Approximately 40% of the total production of beans in the United States comes from North Dakota, making the state the main producer of beans in the country. They are harvested annually around 260,000 hectares with an average yield of 1,700 kg / has. This represents an annual value of approximately $250 million production. Together with its neighboring state Minnesota, which produces approximately 10% of the national total, it can be concluded that 50% of the total production of beans in the United States occurs in this region. The main types of grain are pinto beans, navy (small white), black (bean), kidney (Zaragoza), pink, red and great northern. All production is highly mechanized due to the large areas planted.

The main objective of the bean improvement program at North Dakota State University (NDSU) is to develop high performance, excellent quality of seed varieties, and that adapt to the region known as 'Northern Great Plains'. This involves many characteristics of the beans and also different areas of research (e.g. genetics, plant pathology, physiology, nutrition, etc.). The priority is to improve the main classes such as pinto, navy, and black, but also improve the kidney beans, great northern, small red and pink. The method of crossing used is by pedigree, which enables an evaluation and continuous selection of families and/or press lines. Therefore, activities and procedures remain relatively similar year after year, giving consistency in the development and evaluation of new genetic materials in an organized manner. Every year during the winter, they carry out around 100 new crosses in the greenhouse. The crosses used are cultivars adapted to the area, lines developed at NDSU, and germplasm of other improvement programs containing the desired characteristics. The germplasm which has not been adapted but contains the desired characteristics is evaluated and then its features are introduced into an adapted material. Each year, the breeding program evaluates materials from different parts of the world as potential sources of resistance to white rust, rust, root rot and anthracnose, viruses, bacterial diseases, among others.

Improved lines are evaluated and selected in different environments or conditions and also evaluated for their disease resistance under natural pressure in the field and in the greenhouse. After the early stages of selection, promising lines are preliminary studies of performance in different locations, allowing them to carry out another round of selection, this time based on data from the replicas. Selected promising lines are then included in the performance evaluations, which are also sown in different locations for two or three years. Then, elite lines which were acceptable in performance assessments are performed studies of varieties for three years.

Through the use of nurseries in winter (off-season), it makes the process much more efficient in terms of time, particularly in the first generations, where the main objective is to create homozygosis (lines with a homogeneous behavior). Currently winter nurseries are stocked in Puerto Rico, New Zealand, and sometimes in South Florida. The release of a variety is usually between 7-12 years after the first cross. However, this can be reduced significantly using winter nurseries. Only through a long-term commitment to invest in these activities is it possible to integrate several genes and characteristics of
interest, then generate new varieties that will increase the productivity of producers of beans and the region in general. Only a breeding program is able to combine research of geneticists, pathologists, entomologists, physiologists, etc. within a tangible product: an improved variety.

The breeding program uses laboratory techniques in order to identify and routinely use molecular markers associated with different genes of interest such as the resistance to white rust. Then the breeders can select by the presence of the marker that is associated with the desired characteristic. Other laboratories have identified markers associated with three genes for resistance to rust, anthracnose resistance genes and genes for resistance to the BCMV, among others. Efforts are focused on introducing white rust resistance, resistance to rust, root rot, anthracnose, and quality features. When most molecular markers are available, it will be easier to identify by different characteristics at the same time using DNA extracted from samples of leaves. As part of the routine of the program, it also evaluates the presence of genes for resistance to rust and common mosaic virus using molecular markers. They hope to further evaluate other features with this technology, while it shows advantages in cost and efficiency within the project (time or space).

The dry bean breeding program has been growing significantly since it began in 1980. In addition, the collaboration of other scientists in different departments of the university and scientists at other institutes and universities in the United States allows expanded knowledge bases of genetics of beans and have a major impact on production. The financial support and commitment from the Northarvest Bean Growers Association has been relevant for maintenance and success of this project.