

# Summaries of Selected Research in the Agricultural Experiment Station and Educational Programs of the Cooperative Extension Service

## UNDERSTANDING CROP DISEASES

One of the major educational efforts in the agricultural unit of the North Dakota Extension Service involves promoting the understanding of crop diseases and their control through the use of resistant varieties, fungicides and crop rotation.

Some of the activities the past year in this continuing effort include plant pathology training for agribusiness personnel who advise growers, crop management courses for growers and an in-depth disease workshop for growers. Training included the principles of plant disease control and discussion of specific diseases.

Information on sunflower diseases was presented at 11 meetings, focusing on white mold and the importance of four-year rotations between susceptible crops. This information was also presented at crop field days.

News media releases included information on crop rotation, sunflower diseases, seed treatment and cereal root rot.

The plant disease section of a slide/tape on no-till was shown 65 times to a total audience of 1,715. This program stressed both crop rotations and chemical control.

Have these efforts been successful? A survey of county agents indicated that growers in 35 counties feel increasing concern over plant diseases. Sunflower diseases were considered a major problem in 22 counties. Growers in 35 counties are seeking information on crop rotation. County agents in 36 counties noted a change in grower practices involving rotations, including use of crops to break the small grain cycle in western counties and use of longer rotations between white mold susceptible crops in 24 counties. Some agents reported increased activity in using foliar fungicides, mainly on dry edible beans.

Practices used to control crop diseases are clearly changing, and information proficed by Extension is helping growers make these changes.



## WINTER WHEAT PROGRESS

Roughrider, a new superior variety of winter wheat, was recently developed and released to provide a new specialty crop. Two superior experimental lines are candidates for release soon. One of these, or Roughrider, may provide the very hardy, productive variety needed for diversifying some wheat acres for fall seeding, soil protection in winter, labor distribution, and early harvest, all of considerable value to North Dakota.

Roughrider provided at least \$1,500,000 in income in 1978-79 over the next best alternative variety, and increased seeding in the fall of 1980 will provide added benefits to farmers in 1981.

## WHITE MOLD

White mold is a serious problem because of the long survival period of the resistant fungal bodies and the capacity of the fungus to attack many broadleaf crops (sunflower, soybeans, dry edible beans, flax, mustard, potatoes, etc.) and weeds (lambsquarter, pigweed, Canada thistle, etc.). If the disease becomes serious, only cereal grains, corn, sudan, or similar monocotyledonous plants can be grown for many (up to 10) years.

Growers are turning more toward high cash value crops and the percentage is increasing. Removal of susceptible crops from any rotation represents potentially high losses.

Currently white mold looms as the disease most threatening sunflower production in the future. A 1979 survey of 97 locations in the tri-state area showed one third had the disease present. The potential for yield losses exists due to longevity of the fungus in the soil and the practice of shortened rotations between sunflower and beans and cause loss of this acreage for the two crops for up to five years.

None of the commercial sunflower hybrids have any resistance to the disease, so all USDA inbreds and several

hundred foreign lines are being examined for possible resistance.

Several promising fungicides are being evaluated (pre-plant incorporated) but even if a chemical is found that inhibits the fungus in the soil, cost of application may prohibit its use. Proper rotations and resistant hybrids may be the sole means of combating this disease.

## POPLAR FUNGUS DISEASE

The fungus disease called "Blackstem," which kills the bark of cottonwood and hybrid poplar cuttings, has caused losses of 55 per cent in 1977 and around 35 per cent over a 10 year period at a North Dakota forest nursery. Because of this, the nursery was able to supply only one half of the state's needs for field and farm shelterbelts, and none at all for adjacent states.

Soaking cuttings in a fungicide before winter storage has proved the best solution to date, with an increase in salable plants of 46 and 62 per cent, respectively, for the two years of testing. Adoption of this practice will increase production of cottonwood planting stock by 50 per cent with little additional cost to the nursery. The research costs about \$3,000, and the production increase due to treatment will provide about \$5,000 per year.



## WHEAT STEM RUST

Wheat stem rust has been relatively light over the last few years. However, wheats possessing no stem rust genes for protection have shown rust severities up to 50 per cent at the four dryland and irrigated rust nursery locations in North Dakota.

Minor shifts in rust virulence have been noted in spring cultivars Era, Butte, and Waldron, but showed low severity levels and no effect on quality or quantity of seed produced. Recent cultivar releases Coteau, Len, Calvin, Edmore and Vic showed high levels of resistance to the prevalent races of stem rust.

Continued research work involving the inheritance of resistance and pathogenicity and detection of new genes for resistance in the host and virulence in the pathogen has maintained his present high level of stem rust resistance in spring wheat. A stem rust epidemic, if one similar to 1954 had occurred in 1979, would have caused a loss of approximately \$400 million to North Dakota wheat producers.

## IMPROVED SCREENING TECHNIQUES FOR BARLEY LEAF DISEASES

Screening breeders' lines for reaction to leaf diseases of barley is necessary in improving disease resistance in new barley varietal releases. This procedure normally entails much labor and requires a considerable amount of valuable greenhouse space.

A new procedure has been developed which enables testing of many more lines and requires a fraction of the space of older methods. Up to 720 lines can be inoculated, incubated and read simultaneously, increasing handling efficiency at least 10 times. This permits testing of more material with the same labor and space, improving the probability of selection of lines more resistant to foliar diseases.

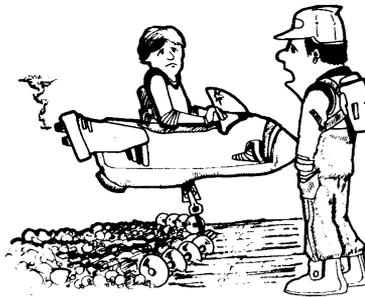
Since improved disease resistance accompanies improved yields, more efficient screening methods are of direct economic benefit in increasing state-wide income from barley production.

## IMPROVING POTATOES BY CLONING

Potato plants cloned from single leaf cells are not identical, as was expected, but show differences in type of vine, tuber yield and composition, maturity, flowering and disease resistance. Plants from this process, called proto-clones, have been evaluated for superior horticultural and disease resistance characters by both laboratory and field tests.

The results suggest that for potatoes, cloning techniques offer a new means for obtaining variability for crop improvement. Increased yields and local adaptability might be possible. The greatest problem in potato production is the control of several major diseases, so identification and development of disease resistance in commercial varieties would not only reduce the need for chemical control, but would reduce the approximately 22 percent annual disease loss.

This project is cooperative with Kansas.



*Quit complaining—when I was your age I had to use a crummy old 4-wheel drive.*

## CONTROL OF ANNUAL WEEDS IN CROPS

In 1980, use of diclofop (Hoelon) for foxtail and wild oats control in wheat and barley could result in a value of \$8.5 million to the state's farmers if used on 500,000 acres (total supply of chemical as first year of conditional registration). This assumes a yield of 7 bu/A and a cost of treatment of barley at \$11/A and wheat at \$4. In some cases the 1980 crop would have been lost without Hoelon.

The acreage treated with trifluralin and propanil for foxtail control probably exceeded 700,000, with an average net return of about \$10/A.

Triallate (Far-go) and barban (Carbyne) were registered before NDSU weed control research began, but fall application and certain mixtures were a result of local research and may account for 50 per cent of usage. A 20 per cent yield increase is possible on the 1,500,000 treated acres.

The use of oil additives with bentazon, linseed oil and others, was developed at NDSU. Use of linseed oil with cyanazine and atrazine is increasing each year. In 1980 the use of linseed oil to cyanazine was especially high because of poor preemergence weed control because of the drought. This treatment provides excellent postemergence weed control and maximizes safety to corn; linseed oil, mainly a North Dakota product is being used widely for this purpose in the Corn Belt.

Use of oil additives reduces cost of treatment about \$3/A, and provides more consistent weed control, while lessening dependence on petroleum products.

## WEED CONTROL IN SUNFLOWER

Registration of all herbicide treatments used on sunflower at present is based on NDSU research. Early development of weed control methods in sunflower has been a key to successful establishment of the crop in North Dakota. Some sunflower is grown even without cultivation because of the developed weed control practices.

Sunflower yield increase from these chemical weed control practices is between 5 and 50 per cent, with 80 per cent of the acreage treated with one or more of the herbicides, for a net gain of about \$42.3 million.

## A DRILL BOX SURVEY

The production efficiency of the American farmer is legendary. Advanced technology has played an enormous role in this success story, but some of the more basic aspects of production are still important as well.

Comments a North Dakota county agent:

"Just one important area that Extension and our Experiment Station can take a lot of credit for is the quality of crops planted, recommended varieties, germination and purity.

"This past spring during seeding I volunteered to do a drill box survey. We took samples from 37 farms across the entire county. Samples were taken directly from drill boxes in the field.

"The information collected or tabulated by the State Seed Department is confidential on each sample received; each cooperating farmer received information on his sample only.

"The average germination was 93.65% on the 37 samples and the average purity was 98.53%. The highest germination was 98% and the lowest 85%. The highest purity was 99.84% on a sample of durum and lowest in purity was 95.16% on a sample of oats.

"Weed seeds involved included green foxtail, wild oats, wild buckwheat, wild mustard, lambsquarter, pink cockle, wild rye, common rye grass and darnell. Fifteen of the samples collected had no mention of weed seeds at all.

"We did see some mix, but in relatively small amounts, such as spring wheat in durum, durum in spring wheat, barley in a sample of oats, flax in a spring wheat sample, rye in a sample of oats being seeded for hay, and so forth.

"The survey showed that all the seed that went into the ground last spring was very good for purity and germination. All the varieties listed were recommended.

"I think the report as evaluated and summarized would speak well for the quality of seed planted by our farmers.

"The team work of the Experiment Station and Extension in promoting variety selection, seed treating, taking purity and germination tests, soil testing and fertilizing when needed all pay off. The value in dollars? Who knows. Millions? It's possible."

## SUNFLOWER INSECT COMPLEX

Early work on the effect of soil moisture on adult sunflower midge emergence indicated 40-60 per cent as optimal. Laboratory tests in 1979 and observations and reports from commercial sunflower fields in 1980 reveal that the midge can emerge in economic numbers from much drier soil. The Red River Valley area has been plagued with periodic outbreaks of this pest since 1971.

Previous years' data are being used to more accurately predict emergence of the seed weevil on the basis of temperature accumulation. This will be helpful in control of this and other pests.

Pheromones and sex attractants are being used throughout the state to attract males of eight species of cutworm moths. All attractants thus far have been effective in luring the moths into the traps. This could become useful in predicting cutworm trouble areas and could serve to alert growers to potential outbreaks, not only for sunflower but for other row crops. This work is cooperative with Agricultural Canada, Lethbridge, Alberta.

In cooperation with the Canada Department of Agriculture, the sunflower moth pheromone is being field evaluated to determine the optimum attractant ratio. North Dakota results are being pooled with those from Texas and Minnesota. Providing growers with an accurate detection method could eliminate unnecessary chemical applications, resulting in savings of \$6.00 to \$9.00 per acre, depending on the insecticide used.

## SUGARBEET INSECT COMPLEX

Economic infestations of the sugarbeet root maggot occurred in approximately 65 per cent of the 275,254 acres of the American Crystal Sugar Cooperative in the Red River Valley of North Dakota and Minnesota in 1979. Expansion of the sugar industry in the Wahpeton area with the addition of the Min-Dak Sugar Cooperative resulted in further spread and increase in economic infestations of this pest. Yield reductions of 4-6 tons/acre can be expected where it is established with high populations with a \$160 to \$240 per acre loss in fields with high populations.

Laboratory reared root maggots provide material for year around studies of basic biology, physiology and control. Current investigations involve isolation and identification of host plant chemicals that serve as attractants for both the female fly and the feeding maggot. Other research seeks to determine the presence of a sex pheromone or sex attractant and its role in the mating process.

It appears that shelterbelts are being used by sugarbeet root maggot adults primarily as protection during windy periods. There is no documentation of feeding activity of flies on flowering plants in the shelterbelts. This research will provide information on fly activity under varying weather conditions both in sugarbeet fields and in grain fields planted to sugarbeets the previous year which are separated by shelterbelts.



Research into the biology and control of cutworms and white grubs in sugarbeets continues, including field research to accumulate data to support registration of more effective compounds for cutworm control, along with recommendation of the most effective time and method of application.

### **WHEAT-SUMMER FALLOW CROPPING SYSTEMS**

North Dakota covers the transition area between a system of alternate wheat-summer fallow in the extreme west to continuous cropping in the eastern edge. Although summer fallowing can increase net return and reduce year-to-year income variability, it does increase soil erosion from wind and water and in some locations contributes to the development of unproductive saline seep areas.

