Our goals at the North Central Research Extension Center (NCREC) are to conduct research to find practical answers to crop production problems, conduct educational programs and demonstrations to address these problems, and to increase foundation grade seed of new and popular varieties for this area. New crops, varieties, and production methods are tested as they become introduced to determine their feasibility in our environment.

Agronomy: The North Central Research Extension Center conducts the majority of its agronomic field research trials at the main research facility south of Minot. The agronomy program also utilized off-station locations to strengthen and enhance its research capabilities. Off-station sites have been established at the Dean Schoenberg Farm west of Mohall, at the Dave Teigen Farm west of Rugby, at the Mike Zimmerman Farm north of Garrison and at the Rod Binstock Farm south of Wilton. A few individual trials were also conducted at various locations throughout the region as are noted in individual research reports. The NCREC thanks these farmer-cooperators along with county Extension staff, agricultural crop improvement associations and many others for their dedicated support with various research efforts.

Beginning with the 2013 cropping year, all agronomic research studies (with a few exceptions) were conducted utilizing no-till methods in a continuous cropping system. In 2016, all crop production and variety trials were moved to a new permanent location directly west of the Research Center. Broadleaf crops were typically planted into small grain stubble and small grain crops were typically planted into soybean stubble. Soil samples from each research site were randomly collected and analyzed for macro and micro nutrients. Each research site then received fertilizer applications based on those results. Urea (46-0-0) was the primary source of nitrogen and was "planted" prior to seeding or was applied in a mid-row band at seeding time. Monoammonium phosphate (11-52-0) was the primary source of phosphorous and was applied either directly in the seed row or in a mid-row band at planting. Seeding rates were adjusted for seed size and germination to provide a uniform number of pure live seeds (PLS) per acre for each crop and variety. Small plots were seeded with no-till drills equipped with Bourgault coulter disc openers set at a 7 or 7 ½ -inch row spacing. Row crops were planted with a SRES small plot planter utilizing Great Plains no-till openers with Monosem singulation seed meters. All small grain crops received an early post-emergence herbicide/fungicide combination for weed and disease control and a fungicide application at flowering/heading to control head diseases. Broadleaf crops typically received a pre-plant herbicide application to control broadleaf weeds followed by a post-emergence herbicide application to control grassy weeds. Other specific pest problems such as flea beetles in canola and leaf rust on sunflower were also treated with appropriate pest control measures when possible.

The fall of 2015 was relatively moist, providing good conditions for winter wheat establishment. The winter of 2015/16 had modest snow cover and no prolonged periods of bitterly cold temperatures. Winter wheat fields for the most part had little winter kill. Warm temperatures in early March melted snow and removed soil frost. Small grain planting began in earnest in mid-April with few weather related interruptions. Spring temperatures were mild and May received little precipitation. There were reports of heavy flea beetle infestations in canola and wheat streak mosaic virus in spring wheat. Summer growing conditions were ideal for both cool and warm season crops, with timely rainfall and mild temperatures. Conditions for fusarium head blight were favorable and many durum growers had unmarketable crops despite timely fungicide applications. Most spring wheat farmers were able to stay ahead of this disease with a combination of genetic tolerance and timely fungicide applications. August was hot and dry, allowing small grain crops to mature and effectively dry down for harvest. These conditions did affect the soybean crop causing terminal pod abortion, but yields were still very good. Minot's fall remained frost free through October allowing row crops to fully mature. Row crop harvest was unimpeded through November.

Extension Education

The North Central Research Extension Center provides information and producer education through a number of Extension specialists located at the Center who work with county Extension agents and state specialists. Activities include consultations and presentations delivered through individual contacts and group meetings, workshops, schools, field days and tours on a variety of topics and issues associated with crop production, livestock production, and resource management. Producers and allied industry are welcomed to contact the NCREC at (701) 857-7682 to discuss issues or concerns with available Extension specialists.

Livestock: Low crop prices stimulated considerable interest in planting annual feed and forage crops including: corn for silage, small grains for hay, and cover crop mixtures for grazing. Limited experience for many, brought about inquiries and field tours on planting, harvesting and feeding. Another wet start to haying and the salvaging of hailed crops during unfavorable weather led to educational opportunities on haylage, baleage and haying technologies and techniques. The biggest challenge to cattlemen came with the summer and fall collapse of calf prices when expectations were for a year similar to last. Considerable interest in feeding calves to add weight and value was met with a state wide series of producer meetings on economics and feeding; along with popular press articles on the subject and web posted information and videos. Coinciding with the fall's interest in feeding was the prevalence of Vomitoxin in scab infested wheat and durum that is being rejected and severely discounted by grain buyers. This has created an opportunity for information and meeting presentations on its feed value and facilitation of movement to cattle feeders and feedlots. With considerable transition the extension positions in the state and area from retirements, I've had the pleasure of providing training and mentoring to new staff in regards to feed and water testing, ration formulation and cattle budgeting and economics on one to one basis, in-service workshops and county projects.

