Winter 1966

South Dakota Farm and Home Research

Agricultural Experiment Station

Volume XVII Winter, 1966 Number 1

South Dakota FARM & HOME RESEARCH

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Agricultural Experiment Station
SOUTH DAKOTA STATE UNIVERSITY
Brookings, South Dakota

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SOUTH DAKOTA FARM AND HOME RESEARCH

Volume XVII Winter, 1966 Number 1

A Report of Progress

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Duane C. Acker, Dean of Agriculture and Director, Agricultural Experiment Station

Frank J. Shideler .... **Editor**

Leland L. Sudlow .... **Photographer**

Nathanial S. Cole .... **(Cover)**

New Dean and Director

Duane C. Acker

Duane C. Acker assumed duties as dean of the College of Agriculture and Biological Sciences at South Dakota State University February 1.

Dr. Acker, 34, replaces O. G. Bentley, who last fall accepted the deanship at the University of Illinois. He will serve as coordinator of teaching, research and extension in the College of Agriculture. In addition, he will be director of the Agricultural Experiment Station.

Before coming to South Dakota, Dean Acker was at Kansas State University, Manhattan, serving as associate dean of agriculture, director of resident instruction, and, since July 1965, assistant director of the Agricultural Experiment Station. He had been at Kansas State since 1962. He was on the staff at Iowa State University from 1955 to 1962, advancing from instructor to associate professor in charge of the farm operations curriculum. He also taught 2 years at Oklahoma State University.

John T. Stone, dean of Extension, will continue to carry out functions of agricultural extension as part of his expanded responsibilities in the total university extension program. Burton L. Brage will continue as director of resident teaching in agriculture and A. L. Musson as assistant director of the Agricultural Experiment Station.

In addition to his academic achievements, Dean Acker served as a consultant in Argentina for the Agency for International Development and as a nutrition consultant for Schering Corp. He also has had experience as an extension youth assistant in Audubon County, Iowa, as a radio farm editor at station KJAN, Atlantic, Iowa, and as a research farm worker for Walnut Grove Production Co., at Atlantic.

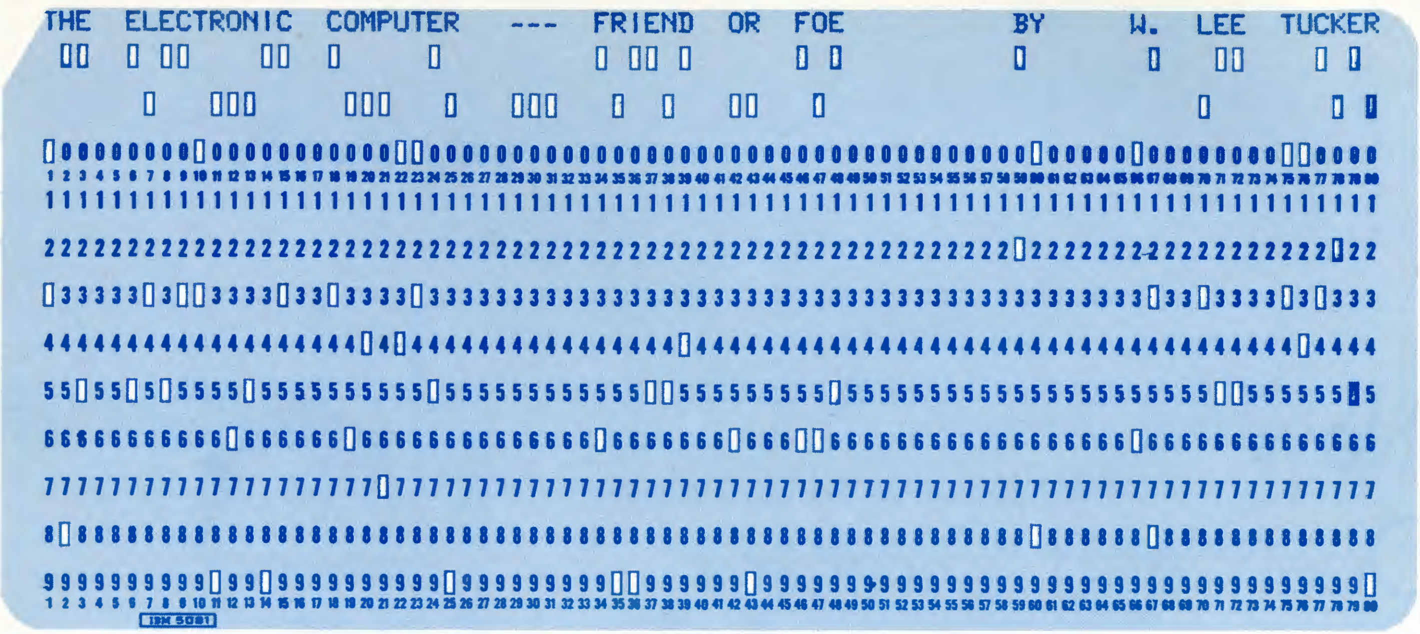
Dean Acker is author of the text book "Animal Science and Industry," 10 research articles on animal nutrition, 17 in farm and feed trade magazines and four on instruction and curriculum.

He was named an honorary State Farmer in 1964 by the Kansas Future Farmers of America. At Iowa State he was designated professor-of-the-year in the College of Agriculture in 1959. He received the Gamma Sigma Delta Tall Corn Award for effective academic advising in 1962 and was given the 4-H Alumni Recognition Award by Iowa 4-H clubs in the same year.

Dean Acker is listed in "Who's Who in America" and is a member of professional and honor societies including Alpha Zeta, Gamma Sigma Delta, Phi Kappa Phi, and Sigma Xi.

A native of Iowa (Atlantic), Dr. Acker graduated from Wiota Consolidated High School in Iowa. He earned bachelor's and master's degrees at Iowa State University and a doctorate in animal nutrition from Oklahoma State University.

Dr. and Mrs. Acker are the parents of two daughters, Diane Jean and Lu Ann.



Combinations of the small rectangular holes in the vertical columns represent coded data that the computer "reads." In the case of the above card (reproduced actual size) the holes, or punches, spell out the title of this article and the author's name.

the electronic computer —friend or foe?

A new "tool" in use at the Agricultural Experiment Station not only speeds up getting research results to the farmer but does it better with a saving in time and money.

This tool is an electronic computer including its human and mechanical accessories. The machine can take masses of research data and come up with answers to complicated research questions in a matter of hours instead of weeks, months or even years if analyses had to be made with hand operated calculating machines. And the computer doesn't make "human" errors.

In addition to these time and labor saving factors, there is even another bonus: wringing the most out of the research data which is collected. Previously, because researchers just did not have time to make all calculations themselves or even supervise semi-skilled help, much of the valuable data obtained from an experiment was not always used. Only a relatively few things were measured and recorded. In turn, because of the time factor, these often were only partially analyzed.

When a South Dakota State University researcher is working in agriculture, he usually spends most of his time during the spring and summer growing season working in the field, checking, taking notes, making observations. He will end up with hundreds of items involving data from each of his experiments.

During fall and winter the researcher must compile and analyze results, write reports. Too, during this time, he usually must conduct laboratory and greenhouse experiments which support the field work. In addition, as with most research personnel at South Dakota State, he will be conducting classes during the academic year. He also must carefully and painstakingly plan the experiments for the following season. All too often, before he has digested and fully understands the results of the previous year's work, the spring-summer growing season is upon him again.

COMPUTOR KEPT BUSY

At any given time the Experiment Station's IBM 1620 computer at the special center in Engineering Hall may be processing data ranging from helping a plant breeder predict hybrid corn yields to determining effect of fox on pheasant numbers. In between the computer processes data about corn and small grain variety trials, beef cattle performance testing, thousands of observations involving plant breeding and disease problems, insect infestations. . .

The center, through a weather

section of the Agricultural Engineering Department, also keeps a running account of daily weather summaries from about 75 stations within the state (See "Weather Data From a Computer," South Dakota *Farm & Home Research,* Vol. XVI, No. 2, Spring 1965). These are added to and coordinated with the more than 4 million cards now punched and which may be used for "instant" information on almost any weather topic or summarized into printed material for public use.

A new use for the computer is the egg and farm record program for farmers conducted by the Extension Service. Certain specified farm records are sent in by each farmer or rancher participating in the program. The subscriber's records are programmed and put through the computer and out comes data which tells him how his farm is doing, which parts of the farm are making money—or free-loading or losing money—how he compares with competition, and how he can plan ahead.

Programming and use of the computer for agricultural research is one of the areas of assistance provided by the Experiment Station Statistician, who is concerned with helping to design experiments, analyze data, and interpret results. Usually, the procedures for setting up the statistical part of an experiment go something like this: the research worker, with his specialized knowledge of the subject, and the statistician, with his specialized knowledge of experimental design, work out the most efficient and effective method for getting and analyzing data. After data from the experiment is in, another consultation is held between researcher and statistician to carry out proper analyses.

MAN STILL IN CONTROL

At this point it is time to tell the computer what it is supposed to do. This is known as "programming." After all, the computer is just a machine which works for man and the machine's claim to fame arises from the fact that man is smart enough to tell it exactly what to do —at least until now, science fiction notwithstanding. In one way it is an information production-line sort of thing somewhat like a very closely controlled manufacturing process. But raw data doesn't go in one end and come out the other automatically as a finished "product" unless the machine is told exactly what to do by means of a carefully controlled process of programming. This is the only way raw data can be converted into meaningful research results.

Basically the computer can only add, subtract, or pick out one of a few clear cut choices. The machine can "store" a vast amount of information but this "memory" is man-made, it comes from the programming process. Man "communicates" with the machine through a special language which to the inexperienced looks like a strange mixture of English and numbers and symbols of algebra. A "program" for a specific experiment may consist of several typed pages.

PUNCHED CARDS ARE KEYS

After the program is completed for an experiment, then tiny rectangular holes are punched or "coded" in the cards used by the machine. Each hole on a card, its position vertically, or in relation to other holes or solid areas has a certain meaning to the machine and the person operating it. This is the key whereby the machine electronically can sort out and classify certain information from thousands of cards fed through it. Each one of the $3\frac{1}{4}$ x$7\frac{3}{8}$-inch cards usually has 20 to 40 items punched on it but under certain circumstances one card may be punched with as many as 80 different items. The trick here is knowing which button to push or how to adjust the machine to get the wanted information from the designated "deck" of cards. It might take the machine minutes or a few hours to do the job, depending upon how much data is fed into it. But if a person was to do the same job with an ordinary calculator, he would spend days or even years—plus the fact he would

Raw data is punched on the cards and verified.

probably introduce human errors the computer doesn't make.

Predicting hybrid corn yields by computer is a prime example of how time, money and effort are saved. A bonus is that additional and more accurate estimates are available.

In obtaining the hybrid yield predictions, corn breeders at State University currently use a program which may include up to 15 different inbred lines. There are 210 possible single crosses of these 15 lines which would produce 4,095 different 4-way crosses. Under ordinary circumstances the job of making such a number of crosses by hand is so enormous and time consuming it would not even be considered. Just hand calculating the data would take a person 4 to 6 weeks full-time. But the computer does this work in about 2 hours! And the results are all listed on sheets of paper with yields appearing in order from high to low along with the pedigree for each hybrid. Another bonus here is the fact that predicted yields on 3-way crosses, which are being grown more than ever, may also be determined by the machine at the same time.

SELECT MOST PROMISING

From the computer's total of 4,095 different possible 4-way crosses (plus 1,365 of the 3-ways if they are being considered) corn breeders might select, say, 64 of the most promising to grow for actual testing. These would be planted in test plots occupying about 1¼ acres of land. This compares with something like 3,636,360 square feet or 83½ acres if all of the 4,095 possible 4-way crosses were grown out in the normal experimental plots with four replications in 40-inch rows. Of course, all of the crosses would not be grown out. The nice part about the computer is that it predicts all crosses. The plant breeder can see which ones show the most promise rather than having to compute a few predictions by hand and then *hope* he has the correct ones.

This is far from meaning that the computer is or will become a corn breeder. In order to produce figures valuable for research, the machine must be fed original data which only a trained human, through experience and careful, painstaking observation, can provide.

FOX-PHEASANT SURVEY

Right now a costly, extensive survey is underway seeking information on the relationship, if any, of fox populations to pheasant numbers. This is an example of research teamwork between the Cooperative Wildlife Research Unit at SDSU, the South Dakota Department of Game, Fish and Parks, and the U.S. Bureau of Sport Fisheries and Wildlife. It will involve thousands of man-hours of work during the next 3 or 4 years. Eight study areas

Machine lists results on paper so they can be read more easily—this is the last step. In background a machine sorts or orders cards in preparation for their use in the computer

each 100 square miles in size in four regions of the State are being used. A distance of 2 miles on all sides of each is allowed for fox and pheasant movement in and out of the area, leaving an inner area of 36 square miles which it is hoped will be unaffected by movement.

