MY OBSERVATIONS ABOUT A CENTURY OF BREEDING AND SELECTION IN THE ALFALFA GENOME

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The development of alfalfas adapted to the Midwest and Northern Great Plains began with the introduction of winterhardy germplasm into South Dakota, Minnesota, and Ontario Canada. The Minnesota source had the greatest impact because the farmer (Wendelin Grimm) conducted recurrent selection for winterhardiness during about 40 years. The superiority of the Grimm strain was documented in 1900 by Dr. Hays at the University of Minnesota. Authentic seed lots of Grimm still perform very well in the upper Midwest when pests, especially bacterial wilt, are not a problem.

Between 1900 and about 1950 most recognized Midwest cultivars were improved selections from one of seven introductions. The three most notable exceptions were AAtlantic@, ARanger@ and ANarragansett@, which were developed by combining germplasms from three or more sources. These varieties served as prototypes for variety development in the 1950's and 1960's. Narragansett had outstanding winterhardineess, but lacked bacterial wilt resistance and high seed yield potential. Atlantic, a synthetic variety with six germplasm sources, was a variety ahead of its time. Unfortunately Atlantic was hampered by lack of consistent seed production. Ranger had moderate bacterial wilt resistance and it was the first alfalfa variety with high seed yield and an organized seed distribution system. The success of Ranger=s bacterial wilt resistance and its seed production program paved the way for the release of AVernal,@ which was a synthetic variety with four germplasm components. Ranger and Vernal became the industry standards for many years.

During the 1950's and 1960's Medicago falcata germplasm from N.E. Hanson=s early 1900's explorations were being studied at South Dakota State University. Likewise Ladak germplasm was being evaluated at the Universities of Minnesota and Montana State. Chilean germplasm was being evaluated at Kansas State University and Turkistan germplasm was the basis for much of the Nebraska breeding program. The Cornell breeding program studied a broad range of germplasms and the crosses between germplasm sources. Northrup King & Co. introduced the first Flemish cultivar, ADu Puits@, into the U.S. in 1947. Other Flemish introductions followed. The Flemish cultivars had excellent vigor and recovery after cutting and foliar disease resistance, but they lacked winterhardiness and resistance to many root diseases. The Cornell program released the cultivar ASaranac@ which combined the bacterial wilt resistance from ARanger@ with the Flemish growth habit. By 1970 most new Midwest adapted cultivars had some Flemish germplasm in their parentage.

All nine-alfalfa germplasms sources (Medicago falcata, Ladak, M.varia, Turkistan, Flemish, Chilean, Peruvian, Indian, and African) introduced into the U.S. had both good and detrimental traits. Each time a new combination of germplasms was developed it usually meant that some undesirable traits needed to be bred out of the population. An example of linkage problems associated with breeding for multiple traits was demonstrated when David Beard at WL Research screened about 15,000 plants of Saranac for resistance to the spotted alfalfa aphid. Only six resistant plants were recovered and all of those plants had phenotypes similar to Saranac=s non-recurrent parent line from Ranger. Similar problems occurred when Flemish sources of resistance to Verticillum wilt were integrated with adapted U.S. alfalfa populations. It was necessary to conduct several cycles of selection for Verticillium resistance. It was also necessary to select for resistance to bacterial wilt, Fusarium wilt, anthracnose and Phytophthora root rot. The Flemish germplasms were generally susceptible to those important U.S. diseases.

The Southern Corn Leaf Blight epiphytotic caused plant breeders to review the germplasm vulnerability of all major crops. It was determined in 1977 that alfalfa was less vulnerable to genetic disaster than it had been 50 years earlier. However the extensive use of the nine recognized germplasm resources suggested that new germplasm sources would be necessary for future improvements in alfalfa. This stimulated efforts to collect new germplasms from most alfalfa growing areas of the world.

The national Medicago germplasm collection is presently maintained at the U.S. Plant Introduction station, Pullman, WA. During the last 20 years the perennial collection has increased in size, seeds of all accessions were increased under cage isolation , and essentially all accessions were evaluated for resistance to pests and growth habit traits. The annual medic collection was also increased and made available for scientific research.

Establishment of the present U.S. Medicago germplasm collection represents the combined efforts of many people. Many of those who were most instrumental in organizing the collection have retired. It is now the responsibility of a new cadre of scientists to insure that the collection is maintained in a viable condition for future U.S. and world scientists to use. During the 25-year development of the present collection there were many heated discussions. There were suggestions that included throwing away the annual medics, combining all accessions into a small number of germplasm pools, and increasing seed of each accession by open pollination. These suggestions and others like them were discussed and dismissed. The guiding philosophy was that no one could know what germplasm would be useful in the future. It was therefore necessary to retain all introductions as individual accessions. Many suggestions were considered for establishing some type of pre-breeding program to increase the usefulness of the collection. (Note: Sorghum breeders are backcrossing day neutral and dwarfness genes into the world sorghum collection.) Unfortunately no viable plan could be agreed upon.

During the last 50 years I have observed that many alfalfa-breeding studies were conducted with less than the most appropriate germplasm. It is important that sufficient effort be given to the selection of germplasm with appropriate pest resistance, adaptation, and germplasm origin. Public germplasm populations may not always contain the best combination of traits. Therefore it may often require establishing cooperative studies with industry breeders.