SDSU Extension

iGrow Wheat

BEST MANAGEMENT PRACTICES

Chapter 2:
Wheat Classes, History, and Breeding Timelines

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The purpose of this chapter is to provide an overview of wheat history, wheat quality, and classes. There are six major classes of wheat produced in the United States. Each class is uniquely suited for different wheat products and environmental conditions. Environmental factors including rainfall, temperatures, soils, available nutrients and topography influence can cause a wide variety of wheat quality characteristics. Genetics is also a major factor.

Wheat breeding programs take all of these factors into consideration when developing varieties for each region. The wheat protein content has a direct impact on its sustainability for the end use of the grain. Hard and spring wheat generally have a higher protein than soft and winter wheat. Although wheat is planted and harvested somewhere in the world almost every day, the United States has the resources and infrastructure to provide its citizens and the world with the most abundant, reliable and safest supply of wheat.

From wheat to flour, the conscientious efforts of wheat producers working with scientists, researchers and technicians provide the world with an economical, plentiful and nutritious food.

History of wheat
http://www.allaboutwheat.info/history.html

Wheat has played a prominent role throughout world history and has impacted human development in Europe, Africa, and Asia. It is noted in ancient Chinese writings (2,700 years BC), referenced in the Bible (the Lord's Prayer), grown in the Nile Valley 5000 years ago, and noted by the philosopher Socrates. Back then, as it is today, bread was and is a primary food staple for much of the world's population.

Wars have been fought and lost over wheat. Napoleon could not feed his troops when they advanced faster than the supply wagons. Even in the United States, the Civil War has been described as a victory of bread over cotton. The North had cereal grains to feed their troops and to trade with Europe whereas the South's major crop was non-edible cotton. President Hoover is quoted as saying, "The first word in war is spoken by guns, the last word has always been spoken by bread." It's no surprise, then, that the availability of this grain directly impacts the success or failure of political leaders.