Certain parts of each area—a sample—are checked to obtain pheasant counts before and after the breeding season and at other times of the year, fox counts at various seasons plus other items preplanned (programmed) to give all possible information on what factors cause increases or decreases in pheasant populations.

Some areas will serve as checks—where nature more or less takes its course. In other areas foxes will be eliminated to see what happens to the pheasants. When all of this preliminary information for all of the factors is collected for 4 years it amounts to a fantastic amount of data.

At this stage the computers take over. While a "yes" or "no" answer regarding fox and pheasant population relationships might be forthcoming, of equal or greater importance may be answers to a lot of "whys" which man could use to alter some environmental aspects and better control game bird populations.☐

(Upper right) Author W. Lee Tucker, Agricultural Experiment Station statistician, removes a compiler deck of cards from its bin prior to readying it to go through the machine.

(Lower right) This is the main console or control panel of the computer.

Flax Research . . .

ARTIFICIAL ENVIRONMENTS

to study *YIELD *MATURITY *OIL QUALITY

By C. DEAN DYBING, *Plant Physiologist*,
and RICHARD A. CARSRUD,
Agricultural Research Technician,
U. S. Department of Agriculture

Environmental stresses modify the growth of the flax plant in many ways. Yields differ greatly from year to year when a variety is grown repeatedly at the same location. This variability is largely the result of environment. Another example is the wide range of yields obtained at different locations. In South Dakota, flax yields average 8 to 9 bushels per acre. In higher rainfall belts, yields increase by several bushels, but, in special conditions, they may reach 40 to 50 bushels. Extremely high yields such as these are typical of the California flax growing region where flower and boll production continue for a much longer period than generally occurs in the North Central states. The yield potential shown by the California production data clearly indicates the need for better understanding of the factors that regulate flax performance in South Dakota. Flower and boll production are obviously far below the capabilities of the plant. We need to know how environmental factors contribute to the early maturity that shortens the flowering period in this region before we can search for improvements in varieties or management practices for our area.

Even if there were no hope of increasing yield by environment studies, there is another important reason for conducting such experiments: environment also affects oil quality. The commercial appeal of flaxseed stems from the linseed oil that can be extracted from the seed and used in the manufacture of paints. The drying characteristics which make linseed oil useful in paints depend upon the proportion of polyunsaturated fatty acids in the oil. Fatty acid composition, in

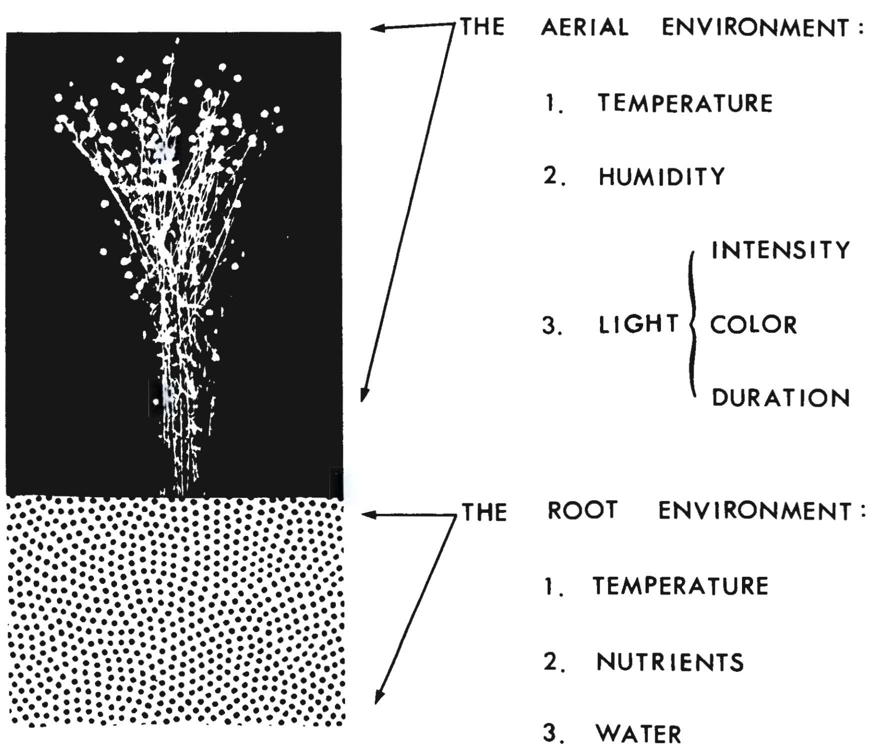


Figure 1. Some parts of the plant's environment that are under investigation. Light intensity, light quality, daylength, humidity, and temperature all affect the aerial portion of the plant. Soil temperature, nutrient level, and moisture availability make up the root environment.

turn, depends on the environment in which the flax is grown.

NORTH FAVORS OIL QUALITY

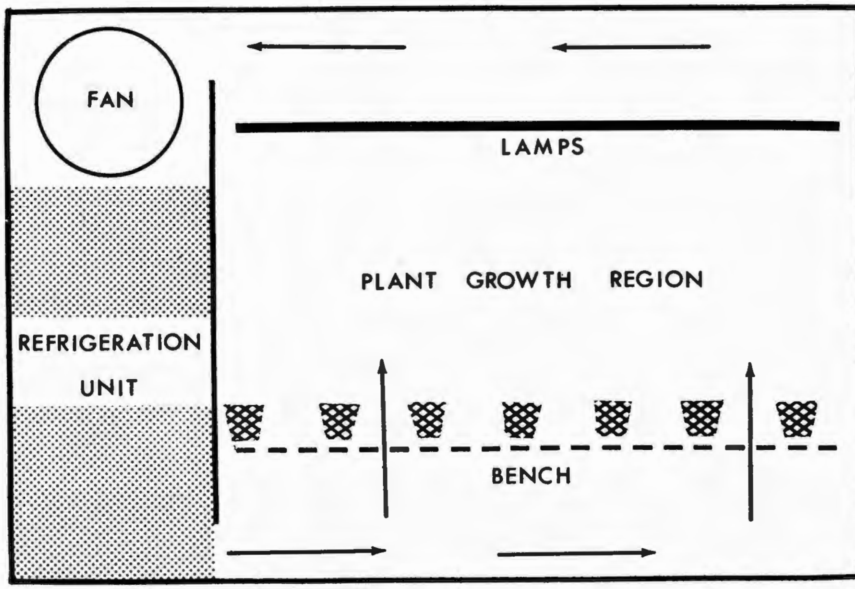
When a variety is grown progressively farther north, the oil increases in unsaturation and, therefore, is improved in quality for paint manufacture. Another way of saying this is that the iodine value of the oil increases in northern latitudes, since iodine value is a measure of polyunsaturated acid content. The fact that Northern climates favor oil quality definitely indicates that temperature and perhaps other environmental factors play roles of great importance to the flax plant. These we must understand if we are to improve the quality of flaxseed oil.

What are some of the environmental factors which are important in determining flax yields and oil quality? Cooperative studies by the U. S. Department of Agriculture and the South Dakota Agricultural Experiment Station are aimed at answering this question. Of course, performance in the field is the net result of the interacting effects of many factors (figure 1). Moisture availablity undoubtedly plays a major role in determining yield and oil production. Temperature, daylength, mineral nutrition, and soil temperature may also be very important. All of these factors are being considered in the series of experiments in progress. Disease, insects, and cultural practices are also important under field conditions, but for the present time they are not included in the study at State University.

USE GROWTH CHAMBERS

The traditional method of determining the effects of environment on a crop has been to make careful weather measurements throughout several seasons and then correlate the measurements with the performance of the crop. In the South Dakota State University studies at Brookings, however, the flax is grown in artificial environments in

Contribution from the Crops Research Division, Agricultural Research Service, U. S. Department of Agriculture, in cooperation with the South Dakota Agricultural Experiment Station.



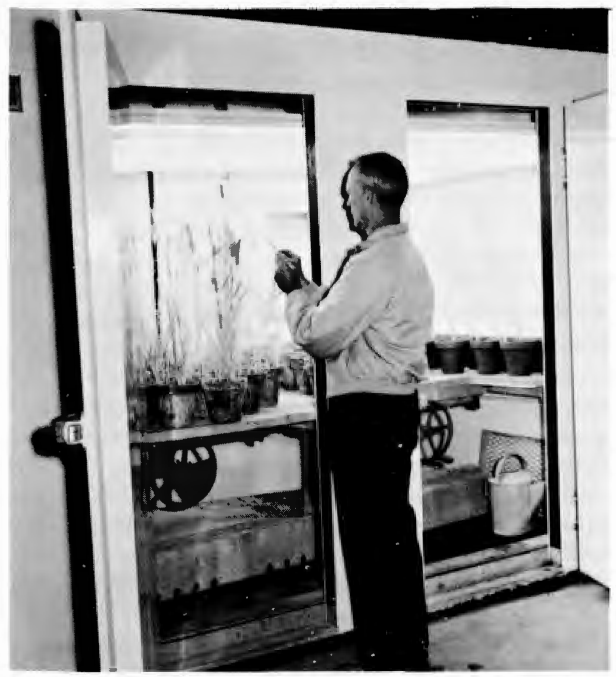


Figure 2. Cut-away side view of plant growth chamber (top, and corresponding photo, bottom) of the type used in these studies. Chamber is a 12x5x9-foot refrigerator equipped with lights and bench for growing plants. Air movement (arrows) is regulated by a fan.

mechanically controlled "plots" called plant growth chambers. A growth chamber is actually a walk-in refrigerator modified for growing plants (figure 2). Alternating "day" and "night" periods are provided by fluorescent and incandescent lamps regulated by time clocks. The refrigeration equipment regulates the chamber temperature, maintaining the desired settings both in light and dark periods by thermostats. Constant air movement assures uniform temperatures over the entire plant-growing region. Light intensity is about a fourth that of full sunlight. Equipment for humidity control is also provided. With this equipment each factor of the aerial environment is carefully regulated and can be individually controlled. Since all of the work is done mechanically, specific environments can be repeated precisely time after time, and experiments can be conducted continuously without interruption by seasonal changes.

Just as the growth chamber regulates the environment around the aerial portion of the plant, other equipment controls the root envir-

onment. Mineral nutrients are supplied to the roots by the technique known as hydroponics. Instead of soil, the plants are grown in a water solution containing all of the essential elements. In this way, the levels of N, P, K, and other elements can be accurately controlled. For example, nitrogen is supplied as ammonium nitrate. Doubling the quantity of ammonium nitrate likewise doubles the nitrogen supplied to the plant without any change in the levels of the other elements or in the acidity of the root medium. Use of the hydroponics method eliminates soil borne diseases and permits control of other important elements of the root environment. Insertion of cooling coils into the pots provides control of root temperature. Drought can even be simulated (in spite of the fact that the roots are continuously immersed in water) by adding to the solution a non-toxic polyethylene glycol compound with high molecular weight which competes with the plants for water and prevents them from removing the water from the solution.

Figure 3. The effect of nitrogen on flax. Left to right: very high, high, medium, low, and very low levels of N applied throughout entire life of plants. N deficiency severely restricted boll development and tiller formation. Very high levels of N slightly reduced oil quality.

STUDY NITROGEN LEVELS

Studies have been conducted for several years at State University using the growth chamber and hydroponics equipment. Results of two experiments, one dealing with several levels of nitrogen and the other with several levels of temperature, are shown in table 1. Characteristics measured were: (1) seed and oil yields; (2) maturity; and (3) oil quality. The variety used, called C. I. 1303, is short and early flowering. Commercial varieties have not been satisfactory for growth chamber studies because they are too tall and slow in development. In both tests only a single environmental factor was studied while all others were held at a constant level. In the nitrogen experiment, for example, the temperature was held at 77°F. and the nutrient solution varied from deficiency to excess nitrogen. In the temperature study, the plants were grown at four different temperatures but all received a high level of nitrogen.

The data of table 1 clearly show effects of nitrogen both on yield and on the oil. As nitrogen increased from deficiency (14 p.p.m.) to excess supply (224 p.p.m.), boll and seed production per plant increased sharply (figure 3). At high levels of N, on the other hand, seed weight and oil content decreased with the result that oil yield per plant for this variety did not rise above that at the 112 p.p.m. level. Nitrogen deficiency depressed seed yield by reducing the number of bolls produced by each plant and by decreasing the number of seeds per boll. Oil quality, measured by iodine value, was reduced by excess nitrogen.

