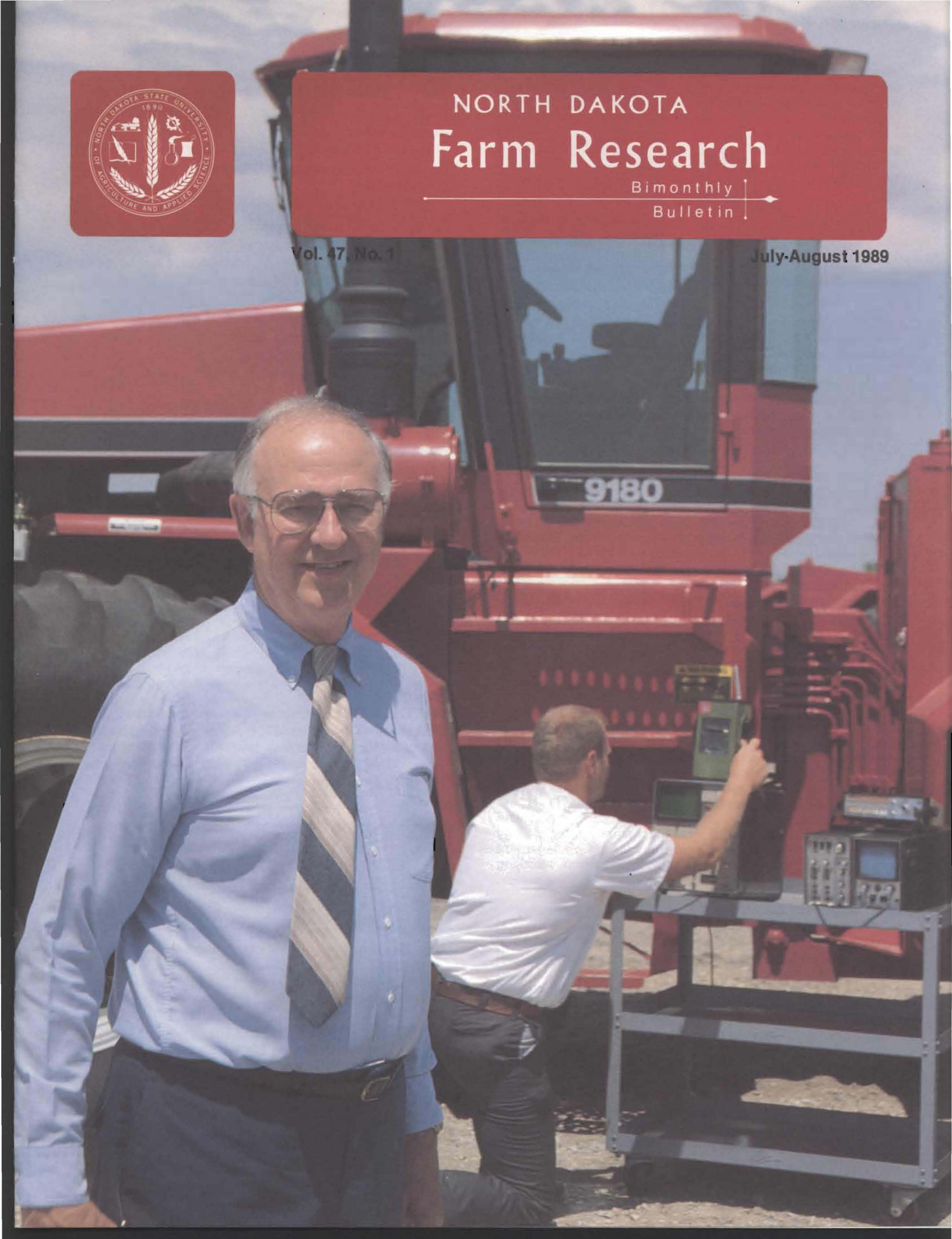


# NORTH DAKOTA Farm Research

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# Guest Column

**George Pratt**
Former Chairman
Department of Agricultural Engineering

At the time of my appointment to the agricultural engineering staff in 1953, the mechanization of North Dakota agriculture was well under way. The time since has been a period of extensive refinement in engineered systems for both agricultural production and the processing of agricultural commodities. New well-engineered machines were needed to handle high-yielding crops, improved livestock, pesticides and fertilizers found in today's production agriculture.

Grain handling improvements probably offer one of the best examples of both drudgery reduction and the improved efficiency needed to handle modern production. We would have trouble finding enough farm laborers today to hand shovel the quantities of grain now produced on North Dakota farms.

Men and women in agricultural engineering operate at the interface between engineering and biology. Agricultural engineering is the profession with the responsibility for the engineering and management of biological systems for agricultural production, food processing, industrial feedstock utilization, maintaining environmental quality, and biotechnology. Knowledge of the physiology of plants, animals, or micro-organisms as they relate to agriculture is the component of agricultural engineering that makes it unique from other engineering disciplines.

