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On the cover:
Research has paid off for wheat growers in Nebraska. The heavy heads shown in this ripening wheat field are the result of new varieties paid for by bargain-loving Nebraska taxpayers. See story on page 3. (Photo by Bart Stewart)

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Does Ag Research Pay?

By Robert W. Kleis and Dave Parrish

A person who invests money in any venture has a real concern over the returns on that investment. In the past 10 years, $38.3 million in State funds went into agricultural research at UN-L. Does agricultural research pay?

Agricultural production increases in recent years have not been a result of increased acreage, but rather a result of technologies and increased efficiency based on research.

Increased yields have not been accidental. In a little over a decade, corn yields have increased over 40 percent. Wheat yields have increased over 50 percent. In a 1973 report, Dr. George Pavelis of the Economic Research Service, USDA, indicated that “research and extension activities explain about 80 percent of the tendency for growth from 1929 to 1972, and from 60 to 70 percent of the tendency for increased efficiency.”

Soil, water, and weather are all significant to agricultural production. The summer of 1974 was a grim reminder that a dry spell can last for weeks at a time. But even in dry 1974, Nebraska’s crop yields were relatively good compared to previous dry years.

Yield improvements have been steady, according to Dr. D. G. Hanway, Chairman of the University of Nebraska–Lincoln’s Agronomy Department, because of improved varieties, irrigation practices, fertility practices, tillage practices, and pest and disease control.

What about the dollar return for the dollar spent? One example is the development of new wheat varieties. Since 1900, a total of $3 million has been spent on wheat breeding research. In 1974 alone, three Nebraska-bred varieties produced a yield valued at $97.4 million more than production value of earlier varieties based on test plots around the state. That’s a return of over 32 times, in one year, the total wheat breeding investment in 74 years.

Similarly, great strides have been made through research in all areas of agricultural production.

A newly developed cattle feed additive has the potential to return $30 million per year to Nebraska farmers and ranchers.

Energy savings from sprinkler and automated gated pipe irrigation total $17 million per year (perhaps more in the future if energy costs increase).

Improved grain drying methods save Nebraska farmers $16 million annually in fuel costs.

A vaccine for calf diarrhea caused by a Rheo-like virus is worth over $18 million per year to Nebraskans. And, since the development of this vaccine, medical scientists have found a similarity in the genus strain that kills millions of human infants every year.

These five projects alone have a combined annual value to Nebraska’s economy of $178 million—or an annual value of 47 times the State funding average for research in the last 10 years. And the list of research accomplishments could go on and on.

Agricultural research pays—in a big way.

Robert W. Kleis is Associate Director of the Agricultural Experiment Station; Dave Parrish is Editorial Associate in Agricultural Communications.
Warm Season,

By R. C. Shearman and D. H. Steinegger

Warm season turfgrasses and ornamental grasses can play an important role in many home, park, school, and business landscapes. Five warm season turfgrasses and forty ornamental grasses are adapted to Nebraska. This article is designed to acquaint the reader with some of the characteristics and potential uses of the warm season turfgrasses and ornamental grasses for Nebraska.

Warm season turfgrasses are grown throughout the warm humid, subhumid and semiarid regions of the United States, and are also found to a certain extent in transitional zones which fall between cool and warm regions. Some parts of Nebraska border on northern portions of this zone. Warm season turfgrasses perform satisfactorily in these areas.

Unlike cool season grasses that evolved primarily in northern Europe, warm season turfgrasses had a more diverse center of origin. Some evolved in areas such as Africa, South America, and Asia. The semiarid species originated in the plains region of North America. Zoysiagrass, buffalograss, blue grama, sideoats grama,
Ornamental Turfgrasses

and to certain extents bermudagrass, are among the warm season species capable of growing in many parts of Nebraska. Bermudagrass is limited to the southeastern portion of Nebraska, due to its susceptibility to low temperature kill.

Zoysiagrass

Zoysiagrass is a long-lived perennial turfgrass that is adapted to southeastern Nebraska, and is generally not recommended for use north of the Platte River. It forms a uniform low growing, high quality turf with a slow lateral growth rate. Even though Zoysia spreads slowly it forms a dense turf that is weed resistant. Its establishment rate and recuperative potential are extremely poor due to the slow lateral growth rate.

The drought and heat hardness of zoysiagrass are excellent. It prefers fertile, well-drained soils with a pH of 6.0 to 7.0. It will not tolerate poorly drained or high saline soils. Low temperature tolerance and color retention of zoysiagrass is better than most warm season grasses. Zoysiagrass turns a light brown to straw color with the first frost in the fall. It remains dormant until late spring when soil temperatures warm sufficiently to initiate new growth.

Zoysiagrass prefers a mowing height of 0.5 to 1.5 inches. Lower heights of cut are preferred for golf course tees. Lawns perform best at heights of 0.75 to 1.0 inch. The tough, wiry nature of zoysiagrass leaves, stems and stolons contribute to its outstanding wear tolerance, but also leads to considerable mowing problems. Frequent mower sharpening and adjustment are needed to maintain desirable turfgrass quality.