The study determined for each of five areas of North Dakota the relative yields on fallowed and nonfallowed ground, wheat price, and nitrogen cost relationships under which the wheat-fallow system would be economical. The information will help farmers make more rational decisions concerning the amount of summer fallow to use to achieve their income and income stability objectives.

### **HIGH VALUES IN SUNFLOWER RESEARCH**

Sunflower acreage and production is rapidly becoming a competitor to durum for second place in crop income in North Dakota. If one assumes 2,500,000 acres of sunflower in the state in 1980, and a 1000 lb/acre yield at \$0.10/lb value, the sunflower crop is worth \$250 million.

The USDA and NDSU cooperating have produced most of the superior disease resistant and productive sunflower inbreds used in the hybrid sunflower production in this region. If one assumes that the hybrids have produced 200 lbs/acre more than open pollinated varieties, research benefit of the sunflower inbreds produced by USDA and NDSU have added \$20/acre, or \$50,000,000 to the sunflower crop value in 1980 alone.

The value of weed control methods for sunflower developed by NDSU in recent years add 300 lbs/acre of extra yield to the sunflower crop, or \$30/acre on 2.5 million acres, \$75 million worth of additional production otherwise lost to weed competition.

Adding it all up, NDSU and USDA research added \$125 million in value to the 1980 North Dakota sunflower crop. That is enough added value to provide approximately five times the total Experiment Station budget, including the branch stations, for the 1979-81 biennium.

### **AGRONOMY RESEARCH BENEFITS ENORMOUS**

The benefit, or return on investment, from crop improvement and weed control research is very great. The increased income alone from improved spring wheat over the best alternative variety was \$68,000,000 for 1978 and 1979, or 2.7 times the entire budget of the North Dakota Agricultural Experiment Station and all branch stations for the 1979-81 biennium as now projected.

The same benefits from durum wheat were \$49,000,000, or twice the 1979-81 annual budget of the experiment station.

The annual benefit from weed control research for 1978 and 1979 is calculated to be \$80,000,000, or three times the Experiment Station biennium budget for 1979-81.

All of these returns are calculated on production on North Dakota farms for prices prevalent in the years involved. These are excellent returns on investment, and highly justify additional investment in research of this type, so badly needed by North Dakota agriculture.

### **GRAIN QUALITY EVALUATION**

Each year the Department of Cereal Chemistry analyzes North Dakota's major grain crops.

Barley crops are surveyed for their protein content, moisture, plumpness, test weight and kernel brightness and survey results are made available to producers and processors shortly after harvest to aid them in buying and selling decisions.

During the 1978 and 1979 crop years, 2,943 samples were analyzed by a series of barley prediction tests and 1594 after malting. This continual and thorough sampling and testing process contributes greatly to the success of malting barleys released by the North Dakota Agricultural Experiment Station.

Quality testing of durum wheats is accomplished through seven different test series, with 4,260 and 3,825 samples tested in 1978 and 1979, respectively.

The USDA Wheat Quality Laboratory analyzed over 2,400 HR samples from eight different nurseries, and from individual breeders in eight different states during the 1978-80 period. During the 1978 crop year alone, 4200 samples of bread wheat were evaluated for quality by micro or macro quality tests or for test weight and protein.

This is only a representative sampling of the many tests involved in the development of new varieties and in the maintenance of quality standards in selling of the state's grain crops.

Results are made available to the North Dakota Wheat Commission, to growers, buyers and sellers.



## DURUM WHEAT IMPROVEMENT

NDSU, with Agricultural Research Service (USDA) cooperation, has developed and released several new durum wheat varieties in recent years, including Rolette, Rugby, Ward, Crosby, Botno, Cando, Calvin, Edmore and Vic.

Cando and Calvin are the first high quality, short-stawed (semidwarf) durums produced in North America. Grain yield levels of the semidwarf durums have been equal to the highest yielding HRS wheats, and they will not shatter or lodge under the highest fertility and moisture conditions.

Edmore and Vic are the first NDSU durum varieties with high gluten strength. They will improve the export demand for U.S. durum since some countries prefer a durum which will produce a higher cooked pasta firmness. Edmore and Vic are also superior to all other durum varieties grown for resistance to root-crown rot disease complex, for kernel size and spaghetti color.

For each dollar invested in durum wheat breeding research at NDSU, a dividend of about \$130 is returned to North Dakota producers and the economic benefit of the state.

The yield advantage of first Ward (1972) and later Botno, Rugby, Crosby (1973) and Cando (1975) over earlier varieties such as Leeds has netted nearly \$120 million addi-

tional income to producers through 1979. Cando and Calvin, the semidwarfs, will bring additional financial benefits to North Dakota while maintaining high levels of quality and disease resistance.

Edmore and Vic will bring additional benefits by encouraging increased export sales and domestic consumption because of their strong gluten.

## SUPERIOR MALTING BARLEY VARIETIES

Superior malting barley varieties developed at NDSU have occupied almost 100 per cent of the barley acreage of North Dakota and of most of Minnesota and South Dakota for many years.

The value of the 1978 barley crop in North Dakota in 1978 was about \$131,000,000. New superior varieties of malting barley have provided added value above the next best variety of about \$11 million per year over recent years. The newest varieties, Glenn and Park, have a greater superiority advantage and will return more added value than even Beacon, Larker and Dickinson gave over earlier varieties. The new variety, Glenn, should provide an additional \$4,000,000 to \$6,000,000 increased income over Larker, Beacon, or other varieties in 1980 alone due to increased yield performance.





## IRRIGATED SUNFLOWER RESPOND TO N FERTILIZER

Fertility experiments with irrigated sunflower at Oakes, ND, in 1979 showed an application of 200 pounds of fertilizer nitrogen per acre increased seed yields 2000 pounds per acre above a check yield of 1340 lb/A. This response required about 12 inches of irrigation water, 8 inches of precipitation and 3 inches of soil water.

Water use efficiencies for non-treated and nitrogen treated plots were 58 and 146 pounds of seed per acre per inch of total water used. When sunflower seed sells for 10 cents per pound and the cost of nitrogen fertilizer is 20 cents per pound, the increased "net" return from N would be \$160 per acre for applying the fertilizer, or a return of five dollars for each dollar invested in nitrogen.

This research, begun in 1978, is on a Maddock sandy loam soil representative of several thousand acres of irrigated and potentially irrigable land in North Dakota.

## PESTICIDE RESIDUES

Application of radio-immunology is being explored for determination of pesticide residues. If successful, the procedure should be especially valuable in screening crops for pesticides at low cost. Methods currently used involve extensive and costly procedures and large amounts of petroleum-based solvents. Though development of an immunological assay is often time-consuming, once developed it offers a low-cost and rapid assay method.

The analytical laboratory in the Department of Biochemistry is conducted in cooperation with EPA, USDA, pesticide manufacturers and state experiment stations in the North Central Region. The data are used to obtain permission to use pesticides on so-called "minor crops" grown in this area, including flax, millet, safflower and potatoes.

## DRYLAND SUNFLOWERS NEED NITROGEN FERTILIZER

Nitrogen fertilizer increased sunflower seed yield significantly in 70 per cent of the field experiments conducted since 1971. Average yield increases for responding sites were 422 and 593 pounds of seed per acre, respectively.

Oil concentrations were reduced by 0.9 and 1.7 percentage units for the 40 and 80 pound N rates, but oil yields were increased by 156 and 207 pounds per acre.

Under dryland conditions non-fertilized and fertilized sunflowers produced 118 and 152 pounds of seed/acre/inch of precipitation plus soil water depletion.

When fertilizer nitrogen costs 20 cents per pound and seed value is 10 cents per pound, the average response data show sunflower growers applying 40 and 80 pounds per acre will obtain an average return of \$5.30 and \$3.70 for each dollar invested in nitrogen fertilizer. At the same nitrogen and seed prices, maximum profit was obtained on soil containing 124 pounds per acre of soil nitrate and applied fertilizer nitrogen.

## INTEGRATED PEST MANAGEMENT

By definition, integrated pest management (IPM) is "the selection, integration and implementation of pest control based on predicted economic, ecological and sociological

## NEW SPECIALTY CROPS

Farmers need new alternative crops to grow while using all their cropland acreage to best advantage.

Proso millet, buckwheat, triticale, speltz, rape, mustard and lentils are being tested at the Williston Branch Station with other new crops, including coriander, dry beans, caraway and canary grass being evaluated under western North Dakota soil and climatic conditions.

Lentils, rape and mustard varieties are being tested at the North Central Experiment Station at Minot in cooperation with the University of Saskatchewan.



What kind of fertilizer do you use, Harold?

consequences. IPM seeks maximum use of naturally occurring pest controls including weather, disease agents, predators and parasites. Artificial controls are imposed only as required to keep a pest from surpassing intolerable population levels after accurate assessment of the pest damage potential."

In the early 1970's, the federal government established a program to train personnel to work with producers in field evaluation of crop pest infestations. A task force at NDSU worked out details and objectives for a weed control program. The initial program, as accepted for federal support, included South Dakota as well as North Dakota.

The original project area, headquartered in Jamestown, included Barnes, Stutsman and Foster Counties in North Dakota and McPherson County in South Dakota. Wells County was added in 1977, Eddy and LaMoure Counties in 1979 and Dickey, Sargent and Ransom Counties in 1980. McPherson County withdrew at the conclusion of the original contract in 1979.

Initial project work included establishment of wild oat control demonstration fields in each county and scouting of cooperator fields during the growing season. Increased sunflower acreage in the project area has greatly influenced scouting activity as about 80 percent of the acreage scouted in 1978, '79 and '80 was sunflower.

The North Dakota IPM project is sponsored by the Extension Service. Area Extension agents are responsible for the field program, with county agents and state specialists supporting the field staff.

The scouting program is administered on an individual county basis. Scouts make written reports for the producer, county agent and area agent on each field visit. If the scout spots a problem he feels needs attention he will personally contact the farmer and will notify the county or area agent of the problem. All recommendations for control are made by the area or county agents or by state specialists. The scout's responsibility is to spot the problem and evaluate intensity, not recommend controls.

A grower organization made up of cooperators was incorporated in 1980. This group elected an executive council which serves as the advisory committee on the scouting project and hires the scouts. The scouting activity was totally self supporting in 1980 with the grower organization collecting and dispersing funds.

The scouting program involved just over 3,000 acres in 1977 and grew to over 34,000 acres in 1979. Acreage was down in the drouth year of 1980, but it is anticipated that the scouting program will increase in scope.

Growing interest in minimum-till and increases in row crops, especially sunflower, will create a change in weed species that could be a problem. Future programs will recognize these changes and modifications in program plans will be made accordingly.

## **PESTICIDE TRAINING**

Training of both private and commercial applicators of "restricted use" pesticides continues to be an important activity of the Extension Service. The North Dakota Extension Service serves a unique role of having both training and certifying responsibility for commercial pesticide applicators.

Enactment of the Pesticide Act of 1975 by the North Dakota Legislative Assembly created a Pesticide Control Board responsible for administering all provisions of the

Act. Members of the Board include the Commissioner of Agriculture, the Director of the Cooperative Extension Service and the Director of the Agricultural Experiment Station.

The Cooperative Extension Service is responsible for preparation of educational materials and training of private and commercial applicators who use restricted use pesticides. The Act identifies the County Extension Agent as the person responsible for determining the qualifications of applicators to apply and use restricted use pesticides and designates the county agent as the certifying agent.

The Experiment Station is the research and resource supporting agency and the Department of Agriculture is the regulatory and enforcement agency. The county treasurers issue licenses and collect fees from certified dealers and commercial applicators.

Since the start of major training efforts in 1977, over 2,900 commercial pesticide applicators have been trained, along with almost 1,400 dealers and nearly 30,000 private applicators.

The major pesticide training emphasis in the past year has been update training and recertification for commercial applicators and dealers. The primary focus of this program is to provide already-trained applicators and dealers with update information relating to new materials, changes in regulations regarding materials already in use, and improving skills of applicators regarding safety aspects and more accurate sprayer calibration.

Private applicator certification is effective for a five-year period, so these individuals have not yet reached the need for recertification. As these certificates expire, county agents in each county will contact individuals needing recertification and encourage them to attend recertification seminars.

## **SUGARBEET ROOT MAGGOT**

The sugarbeet root maggot continues to be the major pest species affecting sugarbeets in the Red River Valley of North Dakota and Minnesota, as well as other beet producing areas to the west.