Table 1. Effects of Nitrogen Level and Temperature on the Growth, Yield, and Oil Production of C. I. 1303 Flax in Controlled Environment Experiments

		Yield Components					Oil Production	
Environment	Dry weight g/7 plants	Bolls per 7 plants	Seeds per boll	Seeds per 7 plants	Seed weight g/1000 seeds	Grams oil per 7 plants	Oil %	Iodine Value
1. Nitrogen Level (Temperature = 77°F):								
14 ppm	2.7	33	6.5	225	5.56	0.54	43.1	170
28 ppm	3.5	41	8.0	328	5.85	0.84	43.9	170
56 ppm	6.3	69	8.4	580	5.92	1.49	43.3	170
112 ppm	11.2	103	8.8	906	6.09	2.26	40.9	167
224 ppm	13.5	139	8.1	1126	5.17	2.17	37.7	160
2. Temperature (Nitrogen = 224 ppm):								
59°F	15.7	......	6.8	....	6.16	......	37.8	177
68°F	13.7	......	7.5	....	5.84	......	37.5	164
77°F	10.2	......	6.6	....	4.91	......	32.7	157
86°F	9.7	......	7.1	....	4.19	......	30.4	140

EFFECTS OF TEMPERATURE

Temperature had effects on flax which were just as striking as those of nitrogen (table 1). When the temperature of the growth chamber was increased during the seed-forming period, seed weight, oil

percent, and oil quality were drastically reduced. Effects on yield were not assessed in this experiment, but the reduction in seed weight and oil content would tend to depress both seed and oil yield. Flower production, however, was favored by warm temperatures in other experiments, so the overall effect of temperature on yield remains uncertain.

As for plant growth and maturity, we observed that temperature and nitrogen had interacting effects. Cool temperatures and high levels of nitrogen favored growth in height and dry matter. Low temperatures and high fertility likewise delayed maturity of bolls, stems, and leaves.

Other environmental factors thus far studied include light intensity, day length, root temperature, drought, and depth of the root zone (figure 4). Each factor had its own particular effects on the flax plants. For example, increasing the day-length from 16 to 20 hours hastened maturity and reduced seed weight. Low root temperatures also retarded maturation, and high light intensities increased oil quality.

Certain questions immediately arise concerning these experiments: How do the results compare with field observations? What practical use can be made of the findings? The question of comparison between field and growth chamber performance is difficult to answer, since field performance is a summation of the effects of many environmental and other factors. Some pertinent observations have been made, however. In 1964, 13 varieties were grown in the field at Brookings and also in the growth chamber in an

Figure 4. The effect of drought on flax. Normal plants (left) and plants subjected to drought during bud and early bloom stage of development (right). Drought reduced plant height, tiller development and boll production. Warm temperatures, which commonly accompany drought in the field, were not important here since the same temperature was maintained for both sets of plants.

Table 2. Performance of Thirteen Flax Varieties in the Field (Brookings, 1964) and in an Artificial Environment (68°F.)*

Characteristic Measured	Field	68°F
Days to Flowering	43	39
Plant Height (cm.)	40	41
Seed Weight (g./1000)	5.2	5.0
Oil Content (%)	40	39
Iodine Value	177	178

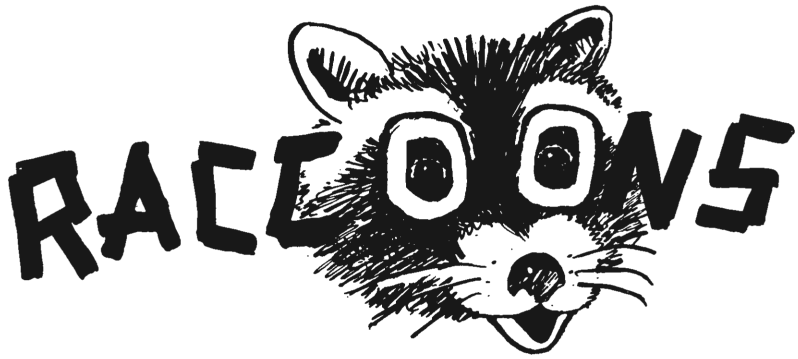
* Each value is the average for the 13 varieties.

environment of 68°F., 16-hour daylength, and light intensity about a fourth of full sunlight. In general, the varieties behaved quite similarly in the two environments (table 2). The close agreement of the averaged data supports the validity of growth chamber findings. The agreement was not perfect, however. For example, one variety was much lower in iodine value of the oil in the field than would have been predicted from growth chamber data. Such exceptions may mean that all of the important environmental factors are still not under our control, or that there are important interactions between environmental factors which must be determined.

WHERE RESEARCH LEADS

Where, then, does research of this type lead us? Obviously, experiments dealing with the isolated effects of temperature or nitrogen on flax under controlled conditions do not provide immediate returns in terms of increased bushels of seed or pounds of high quality oil per acre. Ultimately, the knowledge of responses to various environmental stresses may lead to new varieties or to improved management practices. Conceivably, one could screen the approximately 2,000 available flax varieties to find lines that respond favorably to both high temperature and high nitrogen. Such varieties would remain high in seed weight, oil content, and oil quality as temperature and fertility increase. From these lines, improved commercial varieties could be produced. But what temperatures and nitrogen levels should be considered critical for the selection of these lines? What other factors should be considered? Are there environmental factors of even greater importance than temperature and nitrogen? Clearly, the immediate goal of controlled environment studies can be stated in only one word: knowledge. The great need is for increased knowledge of the physiological processes which control maturity, seed production, and oil synthesis in all environments. Once an understanding of the plant's response to environmental stresses is obtained, practical application of the findings will not be far behind.□

South Dakota



They followed the homesteaders to South Dakota, they are opportunists because they eat the food most available—whether crayfish or corn, they stay close to home, they can be controlled locally without killing every one of them in a widespread area—and, they are protected game in some states.

By **Donald R. Progulske,**
associate professor and head,
Wildlife Management

Racoons were scarce in the northern Great Plains when the white man invaded the area. They now live throughout the United States and southern Canada because they adapted to coexistence with man. Lewis and Clark, when travelling along the Missouri River in 1804 and again in 1806, reported seeing many species of wildlife but not raccoon.

Unbroken prairies did not offer suitable habitat for raccoons. But once prairie homesteads were established and planted trees matured, raccoons began to den around the dwellings and in the trees. They likewise used other animal dens for shelter and for places to bear young. Raccoons are versatile mammals in that they live under a variety of climates and land-uses.

In some states raccoons are considered a valuable natural resource, having both a high recreational value and a marketable pelt—and are fully protected by law. Certain states have even established habitat management programs specifically to increase raccoon populations. In South Dakota, however, the animal has not been so fortunate. Here it is classified as a nuisance species which may be killed at any time by any method. Perhaps once it is recognized for its sport value its status will change. Until then it will continue to lead its present harried life.

RESOURCEFUL ANIMAL

The resourcefulness and adaptability of these animals are reflected in the things they eat. A study of the life history and economic importance of the raccoon has involved examination of food remains in digestive tracts of more than 250 individuals collected since

1958. Also included were examinations of a large collection of droppings. This study spanned a period of dry to wet years when most small water areas dried up by 1960 then refilled more recently.

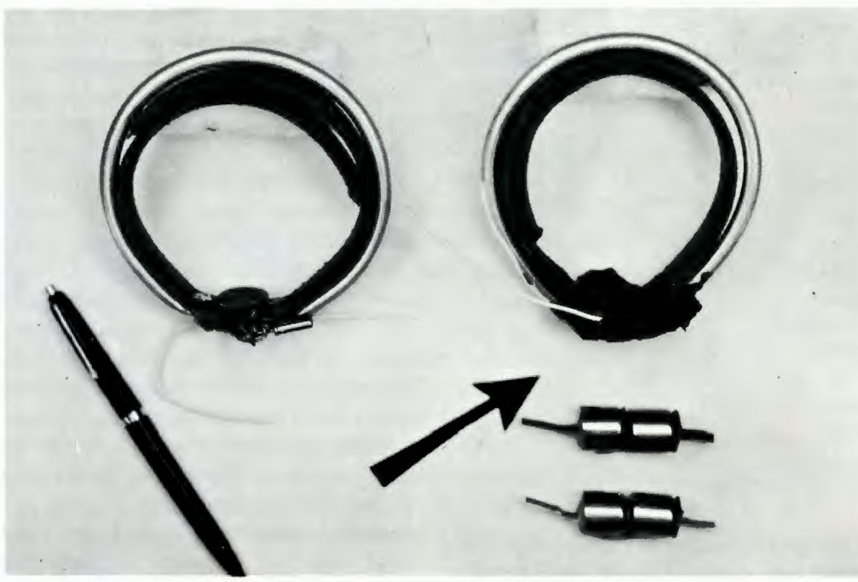
Remains of food items found in digestive tracts indicate some of the foods an animal has eaten within several hours before its death. Certain foods are rapidly digested, therefore are not usually evident among foods with high residue. Analyses of stomach or intestinal contents, therefore, do not necessarily reflect the entire diet. Frequency of occurrence and/or percent of volume of foods are used in listing stomach contents. This sometimes gives a somewhat distorted over-all picture. The finding of a single chicken feather, for example, would show the bird as a food item but represents only a trace of the total food remains. Yet in a stomach full of food, chicken might be the only item. Because of this, one must use some discretion in discussing diets of animals determined by stomach analyses.

DAMAGE IN DRY YEARS

Corn, wild fruits, crayfish, insects and small mammals are staple items in the diet of South Dakota raccoons. Frequency with which these food remains are found in digestive tracts reflects the availability of the items. The abundance of crayfish, frogs and earthworms depends upon the presence of water areas. When such areas virtually disappeared from eastern South Dakota in the "dry" years of 1958-1960, raccoons turned to feeding on other foods—and in doing so sometimes got into trouble with farm people.

Corn appeared consistently in 110 raccoons collected in 1958 and 1959 (table 1). Various other plant materials likewise were found in most stomachs. Oats were commonly eaten during late spring and early summer. Insects (mainly grasshoppers but including crickets and beetles) were common in raccoons killed during summer months. Crayfish appeared in only 12 of the 93 animals and remains of a frog was in a single stomach. Various birds, including chickens, ranked high in frequency in the stomach contents. Pheasant feathers were found in 6% of the tracts. As a group, small mammals (mostly field mice and meadow voles) ranked near the top during all series of collections. In these same years complaints of raccoon damage came from every part of the state. The animals were commonly raiding poultry yards or robbing vegetable gardens. When poisoned eggs or traps were placed at such depredation sites five or more raccoons were commonly taken because the scarcity of natural foods forced many animals to converge at farm yards.

The pattern of feeding was different in typically "moist" years represented by raccoon stomachs



Raccoons are hooked up with tiny collar-type battery-powered transmitters (above) so that researchers with radios can check movements of the animals. Weighing 162 grams (compare size with pen), the transmitter's most satisfactory range is about a mile. Transmitter is shown before (left) and after (right) being encased in waterproofing material. The metal ring is the antenna and webbing inside secures the instrument to the animal. Four mercury cell transistor batteries (right of arrow) put out 2.7 volts and are also encased in water- and bite-proof material. George Geis, graduate student of Webster, S. Dak., who is conducting the telemetry research, was assisted by electrical engineering student Darwin Bayerkohler, Renville, Minn., in constructing the tiny transmitters.

At right is a raccoon, ready to broadcast, taking off just after being released with its collar transmitter.

Table 1. Seasonal Analyses of Foods Found in 110 Raccoon Stomachs Collected During 1958 and 1959. Results Expressed as Per Cent Frequency of Occurrence.

No. Stomachs	Winter*	Spring 13	Summer 77	Fall 20
Corn		61	40	50
Other Plants		92	43	15
Small Mammals		61	8	
Rabbit		15	3	15
Insects		38	55	35
Bird		46	26	20
Oats			23	15
Crayfish		23	21	

*No stomachs collected.

Ear tagging a raccoon in a holding cone.

Table 2. Seasonal Analyses of Foods Found in 75 Raccoon Stomachs Collected During 1964 and 1965. Results Expressed as Per Cent Frequency of Occurrence.

No. Stomachs	Winter 28	Spring 11	Summer 23	Fall 13
Corn	57	64	60	46
Other Plants	39	9	26	
Small Mammals	25	36	13	
Rabbit	10			
Bird	18	11	17	
Insects	7	18	52	15
Oats	14	27	17	8
Crayfish			30	

Table 3. Analyses of 367 Droppings Collected from Study Area West of Brookings, April 1964 through December 1965. Results Expressed as Per Cent Frequency of Occurrence.