Zoysiagrass requires a low to medium intensity of turfgrass culture. The nitrogen requirement for zoysia ranges from 0.3 to 1.0 pounds per 1000 sq. ft. per growing month. Once established, its nitrogen requirement is quite nominal. Higher nitrogen fertilization rates tend to encourage thatch accumulation and decrease its low temperature tolerance. Meyer and Midwest have good low temperature tolerance and spring green-up rate and are the preferred cultivars for this area. They are established from plugs, sprigs, or sod, but not from seed.

The use of zoysiagrass in Nebraska is generally limited to lawns and golf course tees. Its limited growing season, slow growth rate, and poor recuperative potential make it undesirable for use on athletic fields and playgrounds.

Buffalograss

Buffalograss is a long-lived perennial, warm season turfgrass. It is native to the semiarid region of the Great Plains and was one of the dominant species of the shortgrass prairies. Buffalograss was a major component of sod houses constructed by pioneers settling this region.

Buffalograss is the most widely used of the warm season turfgrasses in Nebraska. It forms a fine textured, low growing, gray-green turf. The gray-green color is due to fine hairs that cover the leaf surface.

Buffalograss has both male and female plants. The seed of buffalograss is born on the female plant, and is encased in a hard burr that contains one to two seeds. These burrs germinate very poorly but their germination can be improved by chilling and dehulling. Buffalograss is most commonly established by seed but can be established by plugs or sprigs. It has a fair establishment rate which can be enhanced by irrigation during dry periods.

Buffalograss has the ability to become dormant with severe high temperature and drought stress and to resume growth after these periods have subsided and conditions are again favorable for growth. It has excellent high temperature and drought tolerance and will tolerate low temperatures better than most warm season species. Buffalograss has poor shade tolerance. It can be lost from a turfgrass mixture simply through competition for sunlight. Heavy soil sites are preferred for growing buffalograss. It has good salt tolerance and will also tolerate being submerged.

Buffalograss is well adapted to Nebraska and can be utilized for unirrigated lawns, parks, cemeteries, roadsides, airfields, and other low maintenance turfs. It is commonly grown in mixtures with blue. Once established, buffalograss requires little or no irrigation or fertilization. The nitrogen requirement for buffalograss ranges from 0.1 to 0.3 pounds per 1000 sq. ft. per growing month. It prefers mowing heights of 0.75 to 1.25 inches and requires infrequent mowings. Close and more frequent mowing results in a more dense turf.

Buffalograss should be watered and fertilized with extreme care once it is established. Overfertilization and irrigation can drive buffalograss out of a turfgrass stand and encourage bluegrass to encroach.

Blue Grama

Blue grama, like buffalograss, is a long-lived perennial species that
Turfgrasses for Nebraska

is well adapted to most areas of Nebraska. It is a warm season species that is native to the shortgrass prairies. Its use for turfgrass purposes is limited. Blue grama is most commonly used to enhance stand density in mixtures with buffalograss. It is a relatively low growing, bunch-type species with a gray-green color that blends well with buffalograss. The establishment rate of blue grama is more rapid than buffalograss. It is primarily established from seed.

Blue grama has excellent heat and drought tolerance and good low temperature tolerance, but its spring green-up is slow. It is better adapted to sandy soil sites than buffalograss, and has good tolerance to alkaline soils. Blue grama is used in lawns, parks, cemeteries, airfields, and other low maintenance turfgrass areas in mixture with buffalograss. Its nitrogen requirement is similar to that of buffalo. It prefers a higher height of cut, doing best at heights of 2.0 to 3.0 inches. Blue grama, like buffalograss, will not tolerate overfertilization and irrigation.

Sideoats Grama

Sideoats grama is a long-lived perennial warm season species that is native to this area. It is an erect species with bunch-type growth that results in a relatively weak sod compared with buffalograss. It has a gray-green color and hairy leaves and mixes well with buffalograss and blue grama. Sideoats grama can be propagated by seed or sod.

Sideoats grama is not as drought tolerant as blue grama or buffalograss, and does not adapt well to alkaline soils.

Sideoats grama will not tolerate frequent mowing and is used primarily for low maintenance and minimal use turfgrass areas where soil stabilization is the primary concern. This is due to the fact that sideoats grama forms a weak sod of low turfgrass density. Blue grama and buffalograss are generally preferred for use in areas where sideoats grama might be used.

Ornamental grasses

Grasses are generally considered as the outdoor carpet for home landscapes. However, ornamental grasses can function in other ways and can complement the natural landscape of the state. In Nebraska, our plant material must survive the normal climatic stresses of the Great Plains. Ornamental grasses are uniquely suited to survive in our climate. There are 40 ornamental grasses that are adapted for use in Nebraska. These 40 grasses allow the landscaper many choices of sizes and shapes, foliage color and variation, site adaptation, and native and introduced plant materials.

