

Contributions of the Dickinson Research Center to Western North Dakota

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The Dickinson Experiment Station was established in 1905 by far-sighted early settlers — cattlemen and farmers together — who were convinced of the potential value of agricultural research and who were willing to back up their convictions with the donation of a quarter section of land to get an experiment station started in the grassland and farming region known as the Missouri Slope. L.R. Waldron was named its first superintendent. For 86 years, research has been directed to three major areas: range, pasture and forage production; crop production and tillage; and livestock studies with beef cattle and swine.

One of Waldron's first efforts was to produce a hardy alfalfa variety capable of yielding two crops per season. By 1912, the station, in cooperation with the USDA, had developed one of the largest alfalfa breeding programs in the entire United States. Alfalfa variety testing has continued to date, and it is difficult to measure how much influence this research has had on the 1.5 million acres of alfalfa grown in North Dakota.

The Dickinson Experiment Station was instrumental in the development, testing and distribution of crested wheatgrass, perhaps the best introduced hay and pasture grass grown in the Northern Plains. Fifteen to 20-year-old stands of crested wheatgrass that had averaged 1,262 pounds of forage per acre over a 12-year period at Dickinson responded well to fertilization. Application of 0, 50, 100, and 150 pounds per acre of ammonium nitrate in early spring resulted in significant increases in forage production. The 50 pounds per acre rate appeared to be the most economical, producing an extra 1,125 pounds of hay per acre. The hay was also 2.3 times higher in crude protein. The fertilized plots greened up and were ready to graze five days earlier than unfertilized plots. They also remained green for a week to 10 days later in the season.

During a seven-year grazing trial with yearling steers on crested wheatgrass or crested wheatgrass-alfalfa pastures, the crested-alfalfa pastures produced 27.3 percent more forage. Gains per acre averaged 88.4 pounds on the crested wheatgrass and 117.3 pounds on the mixed pastures, an advantage of 33 percent in beef production for the grass-alfalfa mixture.

In western North Dakota, cattle commonly graze native range and pastures for as much as 10 months out of the year. A study to determine whether supplies of carotene, protein and phosphorus in range grasses, tame grasses and miscellaneous forages of western North Dakota were adequate to meet the requirements of a beef breeding herd during the summer grazing season was undertaken by Warren Whiteman and others in 1947. This trial documented that native and tame grasses lost an average 87 percent of their carotene, 71 percent of their protein and about 66 percent of their phosphorus by the end of September. This information continues to be very useful in planning a year round nutritional program for beef cows especially as it relates to proper range supplementation. The fact remains that native range grasses in western North Dakota do not "cure" on the stalk like hay, but tend to weather and deteriorate in feeding value, losing much of their nutritional value by late summer.

The use of nitrogen fertilizer and interseeding on native range was started in 1969. Treatments consisted of 67 and 100 pounds of nitrogen applied annually, the same amounts applied on alternate years, and 200, 300, and 400 pounds nitrogen applied only once. In additional trials, phosphorus and potassium were also used. The annual nitrogen treatments resulted in a 50 percent increase in yield with little difference between the 67 and 100 pound rates. The addition of phosphorus resulted in a small increase in production but phosphorus alone did not affect production.

Interseeding native range with introduced grass or alfalfa showed that major increases in yield were obtained with the interseeded alfalfa. Interseeding leaves the ground in a broken, rough state that is very difficult to drive or ride horseback across. Where some desirable grass species still remain in the vegetative cover, nitrogen fertilization may be a more desirable way of increasing yields and improving range condition.

A three-pasture grazing system using crested wheatgrass, native range and Russian wildrye grass, each fertilized with 50 pounds of nitrogen, has increased calf gain by 32 percent and cow gain by 49 percent over non-fertilized pastures. In addition the number of days of good grazing has been extended.

From 1981-87, a short duration grazing study was conducted on native range pastures. Over the years, calf gains were 7 pounds per acre more on the short duration grazing than on the continuously grazed pasture. Cow gains were not different between systems. Short duration grazing does require extra fence construction and maintenance in order for the system to work.