Several insecticides have been thoroughly tested and are presently recommended. They provide the only effective control methods for this insect.

Extensive basic laboratory research, including a laboratory rearing program, has been in progress in search of alternative controls. Current studies on maggot feeding and root damage suggest the development of new information on association between microorganisms and all life stages of this insect.

Feeding tunnels formed in soil around beet roots by early instar maggots are generally found with a slime layer which is partially bacterial in origin, and associated with a single species of bacterium. A structure on the insect appears to serve as a filtering mechanism in which the bacterium attaches and accumulates. Transmission of these bacteria to subsequent generations occurs.

Relationships between the bacteria and the host-plant selection, root maggot feeding and nutrition, and beet root damage are under investigation. Further studies may result in the development of alternate mechanisms of control of this insect as well as a better understanding of the host-plant selection, development, and feeding within this entire insect family.

## **NORTH DAKOTA STATE UNIVERSITY RESEARCH ARBORETUM**

Initiated in 1974-75, this arboretum is one of the largest collections of woody plants in the Northern Plains, representing over 1000 accessions in 90 genera. Many plants were purchased, but nursery stock valued at nearly \$10,000 wholesale or \$30,000 retail was contributed from a multitude of sources, far and near.

To reduce maintenance costs, the entire arboretum has been planted to red fescue, with grass-free circles around plants to reduce competition for moisture and nutrients.

A permanent labeling system has been devised with names and accession numbers imprinted on aluminum strips riveted onto fiberglass panels, painted with black automobile paint for contrast and wired to metal stakes. The labels enhance the usability of the arboretum as a "living laboratory" for college students, nurserymen, arborists, foresters, park personnel, horticulturists, botanists, homeowners, and the general public.

Valuable information has already been obtained on the ease or difficulty of establishing different trees and shrubs, growth rate, winter hardiness, landscape characteristics and taxonomic identity. The arboretum will permit valid recommendations for a multitude of plants never before evaluated in North Dakota.

Each general group represents a potential research study. Genera which represent the most extensive collections or studies include: Juniper, linden, maple, buckeye, barberry, birch, hackberry, dogwood, forsythia, ash, cinquefoil, elder, ninebark, honeysuckle, pine, willow, mountain ash, arborvitae, viburnum and rose. Selections of potentially superior plants have been made in some of them, and several new introductions may be released in future years.

### **WOODY PLANTS**

Woody plant research basic objectives are to select and introduce potentially superior woody plant species and cultivars and to evaluate trees, shrubs, vines and ground-covers from North American and foreign origin for winter hardiness, adaptation to soil and climatic conditions in different parts of North Dakota and for potential use in landscape, recreation, highway and shelter plantings.

### **SHELTERBELTS**

Shelterbelts dating from the Prairie States Forestry Project of the 1930's were studied in Barnes, Cass and Ransom counties. The shelterbelts have turned into miniature woodlands with tree and shrub reproduction present, and are still protecting the soil from wind erosion, one of their original purposes. The shelterbelts studies were planted from 1935 to 1942; even those planted in the very dry years of 1935 and 1936 showed remarkable survival and growth.

### **VEGETABLES AND SMALL FRUITS**

A new tomato and a squash selection developed by the vegetable breeding program were tested in 1980 and seed is being increased before naming and release in the near

future. The Sheyenne tomato, a 1960 introduction and one of several from this department, is still grown as the standard variety in North Dakota. Two NDSU squash introductions, Buttercup and Gold Nugget, are widely used across the nation.

A raspberry trial showed Boyne and Killarny the best ones for North Dakotans to plant and nurseryment to stock.

The severe winter of 1978-79 provided excellent information on differences in winter hardiness of the many fruit cultivars. Severe injury to some apple varieties bore out the fact that these same varieties topworked onto hardy interstocks survived well and even fruited, proving that this simple cultural technique works well.

A strawberry management system using wire hairpins to peg the runners is peculiarly adapted to small family operations, with advantages of high yields and first year production.

The Great Plains Produce Association, with Horticulture Department help, issues a weekly newsletter and market report to area fruit, vegetable, honey and farm poultry producers through the summer, giving product, quantity available, and price range. With commercial muskmelon acreage becoming established and with growing demand for the highly flavored North Dakota melons, a bulletin, "Muskmelon Production and Marketing in the Northern Great Plains," was published in June, 1980.

### **POTATOES TOP STATE VEGETABLE CROP**

The potato is the only extensively grown North Dakota vegetable crop and the only one that generates appreciable farm income, 50 to 100 million dollars per year, depending on production and current price. This figure does not include any associated agri-businesses, as chemicals, machinery, transportation, or construction.

The Department of Horticulture has named and released 11 varieties since 1957, including the popular Norland, Norchip, Norgold Russet, Viking and Bison. Norchip is the top chipping variety grown in the United States and Canada. All these varieties are grown extensively in the Red River Valley as well as in other North American potato producing areas.

Crystal is the newest variety released in March, 1980. It is anticipated that this high-yielding, oblong, whiteskinned variety will become important in the frozen french fry and chipping industries.

Several red, white and russet skinned selections are being increased and tested for future introduction by growers in Beach, ND, and in the Red River Valley. The Department of Plant Pathology indexes and tests all new selections for all known potato virus diseases.

Breeding and selection of some 60,000 seedlings continues. The University of California, Texas Agricultural Experiment Station and the USDA potato breeding program at Aberdeen, Idaho, cooperate in seedling selection and testing of advanced selections.

Processing tests for flaking, chipping and french fry quality continue with Pillsbury and Red River Potato companies. The NDSU Home Economics Department also cooperates on some quality tests.

## POTATO PRODUCTION AND MANAGEMENT

A facility was established at the Potato Research Laboratory near Grand Forks for potato growers, brokers, storage operators and others to independently test chipping potato quality. The facility includes specially fabricated frying equipment, detailed directions with photo-illustrations, and charts to help quantifying quality and diagnosing quality problems. The test information helps processor and grower locate sources of and markets for raw potato stocks. The test station is an economical approach to providing a standardized system for quality evaluation, bringing processor and grower to common ground.

Instrumentation, using a load cell system as a research tool, was successfully developed for sensing lateral and vertical bin wall pressure in a commercial-size potato storage. Design data were developed from actual storage tests to obtain empirical pressure values for specific storage dimensions. Effects of pressure on structural, environmental, and product systems can now be properly analyzed and engineered into potato storage systems.

Various chemical and mechanical weed control methods were compared to determine the most economical way to control weeds in potatoes under various growing conditions. Selection of the best weed control program for a specific set of conditions could result in saving two to 10 dollars per acre over an only average program.

A study of weeds in potatoes showed a direct relationship between tuber yields and dry weight of weeds.

## HAZEN APPLE

The Hazen apple was named and released in 1980. It combined a hardy tree, good resistance to fireblight disease, good quality, good sized, attractive fruits on a natural dwarf plant for the Northern Plains.

The Hazen apple has performed well in trial sites across the state and should be used as a replacement for the Beacon apple, which has been widely planted but is very susceptible to fireblight and lacks hardiness for North Dakota. A natural dwarf, Hazen apple eliminates the need for the tender dwarfing rootstocks used for other dwarf apple trees. It begins fruiting when about three years old, two to seven years earlier than most other commonly sold varieties in the state.

The Hazen apple is a joint introduction with the Science Education Administration, Agricultural Research (SEAR), United States Department of Agriculture.

## HORTICULTURE AND FORESTRY

The mission of the Horticulture and Forestry Department to North Dakota is two-fold—enhancement of living for people in the state and with crops—fruits, vegetables and ornamentals.

Application of horticulture to enhance living conditions of North Dakota residents and for developing the state's native beauty is as important to a good life style as is industry and crop production, but because it's esthetic in nature, it can't be measured in dollars. Esthetic pleasure from horticultural endeavors reaches people of all ages.

The potato is North Dakota's major horticultural crop, producing 60 to 80 million dollars annually. Market gardening, home production of vegetables and fruits, the nursery trade and the greenhouse trade all affect the economy and the quality of life in North Dakota.

## UNRAVELING MECHANISMS OF PLANT RESPONSE TO MOISTURE STRESS

Development of crop plants less sensitive to environmental stress conditions is a goal of several plant physiological studies. Knowledge that indicates that mild water deficit stress impairs wheat chloroplast cell development and photosynthetic activity has been obtained. Through application of selective plant hormones or through genetic manipulations some stress-induced plastid aberrations have been overcome.

Assimilation of nitrate nitrogen also is reduced in plants experiencing moderate to severe water deficits.

Through use of tissue culture techniques an understanding of the mechanism(s) by which water stress impairs essential biochemical and physiological processes is being obtained. This basic research information will be useful in breeding programs and the development of new crops.

## MASTER GARDENER PROGRAM STARTED

Home horticulture has become a more and more popular activity in recent years, as many more people become involved in working with landscaping, trees, shrubs, flowers and home lawns as well as vegetables and fruits in the home garden. This increasing activity has prompted many gardeners to seek horticultural information wherever available.

One common source of information, especially for newcomers to gardening, is more experienced friends or neighbors. In an effort to more effectively use these individuals to distribute horticultural information, several states have adopted a Master Gardener program. The North Dakota Extension Service conducted a Master Gardener program on a pilot basis in 1980.

The Master Gardener program is basically a volunteer leader training program made up of people who are knowledgeable in horticulture and want to help others identify problems and answer questions. The program is intended to bring these volunteers up to date in all areas of horticulture to reinforce existing knowledge and help them learn how to share their information with others.

The Master Gardener training course consisted of 48 hours of instruction over a four-week period. Areas of training included landscaping and plant materials; pruning, planting and lawns; insects and pesticides; soils and weed control; vegetables—fruits; culture and diseases; floriculture; houseplant culture and an outdoor workshop.

The goal of training was to offer comprehensive training to individuals experiences in horticulture and provide these volunteers with the information needed to distribute horticultural knowledge in their own locales. The program was initially offered in southwestern North Dakota, with 39 individuals completing the training course. To become a Certified Master Gardener, these trainees must have conducted 48 hours of volunteer work during the year.

All Master Gardener activities are coordinated through the local county Extension staff, and the Extension Service is responsible for the organization of the program. Extension staff members recruit the volunteers and provide the training and educational back-up for the Master Gardeners.

Based on experience in other states and positive response from those involved in the North Dakota program, the Master Gardener program and has the capability of becoming an important resource for the home gardener.

## TRADE TEAMS, SEMINARS, SELL GRAIN

Short courses and seminars for various foreign trade groups and technical organizations sell North Dakota high quality grains, particularly HRS and durum wheat.

In the past two years, the Department of Cereal Chemistry and Agronomy hosted teams from Japan, Italy, France, Switzerland, Germany, Central America, Brazil, Philippeans, Indonesia, Thailand, Netherlands and Belgium.

Technical groups included the National Macaroni Manufacturers Association, which was particularly interested in the new, strong gluten durums for the Italian market, and the annual short course on Experimental Bread Baking/Dough Rheology, and a Japanese Food Agency course on sprouted wheat.

Visits by grain-buying countries are returned, when scientists from NDSU visit their countries to conduct further seminars and short courses to grain buyers and technical people, to 13 countries in Europe, to Central and South America, and Japan, teaching people about our superior varieties and how to make best use of them in the food specialities and preferences of their own people.



### BREWERS SPENT GRAINS IMPROVE NUTRITIONAL QUALITY OF BREAD

Adding brewer's spent grains to bread increases protein and natural fiber content. In experimental bakings, it replaced 5, 10 and up to 15 per cent of the hard red spring wheat flour in a conventional bread formula with little change in baking performance. Consumer acceptance of the bread indicated a potential use for brewery by-products as well as more nutritious bread.

### SUNFLOWER PROTEIN IN BREAD

Adding sunflower protein to white bread will remarkably improve the protein quality of the resulting product, joint Department of Cereal Chemistry and Department of Animal Science research shows.

Lysine is the first-limiting amino acid in sunflower protein.

## AGNET PAYS OFF FOR LIVESTOCK PRODUCERS

Agriculture is moving into the computer age along with the rest of the scientific and business world, and the Extension Service is keeping pace.

The AGNET computer network offers a vast variety of programs that can help make farmers and ranchers make those critical decisions that make the difference between profit and loss.

In the programs available to livestock producers, for example, the program called FEEDMIX for use in formulating rations was used a total of 847 times during the most recent program year. The species breakout shows the program was used by 341 beef producers, 251 dairymen, 186 swine producers, 72 sheep producers and 7 poultry producers.