Grasses are adaptable to traditional landscape uses, and may be grown with shrubs and flowers. For example, in border plantings use: Indian grass (Sorghastrum nutans), feather grass (Stipa pennata), fountain grass (Pennisetum alopecuroides), and plume grass (Erianthus ravennae). Grasses such as fountain grass or reed grass (Calamagrostis epigeous) can be used to accent a particular feature of your property. Other species like sideoats grama (Bouteloua gracilis) or sand lovegrass (Eragrostis trichodes) are excellent for making dried arrangements.

For perennial border plantings there are a variety of forms that may be used. Some are upright and narrow like eulalia grass (Miscanthus sacchari-florus). Others arch, like northern sea oats (Uniola latifolia), while some like dwarf blue fescue (Festuca ovina ‘Glauc’a) form tufts or small clumps.

Other forms exist among the ornamental grasses, allowing the homeowner flexibility in his selection for a particular design. Shrubs may be used to an advantage with ornamental grasses. Fine textured shrubs such as yews and junipers are well suited as background plants. Annual or perennial flowers may be interspersed between the grass plants to add more color to the design.

The short dense growth and attractive form of tufted or low growing grasses such as dwarf blue fescue, sideoats grama, or tufted hairgrass (Deschampsia caespitosa), make these grasses ideal for a living carpet under shrubs or trees. Low growing tufted grasses harmonize with the use of decorative mulches and fit modern as well as more naturalistic designs.

Both annual and perennial ornamental grasses are best started in spring. Annual grasses are seeded while seed or plants serve as starters for perennial grasses. Perennial grasses will require two to five years to reach maturity and flower. Spacing of annual and perennial grasses depends upon their ultimate size and purpose in the landscape. Most form dense clumps and do not spread by horizontal stems.

Ornamental grasses require minimum care. Each spring perennial ornamental grasses should be cut back to within six inches of the ground to ensure vigorous growth and provide a more attractive plant. Plants may require dividing every seven to ten years. Such plants should be divided in early spring before growth is initiated. The taller grasses may require staking.

Ornamental grasses are in harmony with the natural landscape. Furthermore their low maintenance requirements suit today’s lifestyle. As you begin planning your landscape design, consider ornamental grasses as a worthwhile addition to your plan.

R. C. SHERMAN is Turfgrass Specialist and D. H. STINEGER is Extension Horticulturist, Department of Horticulture.
New Protein Sources Evaluated

By Roy Arnold

A new research group, designated as the Food Protein Research Group (FPRG), was formed within the Nebraska Agricultural Experiment Station in 1975. This group includes Experiment Station scientists from several departments with common research interests in food proteins.

The Group's research deals with evaluation of alternatives for supplying protein needs of the world's future population. Potential protein sources are identified, the protein is systematically evaluated for nutritional quality, acceptability of the proteins and economic feasibility of protein recovery processes.

The FPRG developed from research activities initiated by Lowell Satterlee, Professor of Food Science and Technology, and James Kendrick, Professor of Agricultural Economics. The current group also includes Robert "Bud" Britton, Animal Science; Robert Ogden, Ag Biochemistry Laboratory; Milford Hanna, Ag Engineering; and Gary Miller, Food and Nutrition. Roy Arnold, Chairman of the Department of Food Science and Technology, serves as coordinator of the group.

The mission of the FPRG is best described as improved utilization of protein resources. Why and how we go about our work can be compared to our nation's responses to the current energy crisis. In addition to efforts to increase energy supplies and locate alternate energy sources, considerable emphasis has been placed on conservation and more efficient utilization of available energy resources.

Likewise, it seems logical that projected worldwide shortages of protein will require expanded supplies through increased production, alternative sources of protein and improved utilization of existing resources. The FPRG research program deals with alternative sources and better utilization of existing protein resources.

Several of the projects of the group have dealt with recovery of food grade protein products from by-products or low quality materials that are now used inefficiently as livestock feed or discarded. Wheat bran, distillers by-product, or cull dry edible beans are examples. Each of these materials can be "taken apart" to produce food grade protein products plus one or more residue fractions. The residual material may still be useful in feeding livestock. The net effect of the fractionation process is thus better efficiency of utilization of the potential human food value of the material.

The FPRG represents a unique, multidisciplinary research effort. A systems approach to research is involved, including

a) the technology of recovery of proteins from various sources;
b) nutritional properties of isolated protein products, including amino acid composition and biological determinations utilizing animal feeding studies;
c) functional properties of the products in various food systems (i.e., effect of protein on color, flavor and textural properties);
d) animal feed value of the by-product; and
e) economic feasibility of the processes.

Involvement of scientists from several Experiment Station departments is essential for the group's systematic and thorough approach to protein research.

Specific projects of the group have dealt with protein products from wheat bran, cull dry edible beans, distillers by-product, alfalfa leaves, whey, and mechanically deboned meats. Also under active investigation is the concept of blending of these and other protein products, such as soy, peanut, cottonseed and yeast proteins, to achieve specific nutritional and functional properties.