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A complementary rotation grazing system has been evaluated since 1983. In this system, cow-calf pairs start grazing Altai wildrye in early May. After 10 days to two weeks, they are moved to crested wheatgrass pastures. In June, the cows and calves are moved to native range pastures where they rotate through each of three pastures twice during the summer. In early October, they are again moved to Altai wildrye pastures, where they graze until late fall. This system has lengthened the grazing season from the traditional six months to 7.1 months, and has reduced the acres required per pair from 24.4 acres to 11.6 acres. Producers utilizing this system can expect to lengthen the grazing season by a minimum of 33 days, reduce the acreage required per cow-calf pair by 13 acres, and increase the amount of saleable beef produced from each acre grazed.

Currently, a multi-species grazing study is in progress. In this trial, cow-calf pairs and non-lactating ewes graze together. Gains of the cows and calves grazing with sheep have been equal to gains made by control cow-calf pairs. In addition, the ewes have gained 12 pounds per head primarily by grazing woody forbs and undesirable plants that cows do not normally graze. This saving in ewe maintenance cost amounts to over \$8 per head for a 96-day grazing season.

Research and improvement of grass and other forage crops was singled out for special attention when the station was started, but because the homesteaders were rapidly settling the region, farming quickly assumed major importance. Over two million acres were filed on for settlement in 1905, the year the station was established.

CROP PRODUCTION

In his first annual report, L.R. Waldron explained the need for site and situation specific research. He said, "The circumstances which warranted the establishment of an Experiment Station at this point are important. Many if not all of the problems of crop rotation and cultivation methods must be worked out under the conditions existing where they are to be used. It is evident that this work must fall very largely on the Substations. In cooperation with the U.S. Department of Agriculture, the Dickinson Station, along with others, will set itself resolutely to the task of solving some of the important basic problems in cultivation and rotation. The Station will also carry on an independent investigation designed to meet the more local conditions. The opening up to cultivation of such immense areas naturally brings to the surface many perplexing difficulties local in character which can be disposed of only where they originate."

Much of the early work involved studies of different crop rotations and tillage methods. Tillage trials included all of the machinery then available to farmers of the area, and throughout the years the trials have been changed to meet new developments in farm machinery.

Rotation studies included every conceivable combinations of the commonly grown crops in from two to eight-year-rotations. From these and other studies evolved crop production methods that have been widely adapted to the agriculture of the semi-arid regions.

Waldron eventually became chief wheat breeder for North Dakota State University and was recognized as one of the leading plant breeders in the United States. With him in charge of the work at Dickinson in 1905, a program of breeding and testing small grains was quickly initiated. All of the agronomists that have been associated with the

station over the years have worked to improve this program.

The station is a part of the regional testing programs involving cooperation between the USDA-ARS and 40 to 50 stations in a dozen or more states and Canada. Dickinson was one of the original stations involved in the first test of the spring wheat uniform nursery and has been involved on a continuous basis for 62 years. The station has provided excellent data for the Western Regional Spring Barley Nurseries for at least 50 years. According to E.A. Hockett, senior research agronomist at Montana State University, "The best example of the usefulness of these nurseries I can think of is the testing and release of the two rowed cultivar Bowman. This cultivar is an excellent choice for dryland areas in both Montana and North Dakota. I am sure that the release of Bowman, which yields 5 to 10 percent more than previous cultivars, has been worth millions of dollars to North Dakota farmers."

The station has been a cooperator in the Regional Uniform Oat Performance Nurseries since 1942. Of all the research being done with small grain crops, the cooperative small grain testing programs are perhaps the least publicized, but surely rank near the top in importance.

The station has conducted "off-station variety trials" for the past 25 years in order to provide a wider base for interpretation of yield data as it relates to varied soil types and growing conditions over the entire 14-county Missouri Slope area. Data from these trials are combined with data from the Hettinger Branch Station off-station trials to provide an area test of crop performance at 11 locations in southwestern North Dakota.

LIVESTOCK RESEARCH

Livestock research was added to the center's mission by the legislative assembly of 1945, who said in their bill, "The agricultural experiment station at Dickinson when enlarged shall make experiments with livestock breeding, nutrition, management and disease control, and shall conduct such other agricultural research as may further contribute to the benefit of livestock production of western North Dakota and the state of North Dakota."