Estimated savings to the livestock producers using the program total \$569,730. Total savings are probably much higher, but this figure can be substantiated by figures from county agents. Other comments have been received mentioning savings of "several thousand dollars."

In addition, using the program to check for ration deficiencies helped correct 149 rations that were lacking in some nutrients. It's not possible to document a dollar amount on these cases, but increased animal efficiency because these rations were corrected would be substantial.

AGNET economic livestock performance simulator models were used a total of 284 times. Most of these producers proceeded with their planned intentions after using the program. Those who discovered their plans were not economically feasible saved an estimated \$76,750 by finding out in advance.

## FAMILY FINANCIAL MANAGEMENT

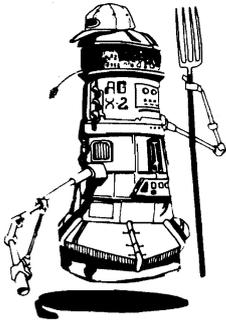
Recent economic conditions have greatly increased concerns and problems relating to budgeting and financial management in the home. In response, family financial matters have been the focus of a major educational effort in the Extension Service.

Workshops have been conducted throughout the state on money management, including credit, social security and medicare, new banking services and retirement planning. Printed educational materials, news media, and other informational media have also been used. The aim of the financial management program has been to provide financial information to individuals and families that will help maximize financial stability and security, and to learn skills, increase competence and recognize alternatives needed to adjust to the impact of economic change.

A total of 523 people participated in 11 workshops. Participants fit no stereotype—they were young, middle-aged, elderly, single, married, men and women.

The workshops were designed so participants could use worksheets developed by the specialist to work on their own specific situations. This permitted individual assistance along with group discussion. In most cases follow-up meetings were helped by Extension economists and specific related topics such as estate planning and tax management.

The educational program in financial management continues to expand, and counties have been provided with educational materials to help conduct local programs and answer individual questions.



## FARM MANAGEMENT ADVICE HELPS FARM FAMILY

Farm management information involving all aspects of the farm business has long been a major focus of the Cooperative Extension Service.

Just one example involves a farm family who went to their county agent for advice.

The farm couple's two sons were ready to move into the family operation, but the unit wasn't large enough and the family was not sure how to draw up an equitable lease. The county agent arranged for a farm management specialist at NDSU to propose an equitable lease between the parents and the two sons.

The family was able to lease an additional two parcels of land. Then, with the aid of the county agent, the possibility of expanding the family sheep enterprise was researched. After considerable pencil pushing, and with advice from the Extension sheep specialist at NDSU, it was decided to include a feeder lamb operation.

The first 1,000 lambs went into the lot in July. So far, the unit is working fine.

This expansion made it possible for two young farmers to get started. The unit is now big enough to financially support three families and provide enough work to keep everyone busy.

## 4-H/CRD REACHES TODAY'S YOUTH

The North Dakota 4-H Community Resource Development program has been in operation for eight years, starting with a pilot project in a single North Dakota town.

CRD is a youth program aimed primarily at youngsters not presently involved in traditional 4-H Club programs. Emphasis has been on youth between 6 and 19 years of age, especially in smaller North Dakota communities. Acceptance of the program has been so favorable that, after starting with a single community, towns in 47 counties have participated.

Program assistants involve youngsters in three main areas—recreation, community improvement and community understanding. Under these headings, projects have ranged from painting and cleaning up local city parks to putting on an afternoon's entertainment for inmates at the State Penitentiary.

The flexibility of CRD has made it possible to place program assistants in low-income areas, on Indian reservations and in other localities where special youth needs may

exist. CRD programming has also assisted in areas where coal development has greatly increased the number of young people but little, if any, local youth programming is available.

In the past eight years, starting with the pilot phases of the program, 155 college age students from 10 different colleges and universities have been hired as program assistants. Many of them have received college credit for the experience. They have involved an average of 70 young people per site for a total of 10,850 youth.

## DESIGNING RURAL WATER SYSTEMS

Large areas of the Great Plains do not have enough water for domestic use. Joint rural water systems have been built. However, their cost is high in areas of low population density.

A computerized model is being developed to design rural water supply systems using multiple delivery methods and sources—joint pipeline systems, joint truck hauling systems, surface water collection, and individual wells. Within the first year of the project the model has been used to design and cost a joint rural water system in Montana, in operation with the Old West Regional Water Office. Continued model development will allow simulation of each water supply alternative from an area perspective and evaluate combinations of alternatives to minimize total cost.

## 'GROWING' NORTH DAKOTA COMMUNITIES

The usual stereotype people have of the Cooperative Extension Service is that of an agency involved in growing crops, growing livestock or even growing youngsters through 4-H. But what about "growing" communities?

The process of community development proceeds along at least two lines—business development and social or human development. As a part of the Title V Economic Development program, formal courses in business and industrial development have been conducted in several North Dakota communities. These courses are designed to teach the fundamentals of business development and the role and responsibilities of community leaders. In cases where local leadership development skills emerge as an impediment to development, workshops to develop these skills may be offered. One example of this was a five-day workshop entitled "How to 'Grow' A Community—North Dakota Style. A Practical EXPERIENCE in Learning Techniques and Ideas for Effective Community Development."

This intensive community development training workshop enabled 46 North Dakota community leaders to become totally involved in a series of lectures, seminars and small group experiences meant to enhance their abilities as leaders of local development efforts.

Objectives of the workshop were to both develop participants' appreciation for the community development process and to serve as a vehicle for encouraging participants to take a more active and knowledgeable role in actual community development activities.

North Dakotans from communities of varying sizes participated in the workshop. Respondents to a follow-up evaluation indicated that almost 90 percent felt they more fully understood the total process of community develop-

ment after the workshop. More important, 78 percent of the respondents indicated that they were taking a more active and knowledgeable role in development activities in their communities since participating in the workshop.

## COAL IMPACT PROJECT

Rapid expansion in development of North Dakota's coal reserves during the 1970's forced economic and social impacts never before experienced in the low population areas of western North Dakota. The Extension Service responded with a special three-year project to help impacted communities and local governments make adjustments to the radical changes in economic activity and population growth.

The Coal Impact Information Project was designed to provide additional Extension education services to the impacted communities. These communities had access to assistance from other state and federal agencies, but some of these groups lacked effective delivery systems. Research related to coal development was being conducted at NDSU, but the distance between the campus and the coal fields restricted university input. Extension's role was to provide the linkage between the many sources of information and assistance and the communities needing help.

The three-year project included a broad range of educational programs in response to a wide variety of community problems and needs. A key feature was Extension's facilitator role in working with community leaders, officials and agencies.

The major emphasis of the project was to explore the use of various media to support community development educational work in a sparsely populated area some 300 miles from the university campus. Primary media used were videotape and slide-tape programs. Extension field staff had access to new tapes developed specifically for this project as well as others in the media library of the Extension Service. The concept of a learning center using these media programs was also explored in cooperation with the city public library in Dickinson.

Other emphasis areas included land use and rural development, local government and taxes and community impact and development. Major activities included multi-county conferences and land use policy and planning for local government officials and other concerned citizens; educational meetings on coal taxes and their distribution; an educational program on county government, state and local taxes and property tax assessment; an informational meeting for school administrators and school boards; short courses on business and industrial development and many local meetings on coal impact.

This Extension project demonstrated the initiation of a new program in community development which involved working with many interest groups and testing the use of educational media. The project resulted in local recognition of Extension's role in communities adjusting to coal development impact. The progress made in developing land use plans and the adjustments made in impacted communities indicated that local officials, leaders and citizens were well informed on the problems, resources available and alternatives for achieving their goals. The Extension

program encouraged cooperation among interest groups and the optimum use of available resources.

The Coal Impact Information Project is formally terminated, but the educational programs initiated by the project are continuing.

## REVERSE OSMOSIS FARM WATER TREATMENT

Reverse osmosis systems installed in 1972 on two farms in western North Dakota have functioned very well in removing color and objectionable minerals from the water. Poor quality water was treated so that it meets Public Health Drinking Water Standards.

Four additional installations have been made in Sargent and Cavalier counties. The systems in western North Dakota used a nylon membrane to remove contaminants; three of the eastern systems have cellulose acetate membranes and one has both to provide comparisons of installation costs, maintenance problems, operating costs, bacterial contamination, water quality and quantity.

This is a cooperative study with the Departments of Agricultural Engineering and Bacteriology.

## SUNFLOWER OIL IN DIESEL ENGINES

Both blended and undiluted sunflower oil compare satisfactorily with diesel fuel when looking at maximum power, specific fuel consumption, and thermal efficiency.

Reports in the literature indicate problems may develop if sunflower oil is used to fuel engines for long periods of time, and long term tests of this kind are underway.

Sunflower seed has an oil content of 40 per cent. Auger type oil extracting machines are available that will remove 75 per cent of the oil from the seed. Filtration upgrades this oil so it will serve as diesel engines fuel, and on-farm processing of the oil for fuels appears feasible.

Chemical and physical properties of sunflower oil and some sunflower oil derivations have been reviewed by the Department of Agricultural Biochemistry.

The chemical properties of sunoil methyl esters, a derivative of sunflower oil, makes this product an ideal diesel fuel or fuel for an oil burning furnace. The product has a low viscosity, but begins to crystallize at about 32 degrees F. Above this temperature the methyl esters show good promise. Cost of converting the oil to the sunoil methyl esters would not add much to the cost of the fuel, preliminary estimates show.



## RESPONDING TO THE WEATHER

"Everybody talks about the weather, but nobody does anything about it."

This old chestnut is certainly not true in the case of the North Dakota Extension Service. The Extension Service can definitely not make it rain—or stop raining when harvest time comes—but during the "strange" weather conditions encountered in 1980 agents and specialists did their best to "do something" about the weather.

As dry conditions and high temperatures continued well into the planting season with little relief in sight, the agricultural unit of the Extension Service began meeting regularly in April to consider educational and informational responses. The primary objective of the entire drought-related educational program was to assist producers evaluate the strategies available to alleviate the serious economic impacts of continued lack of moisture.

Extension used every means of communication at its disposal to get drought-related information to those who needed it, from computer networks to the news media to personal contacts via telephone, letter or personal visits.

For example, during a five-month period starting in mid-April, campus-based Extension specialist generated 61 radio programs, 20 television news clips and 34 newspaper releases dealing with drought information.

Types of information brought to crop producers' attention during the growing season included tillage alternatives for dry soils, comparative drought tolerance among alternative crops, fertilizer recommendations related to soil moisture, seed placement in dry soils, reseeding alternatives, drought stress and plant diseases, emergency grazing of small grains, harvesting problems caused by uneven emergence, erosion control and others.

Limited moisture and lack of snow cover also created a dismal prognosis for livestock producers, with severely restricted grazing conditions and virtually non-existent hay production in many parts of the state.

Educational materials relating to emergency forage production were being made available to county agents by early spring. As the drought continued, additional materials relating to forage management, livestock herd management and financial alternatives for livestock producers were developed.

Other drought-related livestock topics that were addressed included selecting and planting emergency forages, health and breeding management under nutritional stress, calf management strategies, using emergency feed crops, grazing and harvesting weeds for feed, financial alternatives of buying feed versus selling livestock, economics of alternative feed purchases, market outlook and restricted feeding of pregnant cows.

Although moisture conditions have improved, the months ahead will still require intense effort toward nutrition and health management education programs and additional programs aimed at restoration and improvement of severely damaged grazing lands.

### 'HAYLIST' HELPED CATTLEMEN

Computers can't create rain either, but a computer program called HAYLIST on the AGNET system was ac-

tivated to help livestock producers cope with hay shortages.

HAYLIST is designed to electronically create a market setting, bringing together people with hay to sell and people needing to buy hay. Starting with a total of 12 listings in mid-April, eventually as many as 752 specific listings were available. The listing indicates the amount and type of forage (hay or grazing) available and the name and address of the seller.

The weekly HAYLIST summary was a joint effort of the Extension Service, North Dakota Department of Agriculture, and the Agricultural Stabilization and Conservation Service. Lists were available at any time on AGNET and were mailed weekly to county agents and ASCS offices.

An estimated 2,377 North Dakota livestock producers found hay because of the listing, and 504 sold feed.

Some of the comments made by county agents include: "The HAYLIST program proved to be an extremely valuable tool for county farmers and ranchers in locating hay and pasture. I know of cases where farmers took the latest HAYLIST information with them when they traveled to other areas looking for hay. This information provided them with a starting point."