Agricultural mechanization technology is a companion profession that parallels and supplements agricultural engineering. The area of primary emphasis for men and women in agricultural mechanization technology (AMT) is the management interface between mechanical systems and biology/agriculture. Agricultural mechanization technology is the profession with the responsibility for the management of engineered systems for agricultural production, handling and processing of agricultural commodities, and the preservation of the environment.

Engineered systems for the agricultural and biological sciences are needed to provide safe, effective agricultural production and commodity processing to meet international competition. People of the world have looked to the United States as a major supplier of food and other agricultural commodities. As soon as new engineering developments are made public, they are adopted around the world. Research must continually move forward to refine production that will keep agricultural production in the United States ahead of the competition. A wide range of technologies are being introduced. Let me describe a few.

Machine vision is an example of a technology that is here today and offers wide application to agricultural production and processing. Machine vision systems typically include a

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**ON THE COVER:** George Pratt, recently retired chairman of the Department of Agricultural Engineering, shares his views of the past, present and future of mechanization and engineering in agriculture in this issue. Photo by Gary Morgan.

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*Gary Moran*

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video camera and a computer system that acts as an image processor and system controller. A machine vision system can detect defects or sort for size or shape of objects on processing lines.

The U.S. Air Force has a global positioning system partially operational at the present time. Twenty-one satellites will be placed into orbit to complete a basic navigational system. The system provides for accurate location of sites on earth and is being used as a tool for ground surveying. This system, coupled with automatic guidance and variable rate planters and fertilizer applicators, can make possible the optimization of plant populations.

Transmission of electronic signals through the air using infrared light beams is being used in engineered systems. Data collected from sensors can be transmitted more easily from the field using infrared than if the wire is used. An example of this technology is the use of infrared light beams to transmit signals from soil moisture sensors to computers for automated irrigation systems.

Lasers are in use today for controlling land leveling equipment. The equipment is used in the Red River Valley. In this application, the laser is part of the sensor system. The beam is used to indicate if a receiver is above or below a predetermined elevation. In response, the leveling control equipment is activated.

Water balance irrigation scheduling methods, developed in North Dakota, are being adapted to automating irrigation management to make more efficient use of irrigation water possible. These management systems will use data that are transmitted from sensing units in the field to a computer located at the farmstead. Data analyzed by the computer in turn will be transmitted back to the irrigation system to start and stop the unit automatically.

Upgrading food products, developing agricultural based industrial feedstocks, and biotechnology all can be used to develop new uses of crops. Agricultural engineers will design, test, and supervise fabrication of equipment needed to commercialize processes developed by biological scientists.

The stomata of plants provide for movement of gases and water vapor through the plant leaf. Engineers have used computerized finite element analysis to understand and model the opening and closing of stomata. Control of these stomata based upon engineering analysis could affect drought resistance of crops.

A computer-controlled gantry operating over plots of land to carry out field operations from tillage to harvest is under test. Wheels at each end of the gantry run on tracks or compacted soil paths. Overhead trusses span the space between the wheels and are used to guide power units and implements. Greater precision in control of tillage, planting, and harvesting systems may be achieved with the system and soil compaction may be controlled.

Diesel engines with improved efficiency are under development and may be adapted to agricultural tractors. Today's engines utilize only about one-third of the heat energy of the fuel to produce work. The remainder is lost through exhaust gases and cooling system. New ceramic materials are being built into engines to make it possible to operate them at higher temperatures. These adiabatic diesel engines show significant promise of converting a major part of the heat energy of fuels into useful work.

Agricultural engineers are developing automated controls for combines. Several sensors including devices to measure grain loss from the sieves are in common use. Electronic signals from sensors of this kind are being sent to a computer which in turn can send signals for control of appropriate components of the combine. Ground speed, concave clearance and air flow rates are examples of components that can be controlled automatically.

Systems for utilizing on-board computers are being developed to optimize tractor performance. A series of sensors can be used to measure factors to allow computer control based on sensor input. Fuel efficiency is a major variable that may be controlled in this way, but the system could be adjusted for other factors such as maximum work rate in emergency situations.

Robots are being developed for a wide range of agricultural engineering applications. An example is a machine for transplanting plants from greenhouse flats to the field. Sensors are used to identify containers with viable plants.

The future holds potential for many exciting developments. Engineers at NDSU will contribute to these developments. They build on a program that dates back to 1892, two years after the North Dakota Agricultural College was established, when E.S. Keene was appointed Agricultural Engineer with the Agricultural Experiment Station. Research, teaching, and extension activities in agricultural engineering and agricultural mechanization technology have been a part of the university since. Most engineering developments cannot be attributed to single isolated research breakthroughs. Most developments have resulted from evolutionary changes. Researchers and alumni from the Agricultural Engineering Department at NDSU have contributed to these changes over the years. It's been an exciting period of development and shows promise of leading to a future where agricultural engineers will continue to develop equipment and facilities that will insure that North Dakota agriculture remains competitive in the world economy.

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