Early work with cattle emphasized the feeding of corn silage to both the cow herd as well as cattle being grown and fattened in drylot. Research has shown that no forage crop grown in southwestern North Dakota will produce as much tonnage of high quality feed as will corn. Many feeding trials were completed using corn silage as the base feed.

The overall conclusion was that corn silage is an excellent feed that can be combined with various grains and supplements to produce both rapid and economical gains with a minimum of digestive problems. Corn silage combined with a limited amount of soybean meal and 1 to 2 pounds of alfalfa hay will provide a very palatable and nutritious ration for all but the youngest beef cattle.

Successful livestock producers have discovered that growing corn for silage allows for a stable cattle enterprise. Production of wheat on clean corn ground is slightly lower in yield than wheat grown on summerfallow. For cattle, the feeding of corn as silage was superior to "hogging" off the standing corn. Other silage crops such as sudan grass or sorghum yield from 50 to 60 percent as much feed as will corn.

The invention of the large round baler and "tub" grinders pushed research into feeding of complete mixed rations that could be self fed. These rations were easy to prepare and feed and allowed the producer to program whatever kind of grains he wanted, often with the aid of computers. Many farmers opted for this method of feeding since they did not have to invest in additional corn equipment. Research at Dickinson using the complete mixed ration concept produced a very satisfactory performance on both cattle being backgrounded or finished. Incorporation of moderate levels of straw stretched the roughage supply without reducing rate of gain appreciably. Today, this is a widely accepted method of feeding cattle across the state.

Over the years, a large number of feed additives, growth promoting devices, and implants have been evaluated. The first implant tested was di-ethylstilbestrol. Improved gain and feed efficiency in feedlot cattle meant more money in the producer's pocket. However, because stilbestrol was suspected of causing cancer in mice, it was taken off the market by the Food and Drug Administration. Other implant products such as Ralgro®, Synovex®, Compudose®, STEER-oid®, and HEIFER-oid® soon came on the market and were tested at the station. All of these implants gave a positive response in terms of faster gain and lower feed costs. Other products were not as beneficial, and some failed to improve production at all. A plastic "Christmas tree" like device called the Hei-Gro® device was sold as a vaginal insert for feedlot heifers. It was supposed to stimulate extra hormone production in heifers and thereby enhance feedlot performance. Research at Dickinson failed to show any advantage for the use of the device, and hopefully saved many producers from investing in a questionable if not a useless product.

Feed additives known as "ionophores" were tested in both feedlot and gestating cow rations. Two products, Bovatec® and Rumensin®, proved their worth by improving feed efficiency and rate of gain. They also helped reduce the incidence and severity of bloat and aided in the control of coccidiosis in feedlot cattle.

The incorporation of straw into gestation rations for beef cows has received much study at the station and has proven to reduce winter feed costs and stretch short feed supplies.

Liquid supplements using molasses and urea have been tested. Results indicate that these were no better or cost effective than all-natural supplements such as soybean oil meal under limited feeding situations. Consumption of the liquid supplements was hard to regulate when fed on a free choice basis. This led to excessive consumption and increased the cost per day to uneconomical levels.

A slow release biuret product known as Kedlor 230® was tested as a supplement for straw. Because of its poor palatability, grain had to be fed with it in order to insure adequate consumption. Kedlor 230® proved to be safe to feed and compared favorably with soybean oil meal as a protein supplement except for its poor palatability. Kedlor 230® was incorporated into a protein block for use on pasture. When used to supplement native range in late summer and fall, steers gained faster than controls. However, when used to supplement Russian wildrye pastures, gains were disappointing.

ANIMAL HEALTH

Worming beef cattle has been widely advertised as a sound management practice that will improve rate of gain and net returns for cattlemen. The station has evaluated various wormers in both feedlot cattle and with cow-calf pairs. Products tested to date include Thiabendazole®, Tramisol®, Rumatel® Safe-Guard® and a combination of Ivomectin® and Totalon®. Based on fecal egg counts, all of these products were effective in eliminating or reducing worms. However, the response to worming based on animal performance was minimal. To date, worming of trial animals performance was minimal. To date, worming of trial animals has failed to generate additional net income and has been just an additional expense. Producers in western North Dakota should realize a considerable savings in their herd health budget by worming their herds only after consultation with their local veterinarian and not as a routine practice.