	Spring 37 samples	Summer 125 samples	Autumn 179 samples	Winter 26 samples
Vertebrate				
Mammal	3	4	2	19
Bird	5	1	2	4
Fish	22	2		
Earthworms	3	1		
Invertebrate				
Insects	16	8	21	19
Crayfish	5	82		
Vegetable				
Corn	51	14	75	58
Plum		8	10	
Berries		2	2	
Seeds			1	12

collected in 1964 and 1965 (table 2).

Feeding habits of raccoons were also studied by identifying remains of food found in 367 droppings collected in a study area in Brookings County from April 1964 to December 1965. Results of the analyses are given in table 3. Small mammals remained low but fairly constant except during winter when 19% of the droppings showed mice remains. Undigested parts of birds were found in some droppings in all seasons, but they too did not constitute the bulk of the diet. Crayfish, found in 82% of the samples, was the main food item during the summer months. Insects showed high occurrence in all seasons. Corn was the most frequent item during autumn, winter and spring but was replaced by crayfish during the summer.

WHERE RACCOONS ROAM

A second segment of the raccoon study was designed to learn where the individuals roam in search of food. This could be important to farmers experiencing seasonal damage to certain crops by raccoons.

A small radio telemetry system gave valuable information as to where individual animals spent the night and day as well as to hours they were actively moving about. A small battery-operated transmitter was attached to a collar placed on the raccoon. The signal emitted could be picked up by a portable receiver taken near to the area where the animals were living.

Three young and four adult raccoons were equipped for radio tracking. Five transmitters gave signals for an average of 50 days. The home range, movements, and denning patterns of the animals were quite similar. Activity during midsummer centered around available water. Daily observations of these activity areas revealed signs of digging along the banks and shores for crayfish.

In September radio - equipped animals made nightly trips to sweet corn patches, field corn, and plum thickets. The distance traveled each night from a day retreat to a food source or to location of a night observation and return ranged from 1 to 1$\frac{3}{4}$ miles.

A FEMALE HOMEBODY

An adult female with a litter born in June was tracked for 65 consecutive days starting in July. She remained within a quarter section and spent much time along an oxbow of the Big Sioux River. An adult male trapped in mid-September ranged within a mile of the trap site.

Daily fixes on the transmitter-equipped animals also yielded information on denning habits during the summer. The animals favored heavy marsh vegetation for their daily retreats and used the abundant tree dens sparingly.

Information gathered during this study indicates that raccoons are not long-distance travelers but spend most of their lives within the locality where they were born. At times they might be chased out of their normal home range by dogs although most would run to safety of tree cavities or in old buildings where they sometimes den. When feeding, raccoons are opportunists and take whatever food is most available whether it be frogs and crayfish during wet years or oats, garden vegetables, or chickens in dry years. Thus we can expect more widespread crop depredation whenever natural foods are not abundant. Furthermore, we know that individual animals causing local problems live in the vicinity and can be controlled without embarking on a program to kill all raccoons in a widespread area.□

bigmouth buffalo as protein source

By Rena Wills, *associate professor,*
Dorothy Deethardt, *research assistant,*
and Betty Lucas, *senior major,*
in Foods and Nutrition

South Dakota waters abound in fish that attract sportsmen and those of us who enjoy good eating too.

These same rivers and lakes also contain an abundance of certain fish which do not appeal to the sportsman and for various reasons have been of little interest as a source of food.

The bigmouth buffalo is an example of one of these less-desirable fish. It is an excellent source of protein but its eating quality doesn't rate too high because of many small bones and a distinctive muddy flavor. A fresh water fish of the sucker family, the bigmouth buffalo will not bite on a line so is not sought by fishermen. It is seined, mainly in winter, and one of its primary markets is out-of-state processing into cat food. Its usual weight is from 5 to 15 pounds but some are much larger: a 35-pounder was recorded in April 1965 at Lake Mitchell.

SOURCE OF PROTEIN

As protein the buffalo fish is cheaper (about 11 cents a pound live fishweight wholesale at optimum season) and is as good as most other sources of animal protein.

Since food value and availability of the buffalo fish are plus factors, investigations are underway to overcome the minus factors of too many fine bones and muddy taste. Methods of cooking and serving are being tried to promote palatability and to soften the small bones. These studies are being conducted by the Food and Nutrition Department of the College of Home Economics at South Dakota State University.

Three general methods of cooking were employed: baking, frying and pressure cooking. Various sauces served with baked fish included tartar sauce, tomato sauce, lemon butter, cucumber sauce, and cheese dill sauce. Recipes were also developed for fish baked in combination with other ingredients. These included herb-baked fish, creole fillets, stuffed fillet roll ups, fish-in-a-ring and tetrazzini.

The various preparations were rated by a six-member taste panel for appearance, texture, flavor and palatability using a 5-point score evaluation. The panel agreed that addition of sauces or fish baked with other ingredients enhanced the flavor and palatability much more than the plain baked or fried fish. Plain fried fish scored lowest of any of the products. The lemon butter was the least desirable as a sauce.

SOFTENING BONES

Pressure cooking softened the bones to the extent that the fish became suitable for salads and other dishes for which precooked fish are used. In fact, fish salad proved to be highly acceptable.

The abundance of the bigmouth buffalo and other fish in South Dakota waters makes preservation by canning desirable. This study indicates that the pressure cooking involved in canning will soften the bones and give a satisfactory product. The canned fish could furnish a ready supply of high quality protein, and could become an added source of income in South Dakota. Further study is in progress. □

silages fortified with SOYBEANS

By
Emery Bartle, *associate professor*,
and Howard Voelker, *professor*,
Dairy Science Department

Sorghum is being grown more and more for silage, mainly because of high yield and drought resistance. It has become an important crop in South Dakota. But as increasing amounts are fed, the problem of low protein and minerals becomes greater. Much the same applies to corn. One way of overcoming this problem has been determined through research at South Dakota State University.

Corn or sorghum raised for silage can be grown with soybeans to give you dairy cow rations which combine the favorable qualities of each of these crops that are well-adapted to South Dakota conditions. Fortifying either of the two silage crops with soybeans grown separately is another possibility although not included as a part of this investigation.

Separately all three of these crops have certain advantages and disadvantages when grown for silage and fed to dairy cows. However, grown together the advantages of each can be used to produce an excellent silage.

ADVANTAGES		DISADVANTAGES
High yield, better adapted to mechanical feeding than hay. Continual improvement in varieties. Widely grown. Less weather hazard than with hay.	CORN	Low in protein and essential minerals. Less drought resistant than sorghum. Not resistant to corn borer and corn rootworm.
Perhaps of most importance, usually more drought resistant than corn. Better than hay for mechanical feeding. New improved varieties. Widely grown. Less likely to damage by insects.	SORGHUM	Low in protein and essential minerals. Hard seeds may not be well utilized by dairy cows.
High in protein and essential minerals. A legume, soybeans properly inoculated help contribute nitrogen for growing corn or sorghum. Provides variety.	SOYBEANS	If conditions are ideal for corn, soybeans may be shaded too much to produce suitable crop. Less convenient to plant than corn or sorghum alone.

Briefly, the 2-year trials at the Agricultural Experiment Station comparing the two combinations showed that:

- Planting soybeans with silage helps increase energy and balance the protein and mineral intake of cows.
- In terms of milk production, sorghum-soybean silage has about 92% the value of corn-soybean silage.
- Sorghum-soybean silage yielded 23.7% less nutrients per acre.
- Sorghum-soybean silage yielded 27.9% less milk per acre.
- Dairymen planning to substitute sorghum for corn silage in the ration should feed more grain to compensate for the lower energy value and less yield of sorghum.

Silage Production

A 21-acre field was equally divided for two consecutive years, 1960 and 1961. Corn and soybeans were planted in one half and a hybrid forage sorghum and soybeans in the other. Each area was plowed, harrowed and seeded in drill rows. The crops were produced, harvested and stored in the same manner each year.

The forages were harvested as silage during the first week in September. Silages were stored in cement stave tower silos as fresh-green-forage, without wilting, directly from the field cutter. Corn was in the dent stage, with some lower leaves of the plant beginning to dry and lose green color. Sorghum seeds were in dough stage and plants did not show any drying signs. Soybeans had formed pods, many containing full-size beans. The leaves were green.

Composition of Silage

The proportion of corn to soybeans and sorghum to soybeans on a green-forage basis was respectively, 77.3% and 22.7%; and 82.7% and 17.3%. Samples were weighed in the field at the time of cutting.

Silages were analyzed for chemical composition from samples collected as the silos were filled and at weekly intervals during the feeding trials (table 1). There was relatively little difference in the protein and ether extract. The corn-soybean silage was somewhat lower in fiber and higher in nitrogen-free extract than the sorghum-soybean silage. Both were of good quality, bright color and pleasing odor with average pH values of 4.1 for corn-soybeans and 3.8 for sorghum-soybeans.

Feeding Trials

Two consecutive winter trials of 120-day feeding periods started the first week in October. In 1960, 28 cows including 10 Holsteins, 10 Brown Swiss and eight Guernseys were divided into two equal groups by selecting cows as nearly alike as possible according to size, stage of lactation and production levels. One group was assigned to corn-soybean silage, the other to sorghum-soybean silage. A 10-day preliminary period preceded the 120-day feeding trial with cow changeover made every 30 days.

In 1961, 28 cows, including 18 Holsteins, four Brown Swiss and six Guernseys were equally divided and started on the second winter trial with a 10-day preliminary period preceding a 120-day period.

Silages were fed twice daily with daily weigh-in amounts calculated to 10% above the amount of silage cows were expected to consume. Hay was limited to 1 pound per 100 pounds of body weight and fed in the morning following the weigh-back of refused silage. Hay weigh-backs were made in the afternoon before fresh silages were fed, so that silage was available during the night. Grain was fed at the rate of 1 pound of grain for each 3.0 pounds of (4% F.C.M) milk. The grain mixture consisted of 2,000 pounds of cracked yellow corn, 1,700 pounds of rolled oats, 200 pounds of soybean meal, 100 pounds of linseed meal, 50 pounds of steamed bone meal and 50 pounds of trace mineral salt.

Silage Consumed

The comparative efficiency with which the silages were utilized for milk production is indicated by the feed dry matter consumed per 100 pounds of (4% F.C.M.) milk as shown in table 2.

The relative palatability of silages judged by the amount of dry matter consumed daily per 100 pounds live weight favored corn-soybean silage.

Silage dry matter consumed per cow daily was 19.2 pounds for cows fed corn-soybean silage compared to 14.9 pounds for cows fed sorghum-soybean silage.

Body weight changes showed corn-soybean silage was slightly superior in maintaining weight with an average gain of 17.7 pounds per cow compared to a weight loss average of 4.0 pounds a cow on sorghum-soybean silage.

Consumption of dry matter from grain in the silage rations in relation to the amount of milk produced amounted to 1 pound for each 3.43 pounds of milk on the corn-soybean silage ration and 1 pound for each 3.13 pounds of milk produced on the sorghum-soybean silage ration.

Silage Returns

Silage yields per acre on a green-forage basis amounted to 11.2 tons for corn-soybean silage and 9.25 tons for sorghum-soybean silage in 1960 and 9.0 tons for corn-soybean silage and 8.8 tons for sorghum-soybean silage in 1961. Si-

Table 1. Chemical Composition of Feeds*

Feeds	Dry matter	Ether extract	Analysis of dry matter: Crude protein	Crude fiber	Nitrogen free extract	Ash
	%	%	%	%	%	%
Corn-soybean silage	28.2	3.8	10.4	22.2	57.4	6.4
Sorghum-soybean silage	23.5	3.5	9.9	28.3	51.9	6.5
Alfalfa hay	87.5	2.2	18.1	29.0	41.9	8.9
Grain	89.2	3.9	16.6	7.4	66.4	5.8

*These data are averages of two trials, 1960 and 1961.

lages were weighed immediately after field chopping to determine acre yields.

The relative yields per acre of silage dry matter, estimated total digestible nutrients and milk (4% F.C.M.) produced from each silage are shown in figure 1.

An acre of corn-soybean silage furnished enough nutrients for 2.4 cows during each 120-day feeding trial compared to 2.3 cows on the sorghum-soybean silage.

Corn-soybean silage furnished 52.2% of the estimated total nutrients while sorghum-soybean silage furnished 40% of estimated total nutrients (table 3).

The relationship between silages, hay and grain relative to the source of nutrients shows that cows fed corn-soybean silage obtained 52.2% from silage, 10.8% from hay and 37.0% from grain. This compares with 40.0% from sorghum-soybean silage, 20.3% from hay and 39.6% from grain for cows fed sorghum-soybean silage.

