Agroborealis

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Agricultural Experiment Station
University of Alaska

A Review of Some Research in Progress

From The Director's Desk

Agriculture in Alaska as well as across the nation has moved into a new era of public awareness. During the past year, the Alaska Legislature passed Senate Concurrent Resolution No. 77 to establish a comprehensive and meaningful agricultural policy that encourages and promotes the wise use of agricultural resources within the state. As a result, an Agricultural Policy Task Force was appointed to study legislative options for implementing this policy. Moreover, the Governor of Alaska announced that a major goal of state government is to develop industries based on renewable resources including fisheries, forestry, agriculture, and outdoor recreation.

Specific objectives aimed at accomplishing this goal include:

- Broadening the economic base of Alaska through expanded development of land for the production of agricultural and forest products.
- Stabilizing real food costs by increasing food production in Alaska to reduce the almost complete dependence of Alaskan consumers on food imported from Outside.
- Providing alternative job opportunities for Alaskans through the expanded production of food and fiber as well as the necessary supporting services for agriculture, forestry and outdoor recreation.
- Improving rural and community life by developing an economic base through agricultural production, and enhancing agricultural amenities and the quality of food available in Alaskan communities.
- Assisting in meeting the national goal of Increased food production to meet world food needs and to aid in maintaining a positive position for the United States in the balance of world trade.

To provide the technology necessary for these objectives, the Alaska Agricultural Experiment Station must increase research on improved crop varieties, innovative cultural practices, and improved forest and range productivity. It must expand research in animal nutrition for improved milk and red meat production. We must meet the research needs of an expanding greenhouse and landscaping industry. We need to develop the enormous potential of Alaska's surplus industrial heat from power plants and pipeline pumping stations for use in agricultural production and processing. We must develop economic research necessary for the profitable management of Alaska's agricultural, range, forest, and recreational lands.

We need the results of this work for home gardeners, subsistence farmers, part-time farmers, large-scale commercial farmers, land managers and consumers. Moreover, we must teach people to be good farmers, good forest managers, and good recreational land managers.

Toward this end we have organized an undergraduate program in Natural Resources Management at the University of Alaska to provide broad training in the various renewable resource fields of agriculture, conservation, forestry, land-use planning, outdoor recreation, and watershed management. This academic program, as well as the research programs of the Agricultural Experiment Station, the Forest Soils Laboratory, and the Institute of Water Resources, is included in the School of Agriculture and Land Resources Management at the University of Alaska at Fairbanks.

The role of the Agricultural Experiment Station in developing agriculture, forestry, and outdoor recreation in Alaska will depend to a great extent on the support of the Governor, Legislature, Board of Regents, University administration, and the people of the state. With continuing support from these individuals and organizations, we look forward to an improved capability to serve the citizens of Alaska. □

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TABLE OF CONTENTS

Hay Quality —*Page 26*

Plants and Soils —*Page 10*

Meat Prices —*Page 12*

ABOUT THE COVER . . .

Rank growth of bluejoint ***(Calamagrostis canadensis)*** under the long days of early to midsummer provides cover for cattle in foothill grassland east of Anchor Point on the Kenai Peninsula. This grassland type occurs abundantly in southcentral and southwestern Alaska on cleared forest lands and beyond timberline. Bluejoint affords lush, good quality grazing for stock during the rapid growth stage, but after heading, matures into poor quality grass. See page 26. Photo by W. W. Mitchell.

OUTDOOR RECREATION RESEARCH IN ALASKA

Leonard K. Johnson*

Farmers, ranchers, and agribusiness firms are as interested in what is happening in outdoor recreation as are those in recreation enterprises, land managing agencies, and the general public. This is understandable since outdoor recreation is in competition for rural land and resources, and offers a potential opportunity for economic development as well. Therefore, the Alaska Agricultural Experiment Station does research in outdoor recreation along with its studies in agricultural production and marketing.

Previous recreation research at the Experiment Station has been concerned with statewide planning, and with private campground operations. In 1973, a "Catalogue of Assistance for Outdoor Recreation Projects" was produced for the Alaska Division of Parks (1). This document indexes federal, state, and private programs which support the costs of planning and development of outdoor recreation lands and facilities. A procedure for ranking proposed projects is outlined in "A Method for Establishing Outdoor Recreation Project Priorities in Alaska" (2). The Division of Parks is considering adoption of the procedure for selecting outdoor recreation projects to be federally funded. "Outdoor Recreation Responsibilities in Alaska," also prepared for the Division of Parks, is an element in the State's comprehensive outdoor recreation plan (3). The July, 1973, issue of ***Agroborealis*** contains a study by Loan and Thomas on prices in private campgrounds (4).

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A major research effort conducted by Station personnel within the past year studied outdoor recreation in Alaska's national forests. Funded by a grant from the Pacific Northwest Forest and Range Experiment Station of the U.S. Forest Service, with additional support provided by the Agricultural Experiment Station, this project has seven objectives.

1. Describe the recreation resources of Alaska's national forests.
2. Identify and describe recreation patterns of selected forest users.
3. Assess facilities and services, taking into consideration evaluations and preferences expressed by users.
4. Identify and summarize preferences indicated by visitors to the national forests.
5. Develop a systematic method by which differences in the use of various recreation opportunities may be analyzed and explained.
6. Outline a method for evaluating proposed outdoor recreation developments.
7. Examine the economic effect of recreational use of the national forests.

Forest Service inventories of existing resources and facilities in the Tongass and Chugach National Forests and on-site inspection are providing much of the data to describe the forests' recreation resources and opportunities. Secondary sources such as the Bureau of Census reports on population will contribute to the economic analysis. Visitor surveys are producing information on use patterns and preferences for

facilities and services. Personal interviews were conducted last summer at selected campgrounds and visitor centers. Questionnaires were distributed as part of the naturalist program conducted by the Forest Service on the Alaska State Ferry System. A year-long mail survey of residents of Seward, Cordova, Ketchikan, and Hoonah is nearing completion; and a year-long survey of persons using remote cabins has just begun.

More than 4,000 individuals are expected to respond to these surveys. Approximately 2,000 questionnaires have been returned already, and are now being coded for computer processing. Preliminary results will be published later this year.

The Forest Service has created a special unit of its own, The Alaska Planning Team, which is conducting a major study of the proposed Wrangell Mountains National Forest. The University of Alaska is assisting this team with the investigation, and researchers at the Agricultural Experiment Station are responsible for the outdoor recreation section of the project.

The Bureau of Land Management (BLM) has funded a study of recreation in the Denali Highway area and the impact of off-road vehicles on vegetation and soils there. The objectives of this project include:

1. Determine the types, amount and location of recreational activities in the Denali Highway area.
2. Develop basic information on vehicle users relating to patterns of use, preferences and motivations, and social and economic characteristics.
3. Identify and describe major soil types and plant species in areas of vehicle use.
4. Determine relationships and effects of different amounts of vehicle use on soils and vegetation.
5. Revegetate an area such as the Denali Campground, which has been made barren as a result of excessive traffic.

The BLM has received a preliminary report on the soil and vegetation portion of the study. It was noted that where gravel or rocks lie on or just beneath the soil, the area was less susceptible to erosion caused by off-road vehicles, although the vegetation on such soils was more subject to injury or destruction. Taller shrubs were found to be more susceptible to vehicle damage than the low growing plants, with sedges apparently the most resistant to sustained traffic.

The BLM is considering a continuation of the recreation portion of the study in order to obtain more information about off-road vehicle users and conflicts between off-road vehicle use and other recreation activities. The investigation would keep track of recreation use for comparison with past patterns in order to identify any significant changes that might be occurring, as well as to consider the effect of recreation activity on natural and cultural resources in the area.

Agricultural Experiment Station funds support "Determinants of Choice in Outdoor Recreation," a western regional project related to the work for the BLM in the Denali Highway area. Researchers are studying the reasons why people make the choices they do with regard to their outdoor recreation activities. Using data obtained from the BLM projects, they are examining the relationships between off-road vehicle use and factors such as location alternatives, costs, and certain individual characteristics relating to life-style and economic level. The results will aid land managers in the difficult process of allocating funds and land to various uses, one of which is outdoor recreation.

A new project will examine changes in recreational activities made by tourists because of changes in economic conditions. For example, increasing energy costs may cause a tourist to select a different means of travel. Such changes might result in some communities enjoying an increased share of visitor dollars while others experience a smaller portion. The effects of these changes on local economies is important to governmental decisions about rural development.

Other recreation research investigates practical problems involving people, resources, and management decisions. It is a logical part of the Alaska Agricultural Experiment Station, where studies of soil, plant, and animal relationships and processes yield valuable information about the areas and resources which provide the setting for outdoor recreation activities. Revegetation research along the trans-Alaska pipeline corridor, for example, may show public land managers how to restore or rehabilitate areas damaged by recreation activity.

Soil analysis (especially with regard to physical characteristics) is important in recreation site selection and facilities development. Horticultural scientists working on ornamentals produce information, techniques, and plant materials used in landscape management. The recreation benefits of horseback riding are enhanced by the efforts of animal scientists. Economic analysis of production and marketing of agricultural commodities can be used to examine the rural development potential of tourist enterprises.

Looking to the future, Agricultural Experiment Station personnel will continue to consult with federal agencies regarding recreation research needs in Alaska. State agencies such as the Divisions of Parks, Tourism, and Economic Enterprise; Native corporations; local governments; private firms; and the general public will have an increasing interest in outdoor recreation research. The Station will continue to provide information and advice to government agencies, private firms, and individual citizens regarding outdoor recreation and land use, as well as economic trends, area planning, and resource allocations and their effects in Alaska. □

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Trade Interdependencies: The Case of Alaska and Washington

by
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and
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Alaska's uniqueness has always been a source of pride for its citizens. Geographically situated far from "The Lower 48," with a subarctic climate and regionally diverse landscape, Alaska's citizens have found extensive trade with other regions to be a necessary characteristic of Alaskan living. Trade, in both durable and nondurable goods, has become important because Alaska's developing agriculture and industry does not yet have the capability to provide for all consumers and, for some products, is not ever expected to do so.

The need for inbound trade has historically created a high degree of interdependence between Alaska and Washington. Washington has been a major marketing and transportation center for Alaskan trade because of its geographical proximity and physical distribution facilities. Yet, the strength or degree of Alaska's dependency on Washington has only been subjectively estimated and never quantitatively analyzed. At present, the transportation and physical distribution system is facing new short-run stresses because of the on-going extractive resource boom and its accompanying demands for consumer and industrial goods. In the long run, as Alaska's resource development matures, increases in Alaskan export trade might affect the trade channels between the states as well.

The lack of specific information about trade profile, direction, and potential increases resulted in a mutual regional study between the Agricultural Experiment Station at the University of Alaska and the Department of Agricultural Economics at Wahington State University. This on-going study has generated results broad in emphasis but specific in information. These results, reviewed here, indicate the impacts of, and opportunities for, more efficient and increased import and export trade between the two states.

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Alaskan Economy - Boom or Bust

In order to examine the potential interstate movement of goods between the states, an accurate projection of the growth potential and composition was needed. An initial study examining the "Boom or Bust" characteristics of the Alaskan economy was undertaken (1). Alaska's resource base and past developmental surges were analyzed, allowing a qualitative projection of the potential level of the economy and the accompanying pressure on the physical distribution and trade sectors.

The review of the two previous boom periods in Alaska history (gold rush and military) revealed specific problems that caused the "bust" component to quickly follow the boom. Inadequacies in government policies, transportation facilities, and human and physical capital investments were all contributing factors.

It was found that data on industry structure did not allow a comprehensive charting of the state's economic progress. Research was needed on industrial linkage and multipliers in the economy to determine developmental and trade policies to avoid a "bust" following the present oil boom. These studies on the internal structure of Alaska did appear to be the logical step in quantifying the physical distribution dependency, present and potential, between the states.

An Applied Input - Output Study

An input-output model of Alaska was developed to examine the economic impact of increased trade between Alaska and Washington (2). The model allowed identification of economic multipliers in Alaska, and probable growth sectors affected by the oil boom.

The income and employment multipliers for the Alaskan economy are indicated in Table 1. It can be seen that for every increased dollar of income in agriculture, $1.80 of income is generated throughout the total economy. For every additional job created in construction, over three jobs are created in the total economy. Agriculture, with its capital-intensive technology, does not have a very strong effect on labor in the economy (3).

The largest effects of the oil-induced growth, other than the obvious oil and gas sector, are projected to be in the service, FIRE (finance, insurance, and real estate), agriculture, and trade sectors of the Alaskan economy. By 1980, the demand for agriculture and resultant output is expected to be 274% over 1972 production, while the trade sector is also projected to experience the same percentage increase. Although the agriculture sector's output has been stable over the past ten years, if policies were instituted to open up potential new lands, Alaskan agriculture could be expected to provide an output nearly three times its present level, given its present share of economic activity.

The state of Washington is, as expected, experiencing strong impact on its economy as a result of Alaskan trade. The input-output model of Alaska was combined with existing input-output tables for Washington (4). This indicated that in 1980, Washington sectors of agriculture, manufacturing, transportation, finance, trade and households will experience the greatest impact from oil and gas development in Alaska. Seattle (Alaska's transportation, financial and trade center), and the agricultural areas of Washington will benefit most from Alaskan oil development. The total effect in Washington will be a 5.3% to 10.6% increase in Washington's total output, not including other factors influencing change in the Washington economy.

Table 1. Multiplier analysis of the Alaska economy by impact ranking, 1972.

Gross Income Multiplier		Employment Multiplier	
State	2.98	Fish Processing	6.03
Mining	2.93	Construction	3.53
Fish Processing	2.87	State	3.17
Oil & Gas	2.70	Manufacturing	2.82
Construction	2.34	Pulp	1.92
Pulp	2.30	Lumber	1.47
Lumber	1.87	Transportation	1.25
Communication/Utilities	1.87	Mining	1.25
Transportation	1.84	Oil & Gas	1.19
Agriculture	1.80	Communication/Utilities	1.19
Fish	1.74	Trade	1.10
Manufacturing	1.72	FIRE[a]	1.07
FIRE[a]	1.70	Service	1.04
Trade	1.69	Fish	1.03
Service	1.63	Forest	1.02
Forest	1.61	Agriculture	1.01

[a]Finance, Insurance, Real Estate.

Source: Logsdon, Charles L., **A Structural Analysis of the Alaska-Washington Trade: An Input-Output Study**, Unpublished Master of Arts thesis, Department of Agricultural Economics, Washington State University, Pullman, Washington, 1975.

Trade Profile: Water-Borne Commerce

The interdependencies between the Alaska and Washington economies vary according to the amounts and types of products moving between the two states and how those products are moved. In the past, quantitative estimates of water-borne commerce were never definite in amount or where the shipments took place. A major component of this project was to inventory and summarize water-borne trade between the states.