The FPRG makes extensive use of the computer in blending of proteins. The computer is also being used to simulate biological systems for evaluation of protein quality, a concept which is attracting considerable attention from regulatory and industry groups.

Research of the group has been supported by the Agricultural Experiment Station, the University of Nebraska Foundation, and several external sources, including the Nebraska Wheat Commission, Nebraska Alfalfa Dehydrators, Nebraska Department of Economic Development and the National Science Foundation. Drs. Kendrick, Satterlee, and Miller currently hold a second major grant from the National Science Foundation.

A national conference on protein evaluation methodology, to be held in Lincoln under sponsorship of the FPRG and the National Science Foundation, is planned for this fall.

ROY ARNOLD is Chairman of the Department of Food Science and Technology.
Computer Can Analyze Your Diet

By Harriet Kohn and Thomas L. Thompson

Are you getting too little or too many nutrients and calories in the food you eat? The Institute of Agriculture and Natural Resources has developed a computer program called DIETCHECK. The program calculates your food intake for nutrient content and energy levels.

The DIETCHECK program can be used through the AGNET (Nebraska AGricultural Computer NETwork) system. Access to AGNET can be made through a portable computer terminal (it looks like a typewriter) and any telephone.

The computer interacts with the user and asks the questions. One day's food intake or menu is coded and entered. Then the terminal types back the data analysis and a comparison with the recommended dietary allowances. The example on the next page illustrates one type of analysis that can be obtained.

DIETCHECK is a tool that enables much faster analysis of nutritional data than could be done by hand. Its many applications include:

1. Use as a counseling tool by professionals and para-professionals in helping people identify the strengths and weaknesses in their food intake.
2. Use in human nutrition research.
3. Evaluation and planning of menus.
4. Determining nutrient content of recipes.
5. Use as an aide in teaching students applied nutrition.
6. Monitoring actual food intake of hospitalized patients and people with special dietary needs.

A DIETSUMMARY computer program is also available to summarize the results of a number of DIETCHECK analyses. Presently the DIETCHECK program is being modified to include dental food factors. The dental food factors section will be used in preventive dentistry counseling.

Currently the DIETCHECK and DIETSUMMARY programs are in use in a number of places in the state. The Nebraska Department of Health, Division of Nutrition, is considering their use in evaluating menus served in nursing homes and hospitals as well as individual food intakes. They are being used within the Institute of Agriculture and Natural Resources as well as the Food and Nutrition Department of the College of Home Economics. The portable terminals give great flexibility to places of use so long as a telephone is nearby. Extension specialists may carry a computer terminal with them as they travel across the state. Yes, it could even be used from your kitchen table.

Harriet Kohn uses the portable computer system in her Extension research.

Harriet Kohn is Extension Specialist, Food and Nutrition; Thomas L. Thompson is Professor of Agricultural Engineering.

Currently, computer terminals are available at the Panhandle Station, Scottsbluff; Box Butte County Extension Office, Alliance; Northeast Station, Concord; University of Nebraska campuses.

The authors wish to acknowledge the help of Sharon Meyer, North Panhandle Area Extension Agent and Sarah Jones for the programming assistance. The DIETCHECK Program uses the Department of Administrative Services' Computer at the State Capital.
Photographing Rural Nebraska

By Marcia Pearson

Amidst the hoopla and festivities of our country’s 200th birthday celebration, a quiet effort has been going on in every state to capture on film what rural America is like in the mid-1970’s. The photographers involved are part of the U.S. Department of Agriculture’s Project ’76, an ambitious Bicentennial program launched last spring.

The best efforts of these amateur and professional photographers will appear in USDA’s 1976 Yearbook of Agriculture, “The Face of Rural America,” and in a travelling exhibit by the same name.

The outsized (8½” by 11”) pictorial book will have about 300 pages of black and white photos and captions; more than 250,000 copies will be printed. The yearbook is expected to be both an interpretation of agriculture now and a valuable history in years to come. Certainly, too, it will become a treasured keepsake for many Americans.

Nebraska has been part of the project from the start. The 13 participating Cooperative Extension Service photographers—hand-picked by USDA for their skills and location — included the University of Nebraska-Lincoln’s Extension Visual Aids Specialist Bart Stewart and Extension Photographer Dick Dodds.

The unique assignment challenged the photographers to take a fresh look at rural Nebraska. Between them they photographed farm and ranch operations in Sidney, Scottsbluff, Bridgeport, Morrill, Ceresco, Eagle, Weeping Water, Plattsmouth, Hickman, Firth, Wilber, York and Lancaster County.

They’ve taken pictures of planting, cultivating, harvesting, farmers working on equipment and trucks, feedlots, rural communities celebrating the 4th of July, county fairs, State Fair, grain elevators and buildings.

Sandhills ranching, hay operations and wheat harvest in western Nebraska were photographed by freelancers Michelle Bogre and Bill Marr. The two are photojournalism students of Angus McDougal, head of the Photography...
Department at the University of Missouri – Columbia.