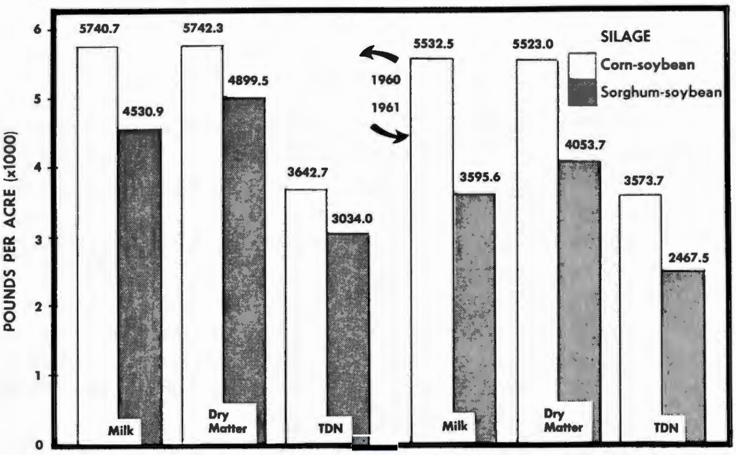


Figure 1. Yields per acre of 4% (F.C.M.) milk, dry matter and estimated TDN from silage.

Economic Returns

Table 4 shows the comparative difference between cost of feed, cost of milk production and net returns per acre. Corn-soybean silage cost $80.80 per acre and sorghum-soybean silage cost $76.25 per acre. The net return per acre was $38.16 for corn-soybean silage compared to $21.21 for sorghum-soybean silage.

Based on each 100 pounds of milk produced, corn-soybean silage showed a feed cost of $1.54 and a production cost of $3.00 for a net return of 40 cents. This compared to a feed cost of $1.65, a production cost of $3.20 and a net return of 20 cents for cows fed sorghum-soybean silage. The net difference was 20 cents in favor of corn-soybean silage.

Feed costs are reflected in the amounts of silage, hay and grain required for each 100 pounds of milk produced. This shows the cows fed corn-soybean silage ate 6.2 pounds (3.4%) more silage, 12.6 pounds (4.8%) less hay and 3.2 pounds (9.1%) less grain than the sorghum-soybean silage fed cows.

The efficiency with which land was utilized to produce the silage needed for each 120-day feeding trial shows that corn-soybean silage furnished the necessary nutrients to feed 3% more cows per acre. However, cows declined less in milk production and gained weight on corn silage. Longer trials may show greater differences in these silages. □

Table 2. Feed Consumption, Milk Production and Changes in Body Weights*

Items compared	Corn-soybean silage	Sorghum-soybean silage
	pounds	pounds
Silage consumed per cow daily	68.8	65.3
Dry matter consumed per cow daily:		
Silage	19.2	14.9
Hay	4.5	8.3
Grain	11.0	11.5
Total	34.7	34.7
Milk production per cow daily:		
During 120-day test period	37.6	35.9
Decline during test period	9.8	15.5
Weight change of cows	+17.7	-4.0
Silage consumed (dry matter) per 100 pounds of milk	51.0	41.6

*These data are averages of two trials, 1960 and 1961.

Table 3. Milk Production Per Acre of Silage*

Kind of silage	Source of T.D.N.		Milk (4% F.C.M.) produced		
	Hay and grain	Silage	Hay and grain	Silage	Total
	(%)	(%)	(lbs)	(lbs)	(lbs)
Corn-soybean	47.8	52.2	5199	5637	10813
Sorghum-soybean	60.0	40.0	6104	4063	10168

*These data are averages of two trials, 1960 and 1961.

Table 4. Costs and Returns of Milk Produced from Silages*

Economic items	Corn-soybean silage	Sorghum-soybean silage
Cost of silage per acre†	$ 80.80	$ 76.25
Cost of hay and grain‡	81.48	91.39
Cow maintenance (estimated)	162.02	156.98
Milk production cost per acre	$324.30	$324.62
Milk returns per acre§	362.46	345.83
Net returns per acre	38.16	21.21

*These data are averages of two trials, 1960 and 1961.
†Feed cost per ton: Silage $8.00, alfalfa hay $15.00, grain $40.00.
‡Building, breeding, equipment, herd replacements, labor @ $1.00/hr.
§Milk sold @ $3.40 cwt.

new varieties of small grain

•WHEAT •OATS •FLAX •RYE

By R. S. Albrechtsen, Assistant Professor of Agronomy; J. J. Bonnemann, Assistant Agronomist; G. W. Buchenau, Associate Professor of Plant Pathology; V. D. Pederson, Associate Professor of Plant Pathology; D. G. Wells, Professor of Agronomy; and L. S. Wood, Extension Plant Pathologist.

The stability of small grain production in South Dakota depends upon a continuing supply of better varieties. The main breeding accomplishments have been the control of plant diseases by pathologists and agronomists working together. However, there have been improvements in other qualities such as in strength of straw, shortness of straw, earliness, higher yield independent of disease resistance, higher test weight, or hardiness.

The improvement program for small grains is intensive and involves both introduction of improved forms from other areas and breeding by hybridization. Standard varieties and new strains are compared at several locations every year. Annually, some of the results are reported in South Dakota *Farm & Home Research* and new varieties are described.

Farmers are invited to visit the Experiment Stations to see the performance tests, the breeding plots, and disease control programs.

SPRING WHEAT

Chris is a new hard red wheat released by Minnesota in 1964. It is highly resistant to stem and leaf rust and most other diseases. Like Lee and Crim, it is moderately weak strawed. It is beardless, one or two days later and an inch or two taller than Crim and Selkirk. Chris is resistant to shattering, good in milling and baking characteristics, has high test weight per bushel, and is a top yielder.

Manitou is a beardless red wheat from Canada resistant to leaf and stem rust. Manitou is an improved form of Thatcher and resembles Thatcher in appearance. It resists shattering. Manitou is high yielding and of good test weight and quality but has not been tested long enough in South Dakota for us to recommend it this year.

Stewart 63 is a new durum from Canada. It is the old Stewart, a North Dakota release, with rust resistance added. It has better resistance to stem rust than Wells or Lakota and like them resists leaf rust. Stewart 63 is 12 inches taller and 4-5 days later than Wells and Lakota and is more susceptible to lodging. It has much larger seed and a better test weight than Wells and Lakota. In tests in South Dakota, Stewart 63 has been yielding slightly less than Wells and Lakota.

WINTER WHEAT

Hume winter wheat, released in 1965 by the South Dakota Agricultural Experiment Station, was described in detail in the Winter 1965 issue of *Farm & Home Research*. In 1965 tests, Hume performed very well because of its hardiness, earliness, and resistance to stem rust.

Several hundred F_1 crosses are planted in this yield test of spring wheat. The caged area (background) is for a technique study involving one cross.

OATS

Two new oat varieties, Tyler and Clintford, were released by the Indiana Agricultural Experiment Station in 1965. Tyler has been added to the 1966 list of recommended varieties for South Dakota. Clintford was not added to the recommended list but a description of it is included since seed will undoubtedly be available in the state. Comparative yields of the new varieties and other recently released varieties plus long-time checks are shown in the accompanying table.

Tyler is an early maturing, short, stiff strawed variety with light yellow, plump kernels having medium to high test weight and a high groat percentage. It has moderately good resistance to leaf rust and stem rust but is susceptible to some of the newer rust races. It is only moderately resistant to smut and is susceptible to the yellow dwarf virus (red leaf). Tyler has given only medium yields in South Dakota. Like Tippecanoe and Clintford, because of exceptional standing ability, it is likely to be most advantageous when grown under high fertility or under other conditions which cause lodging of weaker strawed varieties.

Clintford, similar to Tippecanoe and Tyler in plant characteristics, is early maturing and has short, stiff straw. It has large, light yellow kernels which are very plump, excellent in test weight, and high in groat percentage. It is similar to Tyler in resistance to leaf rust but is susceptible to more of the pre-

Winter Wheat Yields in South Dakota

	Presho			Highmore		
Variety	1965	'64-65	'61-65	1965	'64-65	'61-65*
	Bushels Per Acre					
Hume	31.6	30.0	26.3	33.9	25.0	22.4
Gage	25.9	32.4	----	29.2	28.8	----
Scout	23.2	32.2	----	35.4	31.3	----
Lancer	30.7	33.3	----	39.7	30.7	24.9
Winalta	19.3	27.9	----	25.7	22.0	----
Minter	26.1	29.5	23.1	22.8	19.1	20.9
Ottawa	12.8	26.1	28.6	17.8	21.7	23.1
Nebred	10.6	22.1	19.7	15.7	19.0	19.7
Warrior	10.5	27.1	24.9	13.4	17.4	19.9
Omaha	20.3	27.2	28.2	24.2	24.3	22.8
Bison	7.7	21.6	17.2	21.6	21.7	19.2
Rodco	11.5	22.8	----	20.0	21.9	20.4

*Does not include 1962.

Planting vernalized (cold-adapted) winter wheat in the new South Dakota Wheat Commission greenhouse on the SDSU campus.

Spring Wheat Yields in South Dakota

	Brookings		Centerville		Eureka		Watertown		Wall*		Highmore	
Variety	1965	63'-65	1965	'63-65	1965	'63-65	1965	'63-65	1965	'63-65	1965	'63-65
	Bushels Per Acre											
Chris	46.7	34.3	34.7	26.2	31.6	30.7	44.5	31.3	25.1	23.2	35.1	27.5
Manitou	37.0	----	36.9	----	32.7	----	38.0	----	23.1	----	40.1	----
Crim	36.3	25.2	30.9	21.4	30.4	27.5	28.0	21.3	17.1	17.9	33.7	24.0
Justin	35.3	20.8	20.7	15.5	24.3	24.9	28.8	19.7	13.2	18.7	37.1	24.8
Pembina	34.2	21.6	33.8	20.9	31.2	27.1	29.1	22.0	20.0	19.1	35.1	24.5
Selkirk	33.3	22.1	23.7	17.5	27.9	24.2	26.4	19.9	15.6	18.3	34.0	24.0
Rushmore	32.0	22.1	27.3	19.5	27.6	25.5	24.1	20.4	15.7	20.7	33.2	24.4
Lee	28.4	19.3	24.6	16.9	17.2	19.6	21.3	17.0	6.2	12.9	35.1	24.0
Stewart 63 durum	43.1	----	----	----	34.1	----	35.0	----	----	----	35.3	----
Wells durum	45.7	31.2	----	----	35.8	33.9	39.4	26.8	----	----	38.4	29.6
Lakota durum	44.1	29.7	----	----	37.0	34.2	41.4	27.0	----	----	46.1	32.3

*1963 and 1964 yields used in the average were from Cottonwood.

Oat Yields in South Dakota*

Variety	Brookings '61-65	Brookings '64-65	Watertown '63-65	Watertown '64-65	Centerville '61-65	Centerville '64-65	Highmore '64-65	Eureka '64-65	Wall† '64-65	Newell‡ Dryland 1964	Newell‡ Irrigated 1964
					Bushels Per Acre						
Andrew	76.0	89.8	73.4	84.2	59.5	63.4	70.4	98.3	49.1	34.3	64.1
Brave	89.9	99.4	87.4	97.0	66.4	65.6	79.8	104.0	56.9	41.3	68.4
Clintford	77.0	78.8	76.9	87.8	53.9	67.6	55.6	94.0	59.5	31.9	56.5
Clintland 64	......	90.4	90.7	101.0	......	68.6	59.6	97.6	52.8	38.5	59.8
Coachman	74.1	94.4	75.7	90.0	58.3	65.8	65.2	99.3	46.8	36.1	52.0
Garry	78.2	103.9	72.9	84.9	60.3	72.9	82.4	104.0	......	31.4	48.1
Mo. 0-205	......	86.7	82.7	93.6	......	70.0	78.8	106.2	60.8	46.6	59.7
Santee	......	66.8	......	95.8	......	65.5	58.6	88.9	56.9	44.4	59.3
Tippecanoe	73.1	75.2	79.9	87.0	48.4	64.9	56.4	98.4	52.1	33.1	52.6
Tyler	80.9	90.1	84.0	94.2	54.0	66.6	66.0	95.2	61.8	38.8	66.1

*Comparisons between varieties should be made within columns only, not across columns.
†Nursery grown at Cottonwood prior to 1965. Values shown are averages over the two stations.
‡No data available from Newell in 1965.

Each strain being tested must be carefully harvested.