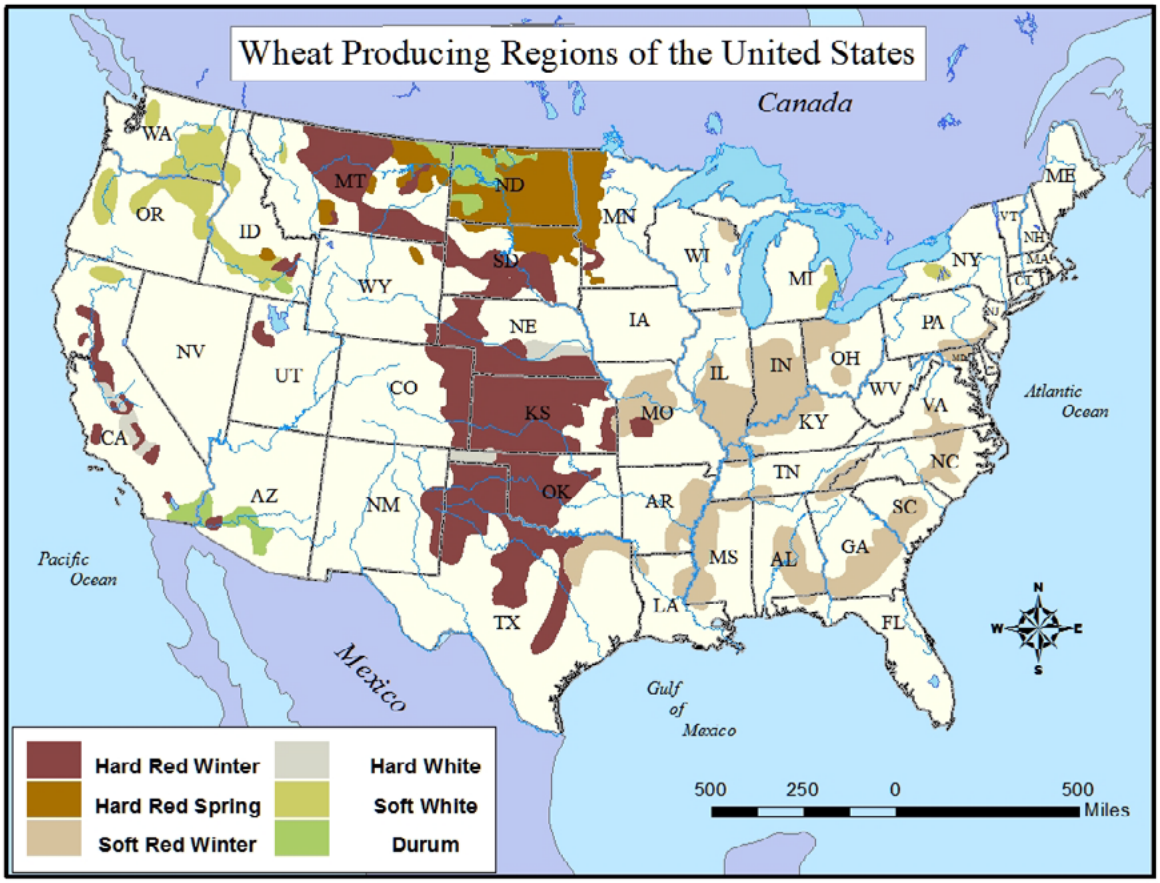

Figure 2.1. Major growing areas of wheat in the United States. (Map created by SDSU.)

In North America wheat was grown in the Spanish Missions in the West as well as the coastal areas of Massachusetts in 1602. More recently, it was a critical food during the settlement of the Great Plains. Wheat as an important food source derives its importance from its ability to adapt to new climatic conditions and market requirements.

One of the most important crops for semi-arid areas of the world is wheat. Currently, it occupies 17% of all crop area and tops trade value among all crops. Together with rice and maize, wheat provides >60% of the calories and proteins for our daily life. Therefore, wheat plays a paramount role in world food security.

Species of wheat

Bread, club, and durum wheat make up 90% of the wheat grown today. The most common species of wheat grown in the world are:

1. Common or Bread wheat *(T. aestivum, subsp. aestivum)*, the most widely cultivated hexaploid group in the world.
2. Club Wheat *(T. aestivum subspecies compactum)*.
3. Durum *(T. durum)*, a tetraploid form that is the second most widely cultivated wheat.
4. Einkorn *(T. monococcum)*, a diploid species with wild and cultivated variants.
5. Emmer *(T. dicoccum)*, a tetraploid species, which has been cultivated since ancient times.
6. Spelt *(T. spelta)*, a hexaploid species cultivated in limited quantities.

The 200-plus wheat varieties grown in the U.S. are divided into classes according to their growth habits, kernel color, and texture of the ripened grain. Growth habits refer to when they are planted (winter or spring), color refers to the color of the grain (red to white), and texture refers to their hardness or softness.

Wheat classes

In the United States, six distinct classes of wheat are produced (Fig. 2.1). Each class has characteristics that make it uniquely suited for a given product. These classes include:

1. Hard Red Winter Wheat is produced in the Great Plains states in an area extending from the Mississippi River west to the Rocky Mountains, and from Canada to Mexico (Fig. 2.2). Winter wheat is planted in the fall and completes its life cycle in the spring. This class produces flour with a wide range of protein content and has good milling and baking characteristics. This class is used to produce yeast breads and hard rolls.

Figure 2.2. Hard red winter wheat.
http://www.millersgrainhouse.com/bulk/index.php?main_page=product_info&products_id=127

2. Hard Red Spring Wheat (Fig. 2.3) is used for yeast breads and hard rolls and blending with lesser protein wheat. Hard red spring wheat is generally grown in areas that are too cold for winter wheat. South Dakota farmers predominantly grow hard red winter wheat and hard red spring.

Figure 2.3. Hard red spring wheat.
http://www.ncwheatmontanacoop.com/order/wheat-c-1_66_35.html

3. Soft Red Winter Wheat is primarily grown east of the Mississippi River. Soft red winter wheat (Fig. 2.4) is generally high yielding and produces flour with relatively low protein content, which is used to produce flat breads, cereals, cakes, pastries and crackers.

