Q. Modern wheat vs. Landrace wheat

I am having a hard time delineating the technical difference between modern wheat varieties and landrace varieties. May 15, 2015

A.

In order to understand modern wheat it is necessary to understand a little about the process of breeding and so producing modern wheat varieties: The wheat flower self-pollinates, therefore in order to make a cross between two wheat varieties, the male pollen anthers are snipped off and the flower is fertilized with pollen from another known variety of wheat. Ever since Mendel described the *laws of inheritance* in the late 1800s, wheat breeders have been able to understand how to expect desired characteristics from each wheat parent to appear in the progeny of the crosses. Plants showing a desired characteristic such as a hard red kernel are selected for growing out. This process of selecting and growing out is continued until a desirable stable variety is produced. When just a single trait or characteristic is desired to be introduced, then the breeding process itself is repeated with the original parent plant in a process known as *back-crossing*. All this takes several years to manage, but more recently it has become possible to use a laboratory method to quickly test the presence of desired traits by finding the corresponding genes. After all, some characteristics such as gluten character cannot be seen in the field, so this is a very convenient marker gene assisted selection that is referred to as *marker assisted selection.*

Thus *modern wheat* can be regarded as a variety produced by the breeding processes introduced since Mendel's laws of inheritance became known in the late 1800s.

Yield has always been an important trait selected, but since the late 1800s the other principle trait selected, has been for a hardness suited to efficient roller milling to refined flour. By coincidence, roller milling was also introduced in the late 1800s. After the 1950s traits introduced into wheat varieties were chosen so that yield could be dramatically increased in the presence of added chemical fertilizers, irrigation, and by denser planting. All this required the wheat to be short in stature since if the wheat were tall and densely produced, it would fall over in the wind; it would lodge and be difficult to harvest efficiently. Such short wheat grown so lushly would be easily overgrown with weeds and become diseased. Such problems are managed with herbicides, fungicides and insecticides. This *modern* conventional system is the antithesis of an ecologically sustainable soil-building approach to growing wheat.

In the Old World wheat originated in the Middle East where related varieties can still be found in the wild. From the points of wild origin wheat was capable of forming natural crosses among the wild varieties just occasionally, since wheat is normally self-pollinated and would normally reproduce without change. However, people have a natural desire to stroke wheat, especially when it is in the young green flowering stage. So that it is easy to imagine that pollen could be removed and transferred in this way between varieties, to produce a plethora of attractive new varieties that could be further propagated. Migrating people carried wheat to all the regions of the world where it is currently found. Eventually over millennia, people settled and grew their wheat as a basic food. Just as races of people populate the earth, people have continually cultivated races of wheat suited to the climate of their land and taste. Varieties of wheat that have been grown continually in some particular region of the world for millennia can be regarded as *landrace* varieties. These landrace varieties are generally a mixture of closely similar varieties, and between them they would be capable of withstanding the weather and soil of the region. Wheat was brought late to the American continent by migrants

after the discovery of the continent in the late 1400s. Landrace wheat from the Mediterranean countries was initially brought here and found to grow well in the Mediterranean climate of the Mexican California region. Similarly landrace varieties from Western Europe grow well in corresponding climate zones in the Eastern States. In the Plains States with their continental climate the landrace wheat from Central Europe and Russia was found to grow successfully. Landrace varieties have already been adapted over hundreds of years to a particular climate zone. Once brought to a similar climate zone on the American continent they continue to grow unchanged, at least within a human lifetime. Thus the landrace *Turkey Red* wheat continues to grow unchanged in Kansas and Oklahoma. *Sonora* wheat continues to grow unchanged in California, the Punjab or wherever it has been planted and is growing successfully. However the farmer and those who service the wheat seed must be diligent in taking out rogue wheat from the field before harvest and cleaning the landrace seed, so that it does not become mixed with other varieties that are now so widely available.