Flax Yields in South Dakota*

Variety	Brookings '59-65	Brookings '64-65†	Watertown '59-65‡	Watertown '64-65†	Highmore '60-65	Highmore '64-65
			Bushels Per Acre			
Dillman	......	24.6	......	26.8	......	19.0
Noralta	......	25.6	......	26.5	......	......
Bolley§	18.6	23.5	18.1	25.8	......	......
Caldwell	......	25.4	......	26.6	......	16.4
Redwood§	19.2	25.2	17.8	25.6	12.2	16.0
Summit§	21.2	28.0	20.5	27.7	15.4	20.3
Windom§	21.0	25.8	20.3	27.6	13.3	18.2
B-5128§	18.1	26.4	17.2	23.8	12.4	16.0

*Comparisons between varieties should be made within columns only, not across columns.
†Data obtained from Uniform Regional Flax Nurseries; all other data from Standard Variety Flax Trials.
‡No data available for 1962.
§Varieties recommended for growing in South Dakota in 1966.

valent races of stem rust. Clintford is resistant to smut and possesses some tolerance to the yellow dwarf virus. It has excellent standing ability, similar to that of Tippecanoe and Tyler, but has generally yielded less than Tyler in South Dakota tests.

FLAX

The new race 300 of flax rust was found in several fields of susceptible varieties in South Dakota in 1965. This emphasizes the importance of growing only resistant varieties to prevent immediate losses and as a long-time control measure by minimizing the build-up of rust within the state. Keeping the rust population at a low level reduces the probability of development of new races capable of infecting presently resistant varieties.

The 1966 recommended varieties are **Summit, Windom, Bolley, Redwood** and **B-5128.** These varieties are resistant to all known North American races of flax rust.

Three new flax varieties having possible value for growing in South Dakota have been released in the past year. None of these has been added to the recommended list of varieties for 1966, but are included here for description only. This does not imply recommendation.

Dillman is a 1965 release from the Texas Agricultural Experiment Station. South Dakota tests have shown it to be of medium maturity and short in plant height, being even shorter than Caldwell,

Laundering research looks for

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Sure: you and your laundry room.

Ladies, when you do the family wash you assume somewhat the role of a chemist and your laboratory is your laundry room—regardless of whether it is hand rub-a-dub-dub or latest washer-dryer equipped.

But don't despair. You won't need to become a learned scien-

NEW VARIETIES (cont.)

another Texas variety, which was described in the Spring 1964 issue of *Farm & Home Research.* This shortness could make the crop difficult to harvest if it were shortened further by unfavorable environmental conditions. It has brown seeds which are average in oil content of fair drying quality. It has blue flowers, is resistant to rust, has fair wilt resistance and pasmo tolerance and is outstanding in frost tolerance. It has given good yields in years of favorable weather but generally does not yield as well as some of the presently recommended varieties (see accompanying table of yields).

Noralta is a 1965 release from Canada. It has blue flowers, brown seeds, medium height, and maturity, resistance to rust, fair resistance to wilt, and tolerance of pasmo. The seed is below average in oil content; oil is of fair drying quality. It has given good seed yields but because higher yielding varieties are available having higher oil content of better quality, Noralta has not been placed on the recommended variety list for South Dakota.

Redwood 65 is another Canadian release. It has blue flowers, brown seeds, medium height and medium-late maturity. It is resistant to rust and wilt but is susceptible to pasmo, having less tolerance than Redwood. The seeds are high in oil of good drying quality. Tests in South Dakota (not included in the table because the variety was not grown in the same nurseries as other varieties reported) have shown it to yield well when seeded early but rather poorly when seeded late. Redwood 65 has not been placed on the recommended list because other varieties are available which are equal in yield and have better pasmo tolerance.

RYE

Von Lochow rye was described in the Winter 1965 issue of *Farm & Home Research* but without available data on its performance in South Dakota. The accompanying table shows the comparative performance of Von Lochow and four other varieties at two locations in 1965. Von Lochow has been described as being less winter-hardy than Elk which in turn is less hardy than Pierre, Antelope or Caribou. The 1965 winter survival data at Centerville substantiate these relationships. Relative yield closely paralleled winter survival at that location. Von Lochow performed very well at the Highmore station in 1965 when there was no observable winter-killing in any of the rye varieties.

Elk performed similar to Von Lochow in 1965. Both yielded well in the absence of winter injury but poorly where winter survival was a significant factor. Neither Von Lochow nor Elk are included in the list of rye varieties recommended for South Dakota because of their lack of sufficient winter-hardiness. □

Rye Data for South Dakota

	Highmore		Centerville		
Variety	'61-65	1965*	'60-65†	1965	Winter Surv. 1965
			Bushels Per Acre		%
Von Lochow	-----	61.0	-----	21.1	15
Elk	38.8	51.8	19.7	17.5	20
Antelope‡	36.4	42.8	32.1	49.6	75
Caribou‡	38.8	47.2	31.5	49.4	80
Pierre‡	34.7	41.0	29.7	53.6	85

*Early varieties injured by late spring frost in 1965.
†No data available for 1961.
‡Varieties recommended for growing in South Dakota in 1966.

Clothes

tist. And your laundry "lab" need not be crowded with test tubes, beakers and other chemical apparatus. Researchers will take care of the technical work for you. In their experimental laboratories with special equipment they seek answers to problems in order to give you in simple, practical form the "how-to" and sometimes the "why" of better, easier laundering.

Textiles research takes many forms at the Agricultural Experiment Station at South Dakota State University. Because of frequent requests for information dealing with laundering problems, a pilot study has been launched by the South Dakota and Minnesota Experiment Stations to help solve some of the difficulties common to both states. The current emphasis is on water because supplies in the two states are frequently high in dissolved mineral salts.

Problems Vary

A chemist knows—and you probably do too—considerable about how to soften water or make it more suitable for laundering. Sometimes it is easy, other times not. If you have a source of water (a well, for instance) different from that of your neighbor, each of you may have a different problem. Presence of iron in your water supply may be even more troublesome than hardness. Some waters have such high proportions of iron salts that brown stains or discoloration are caused during laundering. Manganese will cause gray or black stains on fabrics. Some water can be softened by ion exchange methods—other water is so hard it presents more difficulties.

Textiles research people at South Dakota and Minnesota Experiment Stations cooperatively are looking into the technical aspects of virtually this whole business of laundering clothes in water high in dissolved mineral salts.

Take the instance of the mother who sent textiles researchers at South Dakota State some of her young son's freshly washed knit undergarments to illustrate her laundering problem. The garments, some quite new, were stained and discolored. Her problem, the researchers found, was due to presence of iron in the water supply. They gave her advice on what to do. They also used a special treatment in the laboratory, removed the stains and returned the garments gleaming white. (This treatment is more adapted to the laboratory than home laundry because of the extreme care one must use with an acid during various steps.)

Now don't send your clothes to either the Minnesota or South Dakota Experiment Station and expect to have them laundered. That's not the job of these textiles research people. Their job is to find out what is wrong, how it can be remedied and then get the information to you so your clothes too can come out as clean as wash on a TV commercial.

Problem May Be YOU

And then your laundry equipment and water supply might be just right but your clothes still don't come out white and bright. In this case the problem probably arises because of you. You are not laundering right. (A researcher might say your "methodology" is at fault.) This frequently happens.

As an example, take the case of the homemaker who asked for help because of rust stains in her freshly laundered and ironed clothes. Detailed investigations revealed equipment and water had nothing to do with the problem. The difficulty turned out to be that small specks of the non-liquid bluing agent she used remained on the clothes after they had been removed from the washer. When heated—by ironing or in the dryer—the specks of bluing caused rust stains. What happened, researchers explain, is that the "home chemist" unknowingly had applied heat to a substance (the specks of bluing) and changed its chemical composition enough so that it became a source of rust. Thus, nothing was wrong with the product—it just wasn't given sufficient time to dissolve properly either before or during washing. (This, the textiles research people add, could also happen when a combination of chemicals in the water prevent or slow-up the dissolving process of the bluing.)

Homemakers Cooperating

In order to help homemakers with laundering problems caused by hard water, the two Experiment Stations are pooling their efforts. Cooperating also are the Extension Services of the two states through home economic agents and their direct contacts with the people who will benefit most—the homemakers.

The pilot project now underway is to investigate effects of various degrees of hardness and mineral content on fabrics composed of cotton, chemical fibers or blends. Moody County in South Dakota and Nobles County in southwestern Minnesota were chosen for the initial studies. Home economic agents in each county have enlisted the help of women to cooperate and be a part of the research.

Since keeping nylon tricot (knit) white seems to be a troublesome problem it was decided to select white nylon slips to be worn and laundered by the homemakers themselves. Data was collected by questionnaire concerning source of water, plumbing and mechanical equipment, laundering equipment, and washing agents used. Slips were distributed by home economics agents to the women helping with the research. Slips will be worn and laundered five times and then returned to the research laboratory for examination. They have been returned for two periodic examinations and soon will be returned for the third and final evaluation.

It is hoped that information will come from the laboratory which will be of use to homemakers. If this pilot study appears to help get some of the solutions to hard water laundering problems, the project probably will be broadened to a state-wide area and other garments and fibers considered. □

Water

on South Dakota RANGELANDS

Only 4 inches out of South Dakota's total annual average precipitation of 18 inches goes for surface runoff or percolation to groundwater. How this amount is used and conserved is of great importance to all of South Dakota. Research is showing that if storage losses can be minimized, plenty of water would be available for livestock.

By **Armine R. Kuhlman,** *USDA Botanist,* Newell, S. Dak.

Have we ever stopped to plan our water needs and its best uses based on what surface water is available each season? Too often we only worry about water when acute shortages occur.

Water has been a primary factor in development and stabilization of farms and ranches in the Great Plains during the past 100 years or more. Often at various locations throughout the Great Plains States inadequate water supplies have prevented people from closing the sale of land or proving up the homestead claim. Water has been the focal point in the growth of towns and in attracting small industries. Despite experience gained over the years on the erratic distribution of moisture, operations designed to assure maximum beneficial use of the moisture on the farm and ranch have been slow to evolve.

Hydrologic research data have been collected since 1957 in Butte and Meade Counties within a 50-mile radius of the Newell Irrigation and Dryland Field Station in western South Dakota. Using some of this data, we can compare runoff water supplies from fine-textured soils and moderately-coarse-textured soils. In addition, it soon becomes evident that there is a growing need for conservation of stored water in South Dakota. The 1963 USDA Yearbook mentions that water withdrawals by towns over 2,500 population have increased 190%. Daily water withdrawals rose to 1,425 gallons per capita for all purposes in 1963. Agricultural use had risen 60%, ac-

Contribution from the Northern Plains Branch, Soil and Water Conservation Research Division, Agricultural Research Service, USDA, in cooperation with the South Dakota Agricultural Experiment Station.

counting for 37% of the natural withdrawal. The South Dakota Cooperative Extension Service estimates that farms and ranches need about 70 million gallons of water *daily* for all purposes except irrigation. Over 80% of this water was for livestock consumption. People in towns used about 150 gallons per capita daily.

The average annual precipitation in South Dakota is about 18 inches. Evapotranspiration from grasses and crops accounts for an estimated 14 inches of this precipitation, *leaving 4 inches as anticipated surface runoff or percolation to groundwater.* Proper use and conservation of this 4 inches is of utmost concern to some 56,000 farmers and ranchers in South Dakota. These people and those of adjoining Western States are hopeful that research information will help solve the water phase of their agricultural economy for greater stability.

Figure 1. Instrumentation at the pond of a 160-acre watershed has been measuring runoff since 1957. The stilling well houses an A-35 continuous strip chart stage recorder. To the right is one of the pond staff gage posts. The white area shows large cracks in the bottom of the dry pond.

DESCRIPTION OF RESEARCH WATERSHEDS

Six watersheds, ranging in size from 30 to 800 acres, are situated between Redig in Harding County and Mud Butte in Meade County. Soils in these watersheds are moderately - coarse - textured, and were derived from sedimentary sandstones and shales of the upper Cretaceous Age. Ranchers usually refer to these areas as the "sandy" or "loam" watersheds. Four watersheds, varying in size from 45 to 160 acres and totaling some 400 acres, are on fine-textured soils. These watersheds are situated in the Sulphur-Vale area northeast of Sturgis. Such fine-textured soils of the Pierre-Promise-Lismas associations were derived from Pierre shale and are common to 11.6 million acres, or 23%, of the state. Ranchers refer to them as "gumbo" soils. Of some 26.7 million acres of pasture rangeland in South Dakota, most of the vegetation is "mixed prairie."

Table 1. Runoff Water from Small Rangeland Watersheds in Western South Dakota (1957-1964).