Figure 2.4. Soft red winter wheat.
http://www.uky.edu/Ag/Wheat/wheat_breeding/uk_wheatbreeding.htm

4. Soft White Wheat is primarily grown in the Pacific Northwest and to a lesser extent in California, Michigan, Wisconsin, and New York. Soft White is used for flat breads, cakes, pastries and crackers. Soft white wheat is shown in Figure 2.5.

Figure 2.5. Soft white wheat.
http://www.purcellmountainfarms.com/Organic%20Soft%20White%20Wheat%20Berries.htm

5. Hard White Wheat (Fig. 2.6) is the newest class of wheat and can be grown in many Great Plains states. This class is closely related to red wheat. Hard White is often sweeter than red wheat and is used for yeast breads, hard rolls, noodles, and tortillas.

Figure 2.6. Hard white wheat. http://www.purcellmountainfarms.com/organic%20hard%20white%20wheat%20berries.htm

6. Durum wheat (Fig. 2.7) is grown in the same northern states that produce hard red spring wheat. This wheat is the hardest of all classes. This wheat is used to make high quality pasta.

Figure 2.7. Durum wheat. http://www.purcellmountainfarms.com/organic%20hard%20white%20wheat%20berries.htm

Breeding timeline

A good breeding program must take all aspects of wheat quality (e.g., yield, climatic tolerance, disease and pest resistance, protein quantity and quality, and baking performance) into account to develop truly superior wheat varieties for use by South Dakota farmers. The process of creating a new variety takes several years. Germplasm of individual plants of known varieties with desirable traits are first selected. They are then crossed, and the progeny are grown through several generations under controlled conditions to produce enough seed for evaluation.

Evaluations are first performed on a small scale in a laboratory to identify any improvements. Varieties exhibiting desirable characteristics in the laboratory are then grown in test plots under normal growing conditions. Wheat varieties from the test plots are evaluated for growth characteristics (e.g., yield and disease resistance), milling and baking quality. Those exhibiting superior characteristics in field tests are released to wheat farmers for commodity production.

Adoption of new varieties by wheat producers can take several years. Because the process of developing, testing, and releasing new wheat varieties is time-consuming, the percentages of each variety grown in a given area change slowly from year to year. It may take an improved variety five years or more to move through initial development to acceptance as a commercial variety for production.

To be effective, a wheat breeding program requires a long-term commitment both in time and funding. The typical time requirement for release of a wheat variety is 10 to 12 years. A wheat breeding program must continuously maintain a germplasm base so that production problems or economic opportunities can be addressed in a timely manner.

A generalized timeline for SDSU plant breeding and variety development programs

Today, wheat genetic improvement has been using classical and molecular approaches. In classical plant breeding, interbreeding of related plants are used to produce new crop varieties with desirable properties. An example of classical breeding was conducted by Norman Borlaug when semi-dwarf disease resistant varieties were produced. Molecular approaches are being used to speed up classical breeding (Chapter 31).

Breeding can be separated into:

1. *Germplasm acquisition and development.*
   This component occurs continuously and provides the genes for future varieties.

2. *Segregation.*
   This step takes 5 to 6 years and is used to select potential future varieties for their ability to solve specific problems.

3. *Evaluation and testing of advanced lines.*
   Evaluation and testing takes 2 to 4 years during which advanced lines are rigorously tested. Yields and effectiveness of the line may be compared with commercially available varieties through crop testing.

4. *Breeder seed increase.*
   If a potential future variety has promise, a seed increase is conducted. These increases can occur in winter nurseries around the world.

5. *Variety release and commercialization.*
   If the potential variety meets specific goals, an application is submitted to the SDAES variety release committee. If approved, the appropriate paper work must be completed and foundation seed must be produced.

6. *Certified seed.*
   Foundation seed is provided to the seed growers of the SD Crop Improvement Association to produce registered class seed. Certified seed growers produce seed that can be sold to farmers.

7. *Seed assessment.*
   The variety is continuously assessed for its ability to meet production goals. This assessment is based on findings from the crop performance testing, producer and end-user feedback, and sales of certified seed.

Additional information and references

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Acknowledgements

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