Crop Protection**:** Efforts centered on crop protection continued to focus on pest management among area crops. During the 2016 season, extension and research activities were focused on pest management and prevention. Research related activities investigated control of wireworm and flea beetle. Pest and disease pressure was monitored throughout North Dakota and reported with weekly contributed updates released through the publication of NDSU's Crop & Pest Report. Educational activities included producer attended meetings, summer field tours, and agent trainings. Field tours were well attended and focused on a variety of crop protection/cropping system topics. Youth education continues to serve as an on-going mission in the area with several presentations centered on area entomology and their relation to crop protection and cropping systems.

Cropping Systems: The responsibilities of this position are to provide leadership in the area of crop production for the region. This position provides crop and pest management and soil science information to county Extension agents, producers, and industry personnel. Educational efforts include field tours, meetings, news releases, and videos. They communicate with other Extension specialists to provide demonstration and applied research efforts to address the needs of clientele. This position also is responsible for collaborating with agencies, industry, crop organizations, and crop commodity groups to teach and provide cropping systems programming.

Soil Health: Activities at the NCREC continued to focus on soil salinity, fertility, and cover crops. County based workshops highlighted management of saline areas. Two saline management studies were planted and an evaluation of salinity reduction from drain tile was initiated this year. A five year cover crop project involving 39 farmers across North Dakota that evaluates late season cover crops is in its second year. Year one of a three-year soybean fertility recommendation project was completed. A shrub salinity tolerance study started this year. Several days were spent training county agents one-on-one regarding various soil science topics. A pipeline reclamation study is ongoing. Soil characteristics, soil amendments, and crop rotations are being monitored to determine effective pipeline reclamation practices.

Foundation Seed Increase

The NCREC Foundation Seed program works closely with the Foundation Seedstocks program and plant breeders at NDSU's main campus in Fargo. The NCREC's role is to help facilitate the increase of new varieties from Fargo's main campus out to producers in north central North Dakota. The program also maintains inventory of several popular varieties crops that are grown in the area.
The different crops and varieties that will be available for the 2016-2017 cropping season:
Barley – ND Genesis
Durum –Carpio, Joppa
Flax – Gold ND (DSS), Omega, York
HRSW - Barlow, Bolles, Elgin-ND, Glenn, Surpass
HRWW – Darrell, Decade, Ideal
Oat – Jury (DSS)
Soybean – Ashtabula, Cavalier, ND Henson

Pulse Crop Breeding
Pulse crop breeding research is conducted for the improvement of chickpea, dry pea, and lentil. The primary focus is on increased yield within the quality standards of the various market classes within these three species. Experiments are ongoing which will result in released varieties that have high yield and quality in the presence of several stress factors. The pulse program's first release, named ND Eagle, is a small green lentil. ND Eagle was approved for release in 2016. Some of these stresses are diseases such as Ascochyta blight in chickpea; powdery mildew, the virus complex, *Fusarium* species in pea; and Sclerotinia and Stemphylium blights in lentil. Trials are being conducted that evaluate or generate experimental lines at every step in the breeding cycle from the hybridization of selected parents, to the evaluation of advanced breeding lines.

Weed Science
Weed control studies are conducted in small grains, canola, carinata, fababean, sunflower, safflower, flax, dry bean, pea, lentil, chickpea, mustard, corn, and soybean. We are evaluating new herbicides/adjuvants or different uses of existing products in various crops. Other experiments involve evaluation of the impact of different cultural practices such as crop rotation and conventional tillage vs. no-till on crop yield, seed quality, weed control, and economic feasibility. We also conduct IR-4 residue trials to collect data for registration of pest control products in minor crops. We have studies that target specific weeds such as Canada thistle, wild oat, foxtails, biennial wormwood, kochia, common mallow, common milkweed, and others.

Interpreting Statistical Analysis

Field research involves the testing of one or more variables such as crop varieties, fertilizers, weed control methods, etc. Field testing of such variables are conducted in order to determine which variety, fertilizer, herbicide, etc. is best for the particular area of production. The main objectives of crop production research are to determine the best means of producing a crop and how to maximize yield and economic return from farming.

Agricultural researchers use statistics as a tool to help differentiate production variables so that real and meaningful conclusions can be drawn from a relatively large amount of data gathered from relatively small research plots.

One of these tools is the Coefficient of Variability (C.V.). This statistic gives an indication of the amount of variation in an experimental trial and is a measure of the precision or effectiveness of the trial and the procedures used in conducting it. Attempts are made to control human error and some environmental conditions such as soil variability by replicating the variable in question. For example, there were three plots (replications) of the variety Elgin ND grown in the Minot HRSW variety trial. The plots are mixed and dispersed throughout the trial to help eliminate differences that might be a result of soil, chaff rows or other variables. The numbers that you see in the tables are an average of all three replications. The C.V. for yield in the 2016 Minot HRSW variety trial was 10.5 meaning that there was a 10.5 percent average variation between high and low yields among replications. In summation, a trial with a C.V. of 6 is more precise and more can be concluded from it than a trial with a C.V. of 16.

Another important statistical tool is the Least Significant Difference or LSD. If the yield of variety A exceeds variety B by more than the LSD value, you can conclude that under like environmental conditions, variety A is expected to significantly out-yield variety B. The LSD value allows you to separate varieties, fertilizers, herbicides, or any other variable and determine whether or not they are actually different. The LSD .05 or 5% value is always larger and gives you more precision than the LSD .1 or 10% value. Little confidence can be placed in a variety or treatment unless the results differ by more than the LSD value.