"Calls were made to several states on HAYLIST for pasturing cattle for the summer months with plans to return the cattle to North Dakota this fall. One rancher who sent his cattle to Nebraska commented, 'I just couldn't sell my cows.' He has been in the livestock business for 30 years and has worked hard building his herd. Now his son is taking over, and if they sell, it will be many years before he will get his herd built up again."

"I think we can say without a doubt that this has been a very helpful service to the farmers and ranchers in this part of the state. It sure gives all of us a good idea as to areas that have a surplus of hay."

### WHY AREN'T CANNED BEEF PRODUCTS USED?

A major obstacle to merchandising canned beef products of selected cuts from the chuck, loin, or round of USDA good to choice grades may be the characteristic "canned beef flavor" that develops when sulfur compounds are formed during the sterilization process.

The domestic canned beef retail market consists largely of heat-and-serve products derived from manufacturing grades of beef. The hotel, restaurant and institutional trade uses canned chunk beef in sauce products, also from lower quality beef grades.

A study to determine why canned beef products have not been used in greater quantities is completed, but further investigation into possible domestic and foreign markets for higher quality canned beef continues.

### ANTIBIOTICS FOR PIGS

Lincomycin and Virginiamycin are two antibiotics showing particular promise as substitutes for sulfa drugs in rations for early weaned pigs. It is possible that other antibiotics also could be used with very little proficiency reduction if sulfa drugs should be banned, research results show.

## LIVESTOCK RANKS HIGH WITH 4-H

The 4-H program has expanded into many new and innovative fields in recent years, but the traditionally popular 4-H livestock program continues to play an important role with modern day North Dakota 4-H youth. And there are some new and innovative things going on in 4-H livestock projects, too.

Over 12 percent of the total 4-H project enrollment in North Dakota is in the livestock area. There were 8,728 young people enrolled in livestock projects in 1979-80. The beef project is the largest single enrollment with 2,706 members, followed, in order, by horse, swine, sheep, dairy, poultry and small pets.

One innovative and successful livestock activity was the 4-H beef camp held the past two years at the Western 4-H Camp near Washburn. Members bring their animals to the four-day camp where they are provided "hands on" instruction and training in fitting, grooming, showing, nutrition and management. In 1980 the camp was expanded to include dairy and sheep.

The popular Horse Camp continues to be the most popular specialty camp with around 350 young horse enthusiasts taking part each year.

Special emphasis was placed on introducing a new grassland management project and combining it with the beef project in 1980.

Training in livestock selection and judging activities and contest continues to involve a majority of 4-H'ers enrolled in the livestock projects, and fairs and achievement days involve most of the 4-H livestock project members in North Dakota. (Over 900 4-H horsemanship entries were involved in the 1980 State Fair, for example.)

## RANGE MANAGEMENT

Consecutive burning of low meadow vegetation eliminates shrub species but has little effect on forb (broadleaf plant) species. Burning increases use of the lowland vegetation about seven times, allowing increased carrying capacity. Mowing is not as effective in controlling shrub species as fire. This study has been continued since 1970.

For best use and production of desirable forage for grazing animals, a three-pasture deferred system, twice over on two pastures and once over on one pasture appear most desirable grazing systems.

A series of trials of seeding, adaptation, production and nutritional quality involves 114 grass varieties which may have potential for North Dakota. The trials, cooperative with the Department of Animal Science, are at the Main Station in Fargo and the branch stations at Dickinson and Hettinger.

Seven different methods of reestablishing four native grass species are conducted at Dickinson and the Central Grasslands Station at Streeter. All treatments are being seeded both in spring and fall, on fallow and into oat stubble.

Several grasses, both seeded and transplanted, are being evaluated as vegetative snowfence strips to trap and hold blowing snow. Most species have not been able to compete with the native range to the extent that they are effective as snow fence.

The two departments, with the Agricultural Research Service, USDA, also are determining the adaptability and forage quality of 91 selections of cool-season grasses seeded at Fargo, Mandan, Dickinson and Hettinger.

Changes in native range interseeded to three species of grass and three varieties of alfalfa show, with two years' data, that beef production per acre on interseeded pasture is more than double that from the control comparison at the Dickinson Branch Station.

The Departments of Botany and Animal Science continue a cooperative study of seasonal nutritional qualities of leaves, twigs and fruits of selected shrubs, including wild rose, leadplant, skunkbrush, buffaloberry, snowberry, serviceberry, chokecherry and sandbar willow. Growth, production, and use by domestic livestock and wildlife of buckbrush in the western North Dakota Badlands is also being analyzed, as are the tree, shrub, forb and grass composition and use of woody draws in the Badlands.

Three years of data for seasonal development of dominant grasses in upland, midland and lowland communities is now available for Kentucky bluegrass, needle-and-thread, blue grama, big bluestem, little bluestem and switchgrass. This will help farmers and ranchers plan their grazing schedules.

Effect of date of grazing on species composition of native range at Dickinson, and the effect of grazing on the carbohydrate reserves of two important native range grasses, is another phase of range management study.

## THRESHED SUNFLOWER "TAILINGS" FOR CATTLE

Feeding threshed sunflower heads in long form, unprocessed, seems a very workable practice. Numerous farmer observations confirm the apparent high palatability of this head material to cattle, sheep and deer.

Threshed sunflower heads grown at the Carrington Station were fed at Fargo as one third of the dry matter intake of pregnant beef heifers with quite favorable results, gaining 1.77 lbs. per day compared with a control group's gain of 1.88 lbs. per day on full feed of corn silage and ground alfalfa-grass hay.

Weather conditions caused bad harvest conditions the second year, with a far greater proportion of stalks, and the heifers refused to eat as much sunflower tailings, gaining 1.35 lbs. per day compared to 1.99 lbs. for the full-fed heifers.

Mature cows are less fussy than the heifers and will voluntarily eat part of the upper stalk, while heifers are very adept at leaving the entire woody stalk and selecting only the threshed head portions.

Since sunflower seems more tolerant of drouth than most other North Dakota crops, this material should be somewhat more dependable for drier years than residues from many other crops or even from planted forages.

Trials with steer calves showed digestibility of the separated heads of 57.8 per cent, and of heads and stalks together of 46.9 per cent, compared to 61.2 digestibility for high quality second cutting alfalfa. Protein content of the head and stalks together was 5.75 per cent, with only 6.5 per cent of that protein being digestible.

## **"ECONOMY" BEEF PRODUCTION**

The U.S. fast food trade continues to grow at a tremendous rate. About 40 per cent of the beef eaten today is in the form of hamburger, with projection that in the fairly near future hamburger will amount to 60 per cent of all beef consumed.

The current cattle cycle should dictate profitable returns for the next few years with more cows held to rebuild the national herd and fewer cull cows available for slaughter. Young bulls, dairy steers and exotic crossbreeds grow rapidly, have a high ratio of lean to fat, and can be profitably fed to the grade desired by the fast food trade.

At the Dickinson Branch Station three types of beef cattle were fed primarily for use in the hamburger trade. They included Angus X Hereford crossbred bulls, Charolais cross steers and high percentage Simmental cross steers. The Simmental cross calves gained the fastest, followed by the Angus X Hereford bulls and the Charolais cross.

Feed efficiency also favored the Simmental cross, followed by the Charolais cross and Angus X Hereford bulls. Returns based on the formula, carcass value (feed cost <sup>3</sup> purchase price) tended to favor the Charolais cross cattle by \$20 over the Angus X Hereford calves and by \$27 over the Simmental cross calves. All groups were profit makers at the weights sold.

## **IMMATURE SUNFLOWER SILAGE**

Hail, drouth, insects, plant disease, or premature frost can damage sunflowers irretrievably as a seed crop. Two short-term experiments with immature sunflower silage indicate that animals will eat increased amounts of wet silage trying to compensate for the very low dry matter content.

Animal performance on immature sunflower silage tends to be less than that of more conventional silages. Excessive fermentation and seepage, excessive freezing, and a rather penetrating musky odor peculiar to sunflower are characteristic of the silage.

Adding 8 to 12 per cent dry chopped roughage considerably improved odor and acceptability, reduced or eliminated seepage from horizontal silage piles, improved dry matter intake and slightly reduced freezing problems.

Dry matter acceptability at varied stages of maturity (Sept. and Oct.) is being determined with sheep; it seems best to delay chopping until October 1 or later.

During a 10-week period, steer calves offered sunflower silage gained 1.53 lb. daily compared to 1.78 lb. for calves on corn silage. Mature cows consumed 13.2 lb. dry matter daily from silage of immature sunflower and ground oat straw compared to 9.9 lb. sunflower silage from the same field. Cows getting sunflower and oat straw silage gained 105 lbs. during the test period; those on sunflower alone gained 52 lbs.; while the check group on ground hay with ground oat straw gained 103 lbs.

## **SUNFLOWER MEAL FOR LAMBS**

Lambs fed sunflower meal performed similarly to those fed soybean oil meal as a protein source in Fargo and Hettinger tests. Sunflower meal is becoming increasingly available and will provide a valuable protein source for livestock finishing rations.

## **FEEDING VALUE OF CEREAL STRAWS**

Several varieties each of oats, barley, wheat and durum straw are being tested for feeding value. The oat straws ranged from 7.5 to 10.2 per cent protein, while straws from the other species averages 5 per cent. Oat straws also were much lower in neutral detergent fiber, which averaged about 60 per cent compared to 76 per cent for the other cereals.

There were considerable nutrient variations among the cereals and among varieties within cereals, and these factors will be considered by plant breeders when making selections for new varieties to be released.

All varieties and species were deficient in phosphorus.

## **PROGRESSIVE PNEUMONIA IN SHEEP**

An effective laboratory method for culture of progressive pneumonia virus in sheep and for serological examination of serum to detect infected sheep is the result of cooperative research among scientists in the Departments of Animal Science, Bacteriology and Veterinary Science.

This disease causes an estimated 10 per cent death loss in the United States. With 13 million sheep in the U.S. (1978 estimate) each worth \$200, the annual loss would be \$260,000,000. The loss could be reduced by elimination of sheep identified as infected. Also, sheep free of the disease gain weights approximately 10 per cent higher than infected sheep.

With the test in use, infected sheep can be eliminated from the flock, and newborn animals placed in isolated housing.

## **TEST FOR SWINE PSEUDORABIES**

A rapid, effective test for diagnosis of pseudorabies in swine has been developed. Highly sensitive, it will detect the disease in the incubation stage before it can be detected with the conventional serum incubation test. Because it takes less than one half milliliter of blood serum, swine can be ear bled, so there is less danger to the hog and less time needed for bleeding, lowering the test cost and the time swine need to be held before test results are available.

## **TOXICOLOGY**

A survey for aflatoxins in sunflower showed a very low incidence of contamination, but it did provide the first documented field case of aflatoxin contamination in sunflower seeds.

A new procedure for detecting dicoumarol levels in sweet clover was developed and evaluated after a two-year, four-county survey of the sweet clover poisoning problem.

With the cooperation of four ranchers, field trials were conducted for trace metal content, with pasture, feed and cattle blood samples collected and assayed. Trace element assays in feedstuffs provided justification for a three-year trace element metabolism study at the Carrington Branch Experiment Station.

Development work was completed on assays for mycotoxins, sulfates, zinc phosphide, polychlorinated biphenyls, triarylphosphates, bone fluoride, and the pentafluoroester of warfarin.

## DIAGNOSTIC SERVICE

Demand for veterinary diagnostic service continues to increase. In 1978 diagnostic laboratory accessions totaled 4322, a 21 per cent increase over 1977. Accessions for 1979 totaled 5249, a 21.5 per cent increase over 1978. Requests for diagnostic help in the first seven months of 1980 were 17.6 per cent ahead of the same period for 1979, for a projected total of 6173 accessions for 1980 and a 72.7 per cent increase over 1977. With a reduced livestock population in North Dakota, it appears user acceptance of the diagnostic service is increasing.

Potential savings to the livestock industry by prompt, accurate diagnostic assistance in animal disease outbreaks is substantial, suggesting an annual savings of \$2,000,000.

Perhaps of equal importance is the laboratory's impact on human health through diagnosis of zoonotic diseases. A recent example concerned salmonellosis in a mare and foal which resulted in severe disease in four humans, one of whom required hospitalization. Isolation and identification of the causative organism directly benefited those caring for the people involved.

Prothecosis, a rare disease of man and lower animals caused by microscopic organisms resembling algae was recently diagnosed in a dog. The organism was isolated on artificial media and transmission studies are contemplated.