An earlier study indicated that Washington provides 90% of Alaska's water-borne trade (1). However, initial findings suggest lower dependency than expected (5). However, when petroleum products and wood products were excluded, Washington did handle between 90% and 95% of incoming water cargo to Alaska, depending on the commodity being considered. This trade is important to Washington because the Alaskan market comprised 23% to 35% of total Washington coastwise shipments, 1968 to 1972 (5).

Anchorage is the major Alaskan receiving port for Washington shipments, with Ketchikan serving as the trade center for the Southeast. Anchorage handled from 37% to 57% of total inbound movements, 1966 to 1973. Ketchikan averaged about 8% of total inbound shipments during those years.

About 60% of Alaska outbound movements originate from the southern part of the Alaska Peninsula; Anchorage accounts for about 15% of outbound shipments. As the lumber and fishing industries stagnated in Southeast Alaska in recent years, exports from these areas decreased in relative importance (5).

General information on commodities moved between Alaska and Washington, for 1966 to 1973 by tonnage and by port, have been analyzed and will be published (5). More specific information on individual ports, commodities or years is available from the authors.

Barriers To Trade

Economic activity in Alaska has reached successively new heights as the development of the 800-mile oil pipeline from the North Slope to Valdez becomes a reality. Alaska has changed from a relatively isolated economy to one that is open and experiencing rapid changes. These rapid changes have put tremendous strain on the physical distribution system serving Alaska and Washington trade. A survey of transportation agencies, retailers, wholesalers, bankers, government officials and community leaders was undertaken to identify problem areas affecting trade flows. Surveys and interviews were conducted in fall, 1974 and again in fall, 1975, both in Seattle and various Alaskan communities.

The problems affecting trade between the two states varied in intensity by region within Alaska and occurred in the transportation, storage-warehousing, inventory control and finance and labor sectors of the trade industry (6).

Much of the existing capacity in the transportation system serving Alaska has been absorbed by pipeline-related movement, thus disrupting the normal commerce and trade. In 1974, some of the already short barge capacity was diverted to the North Slope, thereby lengthening the lead time between ordering of goods and expected arrival from several weeks to, in some cases, as much as six months for merchants in Interior Alaska. In Southeast Alaska, served primarily by Foss Alaska Lines, Northland Marine Corporation and Boyer Towing Company, the pipeline disruptions were less noticeable.

Yet, in all areas of the state the goods were able to move north, although the inconveniences caused were substantial. There was increased use of the Southeast Corridor, Alaska Marine Highway and Alaska Highway. The cost of using truck and ferry-truck combination was higher but as lead times increased and routes jammed up, these alternative routes became more attractive.

The need for increased shipping capacity was pronounced in 1974 but by 1975, additional capacity was available. The increase in Sea Land ship numbers, the advent of Tote, a new roll on-roll off trailership (the S.S. Great Land), new barge service from Portland, from Prince Rupert and a proposed service from New Westminster, British Columbia have all increased the capacity and flexibility of the transportation system servicing Alaska-Washington trade. Changes in ICC directives have made the Port of Seattle more efficient in marshalling the goods to be moved (6).

Warehouse capacity was extremely short in 1974 and was still scarce during the 1975 shipping season. Containers, once delivered to Alaska, have historically served as storage space, for the firms found that containers were emptied very slowly by many of their customers. With an increase in demurrage and a strong publicity campaign by the container companies, accompanied by a boom in warehousing in Fairbanks and Anchorage, this storage problem has somewhat diminished.

Other areas of inefficiency in the trade sector were in inventory control by the firms, labor scarcity or poor quality labor due to pipeline employment and shortage of credit as the state became more capital deficient. Historic reliance on Seattle finance is in the process of change because of new progressive banking establishments in Alaska. New firms do have credit difficulties until a credit rating has been established.

Future Directions for Trade

The problems occurring in the physical distribution system are real, but they are being accommodated. The net effect is substantially increased costs of marketing and distribution (6). The "boom town philosophy" of present day Alaska may find these costs presently acceptable, but for future years will find efficiency and balance necessary characteristics of the marketing system serving Alaska-Washington trade.

Additionally, as Alaska develops its renewable resources to minimize economic fluctuations caused by nonrenewable resource development, the physical distribution system will become a two-way street. Exports of agricultural, forest and industrial goods require outbound movement, while tourism and imported goods require inbound movements. The future may well hold a balance for Alaska and Washington trade, a balance based on efficiencies of production and transportation. Attainment of such efficiencies will continue to be a major thrust of our continuing research activity.□

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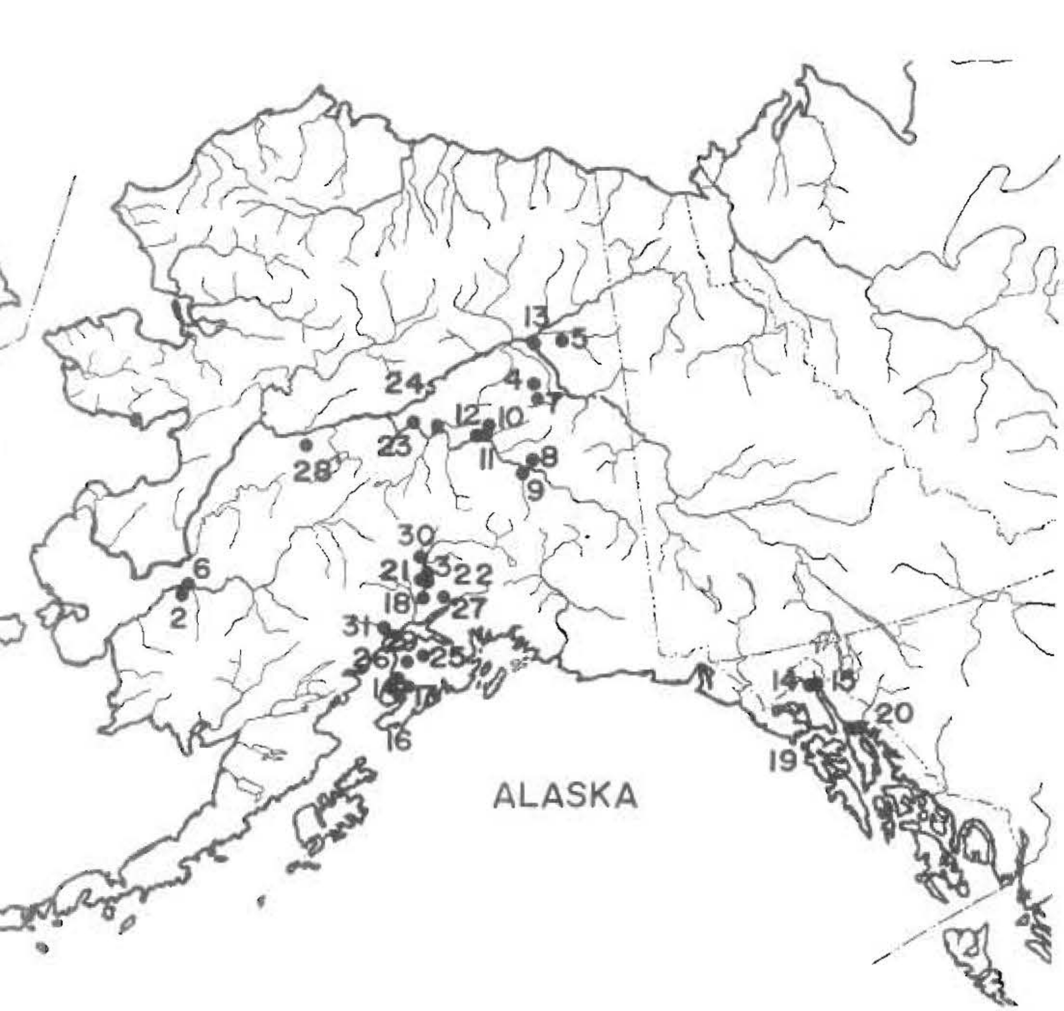

Figure 1. Soil collection sites for growth chamber evaluation.

1. Anchor Point (Cohoe series)
2. Aniak*
3. Caswell (Kashwitna series)
4. Central*
5. Chalkyitsik*
6. Chuathbaluk*
7. Circle Hot Springs*
8. Delta-Clearwater*
9. Delta Junction (Nenana series)
10. Fairbanks (Fairbanks series)
11. Fairbanks (Salchaket series)
12. Fairbanks (Tanana series)
13. Fort Yukon*
14. Haines*
15. Haines*
16. Homer (Beluga series)
17. Homer (Kachemak series)
18. Houston (Homestead series)
19. Juneau*
20. Juneau*
21. Kashwitna (Nancy series)
22. Kashwitna (Susitna series)
23. Manley Hot Springs*
24. Minto (Minto series)
25. Naptowne (Tustumena series)
26. Ninilchik (Island series)
27. Palmer (Knik series)
28. Ruby*
29. Soldotna (Soldotna series)
30. Trapper's Creek (Rabideux series)
31. Tyonek (Mutnala series)

*Soil series not named.

Evaluating Alaskan Soils

T. E. Loynachan*

World population continues to grow, and more of the prime agricultural land is taken out of production to support urban expansion and development. Areas previously considered marginal for agricultural production are therefore being reevaluated.

The arctic and subarctic regions of the world contain vast undeveloped acreages of land which may require future development to prevent world starvation. Alaska contains an estimated 8,852,000 acres of land which have few limitations for crop production (1). Additionally, another 4,659,000 acres have cropland potential, needing only minor corrections such as irrigation. With the future development of these areas, and the continued development of existing agricultural centers, methods of accurately predicting and evaluating the nutritional status of these soils becomes essential.

Evaluating Soil by Measuring Plant Growth

The ultimate method for determining a soil's nutrient-supplying power is by growing plants in the soil and measuring the quantity of nutrients removed by the growing plants. However, when information is desired from many widely separated sites, the logistics of raising plants on these sites makes this method difficult. A separate alternative is to bring the desired soils to a central location for evaluation.

During the summer of 1975, soils were collected from 31 Alaskan sites (Figure 1). Dr. Frank Wooding, Mr. Steve Sparrow, and Cooperative Extension personnel helped obtain these samples. Two additional collections were made in the summer of 1976.

Samples were taken from virgin land when possible. The surface organic duff (unconsolidated and decomposing surface litter) was removed, and the top layer of mineral soil included. Removal of the duff simulates the surface scraping necessary in clearing new land.

After arriving at Palmer the soil samples were screened and stored at 2° C. Studies are presently underway (Figure 2) to evaluate each soil under controlled environmental conditions to determine the response to a) lime additions, b) nitrogen, phosphorus, and potassium treatments, and c) secondary and micronutrients such as sulfur, magnesium, molybdenum, copper, zinc, iron, boron, and manganese. Two hundred and twenty-five cubic centimeters of each soil, along with the fertilizer or lime, are added to each eight-oz. styrofoam cup. Five Weal barley seedlings are then transplanted into each cup.

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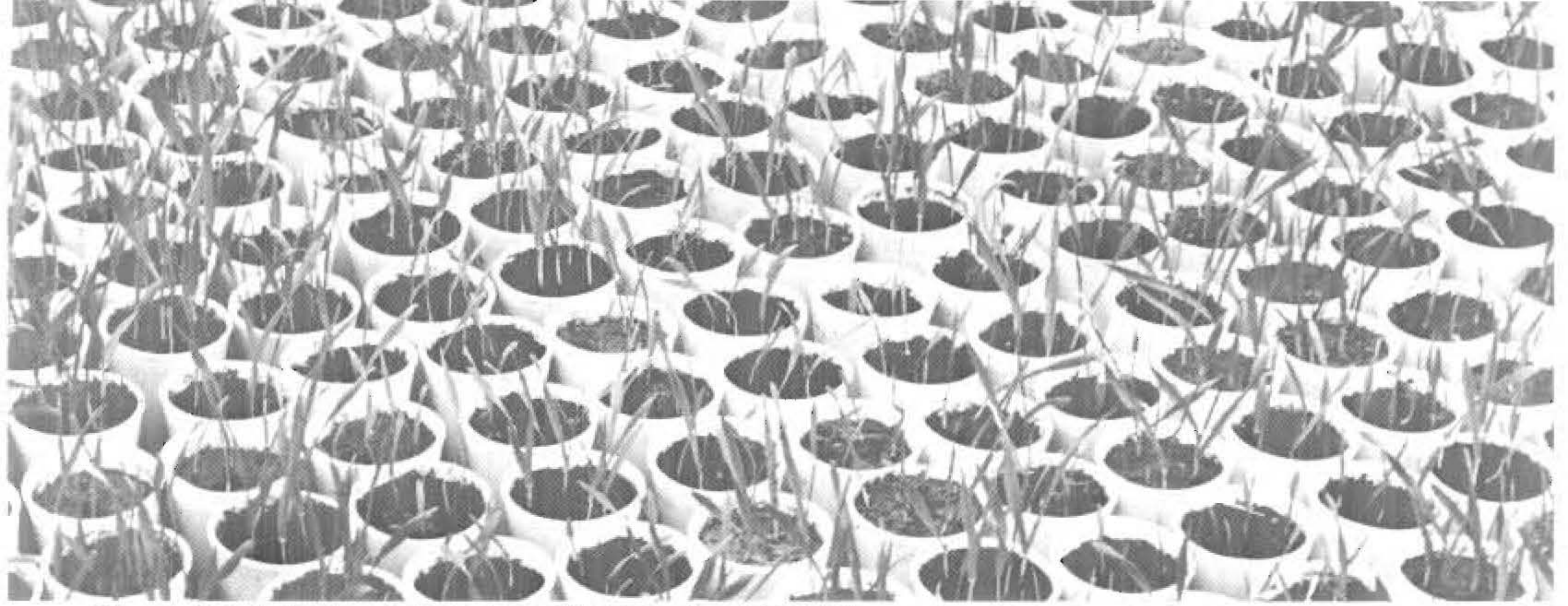

Figure 2. Growth chamber used to evaluate soil by measuring plant growth.

Growth Chamber Simulates Alaskan Conditions

A growth chamber is a self-contained unit which controls the soil-plant environment. The cold-dominated, long days of Alaskan summers are simulated with day and night temperatures of 60° and 48° F, respectively, with 16 hours of light. Thus, irrespective of the climate conditions at the site of collection, all soils can be uniformly evaluated under identical environmental conditions. With the elimination of climatic and seasonal effects, sole consideration can be given to physical and chemical properties of the soil. Suitability for favorable plant growth at a given location from which a soil was collected can not be directly determined from this study since the various climatic factors were not evaluated. Phenology (2) and remote-site studies (3) being conducted by Experiment Station personnel at various locations throughout the state will provide valuable information on local climatic conditions which can supplement information gained from the growth chamber tests.