The USDA team heading up the project has asked photographers for action shots, "slice of life" photos, farmers at rest, crops in trouble, farm families, children in rural schools, church life, and shots of the land and crops. Most importantly, they’ve wanted candid photos of life "as it is."

"Being there at the right moment is the secret behind outstanding candid shots," points out Bart Stewart. "I've set up specific times to take pictures of farmers at work, but some of the best shots came as I was driving along a country road and spotted a combine working in the sunset or an anhydrous rig crossing ahead of me."

Both Nebraska photographers had to contend with bad weather, heat, dust, cloddy ground, and an occasional suspicious subject. Stewart got an irritating whiff of anhydrous ammonia when he came in too close for a picture, and another time almost lost his eyeglasses in a truckload of milo. "The last bushel slid off the truck into the auger and we snatched my glasses out just in time!" says Stewart. Another frustration was setting aside enough time in his work schedule to take pictures.

Every few weeks Stewart sent in contact proofs of the pictures he chose to enter. USDA information specialists are selecting which ones are to be included in the yearbook. Each picture will be captioned to identify people and places, describe the farm operation, and identify the photographer.

A clear distinction has been made between this special USDA yearbook and journals which take a historical look at America's first 200 years. "We are not attempting to recap 2 centuries of U.S. agriculture," says Dave Granahan, Executive Director of the USDA Bicentennial. "Instead, we hope to record what farming and rural life is like right now."

Yearbook Editor Jack Hayes expects the book to be off press in July. If you would like a free copy, write to your Congressman or U.S. Senator in July. □
Center pivot irrigation (above), tow-line irrigation and sprinkler irrigation (right) help nourish research crops at the Mead Station. This is possible only through an adequate water supply.
Irrigation—From Army Ordnance to Ag Research

By Warren W. Sahs

Conducting agricultural research on what once was an Army Ordnance Plant near Mead has presented innumerable challenges over the years to University of Nebraska agricultural researchers. One challenge has been to convert existing facilities to logical and useful purposes in current research programs.

The Ordnance Plant's complex and well designed water system was constructed primarily for fire control. In 1964 its primary use changed to irrigation to become one of the most unique systems in the Midwest.

The 9,500-acre Field Laboratory became available to the Institute of Agriculture and Natural Resources through a Health, Education and Welfare grant in 1962 for research, Extension, and demonstration activities. The land area was essentially the south half of the Nebraska Ordnance Plant.

The original water system provided for immediate delivery, to any area within the ammunition plant, of not less than 3,000 gallons per minute or 4½ million gallons per day for a period of not less than three days. This system was maintained and transferred to the University in excellent condition due to the diligence and close surveillance by the former Ordnance Plant civilian superintendent, F. C. Hastert. Mr. Hastert was retained as facilities manager for the Laboratory and knew the capability of the water system.

(continued on next page)
Irrigation

The value of this water distribution system for irrigation was readily apparent. The existing wells and pressurized 12-inch water main (55 PSI) were visualized as having potential for bringing tractor skid tow lines to various areas and tapping the existing water supply for the surface and sprinkler irrigation of various research plots and demonstration plantings. It also could bring water supplies to livestock pastures and animal confinement areas. Adding 1,000-1,200 GPM irrigation wells to the system greatly enhanced the capability of the system for irrigation.

The engineers agreed that the system could possibly be converted from a military fire protection system to a vast underground irrigation system second to none, provided adequate valving and controls were installed on the large wells. In short, after gingerly testing the system with the first large irrigation well, we now have added a total of five irrigation wells, boosting the water capability 4,500 GPM to a total of 7,500 GPM. The present system of 59,000 feet of 12-inch, 17,600 feet of 10-inch, 30,250 feet of 8-inch, and 4,000 feet of 4-inch pipe (approximately 20 miles) is working and has needed practically no maintenance.

One must remember that the original system was installed in 1942. The initial entire water supply consisted of eleven wells of the gravel packed type. Each original well was equipped with a deep well turbine pump.

A complete chemical analysis of each well was determined showing "sweet," good quality water which was relatively free of harmful minerals. Since the water is moderately hard, some wells contribute iron and manganese to the supply. The static water level is 48 feet, with the water bearing aquifer being in the 90-to 120-foot depth. The Platte River once traversed this area causing water bearing sources of excellent gravel.

Five irrigation wells were added from 1964 to 1975. Standard irrigation risers serve as water taps to the main line and several more were added at strategic sites.

All pumps are driven by electric motors and are equipped with pressure switches and necessary controls for automatic operation during normal, fire, or irrigation use. A veteran employee, Carl Patterson, daily monitors the main pressure and the operation of the motors and pumps.

Within the Field Laboratory area are two elevated steel storage tanks with a capacity of 200,000 gallons. These built-in surge retardents enable the system to handle the starting and stopping of the 1,000 to 1,200 GPM pumps.

All services are valved for independent disconnections. The distribution mains are valved in sections of reasonable lengths to facilitate repair in case of damage, and air release valves are provided at peaks.