Watershed Soils	Av.Annual Precipitation	Av. Annual Runoff: Depth Over Watershed	Av. Annual Runoff: Percentage of Precipitation	Indicated Av. Runoff From a 100-acre Watershed That Could be Stored for Livestock Use	
(1)	(2) Inches	(3) Inches	(4) Percent	(5) Ac.-Ft.	(6) Cow Days*
		Based on Annual Precipitation†			
"Sandy", "Loams" or Moderately Coarse Soils	11.67	0.49	4	4.08	132,900
"Gumbo" Clay Soils	13.23	1.30	10	10.83	352,900
		Based on Precipitation as Snow			
"Sandy" or "Loams"	2.13	0.18	8	1.50	48,900
"Gumbos"	2.68	0.29	11	2.42	78,700

*Cow Day—Assumed average water consumption = 10 gal./day/cow.
†Water from annual precipitation includes snowmelt. April 24 was taken as date when snowmelt ended.

Research Data on Water

Precipitation and runoff records from instrumented small range watersheds (figure 1) on moderately-coarse and fine-textured soils are compared in table 1.

During approximately 8 years, average annual precipitation was about 1.5 inches greater in the "gumbo" area than on the "sandy" area. Runoff from the gumbo area (column 4, table 1) amounted to 10% of the precipitation as compared to only 4% from the sandy loam areas.

The last column expresses the measured runoff in terms of cow days. A cow day, as shown here, is 10 gallons of water per day per cow.

If all the runoff from rangeland could be collected and stored without pond seepage and evaporation losses, the runoff water supply from 100 acres of "sandy"

rangeland watershed would be enough for 100 cows for over 1,300 days. In comparison, the water supply would be more than 2½ times greater when the range was on "gumbo" soil. Looking at it another way, 1 inch of precipitation on 100 acres would produce a 118-day water supply for 100 cows on the "sandy" watersheds and 267 days on the "gumbo" watersheds. If storage losses could be minimized, there would be plenty of water on hand for livestock.

Water Supply from Snow Melt

When planning for early spring grazing and the operations of lambing and calving, it is important to consider the snowmelt water storage and its distribution in relation to early grasses or forage. During the 7 winters observed, the average annual snow moisture was more than 2 inches (column 2, table 1). Over one-third more snowmelt runoff could be stored in ponds located on "gumbo" soils (column 5) as in those on "sandy" areas. When comparing proportions of runoff (column 4), snowmelt from "sandy" watersheds was twice as great as that shown for annual runoff.

Configuration of the watersheds (figure 2), temperatures, and other factors affected these amounts of snowmelt runoff water. If snowmelt were the only source of water supply for the season, the rancher living on the "gumbo" areas could plan on a water supply of 334 days for 100 cows per inch of snow moisture on 100 acres of watershed. In comparison, the rancher on the "sandy" rangeland might be able to count on only 229 days of water stored for the same number of cows.

Stored Water Losses

Stored snowmelt may be lost by seepage and evaporation before the start of the heavier grazing season, particularly on "sandy" ranges. In 1962, an average daily seepage loss of 910 cubic feet occurred during 37 days of observation at a pond of approximately 1 acre surface area and 12 acre feet total capacity. This daily water loss would have taken care of over 600 thirsty cows. In 1964, 27,127 cubic feet of water was stored in a fenced dugout 50 feet square and 11.5 feet deep on a sandy area. A total of 27,000 cubic feet of water was lost. Seepage amounted to 22,300 and evaporation to 4,700 cubic feet in 6 months. This water would have supplied 223 cows during 100 days. For a 3-year period, average annual seepage at ponds in the "gumbo" areas accounted for approximately one-third of the total loss in comparison with two-thirds of the loss at ponds in the "sandy" area. Daily evaporation is about the same in both areas, however, since water is available for evaporation over a longer period at ponds in the "gumbo" sites, the total evaporation is higher. Finding ways and means of reducing these losses is important for the maximum use of water by the livestock industry.

Balancing Water Supply with Grass Available

The rancher obviously must adjust the supply of water to his supply of grass. Generally, there is enough grass on 100 acres for only two to six cows for 6 months. In practice, the ranchers graze smaller fenced paddocks for short periods and thereby adjust grazing practices to fit the surface water supply.

A rancher who is concerned with water conservation knows his range and frequently adjusts plans under erratic rainfall to manipulate the water supply at the areas of unused grass to obtain the maximum economic benefit.

SUMMARY

Research since 1957 in western South Dakota has shown that runoff averages 10% of the annual precipitation on fine-textured soils developed from Pierre shale. In comparison, runoff on moderately-coarse-textured soils was 4%.

Runoff from two soil textures is expressed as water supply per day for a cow. On the average, the surface runoff of moisture falling on 100 acres of fine-textured rangeland would water 100 cows for 267 days as compared to 118 days when the soil was moderately-coarse-textured.

Snowmelt is a relatively dependable source of runoff water for storage in the spring season. Seepage and evaporation are leading factors in reducing the supply of stored water available for use later during the heavier grazing period. □

Figure 2. In the Great Plains the configuration of watersheds and the direction of prevailing winds may cause snow to blow onto or out of a watershed and thus affect the supply of water stored (pond in center) from snowmelt. In the foreground there was insufficient vegetation to hold the snow on this 215-acre watershed.

PROS AND CONS OF

Growing Crambe

Crambe is harvested (below) in a manner somewhat similar to flax.

Crambe, grown experimentally in South Dakota since 1963, in some states became a commercial crop in 1965 and was classified as a mustard under the Feed Grains Program. During the past year acreages were grown under contract in areas of Oregon, northeastern Montana and western North Dakota for processing in Montana.

Oil obtained from crambe seed is currently the most important product. Initial interest in the crambe oil was due to its high content of erucic acid, an industrial product used in the manufacture of rubber, synthetic fibers and jet engine lubricants. Additional new developments include possible use of crambe oil itself as a mold lubricant in the continuous casting of steel, a process being more widely adopted by steel companies as they modernize and expand.

Yield trials of this new U. S. crop introduction in eastern South Dakota have been reasonably encouraging (see South Dakota *Farm & Home Research*, Vol. XV, No. 3, Summer 1964). Estimated value of the oil and a good protein feed as a by-product suggest that crambe could compete profit-wise with wheat and flax.

But South Dakota Agricultural Experiment Station agronomists point out several disadvantages in growing crambe. As the plant matures, the seed shatters quite readily, especially in a windy season like the fall of 1965, they say. Weed control is also important for a successful crambe crop.

Crambe would ordinarily be grown under contract with seed supplied by the processor. The grower usually is paid for seed delivered to the processing plant. Because of the light weight of the seed, nearness to an oil crushing plant would be desirable.

Crambe would be more profitable if a good high protein meal could be obtained from the seed, agronomists say. However, crambe seed contains products which break down during processing and create strong flavors in the protein meal, making it quite unpalatable to ruminants. Other ingredients in the meal make it unsuitable as a feed for non-ruminants. Experiment Station Agronomists believe that it is only a matter of time until these problems are solved.

Crambe resembles wild mustard in general appearance prior to flowering. It has good seed producing habits and shows little susceptibility to insects and disease. The crop is harvested with a combine but minor changes in the machine are desirable.

This new crop will continue to be included in Agricultural Experiment Station experimental plots for agronomic evaluation. Seed is not available through the Experiment Station for general distribution. As markets expand, more information will be available to potential growers in South Dakota. □

South Dakotans, U. S. A.

"I was born in South Dakota."

Nearly a million persons could have said that in 1960 but only a little more than half of them lived in South Dakota.

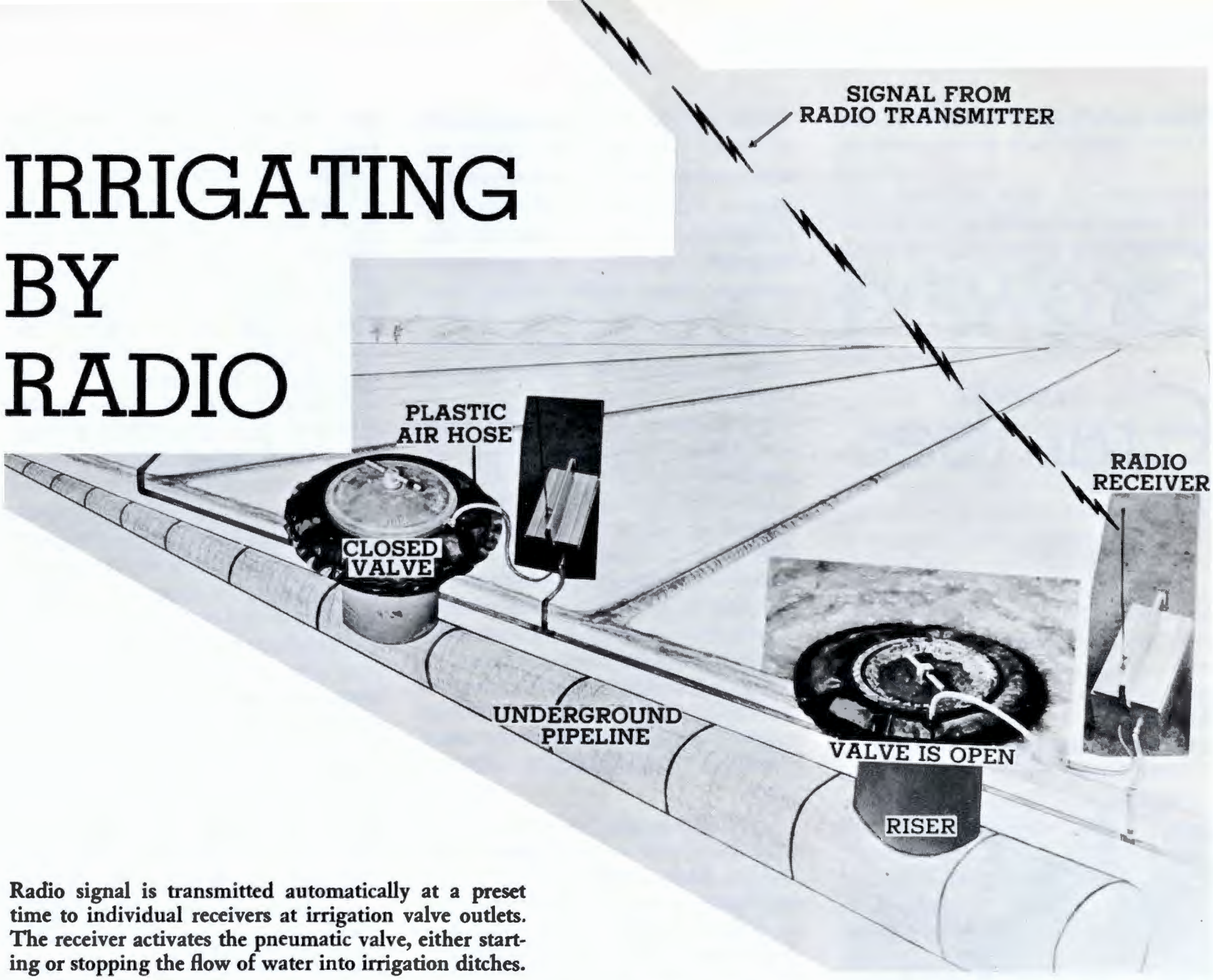
Of the 911,440 native South Dakotans in the United States in 1960, 53% resided in South Dakota and 47% elsewhere. South Dakotans had scattered to every state by 1960 and some of this migration may have occurred as early as 1889.

Thirty-four states had more than 1,000 former South Dakotans each.

And which other state apparently appeals most to South Dakotans? California. The nearly 99,000 ex-South Dakotans in California form a group equal to about the combined populations of Sioux Falls and Aberdeen.

Minnesota attracted the second largest number with 54,000, Washington had 41,000 and Oregon and Iowa tied with 26,000 each. It was readily apparent South Dakotans preferred to go west because New England states attracted the few-

IRRIGATING BY RADIO



Radio signal is transmitted automatically at a preset time to individual receivers at irrigation valve outlets. The receiver activates the pneumatic valve, either starting or stopping the flow of water into irrigation ditches.

South Dakotans, U.S.A. (cont.)

est: Vermont only 97, Rhode Island 165, and Main 268.

These are facts gleaned by Marvin P. Riley, South Dakota State University rural sociologist, in a population study based on the Federal census of 1960. Results have been published as Agricultural Experiment Station Bulletin 528, "Where Native South Dakotans Lived in 1960." Riley was mainly interested in where South Dakota natives lived in 1960, from which states new residents came, amount of net gain or loss, and age structure.

On a regional basis, the three West Coast states had received 4 out of every 10 of all living migrants from South Dakota. The 12 states in the North Central Region had received only 3 out of every 10.

