

Cross breeding methods for plant development



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Most of the increase productivity has relied on cross breeding methods developed long time ago to supply plants with specific traits. However, the growth of new and more productive crops has been improved by domestication which is an accelerated evolution. Domestication defines as the selection of wild plants and animals for adaptation to cultivation and human use (Paran & Knaap, 2007). Plant breeders have practiced selective breeding of domestic species to yield varieties of cultivation. Besides human contribution through breeding, genetic engineering has plays a great role, it defines as the manipulation of biological organisms for the benefit of mankind. According to Graham et al (2006), olden agriculturists learned that if they planted seeds from plants having most desirable food characteristics, the next crop would have more of the desired features. This proves that human have long altered the genetics of domesticated plants and this process, known as artificial selection. There are several examples of plant features that have been improved as a result of domestication and breeder's effort.

Plant features that have been improved include seed shattering, seed dormancy and apical dominance was found in maize. According to Smith et al (2010), its wild ancestor has been identified as a large grass called 'teosinte' and the differences between maize and teosinte concerns the seeds, maize seeds (kernels) are permanently attached to robust structure known as 'cob' while teosinte seeds are attached to a fragile stalk-like rachis. This explains when rachis shatters, teosinte seed dispersal is promoted which is an advantage for wild grains but a crop plant must preserve its seeds long enough before harvest or else loss of yield.

Therefore, loss of shattering has been selected for domestication. Besides, Smith et al (2010) also points out that teosinte seeds often have variable degrees of dormancy while maize seeds have little or no dormancy. This shows that loss of seed dormancy has been selected for, to favor seed germination and minimizes the seed loss before harvest. Also, teosinte is highly branched and maize is not; the reduced branching of maize resulted from increased apical dominance in which the apex of the main stem inhibits the outgrowth of lateral branches from lateral meristems (Smith et al, 2010). This is due to the alteration in the expression of the gene teosinte branched by scientists which is beneficial to farmers because it produced large number of seeds on few lateral shoots instead of smaller numbers on many different lateral shoots and thus eases of harvest.

Polyploidy is another improved feature found in wheat, modern bread wheat (*Triticum aestivum*). Polyploidization tends to cause an increase in the cell of plant size and organs, so it is likely that early farmers first selected for polyploidy wheat because it has larger grains than diploid wheats (Smith et al, 2010). This means increase in plant and grain size has been selected by breeders to improve yield.

The following feature that has been improved is the change in forms in *Brassica oleracea*. For examples, Graham et al (2006) comments that the common grocery vegetables broccoli, Brussels sprouts, cabbage, cauliflower, kale, and kohlrabi are quite distinct in appearance, but they are all derived from *Brassica oleracea*, following thousand of years of artificial election by farmers. This shows changes in form have been selected for domestication of

brassica species to form a wide ranges of vegetables types with different in appearance.

Other features which have been improved are the fruit size, disease resistance and fruit ripening were found in tomato. Bai & Lindhout (2007) finds that wild tomato species, *S. pimpinellifolium* have tiny fruits, unlike the cultivated tomato (*S. lycopersium*). No doubt, the increased in fruit size which cause from human selection were the changes in the domestication of tomato by cross breeding. Besides, tomato breeders are attempting to develop disease-resistance genes to enhance the resistance of cultivated tomatoes. Further crosses of tomatoes form interspecific hybrids and this enables traits which are disease resistance from wild relatives successful incorporated by back crossing. Although linkage drag occurred where harmful traits are transferred together with the good traits, this is no longer an issue. Based on Smith et al (2010) writing, the use of precise molecular markers is assisting the identification of individuals in which the amount of transferred DNA surrounding the resistance gene is small as possible. This illustrates how scientists improved crop by conventional genetic-approach. Furthermore, tomato breeders have utilized genetic control of fruit ripening. Smith et al (2010) explains that tomato undergo respiration and associated metabolic activity at a specific point of ripening which activate by phytohormone ethylene; some of the mutations which affect the reaction of tomato to ethylene have proved very useful to plant breeders. Apparently, this is beneficial as its delayed ripening and reduces spoilage of fruit, firmer for shipping and stay fresh longer, therefore allowing less frequent harvesting of fruits.

Barley is another example of crop plant that has been improved in the adaptation to photoperiod.

Jones et al (2008) states that positional cloning identified Photoperiod-H1 which controls flowering under long-day conditions, a class of genes involved in circadian clock function and by altering circadian expression, photoperiod responsiveness of the *ppd-H1* mutant can be reduced, which is advantageous in spring-sown varieties. Knowing that plants use photoperiod to control the timing of flowering and late flowering is promoted for a long annual growth season; scientists have selected variation in photoperiod response to supply adaptation to different environments in order to increase period of growth and resource storage.

Last feature that has been improved is the nutrition content found in genetically modified rice, also known as golden rice. Low vitamin A content of rice based diet creates health problems such as weakened immune systems and visual problems. Recent research by Thieman and Palladino (2009), show that 500,000 children in the world become blind due to vitamin A deficiency. Consequently, researchers have enhanced the nutrition of rice by transgenic approach where transgenic rice expressing enzymes can increase levels of beta carotene in endosperm and prevent vitamin A deficiency.

In conclusion, there are many plant features that have been improved to make them suitable as crop plants including seed shattering, seed dormancy, apical dominance, plant and grain size, change in form, disease resistance, adaptation to photoperiod and nutritional value. With the

examples of crop plant in the discussion above, it illustrates how plant domestication, breeding and genetic engineering have created changes in the structures, properties and population of the plants. At the current time, human population is increasing and therefore, there is a high demand on the productivity of crop plant which leads to the development of new varieties and better techniques of cultivation. However, these have made environmental issues arise such as water pollution due to leaching of fertilizers, increase level of carbon dioxide in atmosphere and land degradation. In my opinion, the relationship between man and plants is continuously develop in future, thus; this a challenge for plant breeders to increase crop yield at the same minimize environmental issues.