The horn fly, a blood sucking ectoparasite of cattle, slows production and robs producers of potential profits. In the last decade, chemically impregnated fly tags have replaced conventional backrubbers, sprays, and dust bags. However, overwhelming use of fly tags resulted in resistant fly populations. This station participated in research to evaluate chemical formulations designed for slow release ruminal boluses and fly tags created to control pyrethroid resistant fly populations. Horn flies were controlled with all preparations tested. In contrast to other studies in which good fly control resulted in better calf gains, calf gains in this trial where no fly control was used were on par with treated calves. Untreated cow gains, however, were substantially depressed among high milking cows. Stable flies were not controlled, which points out the fact that good, consistent control of all problematic fly species will be a research challenge for the 1990s.

Maintaining health status in beef cattle was the focus of other research with veterinary related principles. Calf diarrhea, ranks as one of the major economic problems facing producers of beef cattle and reduces profits through costly treatment, death loss, and irreparable intestinal lining damage. To address calfhoo enteritis, this station cooperated with the late Dr. I.A. Schipper, DVM, in a statewide study of *E. coli* vaccinations in healthy first calf heifers and cows. Diarrhea incidence did not differ between treated and untreated females, but calves from vaccinated females responded more rapidly to treatment, thus reducing treatment costs. Fluorescent light radiation was also tested as a method for controlling diarrhea organisms in loafing areas of confined cows and calves. Fluorescent light fixtures were affixed to portable calf shelters in confinement and compared to unconfined cows and calves. Radiation reduced the incidence of diarrhea by 11 percent in confinement, but diarrhea incidence was 46 percent lower among unconfined calves, emphasizing the importance and value of clean ungrazed post calving pastures for scours control.

Low levels of trace elements can be associated with reduced performance and calfhoo enteritis. During a two-year monitoring period, hair and blood serum samples from newborn calves were analyzed by the NDSU Veterinary Diagnostic Laboratory for copper, zinc, manganese, magnesium, and iron levels. A positive correlation between serum copper level and weaning weight was identified. This indicates the potential need for copper supplementation in some herds.

Vaccinations of cattle have had a pronounced effect on sustaining health, but the degree of immunity attained is

dependent on how the vaccine is administered. Again cooperating with I.A. Schipper and the Veterinary Diagnostic Laboratory, vaccination with attenuated and inactivated infectious bovine rhinotracheitis (IBR) and bovine virus diarrhea (BVD) vaccines were evaluated in weanling age calves. Antibody titer levels produced by either attenuated or inactivated vaccines were similar, but two vaccinations separated by a minimum of three weeks produced maximum serum antibody levels. When weaning and vaccination occurred simultaneously, antibody titers were substantially lower, and decay was accelerated. Highest antibody production and slowest antibody decay was associated with vaccinations administered six and three weeks before weaning.

LIVESTOCK MANAGEMENT

Proper management of feedlot heifers is a challenge to heifer feeders, and unwanted pregnancies cut heavily into potential profits. Heifer abortion studies evaluated the efficacy of a new synthetic abortifacient compound, Luprostiol[®], compared to Bovalene[®]. Luprostiol[®] was found to be a very efficacious product when used in heifers that were no more than 150 days pregnant.

Feeding intact bulls to slaughter weights has received considerable attention in this country, and the Dickinson Station also contributed to the available data base. In these investigations, castration was carried out at various intervals between 180 and 850 pounds. Intact bulls fed to finished weights outperformed all steer counterparts in rate of gain, feed efficiency, and carcass measurements. Castrating at any other time during the feeding period was very detrimental and should be completed when the calf is young, or not at all, if optimum performance is to be realized. Chemical castration of male calves weighing 200 pounds or less was tested as a bloodless substitute for surgical castration. Bloodless castration with Chem-Cast[®] was a completely effective, nearly painless method for altering male calves. No problems arose from its use and weaning weights were equal to calves castrated conventionally. Economics do not favor chemical castration since altering calves surgically is cost free, whereas the Chem-Cast[®] product cost nearly \$2 per calf.