## ANAEROBIC HOG-WASTE DIGESTERS

Anaerobic hog-waste digesters operated three years at 25°C with turnover times of 75 to 150 days completely metabolized volatile fatty acids to methane. Similar digesters operated at 4°C did not metabolize volatile acids.

Bacteria in hog waste were able to produce volatile fatty acids at 4°C without growth, which resulted in buildup of the acids. If the waste was pasteurized before being fed to the digesters, the acids ceased to accumulate and disappeared from the digesters.

## PINKEYE OF CATTLE

The organism *Moraxella bovis* was isolated from a high percentage of animals in two of three herds with severe

clinical pinkeye, but not from the third herd nor from overwintering, summer hatched or newly emerged face flies. Over 400 cattle from four herds were treated with gentamicin eye spray before going on summer pasture; only one of the herds had any appreciable pinkeye by the end of July.

## INFLATION AND FOOD

Rising food costs tighten the financial squeeze on families with limited income. A major goal of Extension Service home economists is to give people information to help make wise food buys in order to reduce food costs while maintaining nutritional quality and palatability.

Professionals, paraprofessionals, 4-H leaders, homemakers and the general public have received information on food buying, budgeting, low-cost preparation and food preservation. These topics have been offered through a variety of media, including slide sets, self-study loan programs, workshops, meetings, newsletters, news media releases and displays at food stamp-commodity centers.

About 2,350 people received information on making "fast food" at home—at about a 50 percent saving compared to eating at a fast food restaurant. A cookbook called "Classy Commodity Cooking" is being distributed. The loan program titled "Food Prices—Who's Responsible" was used 136 times in the past year. Senior citizens have learned to make better food buying decisions from a workshop on "Food Facts and Fallacies." And many other people are spending their food dollar just a bit more intelligently because of other Extension educational efforts.

With inflation continuing to put the bind on family finances, the need for information on food buymanship will also continue.

## 4-H FOODS A POPULAR PROJECT

Foods and nutrition, always a favorite area in 4-H, received major emphasis during the recent program year. There are 13 different projects in foods and nutrition offered to 4-H members. There were 8,300 youth involved in these projects in 1979-80; 1,110 were boys, double the total of the previous year.

Two 4-H leaders and an Extension home economist attended a National 4-H Foods and Nutrition Forum at the National 4-H Center in Washington. As a result, additional foods training was offered in several counties as well as to all North Dakota program assistants in EFNEP and Urban 4-H.

Besides basic nutrition, they offered new ideas on food waste, such as restaurants, school lunch programs, food processing and consumer waste. Members have been doing surveys in their home communities and schools to better understand food waste and how to eliminate it.

A new project called "Outdoor Eating" was developed to meet the changing eating styles of today's youth. This project offers nutritious meal ideas for picnicking, hiking, backpacking, bicycling and barbecuing. Also, because of recent changes in canning procedures and renewed interest in food preservation, the "Let's Put it in the Jar" project was revised and updated.



The heifers are just crazy about him.

Special ideas were shared on evaluating fast food menus for price and nutrition value. Recipes were shared for preparing fast food at home or at group meetings.

Special emphasis was placed on consumer buying of foods in the home economics judging program in 1979-80. Career education relating to foods and nutrition was another emphasis area.

The Favorite Food Fair, a living exhibit where the member is present with the display, involved 664 4-H'ers at the county and state level.

The foods projects have been a basis for youth involvement on the Indian Reservation sites. Recipes are adapted from the 4-H projects using readily available ingredients. At Fort Totten, over 100 youth showed 345 exhibits at achievement days.

#### **CLOTHING RELATED BURN INJURY STUDY**

The Department of Textiles and Clothing is conducting a study of burn injuries in North Dakota to identify factors such as cause of burn, occupation, age, sex, and geographic location where burn injuries are occurring. High risk occupations and vulnerable groups who are injured most may be the focus of education and preventive measures to help avoid burn injuries and deaths.

The study is cooperative with Nebraska and South Dakota, and will allow comparison of data with other agricultural states as well as on a national level.

#### **LOW TEMPERATURE HOME LAUNDRY**

Textile materials laundered in low temperature water and dried in an automatic drier can provide a suitable environment for growth of microorganisms and can be involved in transmitting disease. Where several families use the same laundry facilities, dissemination of pathogenic microorganisms among them is possible.

With increased use of low temperature water for laundry, the right amounts of detergents and disinfectants is extremely important. The heat from automatic dryers can reduce the number of bacteria on laundered fabrics but cannot be depended on to kill all species of bacteria found on fabrics.

This research was cooperative with the Department of Bacteriology.

#### **ENERGY IN THE HOME**

As concern for energy conservation increases, and consumers become more concerned about stretching the dollars spent for energy use, energy use in the home has become a major emphasis area in the Extension Service home economics unit.

Use of energy as it relates to food preparation was incorporated into on-going programs and activities in the food and nutrition department. Goals are to provide both youth and adults with energy saving ideas and to create an awareness of energy use in the kitchen.

Participants in a microwave oven workshop, for example, indicated a 10 to 25 percent energy saving through learning to use the microwave oven. An Energy Conserving Meals 4-H project was also promoted, with 292

members enrolled. Topics related to energy use in the kitchen were also used in releases for news media use and in newsletters.

Hot water is a major determinant of home energy use, and also affects the degree of cleanliness and sanitation in the home. "Energy in the Home: Hot Water" was designed as a major emphasis topic. Both county and state Extension staff have received in-service training on the topic, and fact sheets and other educational materials have been prepared. These materials will be used to reach audiences state wide in the coming year.

#### **4-H ENERGY PROGRAM LAUNCHED**

North Dakota 4-H members will be learning about energy use and conservation during the coming year. The focus of 4-H programming in the 1980's will be on "critical issues" facing the nation. Energy conservation is one critical issue which North Dakota 4-H is gearing up to face.

A series of nine lessons have been written and combined in a 4-H energy project publication which will serve as a basis for group discussion and study by 4-H members in North Dakota. The objectives of the lesson material are to enable 4-H youth to become familiar with the sources of energy available, develop ideas for energy conservation, and be able to distinguish between energy substitution and energy conservation.

The lessons include Introduction to Energy; Energy . . . In and Around the Home; Water . . . Hot and Cold; Energy and Insulation; Solar Energy; Man vs. Machine; Energy and Automobiles; Energy and Ethyl Alcohol; and Energy in Crop Production.

County Extension staff received training on the energy lesson in April, and the project material will be introduced to volunteer 4-H leaders in 35 counties this year.

This lesson material is the first phase of the 4-H energy program and will be followed by additional program materials and activities.

#### **BIOMASS AND WASTE UTILIZATION FOR FUELS**

Crop residues and wastes have an energy content similar to lignite coal on a pound for pound basis, but differ greatly in density.

Briquets have been made of wheat straw, flax straw, sunflower stalks and turkey litter, without added binder, using a Glomera press. The effects of moisture, pressure, temperature and fineness of grind are being tested to determine the effects on the density, moisture resistance, shatter and tumbling resistance of the briquets.

Machines and methods for collecting sunflower crop residue is being evaluated on a 40 acre plot, using a chaff-saving wagon to collect the residue from a combine. Increasing the amounts of residue through the combine did not decrease the seed harvest but did slow the harvest process considerably.

Whole crop harvest was done using a silage cutter and a stationary combine to separate the seeds. A short (1/4 in.) cut damaged seed considerably and caused loss of seed; a longer cut (3/8 in.) reduced the damage and increased seed recovery.

Bomb calorimetry has been used to determine the gross energy of the various crop residues. A burner is being built to evaluate combustion characteristics and the management needed to use briquetted crop residue for space heating.

### **STATE ENERGY EXTENSION SERVICE WORKING IN FOUR NORTH DAKOTA CITIES**

With transportation and home heating costs rising almost geometrically, the North Dakota Cooperative Extension Service has responded to the need for more efficient energy usage by creating a service to aid state residents in reducing their energy needs.

May 20 was the day the Service accepted responsibility for energy programs of the North Dakota Energy Extension Service. Since that time, an energy extension staff has been hired and placed in four cities in the state.

Energy agents have been located in Minot, Dickinson, Grand Forks and Fargo. In addition to the four agents, two energy specialists and a communication specialist have also been hired. All are located in Fargo.

The Energy Extension Service was established as part of the National Energy Act of 1977, with 10 states participating in a pilot project. In 1980, the Service was expanded nation-wide.

The primary thrust of North Dakota's Energy Extension Service is providing individuals with technical assistance to reduce their residential energy needs.

In North Dakota this assistance is being provided via individual consultations, demonstrations and workshops relative to implementing conservation measures, such as insulating, weatherstripping and managing the heating system.

As a secondary thrust, the Service is promoting the use of renewable resources. In North Dakota, the Energy Extension staff will be providing technical assistance in the use of solar, wind, wood and coal systems for heating homes and domestic water. Since many energy conserving features are easiest to incorporate into new homes, a considerable effort will be made to work with new home builders.

In addition to their other tasks, staff members in the eastern part of the state will provide technical assistance to area church groups about ways to reduce their energy needs.

Another thrust of the program will be an effort to familiarize the state's school administrators with the benefits derived by utilizing a Computerized Bus Route Analysis to plan the most efficient routing of school buses. Average fuel savings have averaged nearly \$10,000 per district when the results of the analysis have been used.

A number of factors were taken into consideration in selecting the sites for the four energy agents. Factors such as population concentrations, new construction, resources availability and funding limitations were all considered when choosing the four cities.

However, residents living in areas other than the four cities still have help available concerning energy conservation in the Cooperative Extension Service.

For those not living in the area served by the Energy Agents, local County Agents have received training related to energy conservation and can answer many questions.

### **DIETCHECK ANALYZES FOOD INTAKE**

The AGNET computer program DIETCHECK performs a nutrient analysis of food intake. The program allows users to see where present food intake could be improved to better meet nutritional needs.

The DIETCHECK printout analyzes calories consumed; amounts of protein, fat and carbohydrates, and compares other nutrient intakes with the recommended daily allowance, considering age and sex.

DIETCHECK programs have been run at health fairs, in supermarkets and in meetings for special groups such as Cowbells, senior citizens, weight control groups and even at a law enforcement center.

In the past year, DIETCHECK performed 2,495 diet analyses. Of these, 867 individuals had the results interpreted and additional nutrition education provided.

As a result of using DIETCHECK, participants have been better able to see where their diets are deficient and make changes.

### **ADDRESSING ENERGY CONCERNS**

Rapidly rising fuel prices and even the threat of farm fuels being unavailable at critical times has brought North Dakota farmers a new interest in energy-related matters.

Considering the big picture of the nation's energy use, agriculture is not a particularly large consumer. But, energy for agriculture is extremely critical to North Dakota's economy, and availability of fuels for farming operations at such times as planting and harvest is critical to farm operation. And, the cost of fuel certainly has an impact on the agricultural profit and loss picture.

Methods of dealing with energy concerns can take two forms—reducing consumption of fuels through altered farming techniques, reduction of heating fuel requirements and other conservation measures, or increasing the output of fuels, such as producing fuels on farms from crop materials as a renewable source of energy.

Extension educational programs have been developed and presented on both conservation and production of farm fuels.

A fuel consumption audit was conducted to determine typical on-farm fuel use for various farming operations, to introduce typical on-farm fuel use for various farming operations and to introduce farmers to a fuel budgeting technique as a conservation tool. Proper ballasting of tractors to increase traction—and fuel efficiency—was demonstrated around the state at agricultural shows and events. The concept of "gear up and throttle down" was also presented to farmers in both public demonstrations and in written form.

The benefits of building insulation as a tool for energy management in homes and farm buildings has been an educational program in both agriculture and home economics. The HOUSE program on the AGNET computer system is an important tool for demonstrating the economic effects of alternate energy management strategies.

Farmer interest in local production, on the farm or in community projects, of fuels from farm products has been enhanced by increasing prices and political instabilities that could disrupt fuel supplies. Primary interest has been

in alcohol production for both direct use and as a component to stretch gasoline supplies. Experiments and demonstrations have been carried out in Extension programs to illustrate the adjustments and modifications needed to effectively use alcohol as a farm fuel.

The considerable research carried out by the Agricultural Experiment Station on production of vegetable oils (primarily sunflower oil) for use in diesel

engines has provided the basis for Extension Service education programs. These programs are designed to help producers understand fuel properties, fuel production and consumption, and power production.

The use of biomass, such as pelleted sunflower hulls and straw, for farm crop drying and other heat uses are being incorporated into educational programs as new materials become available.