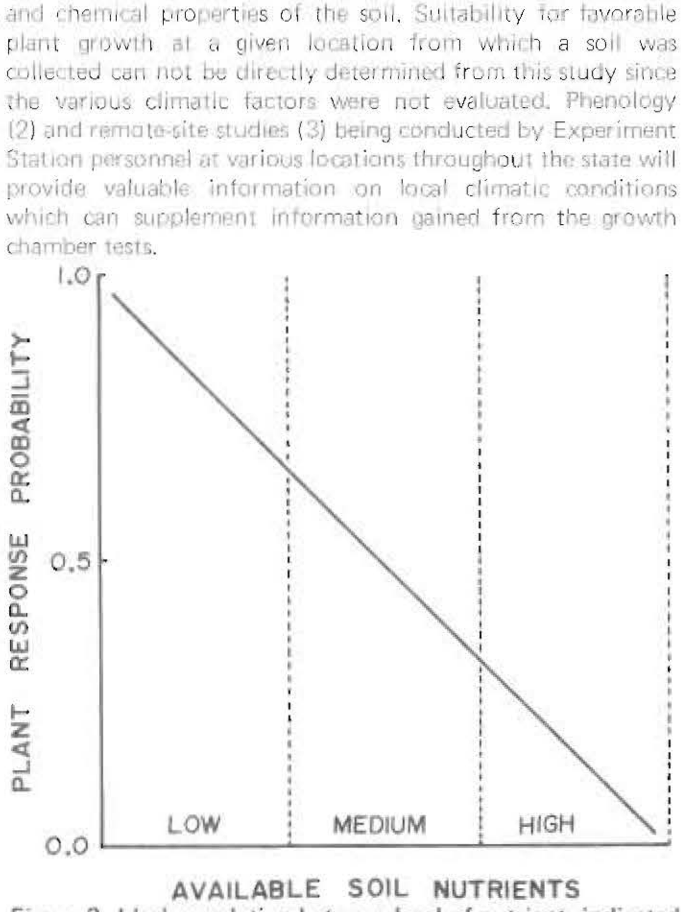

Figure 3. Ideal correlation between level of nutrients indicated by a chemical soil test and plant response if nutrients were added to the soil.

Evaluating Soils by Chemical Nutrient Extraction

A second objective of this study is to evaluate existing chemical soil tests and to develop new procedures suitable for Alaska. The analysis of large numbers of soil samples mandates chemical extraction of the nutrients. Soil testing obtains an indication of the soil's fertility status. For a valid test, this fertility status must be related to the capacity of the soil to release its nutrients to plants throughout the growing season.

Historically, numerous extracting procedures have been developed and wide variations of techniques are used today in soil-testing laboratories throughout the United States. As physical and chemical properties of soil vary from region to region, so do the most suitable extracting techniques. When different chemicals or concentrations of chemicals are used, different quantities of nutrients are extracted. The most desirable procedures should indicate the probability of a favorable plant response if a specific nutrient is added to the soil (Figure 3). Usually, the lower the level of nutrients as shown by a soil test, the greater the chances a favorable plant response will occur if the nutrient is added to the soil, although this response is not necessarily guaranteed.

Comparing Soil Evaluation Methods

In this study, soil will be extracted with various chemicals for nitrogen, phosphorus, potassium, and several of the secondary and micronutrients. Additionally, three lime-requirement tests will be evaluated.

The growth response of plants in the growth chamber with fertilizer additions will be compared with the results of chemical tests. The chemical extractant best able to predict a favorable plant response can thus be statistically determined. This extractant should be chosen for soil testing in the Palmer laboratory. □

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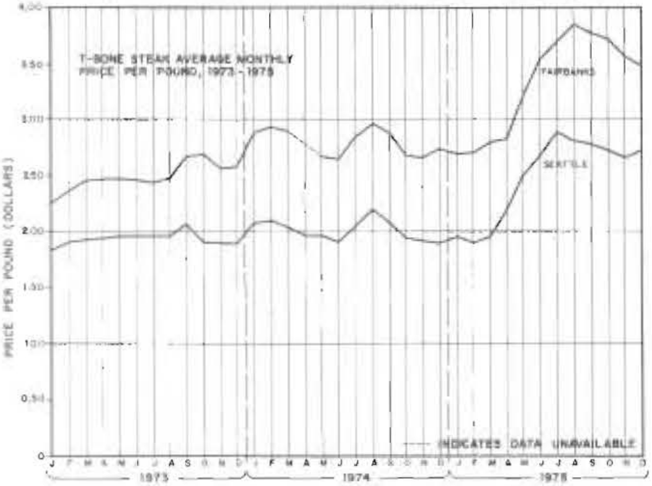
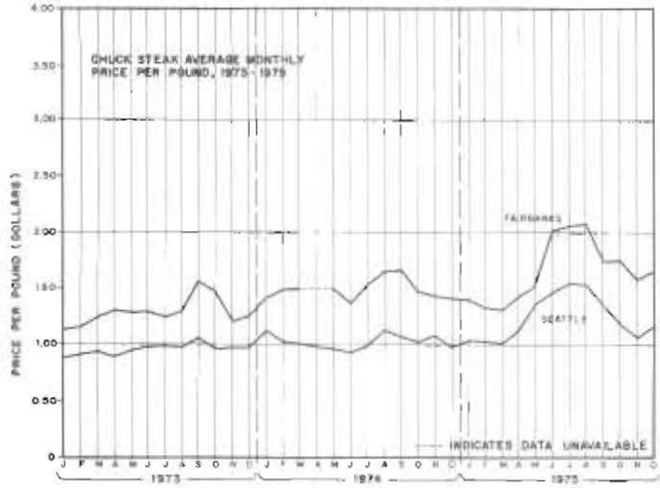
MEAT PRICE TRENDS IN FAIRBANKS AND SEATTLE, 1973-1975

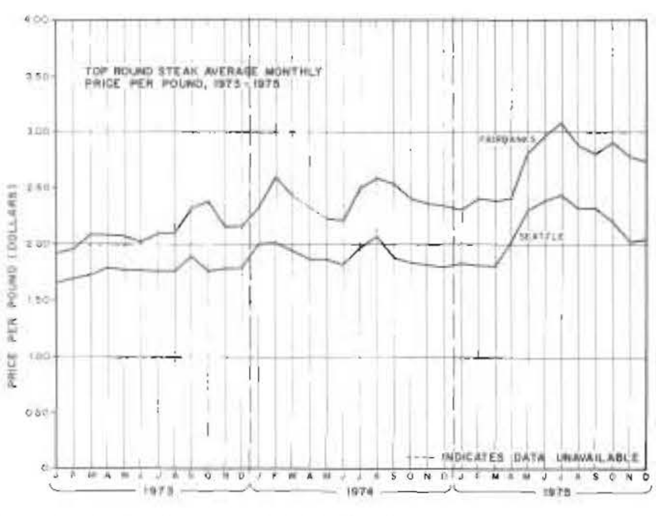
Virginia H. Burke and
Monica E. Thomas*

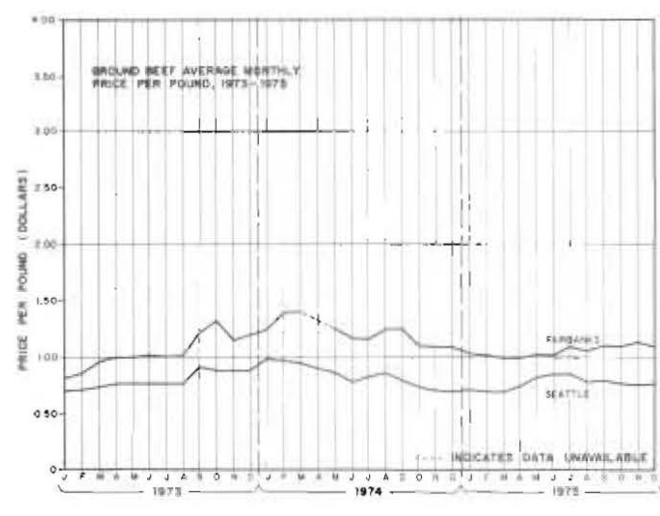
Fairbanks and Seattle meat prices during 1972 were compared in the July 1973 issue of ***Agroborealis*** (1). Research was continued through 1975 to ascertain patterns in meat price fluctuations from 1973-1975. This information on meat price patterns is particularly relevant at the present time. Recent high rates of inflation have slowed the expanding purchasing power of consumers, nationally and in Alaska. Fairbanks shoppers have been particularly affected; these consumers already faced very high costs for all consumer items.

Eight retail meat cuts were selected for price analysis: center-cut pork loin chops, ground beef, bone-in chuck steak, boneless top round steak, T-bone steak, whole fryers, Hormel bacon, and









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Hygrade Ball Park wieners. Prices were recorded for three retail chain stores both in Fairbanks and Seattle. Most of the meat sold by these stores came from wholesalers operating in northwest Washington. Wholesale prices for Fairbanks and Seattle were therefore assumed to have common determinants. F.O.B. price differentials were influenced, of course, by relative transportation costs.

Average Yearly Meat Prices

Prices for all selected retail meat cuts except ground beef increased in both Fairbanks and Seattle over the 1973-1975 time period (Table 1). Ground beef prices were highest in 1974 in both cities. All eight meat cuts were higher in price in Fairbanks than in Seattle.

The Fairbanks-Seattle absolute cost per lb. differentials were higher in 1975 than in 1973 for all selected meat cuts (Table 2). The absolute cost per lb. differentials were even higher in 1974 relative to 1973 for wieners and ground beef. The percentage cost per lb. differentials for the eight meat cuts showed an erratic pattern. An increased differential for absolute costs did not necessarily coincide with an increased differential for relative costs. This occurred because in some cases Seattle had a higher percentage increase in cost per lb. meat prices, particularly over the 1974-1975 time period. Generally, Fairbanks meat prices increased more than Seattle, both in absolute and relative terms, during the 1973-1974 time period (Table 1).

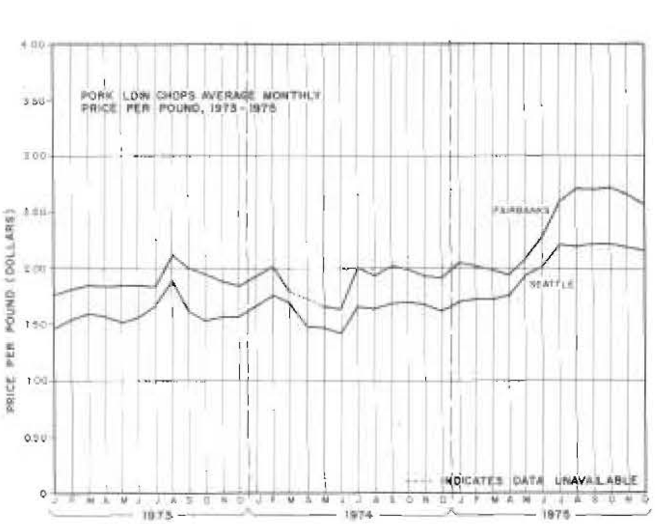
Seasonal price fluctuations of the eight meat cuts were generally more pronounced in Fairbanks than in Seattle. The peak-minimum absolute price differentials, with three exceptions, were higher in Fairbanks than in Seattle over the 1973-1975 time period (Tables 3 and 4). These exceptions were pork loin chops in 1973, wieners in 1974, and ground beef in 1975.

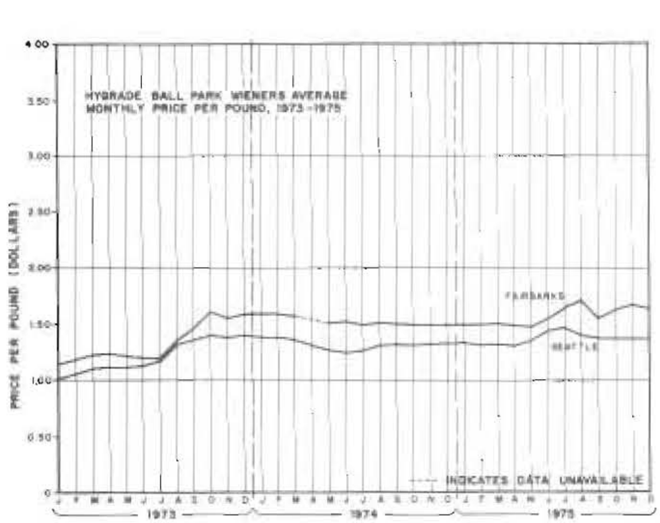
The percentage peak-minimum meat price differentials were erratic (Tables 3 and 4). In approximately two-thirds of the cases over the time period, the percentage difference between peak and minimum prices was greater in Fairbanks than in Seattle. However, in four cases in 1975 the percentage difference was greater for Seattle prices than for Fairbanks prices. In 1973, this difference was greater in Fairbanks for all but one meat cut, pork loin chops. It is apparent that over the time period, particularly in 1975, Fairbanks meat prices showed growing price stability relative to Seattle with respect to percentage peak-minimum meat price differentials.

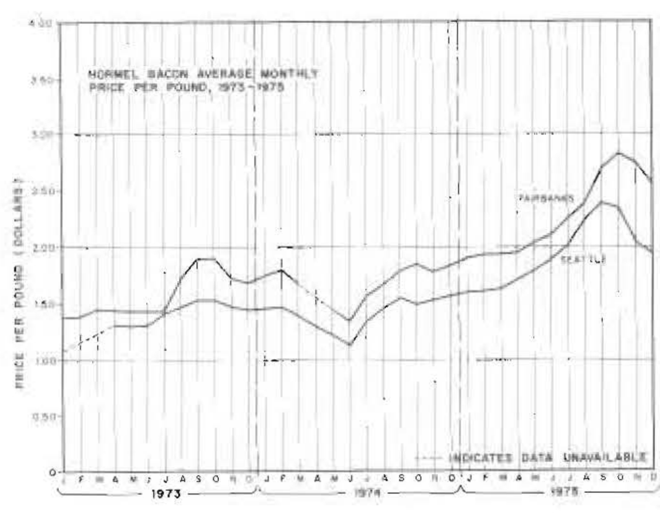
Average Monthly Meat Prices

The average monthly price for each selected meat cut, 1973 through 1975, are illustrated on page 17. Occasionally, the highest weekly price did not fall with the same time period as the highest monthly average price for a particular cut of meat.[8] However, the weekly and monthly meat price fluctuations were generally consistent.