The water mains are of class 150 cast iron pipe (de Lavaud) with the exception of 15,000 feet of 12 inch cement asbestos pipe (transite). The cast iron pipe is of the bell and spigot type and is laid with "mineral lead" joints; the cement asbestos pipe is joined with "Dresser" type couplings. All pipe is laid with a minimum cover of 5 feet.

The development of the Field Laboratory has been accomplished mainly through the recycling or salvage of military financed structures, equipment, and railroad lines. Conversion of the defunct Ordnance Plant's water system to a valuable irrigation resource is one example of how military installations can be renovated and used to meet today's needs.

Warren Sahs is Assistant Director of the Agricultural Experiment Station.
Credit Use Among Nebraska Farmers

By Bruce B. Johnson and Ronald J. Hanson

Farming continues to cost more and more. All assets used in farming in the United States totaled a record $594 billion on January 1, 1976, almost double (a 94-percent rise) the level for 1970. The per farm value of these assets averages nearly $200,000, with many farms easily exceeding one-half million dollars in investments.

Along with this growth in assets has been increased use of credit. Total liabilities in the farming sector were at a record $90 billion for January 1, 1976, up 80 percent from 1970.

Credit is a vital management resource to Nebraska farmers. With the continued price-cost squeeze, farmers must acquire more debt dollars to control more resources and expand production to maintain profit levels.

To analyze the role of credit among Nebraska farmers we have referred to the 1970 Survey of Agricultural Finance, a special sample survey conducted by the U.S. Department of Commerce, Bureau of the Census. This survey was conducted to provide more information regarding farm credit use than is offered currently by other Census of Agriculture reports.

Since this information has not been made available before on a state-by-state basis, this survey offers unique insights into Nebraska's farm credit situation.

Obviously, the level of debt by Nebraska farmers has expanded since the survey was taken. However, the relative patterns of credit use change more slowly. Therefore, this analysis, although based on 1970 data, reveals a useful perspective of the current farm credit situation in Nebraska.

Nearly two out of three farm operators in Nebraska had debt in 1970, as compared to roughly half the farmers in the United States. These Nebraska farmers averaged a $42,900 debt, although this figure would be substantially higher today due to the rapid price increases for farmland, machinery, and operating inputs in the past three years. Farm real estate debt accounted for 57 percent of the total farm debt in Nebraska.

Both the incidence and the amount of debt increased as farm size expanded. For example, 86 percent of the farms generating sales greater than $40,000 annually had debt, averaging nearly $112,000 per farm.

At the other end of the size range—farms with sales between $5,000 and $10,000—less than half reported debt. These farmers averaged a smaller debt ($16,800) which was mostly for farm real estate.

Farm debt in Nebraska is concentrated within the larger operations. For example, those farmers with farm sales exceeding $40,000 accounted for 60 percent of the total farm debt. These farmers represented 17 percent of all farm operators in Nebraska, but accounted for 66 percent of all farm sales. Consequently, indebtedness appears to be closely associated with the level of farm sales, which itself is an indirect measure of debt repayment capacity.

Who are the farm operators in Nebraska with farm debt? Part-owners were the largest users of debt with over three-fourths reporting debt, averaging $57,100. These operators, who own some of their land and also rent from others, tend to be operating larger acreages than full-owners. Therefore they rely more heavily on credit, especially for long-term real estate loans. Fifty-four percent of the full owners reported farm debts; they averaged $35,000.

The frequency of farm debt reported by farmers declined as their age increased. As expected, a very high incidence of debt (75 percent) was found among young farmers (less than 35 years old.) Still, more than a third of the farm operators 65 or older had debt. However, their average amount ($17,000) was generally half that reported by other age groups of farmers.

Bruce Johnson and Ron Hanson are Assistant Professors of Agricultural Economics.
Figure 1 (top) shows a 5-year-old cow with brisket edema probably due to consumption of Senecio. Figure 2 (center) shows a close up of Senecio collected from the Sandhills Agricultural Laboratory at Tryon, Nebraska. Figure 3 (bottom) shows a pasture infested with Senecio.
Brisket Edema

Toxic Weeds Can Cause Disease in Cattle

By Clair Hibbs, Gene White, and Jim Nichols

Livestock producers must constantly be on the lookout for indications of disease in cattle. One affliction they should watch for is the dough-like thickening of the brisket and neck called brisket edema (Fig 1).

The thickening results from accumulation of body fluids in the area resulting from some of the following: hardware, internal parasites (worms), external parasites (sucking lice); raising cattle at altitudes more than 5,000 feet above sea level; consuming such weeds as Senecio (groundsel); Crotalaria and Heliotrope; and chronic anemias such as may be caused by chronic anaplasmosis.

North Platte Veterinary Science Laboratory records show that from 1969 to 1975 22 cases of brisket edema have been brought in for diagnostic examination (Table 1). These cases give a barometric indication of the impact of this condition on the beef and dairy industry in Western Nebraska.

