Objectives of the breeding program:

- Public vs. private role. Both react to projected needs.
- “We need to remember that the first step in plant breeding is knowing what will be desired in the future market -- and choosing the right populations to fulfill that ideal.” (We remind ourselves.)
- Choose the right parents to create the right populations. Some parents are just good, other parental combinations are discovered. (Not all good varieties make good parents that lead to useful populations.)
- What are trends in the market?
- Is there consensus?
- Companies engage in “creating demand.”

After reviewing and analyzing a lot of data it became clear to the statistician how one could maximize yield – by planting only in the most favorable seasons. The plant breeder, like the farmer, is never really sure what they are to expect from Mother Nature from season to the next.

- We are dealing with a large number of known unknowns (for example how much rain the crops will receive) and unknown unknowns (for example if some unexpected new disease or insect rapidly becomes an economic problem)
- Which populations will present the most desirable variation for the given sets of environments they will be tested in – their performance in those environments will determine their futures?
- And what set of environments will they encounter following release?
- Oh545 – high yield and good grain quality – a new disease came out and revealed that it lacked resistance to an important new stalk-rotting pathogen that causes anthracnose

Quotable Quotes and Paraphrases:

- “Selection works.” (Jim Coors) It is hard to make dramatic progress, but it also difficult to just plain go backwards. Usually one can make at least some semblance of progress -- even with less than ideal selection strategies. Insufficient progress, however, quickly leads to unemployment.
- “Everybody has seen one-year-wonders.” (Major Goodman) It is easy to be fooled by spurious variation. Consistently strong performance is an amazing thing!
- “You can’t make a silk-purse out of a sow’s ear.” Lee Stith (traditional) Sometimes it is important to recognize when one should cut their losses – for unknown reasons, some populations never seem to give any lasting, useful variation.
- “You have to select with conviction – don’t lament that you may have thrown out the best future variety you might have ever released with the discards.” Bob Allard. (B73 story – elite public inbred (yield and dry down) was almost discarded because of European corn borer susceptibility. It is important to let the data guide you – as much data as possible. There are truly great varieties that have Achilles tendons but they are tolerated because of their redeeming characteristics or lack of a viable alternative.
Genotype X Environment Interactions:

*A fundamental idea of biology is that of the relation between phenotype and genotype*

Yield of grain, size of plant, color of fruit etc. For example, more or less tolerance to high-N (rubber, barley); “agronomy packages” – wheat and rice semi-dwarfs **better response to high-N**, efficient usage and they don’t flop over. The “Green Revolution” package **modified both the environment and the genotype** to find a favorable interaction that resulted in higher yield.

Highly responsive (less stable) or less responsive (stable) varieties?

- Some varieties are considered by farmers to be more durable and lower risk during poor seasons-- but they typically do not give the highest yields in a good season.
- Other varieties may give exceptional performance during highly favorable seasons, but they might give very poor results in a bad season.
- Maize example – “race-horse” and “plow-horse” hybrids.

**The end product:**

- Depending on the farmer’s exact situation and strategic orientation, one or the other type might be preferred.
- Both types have their uses and obviously the perfect variety would take great advantage of desirable environments and be little affected by stressful one.
- Breeders usually don’t target one type or the other; they usually emerge on their own and are directed toward the most suitable market or region.

**Selection:**

Natural selection acting on genetic variation directs evolutionary change and brings about adaptation to various environments.

The roles of natural and human selection:

The relative importance of natural and directed selection has changed, but there was clearly some conscious selection in the earliest years of domestication and natural selection surely remains a part of the equation in breeders’ plots today.

Whenever a farmer or plant breeder makes a conscious decision to keep the progeny of a particular plant, there will be a shift in the balance toward improved (“hopefully”) adaptation. The goal is enhanced reproductive fitness of those progeny due to the joint circumstances of cultivation and the breeder’s desires.
Who decides what is selected? Farmer, breeder, market, marketing dept.?

- Whenever a farmer or plant breeder makes a conscious decision to keep the progeny of a particular plant, there will be a shift in the balance toward improved ("hopefully") adaptation.
- The goal is enhanced reproductive fitness of those progeny due to the joint circumstances of cultivation and the breeder’s desires.

Breeding as an evolutionary process:

Allard (1999) states, “Plant Breeding has become increasingly efficient and focused as Darwinian and, more recently, Mendelian principles have become firmly established as the framework within which all evolutionary changes occur.”

Crop breeding is the application of Neo-Darwinian principles in an organized and efficient manner, with a goal in mind.

Selection forces continue after the variety has been released:

- In nature: reproductive potential and survival ability of variants.
- In our world: survival in a human-altered environment and in the market.

The variety should suit all “stakeholders” or its survival will be in jeopardy.

“Pulling” the future into the present

- The qualities that determine survival in a plant breeder’s population are thus very much like those qualities that determine survival in nature.
- The breeder must also impose the traits that will ensure survival in future “market” environments.