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### **Loftsgard continued from page 2**

pioneer researchers and educators—the H.L. Bolleys, Shepperds, Waldrons and Ladds—for whom we feel such gratitude today, we find their lives were filled with roadblocks and frustrations they had to overcome. But as our people are today, they were men of vision and great conviction who were willing to battle for what they believed. Progress is almost inevitably the result of conflict between strongly held positions.

Today, therefore, only a single lifetime after its founding, we have a State University which has been forged from trust, confidence and cooperation on one hand and from honest controversy on the other. Both have contributed to its strength. NDSU currently has an all-time record-high enrollment of more than 8,200 students. Its physical plant is modern, attractive and in a high state of maintenance. Its faculty, research and extension staffs are made up of carefully selected, dedicated, highly skilled professionals, many of whom also have their roots in our North Dakota soil. In short, we are approaching our hundredth birthday with a full head of steam.

From time to time the allegation is made that NDSU has grown too big and fancy for the agricultural britches in which it grew up. I strongly disagree with that contention. When the institution's name was changed in 1960 from that of agricultural college to university, one of the arguments advanced was that agriculture, as the state's principal industry, deserved university status. That sounded good to some people, I'm sure. But much more important than that, I feel, is that the students, engineers, home economists, students in the social or physical sciences or the many related fields of business or education, are deserving of a full-fledged, high-quality university education. An education that provides them with a sense of perspective on the state of our planet and its people, within which they can make sound judgments as citizens and professionals. That, to me, is the gist of what NDSU is about. And as long as I have the privilege of serving as its president, that's the philosophy that will guide my actions.

We are proud of NDSU's vital role in the destiny of our state, and willing to battle when we have to gain the kind of support we believe this important work deserves. At the same time, however, we are immensely grateful to those who have the vision, trust and confidence in what we are doing here to give us their unstinting support. After all, whatever else we are as individuals, as North Dakotans we are all in this together.

### **Lund continued from page 3**

chemical fallow. If the work at this station on vegetable oils as a replacement for diesel fuel is as successful as we believe that it could be, we could even see the farm of the future again become self-sufficient for the production of food, fuel and fiber for society, but at a level much higher than we have ever dreamed possible.

Join with me as we look forward with vigor and hope to the upcoming 1981-83 biennium in North Dakota and this exciting entry point into the decade of the 80's!

### **Johnsrud continued from page 3**

was a rather unique piece of legislation because it stipulated that three levels of government would cooperate in funding the Extension Service; county, state and federal. This partnership creates a situation of responsiveness by the Extension Service to local, state and national concerns; at the same time, no single level of government dominates. The real influence is citizen that use the service. Through a citizen advisory committee in each county and at the state level, priorities, concerns and needs are identified and programs developed to meet these needs. We seek and welcome your input through your county Extension office.

I would be remiss not to express a special note of appreciation for the continuing fine support we receive from you and your elected public officials in support of the Extension Service programs. The support includes \$6.5 million dollars in 1980. There is also the thousands of hours of volunteer time and talent contributed each year by 4-H leaders, Homemaker Club leaders, Extension advisory committee members, and the main street business owners who provide community leadership and funds for the county 4-H club program and other Extension special event activities.

May this issue of Farm Research provide you a better understanding of what we mean when we say "In your community to serve you."

# ANNUAL REPORT, 1980

## Financial Statement North Dakota Agricultural Experiment Station July 1, 1979 to June 30, 1980

### OPERATIONS

	Balance 7-1-79	Receipts	Expenditures	Transfer	Balance 6-30-80	Salaries	Operating Expenses	Equipment
<b>Main Station</b>								
State Appropriation	\$1,298,116.85	\$5,798,695.72	\$6,243,284.15	\$(585,339.36)	\$268,189.06	\$4,097,514.71	\$1,326,795.27	\$818,974.17
Federal Appropriations CR, USDA	(383,594.54)	1,211,283.00	1,687,948.00	—0—	(860,259.54)	1,651,170.57	31,595.43	5,182.00
Sales & Service	694,137.92	612,617.69	561,214.38	—0—	745,541.23	135,181.07	331,222.40	94,810.91
Gifts & Grants	284,068.49	1,961,603.21	1,634,200.90	(6,083.71)	605,387.09	1,211,555.52	338,781.42	83,863.96
<b>TOTAL Main Station</b>	<b>\$1,892,728.72</b>	<b>\$9,584,199.62</b>	<b>\$10,126,647.43</b>	<b>\$(591,423.07)</b>	<b>\$758,857.84</b>	<b>\$7,095,421.87</b>	<b>\$2,028,394.52</b>	<b>\$1,002,831.04</b>
Branch Stations	817,570.41	1,124,913.62	1,584,773.71	10,892.34	368,602.66	787,242.14	566,424.66	231,106.91
<b>TOTAL Operations</b>	<b>\$2,710,299.13</b>	<b>\$10,709,113.24</b>	<b>\$11,711,421.14</b>	<b>\$(580,530.73)</b>	<b>\$1,127,460.50</b>	<b>\$7,882,664.01</b>	<b>\$2,594,819.18</b>	<b>\$1,233,937.95</b>

### LAND AND STRUCTURES

<b>Main Station</b>								
State Appropriations	\$—0—	\$234,626.93	\$230,582.87	\$—0—	\$4,044.06			
<b>Branch Stations</b>								
State Appropriations	—0—	1,016,471.29	1,016,471.29	—0—	—0—			
<b>TOTAL Land &amp; Structures</b>	<b>\$—0—</b>	<b>\$1,251,098.22</b>	<b>1,247,054.16</b>	<b>—0—</b>	<b>4,044.06</b>			
<b>GRAND TOTAL</b>								
Operations, Land and Structures	\$2,710,299.13	\$11,960,211.46	\$12,958,475.30	\$(580,530.73)	\$1,131,504.56			

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**NORTH DAKOTA STATE UNIVERSITY**  
**OF AGRICULTURE AND APPLIED SCIENCE**  
(as of June 30, 1980)

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**ANIMAL SCIENCE:** Clayton N. Haugse, M.S., Professor and Chairman<sup>40</sup>; Paul T. Berg, Ph.D., Assistant Professor<sup>75</sup>; Russell B. Danielson, M.S., Assistant Professor<sup>70</sup>; William E. Dinusson, Ph.D., Ph.D., Professor<sup>90</sup>; Charles G. Edgerly, M.S., Associate Professor<sup>40</sup>; Duane O. Erickson, Ph.D., Professor<sup>75</sup>; Gerald M. Erickson, B.S., Instructor<sup>40</sup>; George R. Fisher, Ph.D., Professor<sup>20</sup>; Robert L. Harrold, Ph.D., Professor<sup>75</sup>; Robert L. Johnson, M.S., Associate Professor<sup>60</sup>; Verlin K. Johnson, Ph.D., Professor<sup>65</sup>; John N. Johnson, M.S., Professor<sup>35</sup>; Ladon Johnson, Ph.D., Professor<sup>55</sup>; Merle R. Light, M.S., Professor<sup>70</sup>; Wesley R. Limesand, B.S., Instructor<sup>70</sup>; Michael W. Lund, B.S., Instructor<sup>90</sup>; Martin J. Marchello, Ph.D., Associate Professor<sup>60</sup>; Bert L. Moore, Ph.D., Assistant Professor<sup>60</sup>; Chung S. Park, Ph.D., Assistant Professor<sup>90</sup>; William D. Slinger, Ph.D., Assistant Professor<sup>25</sup>; Craig B. Struble, Ph.D., Research Associate<sup>100</sup>; James E. Tilton, Ph.D., Professor<sup>70</sup>; Gary L. Williams, Ph.D., Assistant Professor<sup>90</sup>; Ronald C. Zimprich, B.S., Instructor<sup>90</sup>; Peter W. Aschbacher, Ph.D., Adjunct Professor, USDA<sup>9</sup>; Kenneth L. Davison, Ph.D., Adjunct Professor, USDA<sup>9</sup>.

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**BIOCHEMISTRY:** H. J. Klosterman, Ph.D., Professor and Chairman<sup>65</sup>; Allan G. Fischer, Ph.D., Professor<sup>60</sup>; James R. Fleeker, Ph.D., Professor<sup>70</sup>; George Graf, Ph.D., Professor<sup>65</sup>; Sean D. Killilea, Ph.D., Associate Professor<sup>60</sup>; Arland E. Oleson, Ph.D., Associate Professor<sup>60</sup>; Brady A. Vick, Ph.D., Research Biochemist, USDA<sup>9</sup>; Don C. Zimmerman, Ph.D., Adjunct Professor, USDA<sup>9</sup>.

**BOTANY:** Harold Goetz, Ph.D., Professor and Chairman<sup>40</sup>; William T. Barker, Ph.D., Professor<sup>60</sup>; Murray E. Duysen, Ph.D., Professor<sup>55</sup>; Thomas P. Freeman, Ph.D., Professor<sup>50</sup>; Donald S. Galitz, Ph.D., Professor<sup>55</sup>; Donald Kirby, Ph.D., Assistant Professor<sup>40</sup>; Paul E. Nyren, M.S., Associate Botanist<sup>100</sup>; Warren C. Whitman, Ph.D., Professor<sup>75</sup>.

**CEREAL CHEMISTRY AND TECHNOLOGY:** Orville J. Banasik, M.S., Professor and Chairman<sup>25</sup>; Bert L. D'Appolonia, Ph.D., Professor<sup>90</sup>; Linda MacArthur, M.S., Instructor<sup>90</sup>; Clarence E. McDonald, Ph.D., Professor<sup>90</sup>; Richard E. Pyler, Ph.D., Associate Professor<sup>90</sup>; Donald W. Lillard, Ph.D., Research Chemist, USDA<sup>9</sup>; Vernon L. Youngs, Ph.D., Adjunct Professor, USDA<sup>9</sup>.

**CHILD DEVELOPMENT AND FAMILY RELATIONS:** Ann K. Mullis, Ph.D., Assistant Professor<sup>15</sup>; Ronald L. Mullis, Ph.D., Assistant Professor<sup>15</sup>.

**ENTOMOLOGY:** John T. Schulz, Ph.D., Professor and Chairman<sup>40</sup>; Alvin W. Anderson, Ph.D., Associate Professor<sup>90</sup>; Edward U. Balsbaugh, Jr., Ph.D., Associate Professor<sup>60</sup>; John D. Busacca, Ph.D., Assistant Professor<sup>90</sup>; Robert B. Carlson, Ph.D., Professor<sup>75</sup>; Richard D. Frye, Ph.D., Professor<sup>55</sup>; Hendrik J. Meyer, Ph.D., Assistant Professor<sup>90</sup>; Gregory B. Mulkern, Ph.D., Professor<sup>70</sup>; Christian Y. Oseto, Ph.D., Associate Professor<sup>90</sup>; Water Valovage, Ph.D., Research Associate<sup>100</sup>; Terrance S. Adams, Ph.D., Adjunct Professor, USDA<sup>9</sup>; Laurence D. Charlet, Ph.D., Research Entomologist, USDA<sup>9</sup>; Leo E.

LaChance, Ph.D., Adjunct Professor, USDA<sup>0</sup>; Edwin P. Marks, Ph.D., Adjunct Professor, USDA<sup>0</sup>; Ian C. McDonald, Ph.D., Adjunct Professor, USDA<sup>0</sup>; David T. North, M.S., Adjunct Professor, USDA<sup>0</sup>; John G. Riemann, Ph.D., Adjunct Professor, USDA<sup>0</sup>.

**HORTICULTURE AND FORESTRY:** Edward P. Lana, Ph.D., Professor and Chairman<sup>75</sup>; Robert H. Heintz, B.S., Associate Professor<sup>00</sup>; Dale E. Herman, Ph.D., Professor<sup>30</sup>; Neal S. Holland, M.S., Professor<sup>70</sup>; Robert H. Johansen, Ph.D., Professor<sup>100</sup>; Donald C. Nelson, Ph.D., Professor<sup>00</sup>; Earl W. Scholz, Ph.D., Associate Professor<sup>55</sup>; Paul H. Orr, M.S., Adjunct Professor, USDA (East Grand Forks, Minnesota)<sup>0</sup>; Joseph R. Sowokinos, Ph.D., Adjunct Professor (East Grand Forks, Minn.)<sup>0</sup>; Jerry L. Varns, Ph.D., Adjunct Professor, USDA (East Grand Forks, Minn.)<sup>0</sup>.