In all months, Fairbanks meat prices







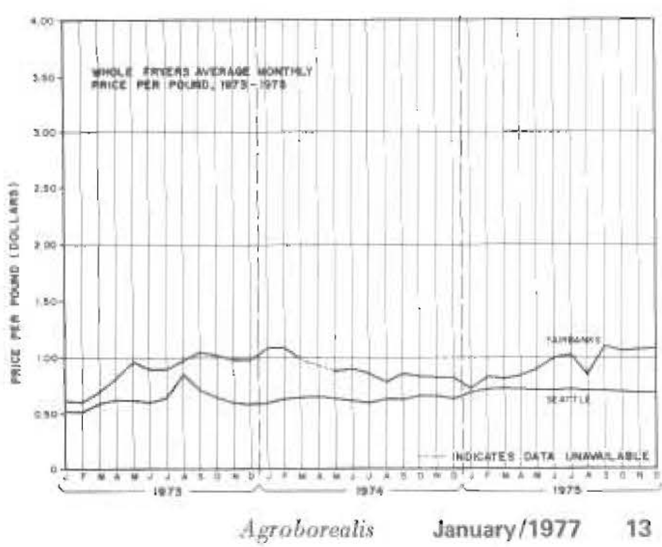


Table 1
Average[a] 1973, 1974, and 1975 Meat Prices by Cut in Fairbanks and Seattle

	Fairbanks					Seattle				
	1973	1974[b]	% Increase 1974/1973	1975	% Increase 1975/1974	1973	1974	% Increase 1974/1973	1975	% Increase 1975/1974
T-bone steak	$2.48	$2.80	113	$3.31	118	$1.93	$2.01	104	$2.47	123
Top round steak, boneless	$2.11	$2.41	114	$2.73	113	$1.75	$1.92	110	$2.13	111
Pork loin chops, center cut	$1.88	$1.89	101	$2.40	127	$1.59	$1.63	103	$2.00	123
Hormel bacon	$1.57	$1.69	108	$2.31	137	$1.44[c]	$1.41	98	$1.93	137
Hygrade Ball Park wieners	$1.31	$1.52	116	$1.57	103	$1.21	$1.31	108	$1.37	105
Chuck steak, bone-in	$1.27	$1.50	118	$1.71	114	$0.95	$1.03	108	$1.24	120
Ground beef	$1.05	$1.22	116	$1.05	86	$0.78	$0.83	106	$0.77	93
Whole Fryers	$0.87	$0.89	102	$0.97	109	$0.62	$0.63	102	$0.71	113

[a]The average was obtained by summing the prices available for each month and then dividing by the total number of prices.

[b]Prices for April were unavailable.

[c]January-March prices were unavailable.

Table 2
Differences between Fairbanks and Seattle Average 1973, 1974, and 1975 Meat Prices by Cut

	1973		1974[a]		1975	
	Difference in Cost/Lb.[b]	Fairbanks as % of Seattle[c]	Difference in Cost/Lb.[b]	Fairbanks as % of Seattle[c]	Difference in Cost/Lb.[b]	Fairbanks as % of Seattle[c]
T-bone steak	$.55	128	$.79	139	$.84	134
Top round steak, bonelsss	$.35	120	$.49	126	$.60	128
Pork loin chops, center cut	$.29	118	$.26	116	$.40	120
Hormel bacon	$.13[d]	109	$.28	120	$.38	120
Hygrade Ball Park wieners	$.10	108	$.21	116	$.20	115
Chuck steak, bone-in	$.32	134	$.47	146	$.47	138
Ground beef	$.27	135	$.39	147	$.28	136
Whole Fryers	$.25	140	$.26	141	$.26	137

[a]Fairbanks prices for April were unavailable.

[b]Seattle price minus Fairbanks price.

[c]Seattle = 100.

[d]Seattle prices for January-March were unavailable.

Table 3
Differences between Peak and Minimum
1973, 1974, and 1975 Meat Prices by Cut in Fairbanks

	1973		1974[a]		1975	
	Difference in Cost/Lb.[b]	Peak as % of Minimum[c]	Difference in Cost/Lb.[b]	Peak as % of Minimum[c]	Difference in Cost/Lb.[b]	Peak as % of Minimum[c]
T-bone steak	$.44	120	$.32	112	$1.14	142
Top round steak, boneless	$.46	124	$.39	118	$0.78	134
Pork loin chops, center cut	$.36	120	$.39	124	$0.78	140
Hormel bacon	$.54	139	$.52	139	$0.92	148
Hygrade Ball Park wieners	$.48	142	$.10	107	$0.24	116
Chuck steak, bone-in	$.43	138	$.30	122	$0.77	159
Ground beef	$.50	162	$.31	128	$0.14	110
Whole Fryers	$.45	175	$.31	140	$0.36	150

[a]Prices for April were unavailable.

[b]Peak price minus minimum price.

[c]Minimum = 100.

Table 4
Differences between Peak and Minimum
1973, 1974, and 1975 Meat Prices by Cut in Seattle

	1973		1974		1975	
	Difference in Cost/Lb.[a]	Peak as % of Minimum[b]	Difference in Cost/Lb.[a]	Peak as % of Minimum[b]	Difference in Cost/Lb.[a]	Peak as % of Minimum[b]
T-bone steak	$.23	113	$.32	117	$1.00	153
Top round steak, boneless	$.23	114	$.27	115	$0.63	135
Pork loin chops, center cut	$.43	129	$.34	124	$0.51	130
Hormel bacon	c	c	$.45	140	$0.79	149
Hygrade Ball Park wieners	$.40	140	$.14	111	$0.17	113
Chuck steak, bone-in	$.18	120	$.20	122	$0.54	154
Ground beef	$.21	130	$.30	143	$0.16	123
Whole Fryers	$.34	167	$.07	112	$0.04	106

[a]Peak price minus minimum price.

[b]Minimum = 100.

[c]January-March prices were unavailable.

were above Seattle meat prices, and the absolute price per lb. differentials were generally stable over the time period. The monthly price fluctuation patterns were quite similar in both cities; peak and minimum prices usually occurred in the same months in both Fairbanks and Seattle.

Prices of five meat cuts showed steady increases in both cities, but month-to-month fluctuations were very pronounced. The five cuts were T-bone steak, top round steak, pork loin chops, Hormel bacon, and chuck steak. Prices remained at record highs during the last months of 1975, although down somewhat from the summer peak.

The other three meat cuts had less extreme month-to-month price fluctuations. Whole fryers exhibited greater price fluctuations in Fairbanks than in Seattle. The patterns were erratic for ground beef and wieners. There was a gradual upward price trend for wieners and whole fryers; ground beef prices were actually lower in Seattle in 1975 than in 1973 and 1974.

A word of caution is necessary concerning this research. Only eight meat cuts were included in the analysis. Therefore, price patterns for these selected meat cuts may not fully measure trends for all meats, particularly lamb and pork. These data are probably quite indicative of beef price trends. □

[a]Monthly price averages were computed as the mean of weekly meat prices. Data were collected weekly in Fairbanks and in Seattle.

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Timothy Yield and Composition as Influenced by Lime and Nitrogen Applications to Kachemak Soil Series

Winston M. Laughlin, Paul F. Martin, and Glenn R. Smith*

Ranchers need considerable supplemental forage for winter feeding of beef cattle in the Caribou Hills area east of Anchor Point and north of Homer, Alaska. Yields of native bluejoint *(Calamagrostis canadensis)* without fertilization are drastically reduced by annual harvests (2). Domestic grass plantings rarely survive for more than one year.

A former garden was the site selected for this 6-year study to evaluate the effects of five lime rates and two nitrogen (N) rates on timothy production. This area of Kachemak silt loam is located on a south-facing slope. The entire area was rototilled several times in 1966 to break up organic debris before planting Engmo timothy *(Phleum pratense L.)*.

A randomized block design was initiated on June 26, 1966 with five lime applications (0, 0.5, 1, 2, 3 tons per acre) and two annual N applications (120 and 240 pounds per acre) with five replications. Lime applications were mixed with the rototiller into the top six inches of soil. The entire area was top-dressed uniformly with 10-20-10 commercial fertilizer at the rate of 600 lb/A and the timothy was seeded immediately at about 2.5 lb/A with a Cyclone broadcast seeder by making several trips perpendicular to each other for uniform seed distribution. After seeding, the seedbed was packed by driving a tractor over it.

All plots received 200 lb/A of phosphorus (P) as P_2O_5 and potassium (K) as K_2O on June 13, 1967; June 11, 1968; May 29, 1969; June 8, 1970; June 23, 1971, and June 6, 1972. Half of the N was applied with these P and K treatments, the other half was supplied immediately after the first harvest each year. All fertilizer treatments were hand broadcast on the soil surface. Soil samples were collected each spring from each plot before fertilization and after the September harvest. Samples in 1971 and 1972 were taken at two-inch increments to a six-inch depth. All were analyzed using a modified Morgan's procedure with sodium acetate buffered at pH 4.8 (4).

Forage from all plots was harvested twice per growing season, except in 1967 when cattle inadvertently grazed the second cutting. All grass was cut with a small sickle-equipped power mower leaving a 1.5-inch stubble. The first cutting was made just before the emergence of seed heads and the second in September (July 6, 1967; July 8 and September 24, 1968, July 9 and September 9, 1969, July 8 and September 29, 1970; July 21 and September 27, 1971; July 12 and September 26, 1972). The harvested area consisted of a 2.5-foot swath cut from the center of 25-foot plots. Green and dry weights were recorded and representative samples from each plot were ground to pass a 40-mesh stainless steel screen. Nitrogen was determined using a modification of the Kjeldahl-N method by collecting the distillate in boric acid (1). We estimated the percentage of each plot invaded by native bluejoint on May 28, 1969, June 8, 1970, June 23, 1971; and June 6, 1972.

Soil reaction and available NO_3-N, P_2O_5 and K_2O

When data for all six years were considered, each lime increment

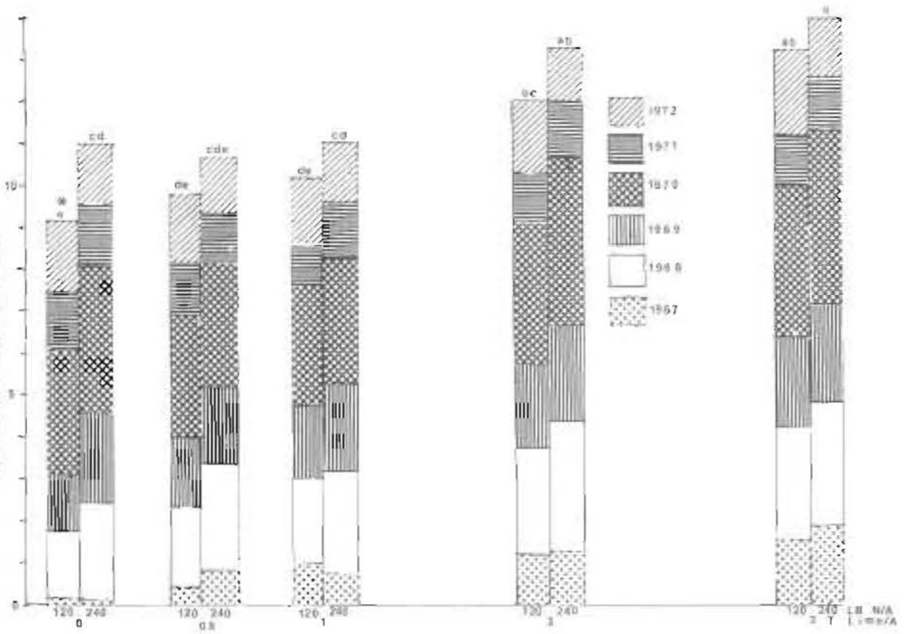

Figure 1. Effect of lime and nitrogen rates on timothy forage yields on Kachemak silt loam, 1967 to 1972. *See footnote 1, table 1.

*Research soil scientist, research soil scientist (retired), and laboratory technician, Agricultural Research Service, U.S. Department of Agriculture, Palmer, Alaska, respectively.

Table 1. Effect of lime and nitrogen of values for six years, 1967 to 1972).

	Pounds per acre available							
	pH (water)		NO_3-N		P_2O_5		K_2O	
Treatment	June	Sept	June	Sept	June	Sept	June	Sept
Lime (T/A)		Effect of lime (means of 60 measurements)						
0	4.41d[1]	4.29e	32.4a	41.3a	119a	126a	275a	299a
½	4.58c	4.46d	33.2a	44.6a	120a	131a	266a	280a
1	4.65c	4.57c	31.6a	38.9a	123a	128a	263a	272a
2	4.84b	4.80b	33.0a	40.6a	121a	128a	262a	263a
3	5.02a	5.01a	31.7a	38.9a	119a	123a	251a	275a
Nitrogen (Lb/A)		Effect of nitrogen (means of 150 measurements)						
120	4.72a	4.70a	32.1a	38.2a	121a	127a	263a	281a
240	4.68a	4.56b	32.6a	43.5a	119a	127a	264a	275a
C.V.[2]	4.2%	4.3%	22.3%	22.4%	19.5%	18.2%	14.2%	14.9%

[1] Letters following tabular comparisons refer to Duncan's Multiple Range Test. Means within each column followed by the same letter are not significantly different at the 5% level of probability.

[2] Coefficient of variation (C.V.) indicates the dispersion of the individual values around the mean. The larger the value, the greater the variation within the experiment.

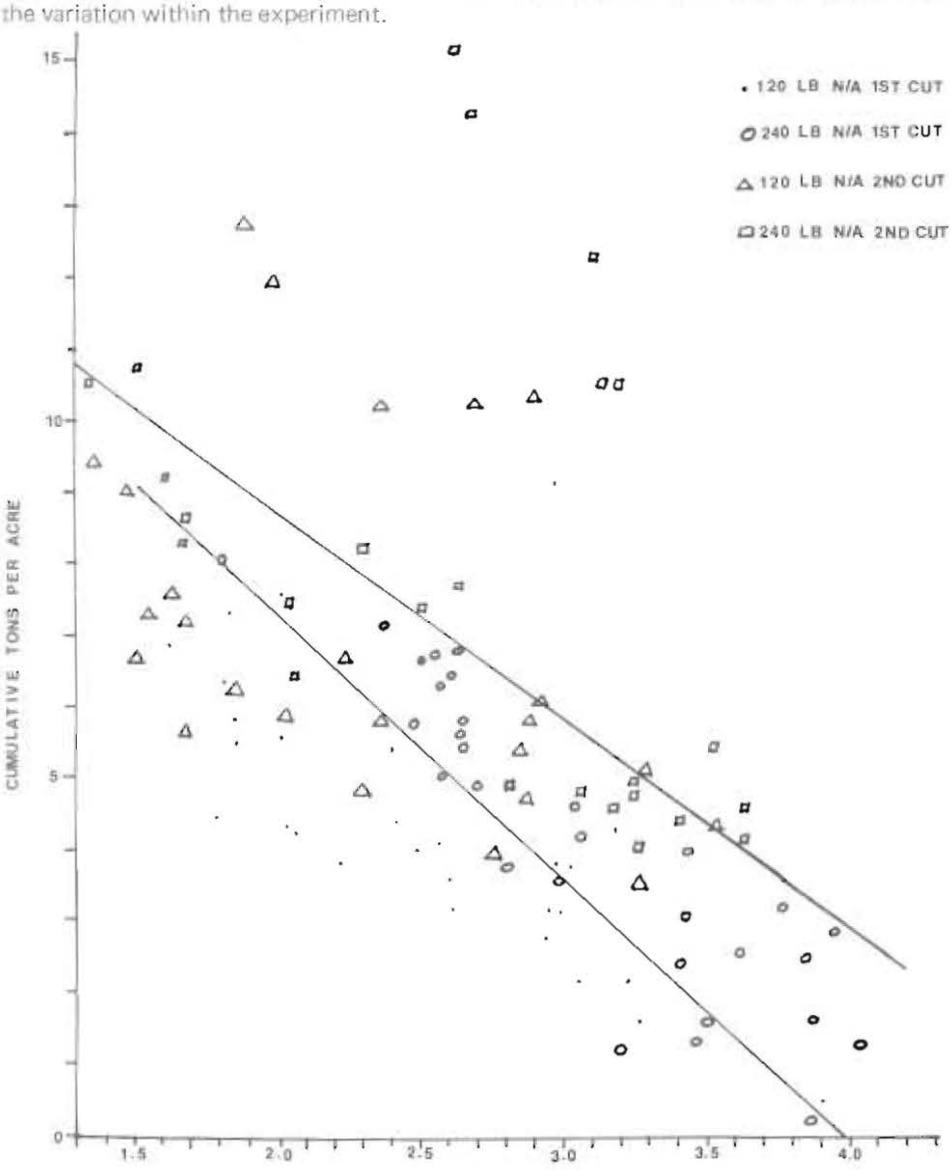

Figure 2. Relationship between N concentration and oven-dry forage yield of timothy on Kachemak silt loam, 1967 to 1972.

increased the soil reaction (Table 1); however, the pH increase below 2 T/A was not large enough to be significant. The soil reaction for June and September 1971 and 1972 was increased significantly by each increasing amount of lime added (Table 2). Available NO_3-N, P_2O_5 and K_2O were not influenced by lime application.