While South Dakota's loss rate is high at 47%, four other states in 1960 were higher. Wyoming led with 51%, then Arkansas 50%, and North Dakota and Oklahoma 49% each. California had the smallest loss rate (12%) followed by Michigan (17%) and New York (19%).

About a fourth of South Dakota's residents in 1960 were born in other states and 71% were native born. The national average for persons residing in their native state is 66% with Mississippi first (86%) and Nevada last (26%).

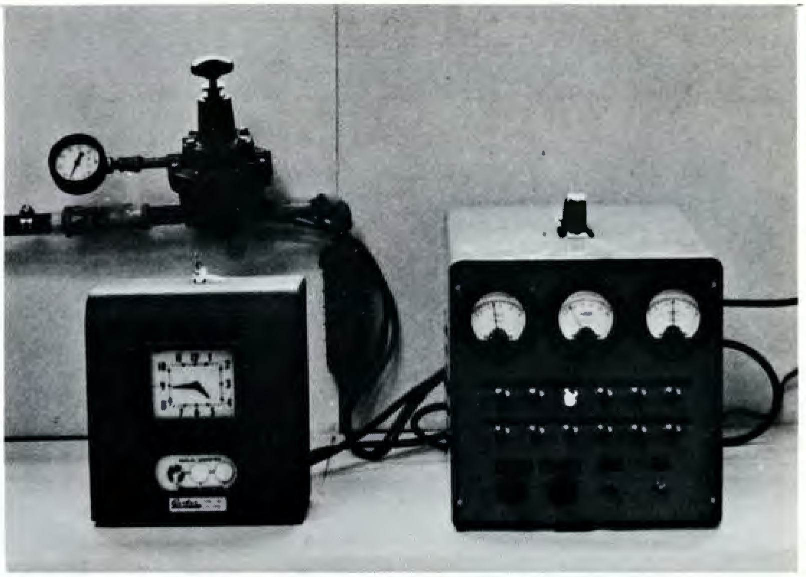
States immediately surrounding contributed mainly to the in-migration to South Dakota. Of the 171,000 total, Iowa contributed 37,286, Minnesota 28,600, Nebraska 21,396, and North Dakota 15,648. California, which took the most, contributed only 3,798 persons. Mountain and Pacific Coast states, which had received the largest proportion of South Dakotans, contributed only 17,250 people. In other words, for every six South Dakotans going to these states, only one of their natives came the other way. As far as distance is concerned, relatively large numbers of people had moved to South Dakota from Pennsylvania, Kentucky, and West Virginia.

Riley's study included a "balance sheet" which shows a net loss to South Dakota of 258,665 people—nearly a third of the total population in 1960. This net loss of 28% ranked only behind North Dakota's 35% and compared with these five other West North Central Regional states: Minnesota 10%, Missouri 15%, Kansas 17%, Iowa 23%, and Nebraska 27%.

The proportion of people residing in South Dakota born in other states has decreased some 14% during the past 40 years to the 1960 total of about 25%. Iowa and Nebraska are two of only six states contributing more people to South Dakota than they have received. □

Each System Uses Inflatable Valves Controlled By Radio Signals

This article on U. S. Department of Agriculture research at the Irrigation and Drylond Field Station, Newell, S. Dak., originally appeared in Agricultural Research magazine. Illustrations are courtesy of Farm Paper Service, Office of Information, USDA.



The 24-hour timer (left) and a set of stepping relays turn on a tone transmitter (right). The transmitter beams signals to receivers at each valve outlet.

A completely automatic irrigation system—one that opens and closes valves at predetermined times—can conserve both water and labor on many western farms.

Soil scientists H. R. Haise and engineers E. G. Kruse and N. A. Dimick, all of USDA's Agricultural Research Service, have developed fully automated irrigation systems. One automates pipeline-irrigated fields; the other, open-ditch-irrigated fields. Agricultural experiment stations in Colorado, South Dakota, and Wyoming cooperated in the research.

The heart of each system is an inflatable valve made of nylon-reinforced butyl rubber.

In pipeline-irrigated fields, for example, the inflatable valve is an O-ring that is mounted between the seat and lid of an alfalfa valve and held in place by a metal sleeve that slides up and down the valve stem. When the valve is open, or deflated, the O-ring washes against the alfalfa valve lid so that it rides on top of the water flowing from the pipeline. When the valve is closed, or inflated, the O-ring seals the opening by filling the space between the alfalfa valve seat and lid.

In open-ditch systems, the inflatable valve is a tube with sealed ends that is fastened in a turnout pipe. When deflated, the tube lies flat in the turnout pipe. When inflated, it blocks the flow of water through the turnout pipe.

Both systems can be controlled from the farm house. In a typical installation, a 24-hour preset timer and a set of stepping relays turn on a 12-channel, citizens-band radio transmitter. The transmitter beams activating signals to individual inflatable valves.

At the individual valve, a battery-powered radio receiver, tuned to one of the transmitter's channels, receives the signal to open the valve. A relay in the receiver activates a solenoid that deflates the valve, and allows water to flow from the pipe.

After the water flows for a predetermined irrigation period, the clock timer and relays again activate the transmitter, and it signals the receiver to close the valve.

The relay in the receiver trips the air-control device, and compressed air—pumped to each valve in flexible polyethylene tubing—inflates the valve and stops the flow of water.

This system can also be operated remotely with a timer and relays that send signals through a pair of wires to the individual valves. And by adding one electrical wire to the two signal wires, the need for batteries to activate the receivers and solenoids can be eliminated.

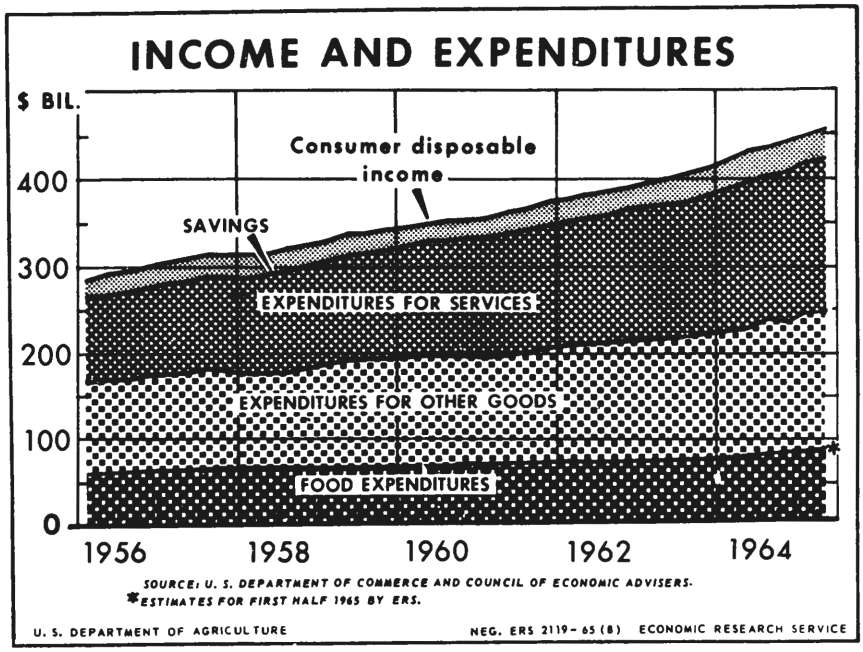
The scientists have field tested the automated system at Newell, S. Dak., and in western Wyoming, but it is still about a year from commercial market. They plan to test several modifications, such as replacing the polyethylene air-distribution lines with nylon-reinforced garden hose, and using water, possibly, instead of air to inflate the valves. ☐

See Photos on Details of Valves . . . next page

Conventional alfalfa valve with lid removed (upper left) is ready for pneumatic valve installation (upper right). Once the valve is in place, lid is put on (lower left) and valve is inflated (lower right) so that water can flow into tile line. At a signal from transmitter, the valve will deflate and water will surge into irrigation ditches.

1966 Family Living Outlook

Alverda M. Moore, Family Economics Specialist with the South Dakota State University Cooperative Extension Service, briefly summarizes the 1966 outlook as it might apply to South Dakota family living. The summary uses information from a Washington outlook conference and material prepared by various authorities.



Optimism characterizes the economy for 1966.

Consumers found 1965 to be a good year, may expect 1966 as good.

Sharp rise in consumer expenditures reflects increase in consumer income.

Farm family income in 1966 to rise further; last year farmers earned better incomes in more than a decade. Influencing factors: decline in number of farms and farm people, shifts in age composition of farm people, Social Security program changes.

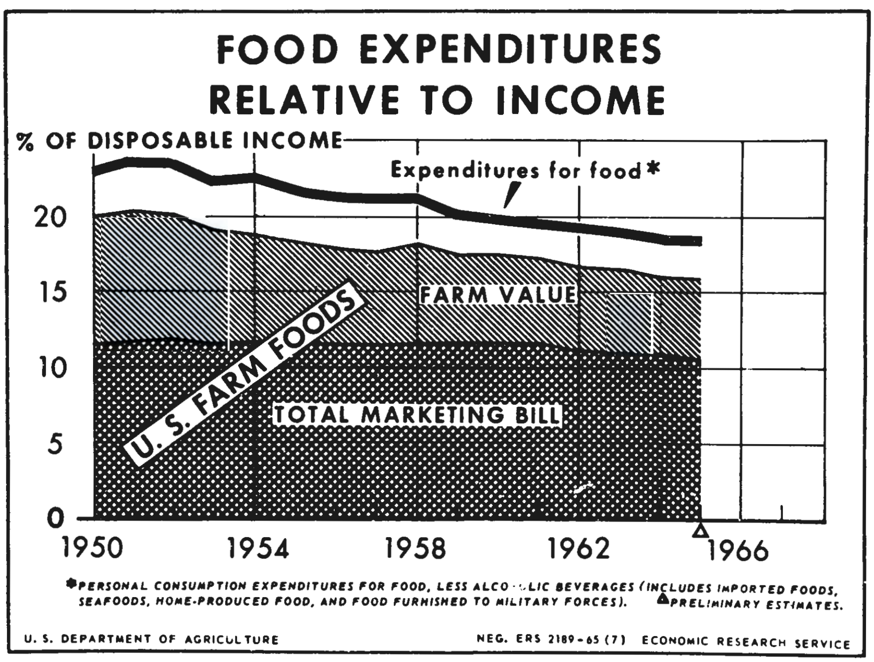
FOOD

Per capita food use in 1966 to about equal 1965 with less pork, lamb, animal fats, but more poultry and food crops such as potatoes and citrus. Little change for beef, milk, eggs. Retail food prices to continue upward but less rapidly than last year's 2½% increase.

Food expenditures were up nearly 6% in 1965, half of it due to higher retail food prices which resulted from higher prices at the farm level.

Commercial food purchases again to be supplemented by various food distribution activities. Emphasis to continue on improving nutrition and food consumption of children, low income families, and those in charitable institutions.

Farmers share of consumer's 1966 farm-food dollar to change little (39 cents in 1965, 2 cents above 1964).



CLOTHING

Clothing purchases to increase because of rising incomes, "trading up," and higher proportion of 15- to 24-year-olds in the population.

Spring lines of clothing to cost more following 5% to 10% rises in men's suits last fall. Boosts of 50 cents to $2 in shoe prices along with 5% to 10% increases in cost of children's clothing.

EQUIPMENT, FURNISHINGS

Another active year in household equipment and furnishing industries. No across-the-board price increases but look for continued moderate price changes—up or down—depending upon the item.

HOUSING

Mortgage money plentiful in 1966 although rates higher and down payments larger. Rent and costs of home ownership moving up about 1 percentage point annually since 1960.

Of special interest to South Dakotans: new FHA provisions broaden opportunities for lower and moderate rural income families to establish homes of their own.□

New Tomato . . .

BONANZA

By Paul D. Prashar, *assistant professor,*
Department of Horticulture and Forestry

Bonanza is the name of a new tomato variety which will give gardeners a large, meaty, crack-free fruit.

Seed is available through the Foundation Seed Stock Division of South Dakota State University Foundation. Seedlings for planting this spring may be available from numerous commercial greenhouses.

The new tomato, developed through 8 years of plant breeding and selection by Agricultural Experiment Station horticulturists, has orange red fruit averaging 10 ounces in weight. Uniform ripening prevents green shoulders.

Mid-season maturity (65 to 68 days) and high yield of marketable fruits (nearly all are crack-free) are other advantages.

Vines are vigorous, upright, indeterminate (they keep on growing until the season's end), and have enough foliage to protect the fruit from sunburn. Vines are suitable for either staked or ground planting. They are not adapted for merchanical harvest but are satisfactory for home gardens and market use. The new variety has field resistance to wilt.

An average Bonanza tomato is 3½ inches wide, 3 inches deep.

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