Producers planning to remodel or construct new cattle holding facilities may find the slotted board fence a low cost and entirely adequate alternative to typical pole barn housing for weather protection in western North Dakota. The idea and design for the low cost shelter was borrowed from a prototype windbreak in use at the University of Saskatchewan at Saskatoon. The slotted board fence has been tested and used at the station for many years with good success. The slotted fence shelters are 9 feet high and constructed of full-cut 1x6 boards set vertically with a 1.5 inch spacing between the boards. This spacing gives the fence a 20 percent porosity and allows for air movement on the leeward side of the fence.

The slotted fence shelters have been used to shelter growing-fattening cattle in the feedlot as well as gestating cows during the winter months with good results. Experience indicates that shade should be provided during the warm summer months. During the winter, snow fence located 50 to 80 feet upwind will trap drifting snow during a blizzard. Producers can take maximum advantage of the shelters by locating them within the livestock holding area and not as part of a fence line. This allows livestock to utilize either side of the shelter for wind protection.

A beef production system known as "grass fed beef" has been tested at the station and may be of particular interest to consumers looking to buy grass fat beef that has not been adulterated with hormones or feed additives. They should expect to pay a premium for beef produced using this system since it requires more time to produce quality beef using this approach.

In this system, calves were weaned and fed a totally mixed growing ration composed of 80 percent mixed hay and 20 percent oats plus minerals and salt. Winter gains averaged a respectable 1.39 pounds per head per day. From early May to late October, the cattle grazed crested wheatgrass, native, and Russian wildrye pastures. Gains for the 190-day grazing period averaged 1.14 pounds per head per day.

Following termination of grazing, the steers were self fed a mixed alfalfa-crested wheatgrass hay of excellent quality for an additional 116 days. The steers were then slaughtered. Over 55 percent graded USDA Choice and returned \$257 above feed costs.

This system has most appeal when grain prices are high in comparison to roughage costs. Using cattle to convert low quality roughage into high quality beef will always appeal to producers, and there are many areas that remain unexplored.

The distillation of ethanol from barley results in production of a by-product feedstuff that contains approximately 26 percent crude protein. North Dakota cattlemen background a large percentage of their weaned calves using rations that normally require protein supplementation. This supplementation is expensive, and it is to the feeder's advantage to lower costs whenever possible. Results at Dickinson indicate that feeding North Dakota protein by-products by backgrounded heifer calves on a pound of protein basis produced nearly equal gains among heifers fed either soybean oil meal, barley distillers dried grain, or sunflower meal. There was a trend toward improved feed efficiency when the barley distillers dried grain was fed. Recently, the Dickinson station has cooperated in the evaluation of ethanol by-products when fed as conditioning feeds, creep feeds and range supplements.

Early weaning of beef calves is not a common practice in southwestern North Dakota. However, during periods of drought, producers may be forced to reduce their cow numbers in order to match pasture conditions. Early weaning of calves from these sale cows allows the rancher to maintain the genetic base with the heifer calves and also increase the value of the total calf crop.

Results at Dickinson suggest that calves should be at least 35 days of age if supplemental milk is not fed. Rations should be high in protein, available energy, vitamins and minerals. Calves should have access to starter rations during a two to three-week adjustment period prior to weaning. Calves should be vaccinated for calfhood diseases including blackleg, malignant edema, hemoglobinuria, pastorellosis, and enterotoxemia. They should be checked regularly for respiratory problems and flies must be controlled for best results.

In this study, both commercial and home grown rations were self fed with high quality crested wheatgrass hay available free choice. Protein levels during the early part of the study ranged between 15.5 to 16 percent and were reduced to 14 percent as the calves matured. Molasses was initially used to increase palatability and control dust, but it also attracted flies and was discontinued early in the study.

During the 142-day trial, calves averaging 155 pounds initially gained approximately 300 pounds. Depending on ration fed, average daily gains ranged from 1.84 to 2.36 pounds per head per day. Feed efficiency averaged close to 5.0 pounds of feed per pound of gain.