Over the six-year period the higher N application significantly decreased the soil reaction in September (Table 1) and in both June and September for 1971 and 1972 (Table 2). The NO_3-N in the soil in September 1971 and 1972 was increased by the higher N rate. Available P_2O_5 was not influenced significantly by the amount of N applied over either the 6- or 2-year periods.

Both the soil reaction and NO_3-N increased with each 2-inch increase in sampling depth (Table 2). This increase in NO_3-N in soil samples taken at 2-to 4-and 4-to 6-inch depths is similar to that reported under grass by Puscaru, et al. (6) in Rumania. Also, available P_2O_5 in the top two inches was less than that at the two deeper sampling depths.

Bluejoint invasion

Through 1967 and 1968, the 1966 Engmo timothy seeding was uniform and dense. Grass on plots that received 0 or 0.5 T/A grew very slowly and was chlorotic[1] throughout 1967. Native bluejoint volunteered on these two treatments in 1968 and competed vigorously with the timothy through 1972 (Table 3). Timothy also grew

[1] Exhibiting a yellowish color.

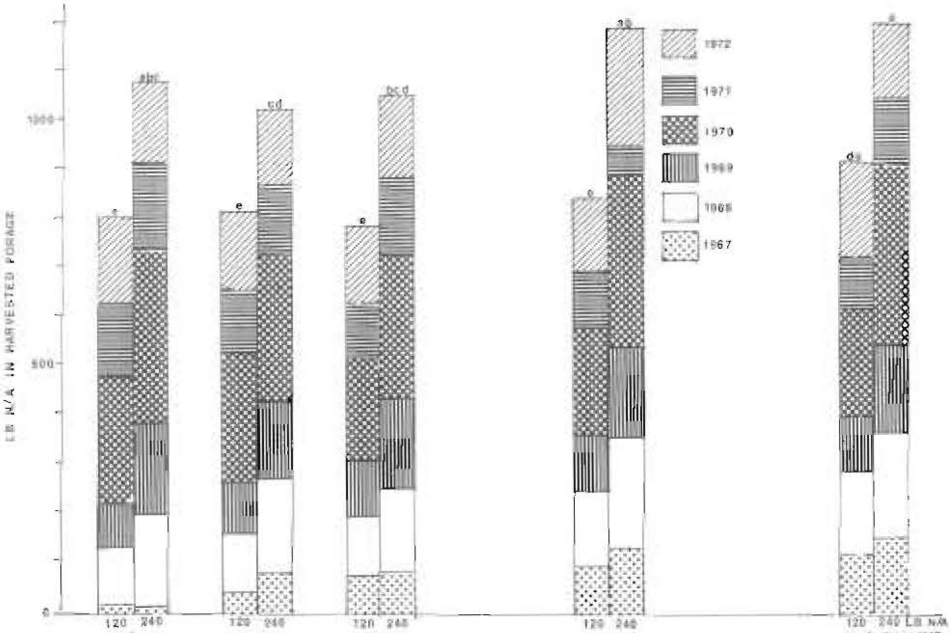

Figure 3. Effect of lime and nitrogen on N uptake by timothy on Kachemak silt loam, 1967 to 1972.

vigorously on plots that received 1 T lime, but by 1972 there was a higher percentage of bluejoint than timothy. On plots that received 2 and 3 T/A lime, a good timothy stand was maintained and successfully withstood bluejoint invasion even though rodents concentrated their feeding on timothy corms.

Despite the two annual harvests, the invading native bluejoint responded well to the higher N rate and increased in vigor. Predominantly bluejoint plots produced yields and forage N concentrations as high as those with timothy alone. Thus, when adequately fertilized, bluejoint grown on soils modified by mixing the organic debris with mineral soil, can be harvested twice yearly with continuing high yields. Some previous observations and studies suggested that bluejoint stands in the native state were rapidly decreased in vigor by successive annual mowings or by continuous grazing (2).

Yield

When data for all six years were combined, each lime application rate increment over 1 T/A increased the oven-dry timothy forage yields (Figure 1). When all lime application rates were combined, the higher amount of N also produced significantly more forage than did the lower. From 1967 through 1970, more than 1 T/A lime caused yields to increase but with no significant differences between the 2 and 3 T/A lime applications. The data of Reith and Robertson (7) showed increased grass growth over a 5-year period in Scotland on an acid organic soil with 250 and 500 lb/A lime but with no further increases from the 0.5 to 2 T/A lime applications. However, in our study there were no significant yield differences between 0 and 0.5 T/A lime in 1967, nor between 2 and 3 T/A in 1968 to 1970. The increased growth of bluejoint on plots that received less than 2 T/A lime caused no significant yield differences in 1971 and 1972.

Mean yearly forage yields (T/A) over all the lime and N rates ranked as follows: 1970 (5.3)>1968 (3.8)>1969 (3.1)>1972 (2.4)>1971 (2.0)>1967 (1.4), with each year's yields differing significantly from the other.[2]

Nitrogen percentage, uptake, and recovery

Figure 2 shows the means of the percentages of N in timothy foliage for each cutting of each treatment plotted against the oven-dry yields.

2. The symbol > indicates "greater than."

Table 2. Effect of lime and nitrogen (N) rates on soil reaction and available NO_3-N, P_2O_5, and K_2O at three sampling depths on Kachemak silt loam (means of values for 1971 and 1972).

	pH				Pounds per acre available					
	water		0.01M $CaCl_2$[1]		NO_3-N		P_2O_5		K_2O	
Treatment	June	Sept	June	Sept	June	Sept	June	Sept	June	Sept
Lime (T/A)			Effect of lime (means of 90 measurements)							
0	4.32e	4.24e	3.72e	3.88e	41.8a	53.0bc	204a	200a	271a	271a
½	4.45d	4.36d	3.86d	4.00d	44.6a	58.0a	209a	211a	271a	274a
1	4.56c	4.46c	3.95c	4.09c	42.8a	51.5c	214a	207a	271a	276a
2	4.70b	4.68b	4.08b	4.32b	45.8a	55.4ab	211a	207a	271a	276a
3	4.81a	4.87a	4.21a	4.49a	44.0a	49.5c	203a	193a	266a	271a
Nitrogen (LB/A)			Effect of nitrogen (means of 225 measurements)							
120	4.62a	4.64a	4.00a	4.22a	42.7a	46.0b	209a	204a	271a	274a
240	4.52a	4.40b	3.92b	4.10b	44.8a	61.0a	207a	203a	270a	274a
Sampling depth (in.)			Effect of sampling depth (means of 150 measurements)							
0-2	4.46c	4.42c	3.82c	3.98c	30.3c	38.0c	173b	171b	266a	269a
2-4	4.57b	4.54b	3.99b	4.21b	47.8b	59.2b	221a	215a	270a	275a
4-6	4.66a	4.60a	4.08a	4.28a	53.2a	63.4a	232a	225a	275a	277a
C.V.	4.4%	4.2%	4.6%	4.6%	19.8%	21.2%	17.0%	18.8%	7.6%	4.0%

[1]Many feel this procedure masks variability in soil salt content and minimizes errors resulting from the liquid junction potential. The soil pH scale is shifted downward.

Table 3. Effect of lime and nitrogen (N) rates on the invasion of Engmo timothy by native bluejoint on Kachemak silt loam, 1969 to 1972.

	% native bluejoint			
Treatment	1969	1970	1971	1972
Lime (T/A)	Effect of lime (means of 10 measurements)			
0	65a	64a	90a	90a
½	18b	32b	60ab	80b
1	15b	14c	40b	60c
2	1b	4c	0c	0d
3	0b	0c	0c	0d
Nitrogen (LB/A)	Effect of nitrogen (means of 25 measurements)			
120	16a	20a	40a	48a
240	20a	24a	38a	45a
C.V.	87%	113%	107%	80%

Increasing lime rates resulted in increased yields with decreased N concentration in the forage. This contrasts with increases of N concentration of oats with liming (too small to be statistically significant) reported by Ogata and Caldwell (5) where both yield and N percentage of oat forage were increased by the higher lime rate.

Like yield, combining all 6 years' data showed the higher N rate significantly increased and each lime increment over 1 T/A tended to increase the N uptake (Figure 3). Also, no significant differences in N uptake resulted from increasing the lime rate from 2 to 3 T/A. When each year's data were considered individually, the two highest lime rates (2 and 3 T/A) increased N uptake only in 1967 and 1968, with differences from 1969 to 1972 not large enough to be statistically significant.

Doubling the N application rate from 120 to 240 lb/A increased the N uptake each year from 1968 through 1971, with only the 1967 and 1972 uptake differences between the two N rates being too small to be significant.

With 120 lb/A, 121 percent of all the N applied during the six-year period was recovered by the plants as compared with 80 percent N recovery with the 240 lb/A rate (Figure 4). The two higher lime rates also increased the percent recovery of applied N at both N rates. This higher recovery of applied N probably indicates that fertilization increased the soil biological activity releasing N in the decomposition of the organic material. This recovery of applied N compared favorably with the 83 to 121 percent N recovery by Engmo timothy on Mutnala silt loam receiving 150 lb/A N (3).

Since this experiment suggests that native bluejoint responds very well to fertilization and to two harvests a year, another study was established at the Jack Epperson ranch. In this experiment, we will compare both timothy and native bluejoint at four different N and two different P and K rates. □

ACKNOWLEDGEMENTS

We acknowledge the assistance of Mrs. Erma Liebing in preparing the figures.

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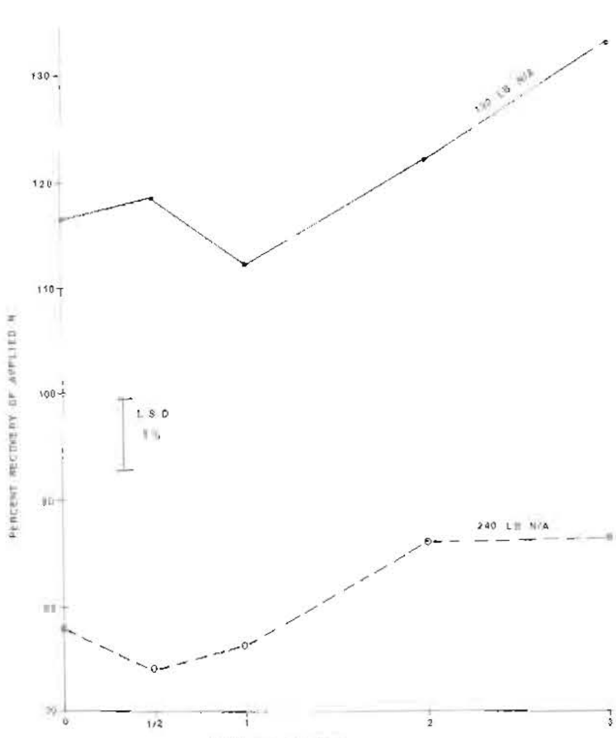

Figure 4. Recovery of applied N on Kachemak silt loam, 1967 to 1972.

Unusual Autumn Temperature Pattern Implicated in 1975-76 Winterkill of Plants

L. J. Klebesadel*

Like squirrels that store away nuts in autumn, and bears that accumulate fat before hibernating, perennial plants, too, must make preparations for winter. In order to survive winter's freezing temperatures, plants must first undergo certain physiological changes during autumn that prepare them to survive the cold, dormant season.

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Those physiological changes, that prepare the plant's overwintering tissues to tolerate sub-freezing temperatures, are caused to occur by gradual changes in the plant environment during autumn. The dominant environmental factors that cause the development of cold hardiness in plants are (a) gradually shortening duration of daylight (photoperiod), and (b) progressively colder temperatures.