**PLANT PATHOLOGY:** Richard L. Kiesling, Ph.D., Professor and Chairman<sup>55</sup>; Robert M. Hosford, Ph.D., Professor<sup>90</sup>; Larry J. Littlefield, Ph.D., Professor<sup>90</sup>; Berlin D. Nelson, Ph.D., Assistant Professor<sup>90</sup>; Vernyl D. Pederson, Ph.D., Professor<sup>35</sup>; Gary Secor, Ph.D., Assistant Professor<sup>55</sup>; Robert Stack, Ph.D., Associate Professor<sup>90</sup>; Glen D. Statler, Ph.D., Professor<sup>90</sup>; James Venette, Ph.D., Associate Professor<sup>55</sup>; William M. Bugbee, Ph.D., Adjunct Professor, USDA<sup>0</sup>; Thomas J. Gulya, Jr., Ph.D., Adjunct Professor, USDA<sup>0</sup>; Virgil L. Jons, M.S., Plant Pathologist, USDA<sup>0</sup>; James D. Miller, Ph.D., Adjunct Professor, USDA<sup>0</sup>; Roland G. Timian, Ph.D., Adjunct Professor, USDA<sup>0</sup>.

**SOILS:** Charles M. Smith, Ph.D., Professor and Chairman<sup>00</sup>; Lynn J. Brun, Ph.D., Associate Professor<sup>00</sup>; Fredric S. Carter, B.S., Research Assistant<sup>100</sup>; William C. Dahnke, Ph.D., Professor<sup>100</sup>; Edward J. Deibert, Ph.D., Assistant Professor<sup>00</sup>; John W. Enz, Ph.D., Assistant Professor<sup>00</sup>; Joseph F. Giles, Ph.D., Assistant Professor<sup>00</sup>; Gary A. Halvorson, Ph.D., Research Associate<sup>100</sup>; Brian E. Johnson, B.S., Assistant in Soils<sup>100</sup>; Jay K. Larsen, B.S., Research Assistant<sup>100</sup>; D. A. Lizotte, B.S., Research Assistant<sup>100</sup>; Alexandru Maianu, Ph.D., Assistant Professor<sup>100</sup>; Sigurd W. Melsted, Ph.D., Research Scientist<sup>100</sup>; John T. Moraghan, Ph.D., Professor<sup>00</sup>; Hollis W. Omodt, M.S., Professor<sup>100</sup>; Donald D. Patterson, M.S., Associate Professor<sup>100</sup>; Lyle D. Prunty, Ph.D., Assistant Professor<sup>00</sup>; Jimmie Richardson, Ph.D., Associate Professor<sup>70</sup>; Dale Shay, B.S., Assistant in Soils<sup>100</sup>; Francis J. Sobolik, M.S., Area Extension Agent<sup>30</sup>; Michael D. Sweeney, M.S., Associate Professor<sup>100</sup>; Larry J. Swenson, B.S., Assistant in Soils<sup>100</sup>; Nyle C. Wollenhaupt, M.S., Research Associate<sup>100</sup>; Joseph C. Zubriski, Ph.D., Professor<sup>65</sup>; Armend Bauer, Ph.D., Adjunct Professor, USDA<sup>0</sup> (Mandan); A. L. Black, M.S., Adjunct Professor, USDA<sup>0</sup> (Mandan); Donald G. Harris, Ph.D., Adjunct Professor, USDA<sup>0</sup> (Mandan); Stephen D. Merrill, Ph.D., Adjunct Professor, USDA<sup>0</sup> (Mandan); George A. Reichman, M.S., Adjunct Professor, USDA<sup>0</sup> (Mandan).

**TEXTILES AND CLOTHING:** Coila M. Janecek, M.S., Professor<sup>25</sup>.

**VETERINARY SCIENCE:** Myron F. Andrews, D.V.M., Professor and Chairman<sup>60</sup>; Arnold D. Alstad, D.V.M., Associate Professor<sup>100</sup>; Ivan E. Berg, D.V.M., Associate Professor<sup>100</sup>; Howard H. Casper, Ph.D., Associate Professor<sup>35</sup>; Allan Peterson, D.V.M., Assistant Professor<sup>100</sup>; Dennis Saari, D.V.M., Associate Professor<sup>100</sup>; Ithel A. Schipper, D.V.M., Professor<sup>60</sup>; George E. Staples, D.V.M., Associate Professor<sup>90</sup>; Donald K. Christian, D.V.M., Adjunct Professor (Private Practice); Gary R. Christian, D.V.M., Adjunct Professor (Private Practice); Merrill J. Reinhillier, D.V.M., Adjunct Professor (Private Practice); Daniel P. Treat, D.V.M., Adjunct Professor (Private Practice).

## BRANCH STATIONS

**DICKINSON:** Thomas J. Conlon, M.S., Superintendent<sup>100</sup>; Douglas G. Landblom, M.S., Assistant Animal Husbandman<sup>100</sup>; James Lee Nelson, B.S., Animal Husbandman<sup>100</sup>.

**HETTINGER:** Timothy C. Faller, M.S., Superintendent<sup>100</sup>.

**LANGDON:** Robert E. Nowatzki, B.S., Superintendent<sup>100</sup>.

**NORTH CENTRAL:** Ben K. Hoag, M.S., Superintendent<sup>100</sup>; John Lukach, B.S., Assistant Agronomist<sup>100</sup>.

**WILLISTON:** Ernest W. French, M.S., Superintendent<sup>100</sup>; Neil Riveland, M.S., Associate Agronomist<sup>100</sup>.

**CARRINGTON:** John Gardner, B.S., Assistant Agronomist<sup>100</sup>; Vernon Anderson, B.S., Assistant Animal Husbandman<sup>100</sup>; Howard Olson, M.S., Superintendent and Agricultural Engineer<sup>100</sup>; Ronald F. Meyer, B.S., Assistant Agriculturalist<sup>100</sup>.

**AGRONOMY SEED FARM:** LeRoy A. Spilde, Ph.D., Superintendent<sup>100</sup>.

The small superscript figure after each title indicates the percent of the salary paid by the Agricultural Experiment Station. The superscript zero indicates the entire salary is paid by some state or federal agency, usually the United States Department of Agriculture.

## GIFTS AND GRANTS

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BASF Wyandotte Corporation  
Battelle Memorial Institute  
Beet Sugar Development Foundation  
Binsure  
Boots Hercules Agrochemical  
Bureau of Reclamation, Department of Interior  
Burleigh County Water Management  
Canadian Horticultural Council  
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Economics Statistics and Cooperative Service, USDA  
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Minnesota Wheat Council  
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Monsanto Agricultural Products  
Montana State University  
National Crop Insurance Association  
National Institutes of Health  
National Macaroni Manufacturer's Association  
Nor-Am Agricultural Products, Incorporated  
North Central Regional Center  
North Dakota Beef Cattle Improvement Association  
North Dakota Business and Industrial Development Department  
North Dakota Cooperative Extension Service  
North Dakota Department of Accounts & Purchases  
North Dakota Department of Agriculture  
North Dakota Lamb and Wool Producers Association  
North Dakota Legislative Council

North Dakota Livestock Mutual Aid Corporation  
 North Dakota Parks and Recreation Department  
 North Dakota Power Use Council  
 North Dakota Regional and Environmental Assessment  
 Program (REAP)  
 North Dakota Soils Conservation Commission  
 North Dakota State Beef Commission  
 North Dakota State Board for Vocational Education  
 North Dakota State Wheat Commission  
 North Dakota Sunflower Council  
 Northern Great Plains Research Center  
 Northwestern Public Service Company  
 Office of Water, Research and Technology  
 Ohio Agricultural Research & Development Center  
 Old West Regional Commission  
 Olin Chemicals Group  
 Oregon State University  
 Ottertail Power Company  
 Pacific Oil Seeds, Incorporated  
 Pennwalt Corporation  
 Richard L. Post  
 Potato Chip Snack Food Association  
 Purdue University  
 The Quaker Oats Company  
 Ralston Purina Company  
 Red River Edible Bean Growers Association  
 Red River Valley Potato Growers Association  
 Rohm & Haas Company  
 Harold Schafer  
 Shell Chemical Company  
 Shell Development Company Medesta  
 Sheyenne Valley Grazing Association  
 Sigco Research Incorporated  
 Skinner Macaroni Company  
 South Central Crop Improvement Association  
 State Commissioner of University and School Lands  
 Stauffer Chemical Company  
 Sugarbeet Research and Education Board of Minnesota and  
 North Dakota  
 Sunflower Association of America  
 Tennessee Valley Authority  
 Union Carbide  
 Uniroyal Incorporated  
 United States Fish & Wildlife Services, Department of the Interior  
 University of California  
 University of Nebraska at Lincoln  
 University of Wisconsin  
 Upper Great Plains Transportation Institute  
 Van RIJN  
 Velsicol Chemical Corporation  
 Water Institute

**PROFESSIONAL  
 STAFF CHANGES**

(to June 30, 1980)

**ADDITIONS TO STAFF**

George R. Fisher, Ph.D.  
 Professor..... July 1, 1979  
 Thomas P. Freeman, Ph.D.  
 Professor..... July 1, 1979  
 Linda MacArthur, M.S.  
 Instructor..... July 1, 1979  
 Andrew Jacobson, M.S.  
 Research Associate..... July 19, 1979  
 Vernon Anderson, B.S.  
 Assistant Animal Husbandman..... August 1, 1979  
 Dale F. Zetocha, M.S.  
 Research Assistant..... September 1, 1979  
 Gerald M. Erickson, B.S.  
 Instructor..... September 13, 1979  
 David Gabrielson, Ph.D.  
 Assistant Professor..... October 1, 1979

John D. Busacca, Ph.D.  
 Assistant Professor..... October 3, 1979  
 Vernon A. Borgen, B.S.  
 Research Assistant..... November 1, 1979  
 Berlin D. Nelson, Ph.D.  
 Assistant Professor..... November 1, 1979  
 Larry J. Roehl, M.S.  
 Research Associate..... November 1, 1979  
 Stephan Schroeder, Ph.D.  
 Research Associate..... November 5, 1979  
 David M. Saxowsky, J.D.  
 Research Assistant..... December 1, 1979  
 Craig B. Struble, Ph.D.  
 Research Associate..... December 3, 1979  
 Glen Pederson, Ph.D.  
 Assistant Professor..... January 1, 1980  
 William W. Wilson, Ph.D.  
 Assistant Professor..... January 15, 1980  
 John Gardner, B.S.  
 Assistant Agronomist..... February 1, 1980  
 Walter Valovage, Ph.D.  
 Research Associate..... April 1, 1980  
 William Alexander, Ph.D.  
 Research Associate..... April 22, 1980  
 Ronald F. Meyer, B.S.  
 Assistant Agriculturalist..... May 1, 1980  
 D. A. Lizotte, B.S.  
 Research Assistant..... June 1, 1980  
 Alexandru Maianu, Ph.D.  
 Assistant Professor..... June 1, 1980  
 Nyle C. Wollenhaupt, M.S.  
 Research Associate..... June 1, 1980  
 Donald Kirby, Ph.D.  
 Assistant Professor..... June 16, 1980

**DELETIONS TO STAFF**

Thomas K. Ostenson, M.S.  
 Associate Professor..... June 30, 1979  
 Brendan J. Donnelly, Ph.D.  
 Associate Professor..... July 17, 1979  
 Timothy W. Martens, B.S.  
 Instructor..... July 20, 1979  
 Rodney J. Ehni, M.S.  
 Research Associate..... August 24, 1979  
 Joseph J. Caroline, B.S.  
 Assistant Agronomist..... August 31, 1979  
 Duane E. Gronhovd, M.S.  
 Research Assistant..... August 31, 1979  
 James Knuteson, M.S.  
 Research Assistant..... August 31, 1979  
 David E. Chandler, M.S.  
 Research Assistant..... September 30, 1979  
 Michael Pole, M.S.  
 Research Associate..... September 30, 1979  
 Russell P. Schneider, Ph.D.  
 Assistant Professor..... October 1, 1979  
 Kent A. Belland, B.S.  
 Research Assistant..... October 24, 1979  
 Robert Hoffman, B.S.  
 Assistant Agriculturalist..... October 31, 1979  
 Steven C. Hvinden, M.S.  
 Research Assistant..... January 25, 1980  
 Mathias F. Lanz, B.A.  
 Associate Professor..... March 31, 1980  
 Randall L. Hemb, B.S.  
 Research Assistant..... April 30, 1980  
 Roy A. Johnston, M.S.  
 Research Assistant..... May 9, 1980  
 Rollin G. Sears, Ph.D.  
 Assistant Professor..... June 30, 1980  
 Ronald E. Zuber, M.L.A.  
 Assistant Professor..... June 30, 1980