The affected cattle originated from 10 ranches or farms in 7 counties. Various breeds and crossbreeds of both sexes were affected. All but two cases occurred in cattle less than 2 years old. Two adult cows 5 years old were observed with the disease. Most cases have been observed in late fall and early winter.

A complete history and thorough examination of the carcass and organs eliminated hardware, internal parasites, external parasites, elevation effects, and chronic anemia as the cause.

Theoretically, this leaves toxic weeds as a possible cause. Weeds of the genera Crotalaria and Heliotrope are not common to Western Nebraska; yet, Senecio, especially *Senecio ridellii* (riddell groundsel), is common on Western Nebraska rangeland (Fig. 2).

Senecio is a yellow flowering seed that blooms and is most palatable during late fall when pastures are often dry and may be overgrazed. All of this tends to incriminate riddell groundsel as a cause of otherwise unexplained cases of brisket edema. There are other species of Senecio that may cause brisket edema in cattle; however, they are less prevalent in Nebraska.

It has been difficult to prove that eating Senecio by cattle causes brisket disease in field cases, since the disease may not develop until 3 weeks to 6 months after the animal first eats the weed.

Similar conditions have been artificially produced in rats, cattle, and monkeys. Medical literature calls this pulmonary hypertension, which means high blood pressure due to resistance to blood flow through the blood vessels of the lungs.

Senecio has been recognized as a problem weed for many years, but perhaps for a different reason. Doctors L. Van Es, L. R. Cantwell, H. M. Martin and J. Kramer, formerly of the University of Nebraska, described "Walking Disease" in horses due to eating Senecio in 1929.

Brisket disease is another disease of cattle which may be commonly overlooked or misdiagnosed in Western Nebraska. Data collected at the Veterinary Science Laboratory at the University of Nebraska North Platte Experimental Station point out the fact that this condition is important to the cattle industry in Western Nebraska. Perhaps proper grazing and weed control could significantly reduce this disease. Examination by a veterinarian is helpful in differentiating this condition from various related diseases.

Table 1. Summary of 1969-1975 North Platte Veterinary Science Cases of Bovine Brisket Edema—Unknown Etiology.

<table>
<thead>
<tr>
<th>Breed</th>
<th>County</th>
<th>Age</th>
<th>Sex</th>
<th>Date</th>
</tr>
</thead>
<tbody>
<tr>
<td>Angus</td>
<td>Lincoln</td>
<td>7 months</td>
<td>Male</td>
<td>November</td>
</tr>
<tr>
<td>Angus</td>
<td>Lincoln</td>
<td>7 months</td>
<td>Female</td>
<td>December</td>
</tr>
<tr>
<td>Cross</td>
<td>Lincoln</td>
<td>1 year</td>
<td>Male</td>
<td>October</td>
</tr>
<tr>
<td>Angus</td>
<td>Scotts Bluff</td>
<td>1 year</td>
<td>Female</td>
<td>April</td>
</tr>
<tr>
<td>Hereford</td>
<td>Cherry</td>
<td>10 months</td>
<td>Female</td>
<td>December</td>
</tr>
<tr>
<td>Hereford</td>
<td>Scotts Bluff</td>
<td>9 months</td>
<td>Female</td>
<td>December</td>
</tr>
<tr>
<td>Hereford</td>
<td>Cherry</td>
<td>11 months</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Angus</td>
<td>Custer</td>
<td>1 year</td>
<td>Male</td>
<td>August</td>
</tr>
<tr>
<td>Hereford</td>
<td>Cherry</td>
<td>1 year</td>
<td>Female</td>
<td>March</td>
</tr>
<tr>
<td>Angus</td>
<td>Scotts Bluff</td>
<td>7 months</td>
<td>Male</td>
<td>October</td>
</tr>
<tr>
<td>Angus</td>
<td>Scotts Bluff</td>
<td>1 year</td>
<td>Male</td>
<td>October</td>
</tr>
<tr>
<td>Angus</td>
<td>Scotts Bluff</td>
<td>1 year</td>
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<td>October</td>
</tr>
<tr>
<td>Angus</td>
<td>Scotts Bluff</td>
<td>1 year</td>
<td>Female</td>
<td>December</td>
</tr>
<tr>
<td>Angus</td>
<td>Scotts Bluff</td>
<td>1 year</td>
<td>Female</td>
<td>December</td>
</tr>
<tr>
<td>Angus</td>
<td>Deuel</td>
<td>7 months</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Charolais</td>
<td>Frontier</td>
<td>1 year</td>
<td>Female</td>
<td></td>
</tr>
<tr>
<td>Hereford</td>
<td>Lincoln</td>
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<td>September</td>
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<tr>
<td>Angus-Hereford</td>
<td>Sheridan</td>
<td>8 months</td>
<td>Female</td>
<td>October</td>
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<tr>
<td>Angus</td>
<td>Scotts Bluff</td>
<td>1 year</td>
<td>Female</td>
<td>October</td>
</tr>
<tr>
<td>Angus X</td>
<td>Sheridan</td>
<td>8 months</td>
<td>Female</td>
<td>September</td>
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<tr>
<td>Hereford</td>
<td>Lincoln</td>
<td>5 years</td>
<td>Female</td>
<td>December</td>
</tr>
</tbody>
</table>

CLAIR HIBBS is Professor of Veterinary Science; GENE WHITE is Associate Professor of Veterinary Science; JIM NICHOLS is Professor of Agronomy at the North Platte Station.
Is Solar Heating

By J. A. DeShazer and N.C. Teter

Solar energy is the new, "hot" energy topic this year, and these are some of the questions research engineers are answering:

Is a solar heating system feasible for livestock housing?

