchumina was not harvested because the landing strip was closed by early snowfall. One of the two sites in the Fort Yukon area was totally destroyed by marmots about a week before it was scheduled for harvest. At Koliganek, all grains failed to ripen. At Saint Marys, barley and wheat were harvested but oat stands were reduced by cutworms to such an extent that yield estimates could not be obtained.

Ruby test site, Albert Yrjana, cooperator.

Barley

The average yield of 6 barley varieties grown at 13 Alaska locations was 57.2 bushels per acre. Average yields of the six varieties at 9 of the locations exceeded the 1969-1973 national average of 43.3 bushels per acre (1). Average barley yields of the six varieties at specific locations ranged from a high of 110 bushels per acre at Manley Hot Springs to a low of 25 bushels per acre at Fort Yukon. The highest yield recorded for an individual barley variety was 155 bushels per acre for Weal at Manley Hot Springs.

Oats

The average yield of 6 oat varieties grown at 12 Alaska locations was 75.7 bushels per acre. At 10 of the locations, average yields for the six varieties were greater than the 1969-1973 national average of 51.2 bushels per acre (1). Average yields for the six varieties at specific locations ranged from a high of 107 bushels per acre at Delta Junction and Chuathbaluk to a low of 41 bushels per acre at Fort Yukon. The highest yield recorded for an individual oat variety was 168 bushels per acre for Toral at Manley Hot Springs.

Wheat

Wheat was marginal in maturity at sites in the Lower Yukon River Valley (Saint Marys and Holy Cross), the Middle Kuskokwim River Valley (Aniak and Chuathbaluk), and in the Bristol Bay area (Dillingham). The average yield for 6 wheat varieties grown at 13 Alaska locations was 32.3 bushels per acre. Average yields for the six varieties at 8 of the locations exceeded the 1969-1973 national average of 32 bushels per acre (1). Average wheat yields at specific locations ranged from a high of 54 bushels per acre at Manley Hot Springs to a low of 9 bushels per acre at Dillingham. The highest yield recorded for an individual wheat variety was 79 bushels per acre for Pitic 62 at Fairbanks.

Summary

Results from the 1974 small grain testing program were encouraging. Yields indicate that a number of the locations evaluated could compete, productivity-wise, with long-established grain producing areas outside of Alaska. However, data obtained from one year's testing should in no way be interpreted as conclusive. The results do, however, provide additional evidence to indicate that Alaska has millions of acres of potentially very productive land that could someday be utilized, if or when the need should arise. □

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Manley Hot Springs test site, Gilbert Thompson, cooperator.

Thomas E. Loynachan

Thomas E. Loynachan has recently joined the Palmer staff of the Institute of Agricultural Sciences as Assistant Professor of Agronomy. Just prior to his arrival in Alaska, Tom completed his Ph.D. program in soil science with major emphasis in soil microbiology at North Carolina State University. Dr. Loynachan received his master's degree from Iowa State University.

Tom and his wife, Jean, are native Iowans from agricultural communities. Tom taught vocational agriculture and was involved in commercial application of fertilizer. He served two years in the army prior to entering graduate school.

Dr. Loynachan's previous research has dealt primarily with environmental implications of animal wastes. The research involved decomposition rates of feces in soil, the effects of sprinkler application of anaerobic lagoon effluent on growing crops, and nitrogen transformations in aerated swine manure slurries. The work concerned both microbiological and fertility aspects. His training and experience have given him a good background in both environmental and fertility oriented work.

Dr. Loynachan will be involved in oil spill research with particular concern for the processes of decomposition in soil and means for rehabilitation of oil contaminated ground. He has taken charge of the soil testing program at the Institute and is enlarging upon the newly instituted tissue testing program.

The Loynachans have two children, Mark (6) and Timothy (3), and have taken residence in Palmer.

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JOHN C. BRINSMADE

John C. Brinsmade, formerly agronomist at the Fairbanks Research Center, died at the Tucson, Arizona Medical Center on February 20. He was 83.

During Mr. Brinsmade's 18-year assignment in field crops research at the Fairbanks agricultural facility, he worked with small grains, corn, and forage crops. Mr. Brinsmade selected the basic alfalfa lines that with later refinement became the new variety Denali, and he worked to develop corn that would mature in the short growing seasons of interior Alaska. He recorded weather observations for the Fairbanks station, and also regularly prepared attractive crops exhibits for display at the annual Tanana Valley Fair. Prior to coming to the Alaska station in 1946, Mr. Brinsmade worked with flax as a U. S. Department of Agriculture employee in North Dakota.

His wife, Ellen, graduated from the University of Alaska in 1948 and later was employed there as a teacher. The Brinsmades retired to Arizona in 1964. Mrs. Brinsmade died in 1972 from injuries suffered in an auto accident.

Alaska


0 200 400
Scale in Miles
Arctic
Ocean
U.S.S.R.
Bering Sea
ARCTIC CIRCLE
UNIVERSITY OF ALASKA
Institute of
Agricultural Sciences
Research Centers
A Fairbanks
B Palmer
C Homer
Research Farms
a Fairbanks
b Matanuska
c Kodiak
A,a
University of Alaska
Canada
b
B
C
c
Kodiak Island
Gulf of Alaska