Plant winterkill is of considerable economic significance in Alaska, for many classes of plants important to man can be

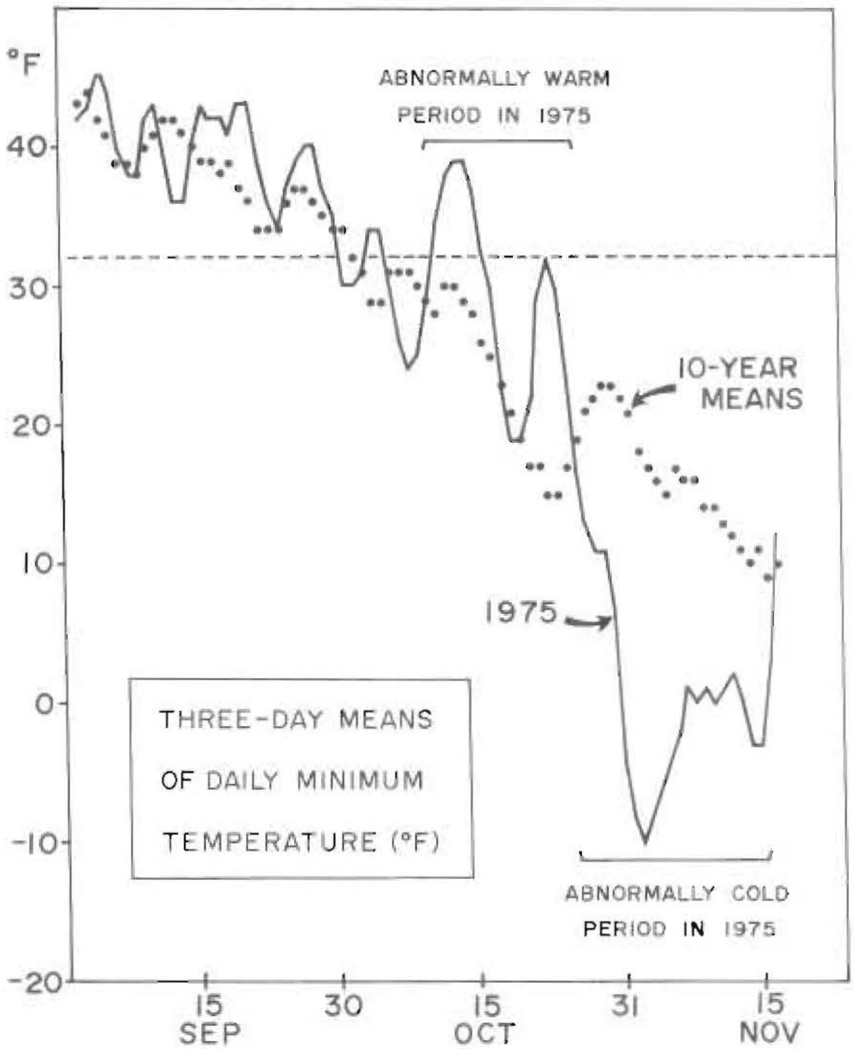

Figure 1. Comparison of autumn temperatures during 1975 in contrast to previous 10-year means, at the Matanuska Research Farm. Data are minimum daily air temperatures calculated as 3-day means to moderate day-to-day fluctuations.

Figure 2. Photo taken 20 May 1976 of broadcast perennial grass plots at the Matanuska Research Farm. All dead plots shown were 17 different varieties of timothy from North America and northern Europe; all winterkilled 100%. Uninjured plots are Polar bromegrass and Garrison creeping foxtail. The randomly occurring individual living plants are Kentucky bluegrass. All plots were planted June 17, 1974.

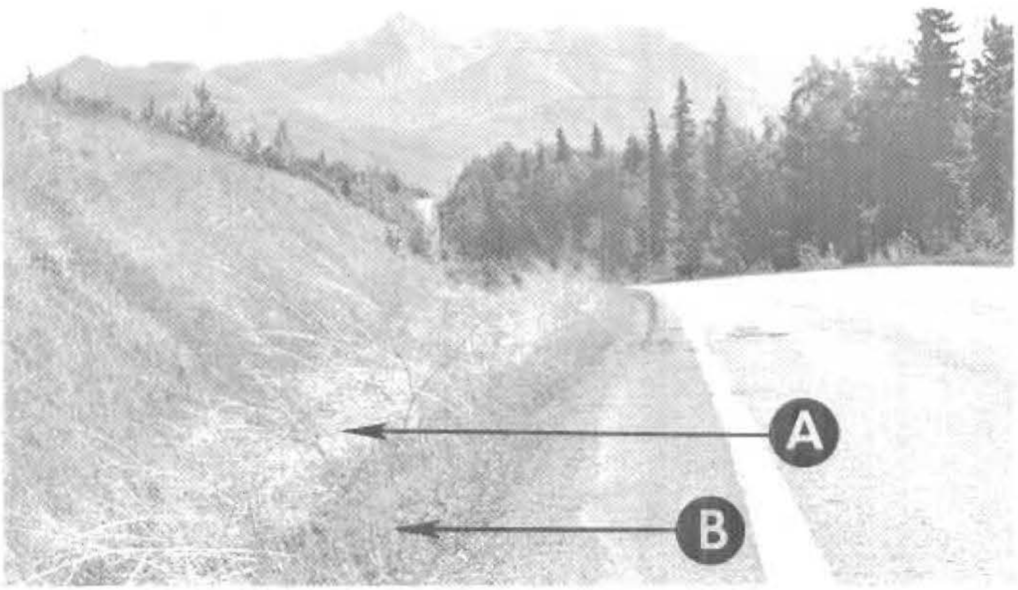

Figure 3. Photo 26 July 1976 of a roadside stand of biennial sweet-clover in the Matanuska Valley. Tall, dead stalks (A) are plants that produced seed in 1975 and died at completion of life cycle. Short, living plants (B) are seedlings that started growth in spring of 1976. Completely missing here, as noted in other roadside stands throughout the Valley, are the plants that were seedlings in 1975 and would have grown to be tall, flowering plants producing seed in 1976; those did not survive the winter of 1975-76.

affected. These include field crops such as bromegrass and timothy; lawn grasses; small fruits including raspberries, strawberries, and currants, woody ornamental bushes and trees, and herbaceous ornamental perennials such as lilies, peonies, and delphinium.

When winterkill of plants occurs, it can be due to one, or to a combination of factors. These include actual cold stress, dessication, weakening by diseases, suffocation under ice, physical injury, soil heaving, and warm periods during winter (3). However, the principal and most widespread causes of winterkill in Alaska are believed to be (a) failure of plants to undergo adequate physiological preparation for winter, and/or (b) excessive cold stress.

Failure of plants to develop an adequate level of cold hardiness in Alaska occurs most frequently in introduced plants from more southern sources that, when grown here, are not attuned to the unusual subarctic pattern of temperature and photoperiod changes during Alaska's autumn (2). Another factor that could preclude development of adequate levels of cold hardiness in plants would be the occurrence of abnormally warm temperatures during autumn. The gradually shortening daily photoperiods (or lengthening nyctoperiods) during autumn, that assist in the process of hardiness development (2), do not vary from year to year and would not cause year-to-year differences.

The autumn of 1975 presented certain unusual temperature deviations from the normal pattern characteristic for southcentral Alaska. Minimum air temperatures during September, 1975, and up to about October 10, were very similar to mean temperatures recorded for the same period during the previous 10 years; however, a considerable departure from the 10-year mean pattern was noted during the next two weeks of October (Figure 1). From about October 10-25, during the critical period when plants are in the process of developing cold hardiness, temperatures during 1975 were significantly higher than normal. The unusually warm temperatures during most of October of 1975 would tend to hinder cold-hardiness development.

Moreover, just prior to the warm temperatures during October, 1975, over an inch more of rainfall than normal (3.30" vs. 2.28") was received at the Matanuska Research Farm during the month of September (1). During the development of cold hardiness, plants cease growth and, attendant with physiological changes, achieve a lowered total water content in overwintering tissues. The combination of warm temperatures and abundant soil moisture in October would tend to prolong growth and slow the development of cold hardiness and dormancy in plants, leaving them ill-prepared for winter.

A field experiment was being conducted at the Matanuska Research Farm during 1974 and 1975 involving several latitudinal ecotypes of timothy and bromegrass. Plants were dug from the field in late October to measure the extent of hardiness development in overwintering tissues. In the measurement technique employed, plant tissues were subjected to different levels of artificial freeze stress, and then tested for tissue injury by the electro-conductivity method. When the laboratory tests showed very minimal evidence of hardiness development in the grasses, the experiment was abandoned in the belief that faulty technique was somehow involved. In retrospect, however, it is now believed that the evidence of little hardiness development detected, in contrast to vastly higher levels found in the same grasses in late October, 1974, may have been due to a considerable extent to warm air temperatures that impeded cold hardiness development during October, 1975.

Undoubtedly of more devastating effect on plants, however, but probably of even greater harm because of the warm period immediately before it, was the precipitous plunge of temperatures immediately following October 25 (Figure 1). Daily minimum air temperatures at the Matanuska Research Farm on November 1, 2, 3, and 4 were 0°, -12°, -11°, and -7° F., while normal minimum temperatures for those days are between 15° and 20° F. At the Alaska Plant Materials Center, about six miles ESE of the Matanuska Research Farm and at a somewhat lower elevation, minimum temperatures for the first four days of November were -14°, -15°, -16°, and -13° F.

These unusually low temperatures for early winter would have been much less significant to overwintering plants if an insulating snow layer had been present; however, in 1975 no snow cover was present during October and November to protect plants from the low air temperatures.

An unusual differential winter survival of different classes of plants, related to the position of overwintering tissues (at the soil surface or beneath it), was noted in spring of 1976. Plants such as timothy and strawberries, which have overwintering tissues at or above the soil surface and thus relatively exposed to air temperatures, sustained severe winter injury or kill throughout southcentral Alaska (Figure 2). Biennial sweetclover, a plant with overwintering crowns near the soil surface, also sustained severe winterkill (Figure 3). Similarly, many introduced species and varieties of bushes and trees that are marginally hardy in Alaska were also badly winter-injured or killed. Many introduced grasses used for revegetation purposes sustained injury or winterkill as did a considerable quantity of herbaceous, perennial ornamentals such as peonies and lilies. It is believed that most of this winter damage to plants, apparent in spring of 1976, occurred during the unusually early and rapid onset of abnormally low temperatures during November, 1975. The 1975-76 winter, after mid-November, showed no unusual deviations of any great significance from other more typical winters.

In contrast to timothy and strawberries, plants such as bromegrass, Kentucky bluegrass, and creeping foxtail, which have predominantly underground overwintering tissues, did not show any winter injury from temperature stress (Figure 2). This indicated that the soil itself served to insulate and protect those types of plants to a greater extent from the short interval of otherwise lethal cold stress in early November. Other studies (4), have shown that underground plant tissues can be protected by the insulating effects of the surrounding soil and effectively buffered against the effects of rapid fluctuations in air temperatures.

These observations illustrate the dependence of overwintering plants upon accustomed autumn temperature patterns for best hardiness development and winter survival, and add to our understanding of the complex problem of plant winterhardiness and survival in Alaska.☐

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With this issue, Mayo Murray becomes the new managing editor of Agroborealis. From her office at the Fairbanks campus, Mrs. Murray also edits all publications published by the staff members at the Agricultural Experiment Station. Her appointment with the station is on a half-time basis, as she also performs similar duties at the Institute of Water Resources, another division of the School of Agriculture and Land Resources Management.

Mrs. Murray is a twenty-year resident of Fairbanks, having arrived at the University of Alaska as a freshman in 1957 from Boston. She worked on the editorial staff at the Fairbanks Daily News-Miner for several years and has been with the University of Alaska as an editor and technical publications specialist for the past five years.

The Murray family includes Frida, 18; Eva, 17; Eric, 15; and Mary, 12. They reside in their log home just north of Fairbanks on Gilmore Trail.

CONSUMER REACTION TO CEA VEGETABLES

William G. Workman, Carol E. Lewis and Charles F. Marsh*

The technical and economic feasibility of producing salad vegetables under controlled environmental conditions has been studied during the past three years by the University of Alaska in cooperation with the General Electric Company, the Kenai Native Association, Inc., and the U.S. Department of Agriculture. The facility for the project is located on the former Wildwood Air Force Base at Kenai, Alaska. Experimental controlled-environment facilities and a pilot production plant were designed to examine plant responses to changes in the environment and to determine the most economical conditions for producing vegetables (2).

Consumer Acceptance Study

An initial step in assessing the economic potential of the controlled environment agriculture (CEA) system was to examine the salad vegetable markets of Anchorage and the Kenai Peninsula (1,3). As a continuation of the market survey work, vegetables produced at the Wildwood facility were evaluated by consumers during the Spring of 1975, to compare the quality of the CEA vegetables to that of salad vegetables available in local Alaska supermarkets. Twenty-six households in Anchorage and 20 in Kenai participated in this eight-week program. Arrangements for the acceptance testing were made through the Cooperative Extension Service offices in Homer and Anchorage.

Each week during the study, one-half of the participating families received a basket of CEA vegetables containing one bunch of leaf lettuce, four tomatoes, one European cucumber, and one bunch of radishes. These vegetables were distributed one day after harvest. The other households were presented with similar vegetable baskets purchased from supermarkets in the Anchorage area. A randomization procedure was used each week to determine which families would receive CEA vegetables and households were not informed of the sources of the produce. Questionnaires were completed by the families as they assessed the flavor, texture, and general appearance of each vegetable type. A five-point rating scale was employed in these tests with "5" indicating excellent quality and "1" representing poor quality.

CEA Vegetables Rated Higher

The CEA vegetables were typically assigned higher values than the produce purchased in local supermarkets on all characteristics tested although in most comparisons there were only slight differences in ratings. The only exception to this pattern was in the evaluation of the general appearance of radishes by the Anchorage consumers. CEA tomatoes rated considerably higher than those purchased locally in all tests in both Anchorage and Kenai. The freshness of the Alaska-grown vegetables no doubt contributed to their overall higher ratings.

Figures 1-8 summarize the results of the eight-week evaluation program. The heights of the bars on the charts indicate the average values recorded for the various characteristics tested. Figures 7 and 8 combine the information from Figures 1-6 to provide the overall mean ratings assigned to the vegetables.

Inspection of the charts shows that Anchorage consumers rated both CEA and imported vegetables higher than Kenai consumers did. There was nothing in the study design which can explain this result. One might speculate, however, that the rural-urban differences between the two test areas contributed to this outcome.

The study demonstrates a favorable reaction to CEA produce. All indications are that locally produced CEA salad vegetables can compete with vegetables shipped into the state, provided they are priced competitively. If a controlled-environment agriculture system can be operated with economic efficiency, fresh, attractive salad vegetables could be available to Alaskans on a year-round basis. Results of research concerning the costs of operating a CEA system will be available from the Wildwood plant in the near future. □

*Assistant Professor of Economics and Assistant Professor of Resource Management, University of Alaska Agricultural Experiment Station, Fairbanks, Alaska; and Research Economist, Agricultural Research Service, U.S. Department of Agriculture, Palmer, Alaska, respectively.