What kind of system design should I use?

Should heat pumps be used to transport heat from one area to another?

Should building floors and walls be used to store solar heat?

How about using the lagoon to collect and store solar energy?

Research supported by the Energy Research and Development Administration may hold answers to these questions. This Administration is working with the U.S. Department of Agriculture and the UN-L Agricultural Experiment Station. Nebraska is one of four states involved with solar swine housing; Kansas, Virginia, and Missouri are the others.

What is Nebraska doing? UN-L
Feasible for Livestock Housing?

research is determining the feasibility of using solar heating during the winter for growing-finishing pigs. Fuel saving, gas or electric, and feed saving are possible ways to pay for solar collection. We are studying solar collection, insulation, and retrieval of latent heat as conservation principles.

As part of our research, we modified one quarter of an existing 144-foot by 12-foot swine building at Mead to include a solar heating system (Fig. 1). The heating system consists of a flat plate collector, 6-foot by 36-foot, to bring heated air to the sleeping areas of the building and translucent overhead doors to allow additional solar heat to come directly into the building. With the overhang as shown, very little solar energy passed through the overhead doors during the experiment. Almost all solar energy collected came from the black collector plate.

Economics played an important part in the design of the flat plate collector. The collector surface (that part receiving the solar energy and converting it into heat) is ½" plywood painted with a special black paint that has a high absorptivity over a wide band of the sun's rays. The glazing which traps the sun's rays is made from a 4 mil PVF (poly vinyl fluoride) plastic shrunk on 3' x 6' oak frames. Double glazing was used to reduce heat loss by conduction through the plastic. The efficiency of this system can vary from 20 percent to 70 percent depending upon the cloud cover and time of day.

The air flow for the system is shown in Figure 2. Attic air is brought through the 1½-inch space between the collector and glazing. Then the heated air is transported through an insulated 12-inch duct to the back of the pen (Fig. 3), and distributed along the insulated north wall by plastic tubes pressurized with a 1000 cfm blower (Fig. 4).

The air flow of 100 feet per minute across the north wall chilled the growing pigs that had an average starting weight of 30 lb on January 23rd. In growing to 80 lb., the pigs subjected to the forced ventilation required 0.1 pound more of feed to make a pound of gain than those pigs without forced air in the conventional side. Winter air flow should be initially directed across the ceiling as opposed to across the pig.

The return air from the building is brought over the top of a 4-foot wide metal plate which is cooled by outside air passing on the underside of the plate. The plate was designed to condense moisture out of the room air and heat up the incoming winter air.

Some ventilation is needed to remove gases and additional water from the building. The 6' x 7' translucent overhead doors on the south side of the pen condensed water. Therefore, these doors served as condenser plates, making the 4' metal plate (Figure 2) ineffective.

What happens when you don't

(continued on next page)
Solar Heating

have solar energy? When the collector air temperature is within 3°F of the attic temperature a motorized damper causes air to bypass the collector. At the same time the fan delivery of air from the attic space is reduced to a rate of 700 cfm. When the collector air temperature is 20°F higher than attic temperature, the flat plate collector operates. Heat lamps are turned on by a thermostat when the temperature in the building drops below 40°F for the growing pig (40-100 lbs) and 35°F for the finishing pig (100 lb-market weight).

On the average we have a potential of collecting 800 Btu/day/ft² of the collector surface in Nebraska. For growing-finishing pigs we will probably use the system 120 days from mid-November to mid-March. Therefore, we will collect 96,000 Btu per square foot which is approximately the energy values of a gallon of propane. The collector plate for our system costs 40¢ per square foot and the glazing costs $2.67 per square foot, the major expense of $1.67 of the $2.67 being the glazing frames. This could be reduced.

The total materials cost for the system including ducting, fans and thermostats is $6.00 per square foot. Labor adds an additional $10 per square foot to the collector cost. Therefore, for a total cost of $16 per square foot the collector retrieves a gallon of propane, or 26 kwh of electricity, yearly. However, final judgment of the feasibility of solar heating systems should await the results of these and other national tests. The day may soon come when we can’t get conventional fuels, but solar energy is free and here to stay.

J. A. DeShazer and N. C. Teter are professors of Agricultural Engineering.

The concept of the solar system at the UN-L-Field Laboratory at Mead has come about through group discussions with the Departments of Agricultural Engineering, Construction Management, Animal Science, and with industrial cooperation with OPPD, Solar Incorporated and Perkasie Industries.