There are thousands of landrace varieties of wheat, and when modern wheat breeding was begun these landrace varieties formed the basis for the crosses that breeders were making. As a result fortunately, landrace wheat varieties were collected from around the world and maintained in seed banks such as the *USDA Small Grains Collection in Aberdeen, Idaho*. Most breeders use this collection as a source of particular traits in wheat so that they can design a new variety of modern wheat. However the alternative is to select from these landrace varieties primarily for appropriateness to the local climate and soil, and satisfactory yield. These landrace varieties were grown for various particular end uses. In particular those grown as basic food were destined to be stone ground to flour and produce pleasing ethnic products. The landrace wheat varieties were also grown under lean organic conditions since they are generally naturally taller and more deeply rooted than modern wheat.

Thus both a field of modern wheat, and a field of a selection from a landrace wheat, will have the appearance of a uniform field of wheat with very few rogues to disturb the pattern. However there are many varieties of modern wheat, so that some will be bearded, some will have no beard, other will be red headed yet others white headed and so on. This is reasonable considering the numerous varieties of landrace wheat from which modern wheat varieties are descended.

Q. Hybrid wheat

I understand that modern wheat has been bred to contain a dwarfing gene to allow it to be especially high yielding, but it is not technically considered a "hybrid." So I am wondering, can a farmer save seed and replant from a modern variety? How is the seed for these varieties produced? May 15, 2015

A.

The simple meaning of the word *hybrid* is a cross between varieties of a plant. However hybrid takes on a special meaning in vegetable plant breeding because the first generation of plants produced from a cross is especially vigorous, and the observation is known as *hybrid vigor*. But this vigor is not maintained in the subsequent generations. Seed companies selling *hybrid* seed are selling seed from this first generation cross. The farmer who saves seeds from the crop of these hybrids will not see the same vigor in the plants grown the following year. So it is not worthwhile for the farmer to save seed from hybrids.

The self-pollination of wheat normally ensures the exactness from one generation to the next, barring a chance cross or deliberate breeding intervention. Self-pollinated

plants cannot reasonably be bred to produce a first generation vigorous hybrid, since the process of making the cross is too complex. Modern wheat results from selecting through several generations after the original cross, until a small number of plants with the desired characteristics are exactly the same as the previous generation; the variety is by then stabilized. Thus a farmer can indeed save seed from any variety of wheat whether modern or landrace and expect the plants in the next generation to be the same. The only limitations to propagating modern wheat are generally legal, due to the various types of copyright obtained by breeders and seed companies.

Q. Sonora wheat character and adaptation

What makes the Sonora grown here, on my farm for instance, and the Sonora grown in Punjab or New Mexico, all considered Sonora? As I understand it, the wheat from each of these places would demonstrate quite different characteristics as it has been adapted to different climates and cultural needs. So what makes it all considered Sonora? May 15, 2015

A.

Sonora wheat is a distinct variety that is therefore consistent in its appearance and character wherever it is grown. However *Sonora* wheat will grow best in the climates that match its origin, which was somewhere in the Middle East. Parts of California, Mexico and the Punjab in India have in common similar climates that can support a good yield of Sonora wheat. The adaptation to a particular climate occurred long ago, in the hands of a farmer making selections, probably thousands of years ago in the Middle East.

It is interesting to note that landrace *Sonora* wheat being grown in the 1800s was seen to be a mixture of white head and bronze heads. Farmers selected out the bronze heads and grew that separately to be the Sonora wheat that we know in California. But this bronze head selection produces a small number of white heads every year even though the white heads are rogued out in the previous season. Also at some point in time the white heads were separated and propagated as *Indian wheat*[1]. The name *Indian wheat* probably arose because the Native Americans (Indians) were seen to be growing this rather than the bronze heads. Similarly in South Africa wheat landrace varieties known as *Rot Wol Koring* and *Wit Wol Koring* appear to be identical to bronze head *Sonora* and white head *Sonora*, respectively. I suppose that the word *wol* and *koring* can be translated as woolly or velvety corn, and using corn as the general name for the common grain of the region.

[1] USDA Bulletin Number 1074. Page 121. *Classification of American Wheat Varieties*, by J.Allen Clarke, November 8, 1922.