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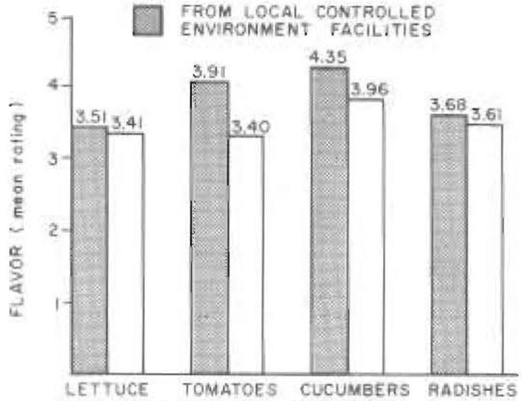


FIGURE 1: FLAVOR, ANCHORAGE

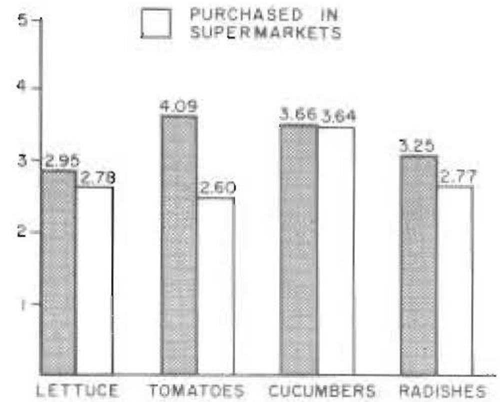


FIGURE 2: FLAVOR, KENAI

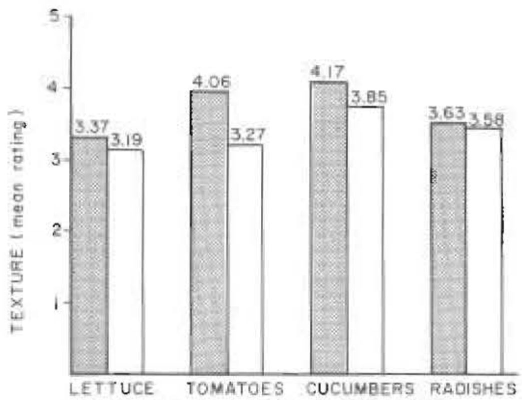


FIGURE 3: TEXTURE, ANCHORAGE

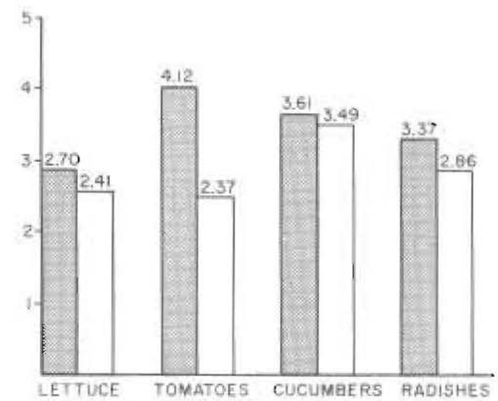


FIGURE 4: TEXTURE, KENAI

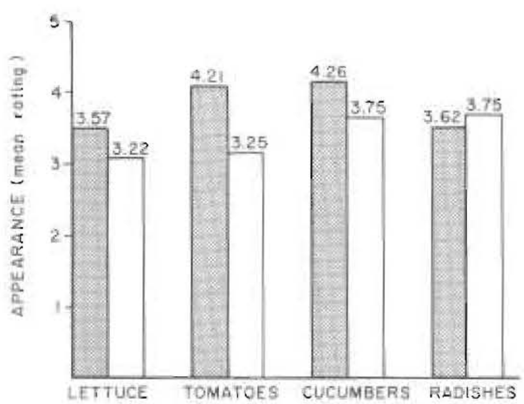


FIGURE 5: APPEARANCE, ANCHORAGE

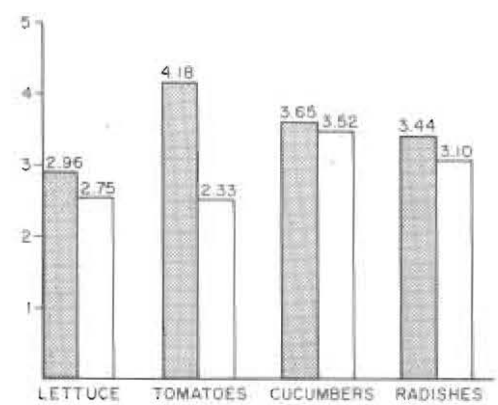


FIGURE 6: APPEARANCE, KENAI

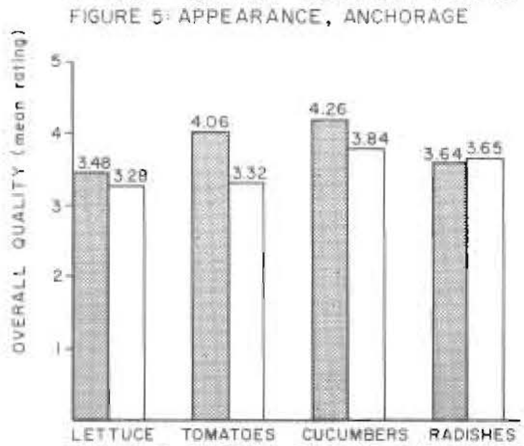


FIGURE 7: OVERALL RATING, ANCHORAGE

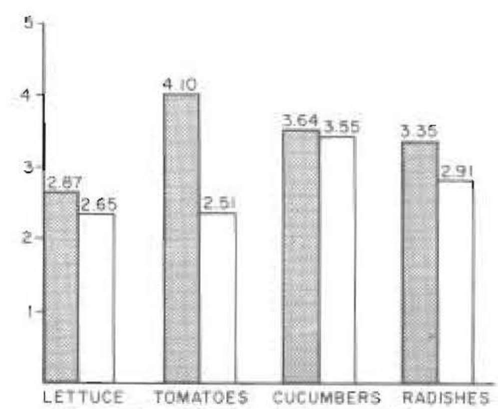
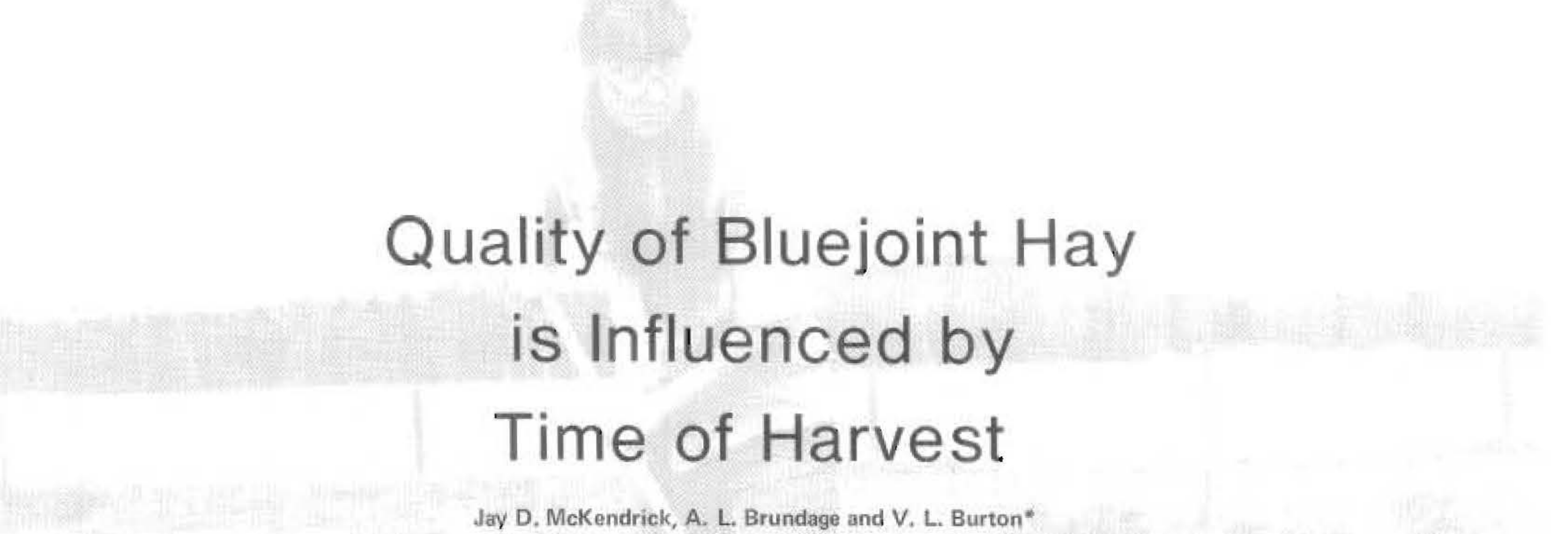


FIGURE 8: OVERALL RATING, KENAI

VEGETABLE RATINGS



Quality of Bluejoint Hay is Influenced by Time of Harvest

Jay D. McKendrick, A. L. Brundage and V. L. Burton*

Bluejoint grass is the most abundant, tall-growing, native grass in Alaska (Piper, 1905 and Mitchell, 1974). Various opinions have been expressed on the merits of bluejoint *(Calamagrostis canadensis)* for forage.

In the early 1900s, Piper (1905) described it as being "the usual hay grass of Alaska." Ross (1907) indicated the native grasses (probably including bluejoint) cured well even in damp weather, due to their fine-stemmed growth form. Later, Alberts (1933) reported bluejoint was a "fair hay for horses, and could be fed to cattle; but that was not recommended." Irwin (1945) suggested that the native grasses in Alaska, if cut at the proper time resulted in "palatable, leafy and nutritious" silage or hay. Corns and Schraa (1962) concluded that under certain management conditions "fairly good" quality forage could be expected from this species.

Klebesadel and Laughlin (1964) summarized the available information on bluejoint, stating it was of "reasonably good forage quality" during early stages of development. Mitchell (1974) referred to bluejoint as a "valuable forage."

None of the reports on bluejoint directly compared it to either standard roughages or to standard animal responses. Instead, the descriptive terminology could be variably interpreted, depending on one's frame of reference for "good," "fair," and "poor."

White (1928) was the first to publish data on fat, crude protein, crude fiber, ash and water content, showing seasonal changes in bluejoint forage on a weekly basis. However, both palatability and digestion data were absent. Thirty-four years later, Corns and Schraa (1962) observed that feeding trials would be instructive regarding use of bluejoint hay.

The need for specific evaluations of bluejoint's forage quality has been recognized. Such an evaluation would be most helpful to stockmen to obtain maximum yields of satisfactory quality native hay. To those who either buy or sell native hay, guidelines for determining a fair market price would also be useful.

Evaluation of Bluejoint Hay

We decided to evaluate bluejoint hay quality in terms of ruminant digestibility on a seasonal basis. Since animal feeding trials are expensive, time consuming, and require large quantities of feed, we used as an alternative the *in vitro* dry matter disappearance (IVDMD) technique as described by Tilley and Terry (1963), and as later modified by Kansas researchers (Meyer, 1971).

In 1972 an unmanaged, unfertilized stand of bluejoint that invaded a power line right-of-way south of Palmer, Alaska, was chosen for testing over a three-year period. It represented a typical southcentral Alaskan "go-back" situation which occurs when the spruce-birch forest is removed and bluejoint temporarily dominates prior to the return of the trees. There was no grazing by large herbivores in the study area during the growing seasons, although moose browsed the willows in late winter.

Whole shoots of bluejoint were collected on a weekly basis (with a few exceptions) during the growing season. Sampling commenced July 11th, 1972 and during the third week of May in 1973 and 1974.[1] Each collection was oven-dried for a day at 60° C (144° F), ground in a Wiley mill and stored in air-tight glass jars for laboratory analysis.

IVDMD percentages were used to compare bluejoint forage and four other roughages (Brundage, 1972) with respect to the ration requirements of beef cattle (National Academy of Sciences, 1970). A formula cited by Brundage (1975) was used to convert IVDMD percentages into metabolizable energy units.

Figure 1 summarizes the results of this study, and indicates the seasonal brevity of bluejoint's prime quality period in terms of metabolizable energy and beef animal-ration requirements.

Late-Harvested Bluejoint Almost Worthless

Obtaining adequate-quality hay from a single cutting of bluejoint required harvesting prior to flowering (anthesis), according to our data. Stockmen feeding growing steers, heifers and pregnant cows should plan on harvesting bluejoint at the "boot" stage, just prior to head emergence.

Samples collected during the seed-shattering stage, had a feed value equivalent to barley straw, which was too low for wintering dry, pregnant cows. After leaf death commenced, quality was similar to that of soybean straw and well below the minimum for maintaining mature, dry cows. Since the latter age class of animal has the lowest ration requirement

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reported among beef cattle (National Academy of Sciences, 1970), bluejoint hay harvested late in the season would be almost worthless as a beef cattle feed. That could explain why some people have classified bluejoint as a poor livestock feed.

Bluejoint accumulated dry matter very rapidly during jointing, late June, with nearly 50% of the annual production occurring during that two-week period. According to the 1974 growth data for bluejoint (Figure 1), peak dry-matter yield coincided with the flowering stage. Grasses with such a rapid growth habit are extremely difficult to manage for either grazing or haying operations compared to grasses which grow more slowly and for longer periods of the year.

Figure 2 shows the appearance of bluejoint at 5-growth stages. It was obvious little forage could be harvested at the 3-4 leaf stage when quality was maximum and equivalent to alfalfa pellets (last week in May). However, on June 20th, when bluejoint was in the "boot," forage quality was similar to that of high-quality bromegrass and adequate for growing steers, heifers and cows with calves. Klebesadel and Laughlin (1964) reported harvesting about 0.5 Ton (T) dry matter per acre in the Matanuska Valley on June 18th.

Phenological observations taken during our study suggested that lateral buds on bluejoint rhizomes had developed sufficiently by June 18th in the Matanuska Valley to permit plant regrowth and recovery following clipping. That date corresponded to the boot stage of plant development.

Because of seasonal differences throughout the habitat range of bluejoint, growth stage rather than calendar dates should be the guiding factor in deciding when to harvest native hay. With sufficient experience for a given locality, operators could probably predict proper harvest dates.

Boot Stage Harvest Recommended

It is very likely that the differences in opinion concerning bluejoint's forage value have resulted largely from variations in harvest times relative to the plant's developmental stages. Generally, harvesting has been recommended during the boot, or early-heading, stage (Alberts, 1933; Irwin, 1945) which would produce hay suitable for certain classes of beef animals. However, Ross (1907) reported harvesting two T/acre of native hay on July 30th and 31st, 1906. Judging those yields and the late July harvest date, harvesting was too late for bluejoint to make suitable hay for beef cattle. Piper (1905) reported that crude protein for bluejoint harvested when flowering was 4.58%, a level approaching that for barley straw. Crude protein was only about 4% in our samples at the flowering stage.

Because unfertilized bluejoint is intolerant to heavy grazing and repeated harvests, harvesting schedules should be a single cut per season (Klebesadel, 1965); unfertilized stands should be cut only once on alternate years in order to maintain the grass stand (Klebesadel and Laughlin, 1964).

Thus, assuming a single harvest per season, a winter feeding period of seven months, and a 0.5 T yield per acre, a livestock operator relying on unfertilized native bluejoint stands for winter feed would need to harvest approximately 4.5 to 5.5 acres of prime quality bluejoint for each animal unit being overwintered. Considering the brief (2-3 week) period when bluejoint's forage quality is adequate for beef animals, it would be extremely difficult for a single operator of even a medium-sized cattle ranch to harvest enough bluejoint hay during a two-week period to winter his herd. In terms of 100 animal units, it would mean harvesting in excess of 25 to 37 acres daily during that prime period. Thus, several forms of forage management are essential for successful livestock operation in southcentral Alaska.

