Vol.1 Issue-7, MARCH 2021 (e-ISSN: 2582-8223)

JUST AGRICULTURE
multidisciplinary e-Newsletter

Plant Breeding (Evaluation & Methods)

Sudhanshu Singh[1], Garima Tiwari[2]

[1]Aacharya Narendra Deva University of Agriculture & Technology, Kumarganj, Ayodhya, [2]Integral University Lucknow

ARTICLE ID: 009

Introduction

Plant breeding is an application of genetic principles to produce plants that are more important to humans. This is accomplished by selecting crop plants found to be desirable by controlling the mating of selected individuals, and then by selecting certain individuals among the progeny. These processes, repeated over many generations, can change the hereditary makeup and value of a plant population far beyond the natural limits of previously existing populations. This article emphasizes the application of genetic principles to the improvement of crop plants; the biological factors underlying plant breeding are dealt with in the article heredity.

History

Plant breeding is an ancient activity, dating to the beginnings of agriculture. After the domestications of cereal, humans began to recognize degrees of excellence among the plants in their fields and saved seed from the best for planting new crops. Such selective methods were the forerunners of early plant-breeding procedures.

The results of early plant-breeding procedures were conspicuous. This time varieties are so modified from their wild progenitors that they are unable to survive in nature. Indeed, in some cases, the cultivated forms are so different from existing wild relatives that it is difficult even to identify their ancestors. These remarkable transformations were accomplished by early plant breeders in a very less time from an evolutionary point of view, and the rate of change was probably greater than (<) for any other evolutionary event. In the mid-1800s G. Mendel outlined the principles of heredity using pea crop plants and thus provided the necessary framework for scientific plant breeding. In Plant Breeding, The plant breeder usually has in mind an ideal plant that combines a maximum number of desirable characteristics. These characteristics may include resistance to diseases and insects-pest; tolerance to heat, soil salinity, and frost; appropriate size, shape, and maturity; and other general and specific traits that contribute to improved adaptation to the environment, ease in handling and growing, greater yield, and better quality. The horticultural plants breeder must also consider aesthetic appeal. Thus the breeder can rarely focus attention on any one characteristic or traits but must take into account the manifold traits that make the plant more useful in fulfilling the purpose for which it is grown. Plant breeding is an important tool in promoting food security, and many staple crops have been bred to better with stand extreme weather conditions associated with global warming, such as drought or heat waves.

Increase of yield

One of the aims of every breeding project is to increase yield. This can be brought about by selecting obvious morphological variants. Rice is example of the selection of dwarf, early maturing varieties. These dwarf varieties give a greater (<) yield of grain. Furthermore, their early maturity frees the land quickly, often allowing an additional planting of rice or other crop the same year. Another way of increasing yield is to developed varieties resistant to diseases and insects-pest. In many cases the development of resistant varieties has been the only practical method of pest control. Perhaps the most important feature of resistant varieties is the stabilizing effect they have on production and hence on steady food supplies. Varieties tolerant to drought, cold or heat provide the same benefit.

Modifications of range and constitution

Another goal of plant breeding is to extend the area of production of a crop. A best example is the modification of grain sorghum since its introduction to the United States in the 1750s. of tropical origin, sorghum was largely confined to the southern Plains area and the Southwest, but earlier-maturing varieties were developed, and grain sorghum is now an important crop as far north as North Dakota. Development of crop varieties suitable for mechanized agriculture has become a big goal of plant breeding in recent years. Uniformity of plant characters is very important in mechanized agriculture because field operations are much easier when the individuals of a variety are similar in time of germination, size of fruit,

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growth rate, and so on. Uniformity in maturity is essential when crops such as peas and tomatoes are harvested mechanically. The nutritional quality of plants can be improved by breeding, for example, it is possible to breed varieties of corn much higher in lysine than previously existing varieties.

Evaluation of Plants

The value of plants so that the breeder can decide which individuals should be discarded and which allowed to produce the next generation is a much more difficult task with some traits than with others.

Qualitative characters

The easiest characters, to deal with are those involving discontinuous or qualitative, differences that are governed by one or a few major genes. Many inherited differences exist, and they frequently have profound effects on plant value and utilization. Examples are starchy versus sugary kernels and determinant versus in determinant habit of growth in green beans. Such differences can be seen easily and the expression of the traits remains the same regardless of the environment in which the plant grows. Traits of this type are highly heritable.

Quantitative characters

Plant traits or character grade gradually from one extreme to another in a continuous series and classification into discrete classes is not possible. Such variability is termed quantitative. Many traits of economic importance are of this type; Example- cold and drought tolerance, time to maturity, height and, in particular, yield. Many genes are governed these traits, each having a small effect.

Quantitative characters are difficult for the breeder to control, for three main reasons: (1) the sheer numbers of the genes involved make hereditary change slow and difficult to assess; (2) the variations of the traits involved are generally detectable only through measurement and exacting statistical analyses; (3) most of the variations are due to the environment rather than to genetic endowment; example, the heritability of certain traits is less than (>) 5 %, meaning that 5 % of the observed variation is caused by genes and 95 % is caused by environmental influences.

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Methods of Plant Breeding

Mating systems

Angiosperm mating systems devolve about the type of pollination or transferal of pollen from one flower to another flower. A flower is self-pollinated crop if pollen is transferred to it from any flower of the same plant and cross-pollinated crop if the pollen comes from a flower on a different plant. About half of the more important cultivated plants are naturally cross-pollinated and their reproductive systems include various devices that encourage cross-pollination Example- protandry, dioecy (male and female parts are borne on different plants) and genetically determined self-incompatibility (inability of pollen to grow on the stigma of the same plant, as in cabbage and many other species). Other plant species, including a high proportion of the most important cultivated plants such as barley, rice, wheat, peas and beans are predominantly self-pollinating. There are relatively few reproductive mechanisms that promote self-pollination; the most positive of which is failure of the flowers to open, as in certain violets. In barley, wheat the pollen is shed before or just as the flowers open, and in the tomato pollination follows opening of the flower but the stamens form a cone around the stigma. A cross-pollinated plant, which has two parents, each of which is likely to differ in more genes, produces a diverse population of plants hybrid for many traits. A self-pollinated plant, which has only one parent, produces a more uniform population of plants pure breeding for many traits. Thus, in contrast to out breeders, self-breeders are likely to be highly homozygous and hence true breeding for a specified trait.

Breeding self-pollinated species

The breeding methods that have proved successful with self-pollinated species are: (1) pure-line selection; (2) mass selection; (3) hybridization, with the segregating generations handled by the pedigree method, the bulk method, or by the backcross method; (4) hybrid varieties development.

Breeding cross-pollinated species

The most important methods of breeding cross-pollinated species are (1) development of hybrid varieties; (2) mass selection (3) development of synthetic varieties. Since cross-pollinated species are naturally hybrid (heterozygous) for many traits and lose vigour as they become purebred (homozygous), a goal of each of these breeding methods is to preserve or restore heterozygosity.

Distribution and maintenance of new varieties

The benefits of new varieties obviously cannot be realized until sufficient seed has been produced to permit commercial production. The primary function of the plant breeder is to developed new varieties. Seed thus produced is called breeders seed. The breeders seed to produce foundation seed. The certified seed is the progeny of foundation seed, produced on a large scale by specialized seed growers for general sale to farmers and gardeners. Seed associations are also usually responsible for maintaining the purity of new varieties.