Results of this study clearly indicate that livestock producers wanting to wean beef calves early have several feeding options at their disposal depending on individual circumstances, available feed supplies and processing and handling equipment.

Many calves in North Dakota are weaned in the fall and backgrounded to approximately 750 pounds before selling. The manner in which calves are handled before and after weaning can have a positive or negative impact on calf performance and net returns. While long term creep feeding may not be cost effective every year, short term creep feeding beginning 30 days before weaning minimized weaning stress, reduced post calving gain fluctuations, and increased net body weight gains following a short backgrounding period. Sixty-eight days after weaning, calves that were creep fed for 30 days on pasture and weaned directly into drylot were 18 to 20 pounds heavier than control calves, and the cost per hundredweight of gain was lower. Results of the investigation clearly demonstrated that weight loss normally associated with weaning could be circumvented by creep feeding and still remain cost effective.

BREEDING MANAGEMENT

Management of the breeding herd is essential to profitability, and much adaptive research has been directed toward this important area. Replacement heifer development has received a considerable amount of attention. One of the early investigations evaluated the usefulness of bedding on heifer growth performance. Bedded heifers were more comfortable, gained significantly better, and utilized .9 pound less TDN per pound of gain than controls. Using bedding proved to be a very sound, cost effective, management procedure.

Complete mixed rations, proven to yield excellent performance among steers and heifers fed for maximum gains, were evaluated for developing heifers fed at slower gains. Self fed heifers had greater dry matter intakes, were more efficient, weighed more when turned out on pasture, and had 6.4 percent higher first service pregnancy rates.

Feeding replacement heifers to predetermined target breeding weights was investigated during the mid 70s. Heifers were sorted into winter gain groups according to the rate of growth needed to weigh 650 to 700 pounds at the start of the breeding season. Moderate winter growth of 1.25 to 1.50 pounds per day resulted in nearly twice as many heifers pregnant in the first heat cycle as in the other groups. Heavy, medium to large-framed heifers grown at 1.0 pound per day were not adequately developed to cycle early, while lightweight, medium framed heifers grown at 1.75 pounds per day were overconditioned when turned out on pasture, lost weight, and early cycling was depressed.

Efficiency in beef cattle production has resulted in a thrust to breed replacement heifers 30 days before the main cow herd in short 45 day breeding seasons. Shorter breeding seasons were accompanied by fewer heifers pregnant in the allotted time. Selling open heifers directly off pasture after fall pregnancy testing versus feeding to finish weights was the subject of a feeding and economic study to com-

pare marketing methods. Net returns were greatest when selling open yearling heifers directly off pasture weighing 730 to 750 pounds.

Calving difficulty, an expensive and perennial problem for cattlemen, can be significant in first calf heifers bred to calves as two-year-olds. Selecting easy calving sires is difficult and often a hit and miss proposition. Texas Longhorn and light birthweight Angus sires were evaluated for their potential to reduce calving difficulty. Twenty-five percent of the Angus-sired calves required assistance ranging from light pulls to caesarean sections, whereas only 5 percent of Texas Longhorn-sired calves needed assistance, without caesarean sections. Texas Longhorn calves averaged 10 pounds lighter at birth, were significantly lighter when weaned, and were discounted \$6 to \$10 per hundredweight when marketed compared to the Angus-sired calves. Eight hundred calving and weaning records were summarized over an 8-year period. Breeding heifers to Texas Longhorn sires resulted in easier calving but was also associated with lower overall pregnancy rate. Breeding to light birthweight bulls the first year had no effect on calving difficulty in subsequent years and sire type did not effect lifetime adjusted weaning weight or the number of years that a cow stayed in the herd.

During the last decade, research has focused on manipulation of the reproductive cycle in heifers and cows. Producers have been shown new ways to increase the number of cows calving early in the calving season. Initial emphasis was on the cycling cow and compared estrus synchronization products, management methods and economics.

Synthetic and natural occurring prostaglandins were evaluated in cows and heifers at regular and reduced dosages. In heifers, reduced dosages of a natural prostaglandin proved to be as effective as full dosages, and at less cost. In contrast to heifers, poor synchrony was obtained in mature lactating cows when reduced dosages were administered, which resulted in disappointingly low first service conception and pregnancy rates.