Others at this station are continuing important studies on the effects of various fertilizers on bluejoint's yield and quality at time of harvest. However, additional management techniques must be developed to convert bluejoint stands into dependable sources of winter feed for commercial beef cattle operations. Extending the prime forage-quality period for bluejoint through chemical curing is one promising approach (Kay and Torrell, 1970; Sneva, Raleigh and Turner, 1973). Such a technique would allow livestock to graze and gain for longer periods on bluejoint ranges and reduce the winter

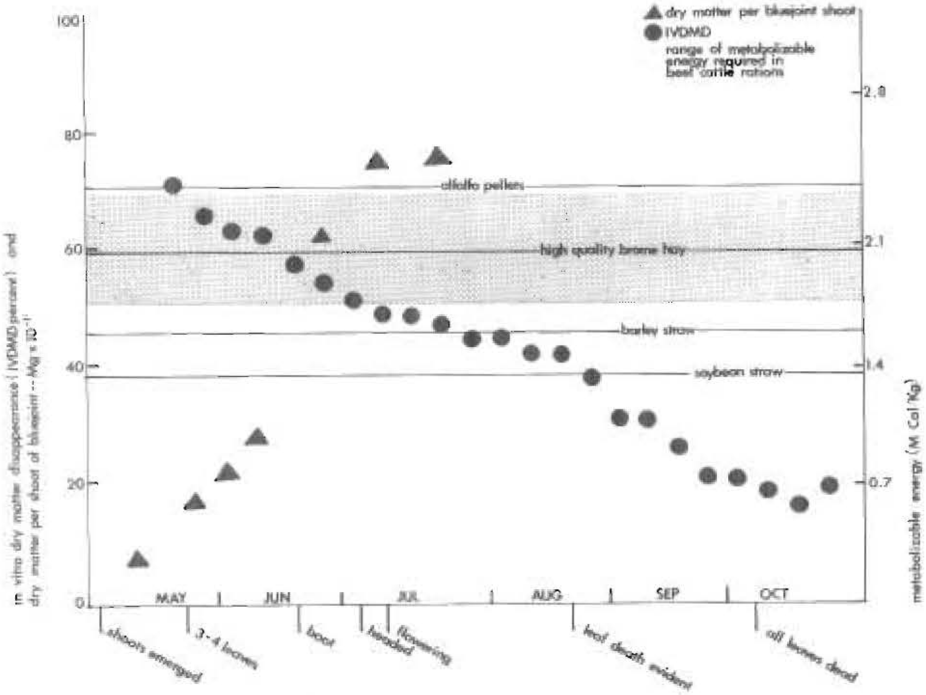

Figure 1. A three-year average of weekly *in vitro* bluejoint dry-matter disappearance percentages, and cumulative dry-matter per shoot during spring and early summer of 1974. Corresponding metabolizable energy values in terms of beef cattle ration-requirements are shown on the right. Occurrence of various developmental stages for bluejoint are indicated along the lower edge.

29 May

2 September

20 June

3 October

10 July

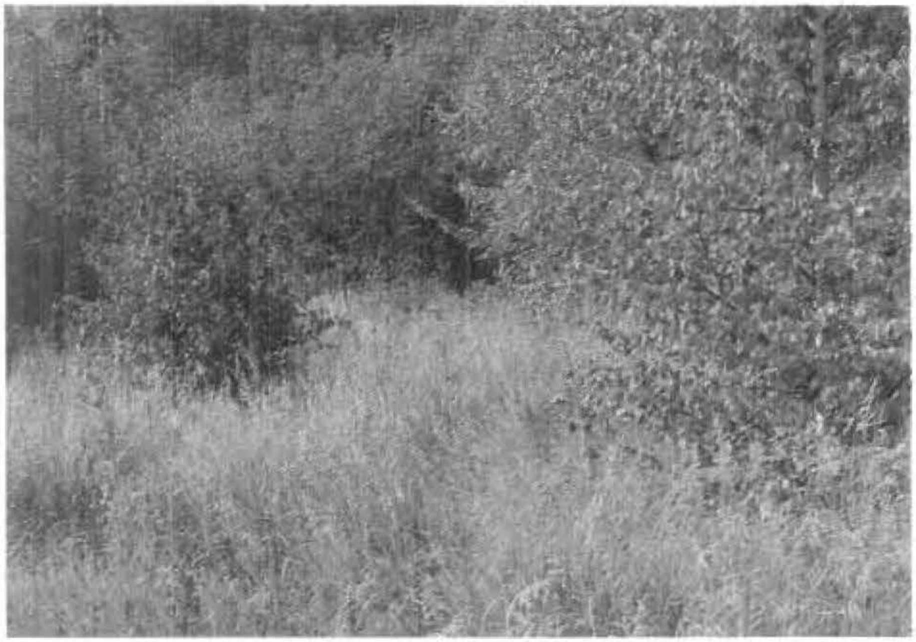

Figure 2. Five photos showing the seasonal changes for a bluejoint stand near Palmer, Alaska. By May 29th herbage growth was well underway, but shoots were still too short for hay harvesting. On June 20th, the stand was in the boot stage and if properly harvested then would yield a good quality grass hay. By July 10th, heads had emerged and hay quality was still satisfactory for wintering dry, pregnant beef cows. Leaf death was progressing by September 2, and forage quality was about equal to that of soybean straw, and too low for maintaining any age class of beef cattle. All leaves were dead by October 3rd, and forage quality was well below the required level for beef animals.

feeding period. In addition, quality bluejoint hay could be harvested over a longer period during the growing season than is now possible for unmanaged bluejoint stands.

Knowing the relative feed value of bluejoint hay in terms of livestock ration requirements, as reported here, aids in evaluating management alternatives. These data also point out the importance of forage quality-testing as a basis for determining fair hay prices in Alaska, and the need for hay-buyers to be wary of poor quality forage. □

1. We wish to recognize Mary Fondahn's contribution of collecting the 1974 samples.

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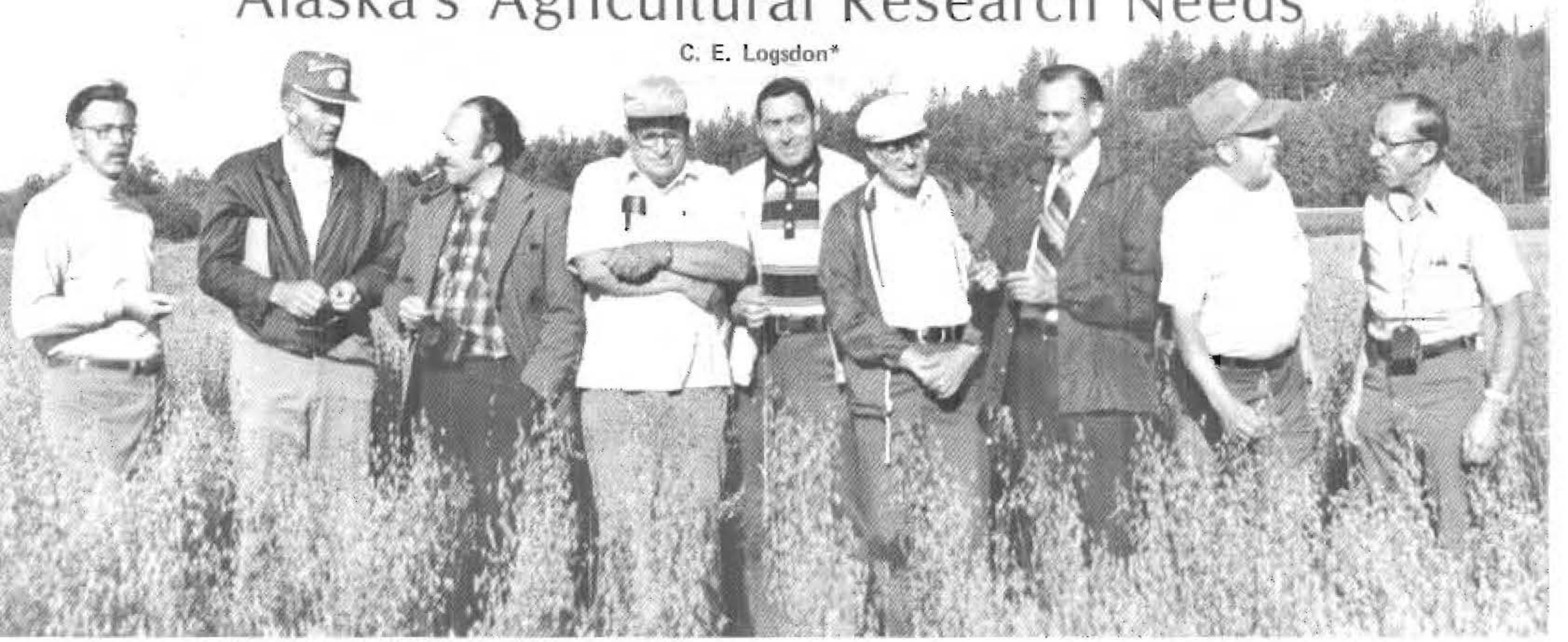
High-Level Panel Reviews Alaska's Agricultural Research Needs

C. E. Logsdon*



Three members of the Review Team are shown above with Alaskan scientists. Left to right: A. L. Brundage, L. J. Klebesadel, ARS Administrator T. W. Edminster, R. L. Taylor, P. J. Fitzgerald, C. H. Schmidt, Alaska AES Director J. V. Drew, C. E. Logsdon, and C. H. Dearborn.

At the request of Alaska's Governor Hammond, Assistant U.S. Secretary of Agriculture Robert Long sent a team of scientists, federal agency administrators, and private industry representatives to Alaska in August of 1976 to review Alaska's land and resource situation relating to agricultural research and development. This review team, which was headed by **Dr. Clare Harris,** Deputy Administrator, Cooperative State Research Service (CSRS), USDA, consisted of

Mr. T. W. Edminster, Administrator, Agricultural Research Service (ARS), Washington, D.C.

Dr. Paul Fitzgerald, Associate Deputy Administrator, North Central Region of ARS, Peoria, Illinois.

Dr. Claude Schmidt, Dakotas-Alaska Area Director, ARS, Fargo, North Dakota.

Dr. Robert Barnes, Plant and Entomological Sciences, National Program Staff, ARS, Washington, D.C.

Dr. E. J. Warwick, Livestock and Veterinary Sciences, National Program Staff, ARS, Washington, D.C.

Dr. Harold Barrows, Deputy Ass't. Administrator, Soil, Water, and Air Sciences, National Program Staff, ARS, Washington, D.C.

Dr. John D. Sullivan, Deputy Administrator, CSRS, Washington, D.C.

Dr. Robert Tarrant, Director, Pacific Northwest Forest Research Station, Portland, Oregon.

Mr. Weymeth Long, State Conservationist, Soil Conservation Service, Anchorage.

Dr. Melvin Cotner, Director, Natural Resource Economics Division, Economics Research Service, Washington, D.C.

Dr. Richard Thompson, Director, Denver Service Center, Bureau of Land Management.

Dr. Bernard Sanders, Executive Director, Economics and Marketing Research Division, Farmland Industries, Inc., Kansas City, Mo.

Dr. Casey Westell, Director, Industrial Ecology, Tenneco, Corp., Houston, Texas.

Governor Hammond's letter to Assistant Secretary Long reads in part:

> "This review comes at a very propitious moment for Alaska. Our legislature recently passed a resolution to establish an agricultural development policy for Alaska, a resolution indicating the desire of Alaskans to participate in the national policy of increasing food production. Moreover, a number of federal agencies including the Soil Conservation Service, Forest Service, Economic Research Service, Bureau of Land Management, and National Park Service are deeply involved in the management of agriculturally-related resources in Alaska. In addition, state agencies such as the various divisions of our Department of Natural Resources including Lands, Forestry Section, and Agriculture, as well as the Department of Commerce and Economic Development and my own office of Policy and Planning, are engaged in extensive operations requiring agricultural research.
>
> It would be most useful to me if the review planned for this summer could be extended to include this array of research needs."

With this charge to the committee, it was necessary for them to accomplish in a very short time the following:

(a) review present research in progress at the Alaska Agricultural Experiment Station's facilities in Fairbanks, Palmer, and Homer,

(b) gain an understanding of existing Alaskan agriculture;

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(c) comprehend the extent and geographic dispersion of potential agricultural and forest lands;

(d) witness emerging agricultural development in the Delta Junction area;

(e) become aware of the agricultural development plans of the Nenana region

(f) see firsthand the possibilities inherent in controlled-environment agriculture at Kenai; and

(g) be briefed on several Alaskan lands questions, including the d-2 issue, and the relations of the Native Claims to future agricultural possibilities.

The group made an overflight of the Susitna Valley, part of the Kuskokwim Valley, the upper Yukon Valley, and the Tanana Valley. They drove the highway from Anchorage to Fairbanks and from Kenai to Homer and back to Anchorage via Seward. They toured the Delta Junction area and Kodiak Island, talking to farmers wherever they went. They visited with State and Federal agency people, Native corporation representatives, and members of industry.

From this overview, which was both general and detailed, the committee will make specific recommendations concerning Alaska's agricultural research needs.

Only three times in Alaska's history have such intensive surveys of agriculture been made by the U.S. Department of Agriculture. The first, in 1898, was done to determine if there was sufficient agricultural potential to provide food for miners and others who were flocking to Alaska in search of gold. This review resulted in the establishment of a series of Agricultural Experiment Stations from Sitka in the Southeastern Panhandle to Rampart on the Yukon, and at several other locations between.

The second intensive survey was made just 30 years ago, following World War II, to determine if sufficient agricultural potential existed in Alaska to serve as a support base for a significant military presence in Alaska. World War II had focused attention on the strategic location of Alaska astride the north Pacific and on potential polar routes between the U.S. and Asia and between Asia and Europe. Alaska was no longer seen as an isolated area at the end of the world, but was beginning to be conceived of as being somewhere near the connecting routes between scattered points around the globe. This review resulted in the establishment of a new joint agricultural research effort between the University of Alaska and the U.S. Department of Agriculture, and the establishment of new Experiment Station facilities at Palmer with greatly increased sophistication in scientific research capability.

The review in 1976 was based on the fact that Alaska is no longer considered an isolated area on the globe, and not a point on transportation routes between more settled areas of the world; but rather, it is an integral part of global settlement. In addition, the 20,000,000 acres of identified tillable lands in Alaska can make a significant contribution to total world food needs.

The report from this review team has not been finalized. The results will not be the report, but the effects of actions taken as a result of that report. Perhaps 20 years from now, *Agroborealis* will carry an article telling of the major effects of the Review Team that came to Alaska when agricultural development was just getting underway in 1976. □

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Alaska
0 200 400
Scale in Miles
Arctic
Ocean
U.S.S.R.
Bering Sea
ARCTIC CIRCLE
Canada
UNIVERSITY OF ALASKA
Agricultural
Experiment Station
A,a
b
B
C
RESEARCH CENTERS
A. Fairbanks
B. Palmer
C. Homer
RESEARCH FARMS
a. Fairbanks
b. Matanuska
Gulf of Alaska