Most recently, emphasis has shifted to developing a program for induction and synchronization of fertile heat cycles in non-cycling beef cows. Ovulation induction techniques were applied to the last one-third of cows calving in a herd as a way to move up late cycling cows. Using therapeutic treatments in non-cycling cows resulted in 14 to 25 percent more cows pregnant at the end of the first heat cycle compared to untreated control cows. In a 100-cow herd, a 20 percent improvement in first service pregnancies equate to approximately 1,000 pounds more weaning weight, but the value of increased gain is offset by treatment costs the first year. The value of advancing a cows' calving date is not confined to a single year, however, but carries through into subsequent years when the advantages of earlier calving and added weight gain are realized.

Since crossbreeding has become a common practice, cattlemen have argued the merits of which cow type makes the ideal range cow. Research has shown that there is no single cow type that performs the same in all environments. Currently, straightbred and crossbred cows that vary in body weight and lactation potential are under investigation. While much can be said about them relative to size, weight, energy intake, and range carrying capacity, reproduction has been the most limiting factor in terms of sustainability. Within the environment of southwestern North Dakota, cows that possess moderate body weight and season-long lactation potential of 12.7 to 13 pounds of milk have shown the greatest longevity by producing the most

pounds weaning weight per cow exposed. This added weaning weight translates into an added return of \$10.58 per cow exposed.

SWINE RESEARCH

Swine research at the research center has varied widely, and like the beef cattle effort investigations were often developed in response to producer questions. Early work focused on pasture rearing, types of pasture crops, pasture rearing versus confinement, vitamin supplements, grain processing, and the impact of protein and specific amino acids on pig performance.

A wide variety of spring seeded winter grains, alfalfa, spring rye, and sudangrass were compared as pasture types. Spring seeded winter wheat proved to be the best all around pasture. The annual plowing and seeding provides an opportunity to level lots and bury accumulated manure, thereby reducing worm contamination. Pastured reared pigs gained nearly as well as confined pigs but consumed 7 percent less processed feed per hundred pounds of gain.

At the turn of the century pigs couldn't be produced efficiently without pasture or harvested forage to provide essential vitamins, minerals and amino acids not available in feed grains. Advances in nutrition eliminated the need for pasture and opened the door for confinement rearing. Investigations with B-complex vitamins, vitamin B₁₂, and vitamins A and D in growing-finishing rations improved rate of gain by 4 percent and feed efficiency by 6.7 percent.

Protein supplement studies compared soybean meal (SBOM) to dried buttermilk, dried whey, liquid whey, and the synthetic amino acids lysine and methionine. Heavy and lightweight pigs were fed SBOM and SBOM/dried buttermilk combinations. The combination supplement produced better performance in light pigs, but the diet was also more costly.

As protein research developed, researchers and producers alike questioned what optimum protein levels were for swine, and how those levels should change with respect to the growing animal. Using soybean meal and fish meal, growing pigs were fed diets of varying protein levels and duration through to finished weights. Pigs fed a 16 percent crude protein diet to 125 pounds, followed by a 12 percent crude protein finishing ration containing 0.6 percent lysine produced the most favorable gains and feed efficiency and resulted in the most desirable cost to gain ratio.

By-products have always played an important role in swine production. Excess liquid whey from cheese processing plants presented a disposal problem. Disposal of the whey solution included dumping on crop land, feeding it as a liquid, or drying. Once dried, the whey could be used in human food and animal feeds. As a liquid, its best use was as a source of water and protein for swine. Rations containing either liquid or dried whey produced faster gains and improved feed efficiency when compared to controls. This clearly demonstrated that a potential environmental pollutant was really a valuable feed source for swine.

A ration containing two-thirds barley and one-third oats supplemented with SBOM was tested against many other diets and was found to yield very consistent performance. In fact, so consistent, that it was referred to as the "DES Basic Ration."

The basic ration supplemented with SBOM was compared to diets supplemented with lysine and methionine only. Performance was nearly identical, indicating that lysine was the most limiting amino acid followed by methionine. The trial also pointed out that when these amino acids were competitively priced they could replace all of the SBOM in growing-finishing diets.

Numerous grains were evaluated to determine their substitution value compared to barley. Wheat, which is generally too expensive to be considered as a feed grain, was one of the first grains tested. The data from those studies is very relevant today in light of current farm policy and subsequent low commodity prices. The replacement value of wheat was compared to barley. Seventy-five percent wheat replaced barley in growing-finishing diets. Palatability and rate of gain were unaffected and feed efficiency was improved 6 percent. In other trials, rye and triticale were studied. Rye, which is susceptible to ergot infestation, was not very palatable for swine. When it replaced no more than 25 percent barley in the diet, growing to finishing performance was unaffected. In addition, ergot free triticale, a cross between durum wheat and rye, could replace all of the barley in growing to finishing rations with little difference in expected rate of gain or feed efficiency. Hulless barley was also compared to conventional barley for growing to finishing pigs. Daily gains were similar, but feed efficiency with hulless barley was 8.7 percent better.

Producers have always searched for ways to reduce labor. Gestating sows are commonly hand fed to lower costs and to prevent them from becoming over conditioned. Self feeding bulky rations was investigated to determine if a positive cost benefit ratio could be obtained while saving the labor of daily feeding. Gilts and second litter sows were self-fed gestation rations containing 40 percent or 70 percent alfalfa. With gilts, high levels of alfalfa reduced litter size by one pig. Birth weights were one-half pound lighter, and total litter weight at weaning was nearly 60 pounds lighter. Second litter sows, however, performed satisfactorily at both levels of alfalfa, but even with bulky, high levels of roughage some type of restriction was necessary to avoid costly overconsumption.

Sow's milk is almost devoid of iron, an essential constituent of hemoglobin. As a result, confined baby pigs that do not have access to soil become anemic very rapidly. Zero, one, and two injections of iron dextran were evaluated for the prevention of baby pig anemia. Pigs receiving two injections at three and 35 days of age were 22 percent heavier when marketed.

Swine AI was found to be a very useful tool for genetic improvement, but was also labor intensive and time consuming. Early work at this station with AI using frozen semen resulted in variable litter size and poor conception rates. However, properly preserved and stored fresh boar semen has a shelf life in excess of four days. This allows fresh semen to be used in breeding sows synchronized at weaning. Using genetically superior sires artificially resulted in significantly better carcasses and higher average returns per head.

Grade and yield marketing was compared to marketing butcher hogs locally. The added returns per head, however, were offset by the additional transportation costs.

Overall, swine research has been addressed from a very practical, adaptive perspective. This approach has resulted in strong producer support for the research effort over the years.

TREES AND WEATHER STATION

Woody plants and ornamentals have always been an important part of the Dickinson Station and are currently being studied in cooperation with the USDA Plant Materials Center in Bismarck, the Department of Horticulture at NDSU and the Regional Plant Introduction Station, Ames, Iowa. A distinctive landscape feature of the station is the large number of Bull pine trees that were planted between 1906 and 1936 and are still thriving today. In 1989, during the state centennial celebrations, former governor Arthur Link planted the first tree in an ash grove commemorating the centennial and named in honor of former superintendent Raymond J. Douglas.

The station, in cooperation with the National Weather Service, has logged a continuous weather record at the same location since 1892. This makes the Dickinson Station a "bench mark" weather station and gives it the distinction of being one of the oldest weather stations in con-

tinuous operation at the same location in the entire US. This current and historical record has proven immensely valuable to producers and others and has evolved baseline information on all aspects of the weather for the past 99 years. The station is also part of a multi-location automated weather data network for North Dakota. Anyone with a computer and telephone modem can access the system day or night and get hourly reports of the weather.

While this review of some of the contributions of the Dickinson Research Center to western North Dakota agriculture is by no means complete or exhaustive, it does point out that for the past 86 years, the Dickinson Station has strived to serve a diversified farming and ranching community in the Missouri Slope area and the state of North Dakota in general. The broadbased research effort in grassland and pasture management, crop production and tillage and livestock management has included both basic and applied research and is in keeping with the mission as defined by the Legislature.