

Plant Breeding-Battle for Grain

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An ancient human civilization vividly depicts, various agricultural practices sporadically practiced for the past 13,000 years like hunting wilds, gathering fruits, fishing and cultivation to some extent for foods to withstand hunger and to get energy to carry on their life. Agriculture has widely established for only 7,000 years. During ancient time, People could move from one place to another for food, if in case of food scarcity around the living territory, since there was no such degradation of natural resources, no food wastage and no deterioration in climate at that time, they could easily get their food to sustain their life. In fact, of-course they needed to struggle with some climatic factors and food to some extent but did they really lose their life just because of starvation at that time? Probably not! Why is the situation like that, at present days then?

With the commence of 21st century till now, huge progress and modernization has been made in the field of agriculture surveys and data show that, millions of people in the world are still losing their lives every year just because of no foods to eat. People in

many parts of the world are still striving for just a single grain of rice, most of them are compelled to sleep with empty stomach. According to the, Food Aid Foundation organization, the condition of the world population just because of food scarcity can be summarized as following:

- Some 795 million people in the world do not have enough food to lead a healthy active life. That's about one in nine people on earth.
- The vast majority of the world's hungry people live in developing countries, where 12.9 percent of the population is undernourished.
- Asia is the continent with the hungriest people - two thirds of the total. The percentage in southern Asia has fallen in recent years but in western Asia it has increased slightly.
- Sub-Saharan Africa is the region with the highest prevalence (percentage of population) of hunger. One person in four there is undernourished.
- Poor nutrition causes nearly half (45%) of deaths in children under five - 3.1 million children each year.
- One out of six children -- roughly 100 million -- in developing countries is underweight.
- One in four of the world's children are stunted. In developing countries, the proportion can rise to one in three.
- If women farmers had the same access to resources as men, the number of hungry in the world could be reduced by up to 150 million.
- 66 million primary school-age children attend classes hungry across the developing world, with 23 million in Africa alone.
- WFP calculates that US\$3.2 billion is needed per year to reach all 66 million hungry school-age children.

On the other hand, different studies, surveys done and data collected by the various agencies, INGOs, societies, disclose the increasing percent of world population with stunting, increasing

children mortality rate just because of food scarcity, starvation and lack of balanced nutritious diet, which can be clearly seen from the

following statistics collected from the surveys of UNICEF/WHO/ THE WORLD BANK.

Figure 2

The population of the world is increasing in a skyrocketing way, at the rate of around 1.09% per year. The world population has already reached 7.6 billion but growth and development in agriculture which feeds the whole world hasn't been developed proportionally. The present systems, methods, patterns of agriculture can hardly meet the increasing demand of foods. It is quite essential to bring changes, modifications and development in our agriculture system that can yield enough to feed the growing population with quality and nutritive foods. But many countries in the world seem to be over concerned towards the wars, the people, advocates, powerful countries argue that it's quite essential to settle the disputes among the countries, just to prevent the wars and save the world, but the starvation, which has been found to be even more destructive and rapidly growing, seems neglected but if we keep neglecting, no doubt the world will end because of hunger rather than wars. That's why, it has been subject matter to be discussed and work on, because children, the pillars of the future world, the precursors to the next generation have been badly crippled by the brunt of starvation. Millions of children are dying every year just because of starvation.

Scientists have discovered many new varieties of high yielding crops, they have formulated different fertilizers, different irrigation technology, numbers of solutions to control pest and insects of the crops, despite of all these growing modernization,

advancement and improvement in the field of agriculture, the rate of starving population is increasing day to day. This is just because we haven't been able to utilize the resources wisely with developments. The rapid and random use of the natural resources, increasing industrializations, have caused huge destruction of the environment, nature and natural resources, unbalance in the environmental elements leading to the increasing global warming, eventually decreasing the yielding capacity of the many crops, many crops are losing their adaptability to the changing climate and environment with reduced food quality, ultimately leading to the food scarcity resulting in deadly famine condition. Moreover, utilization of the cultivable fertile lands for the urbanization, wars among the powerful nations (like WW2) have caused destruction in fertility of the cultivable lands, resources, manpower for agriculture are being used in the wars, these all lead to huge reduction in the net agricultural production of the world. All those lands and resources, that have already been misused and destroyed can't be taken back into their original conditions with same productivity and fertility, but the cultivation of the crops to feed the growing 7 billion population of the world is must. As there is saying "where there is will there is way" there are many ways to combat this growing starvation. Ways may be different, we may control food wastage, increase production of foods by use of various fertilizers, using improved varieties of crops, different cultivating techniques may be used. Among all of these, plant

breeding has been proved to be most crucial one, playing vital role in developing improved varieties of crops with desired characters and increased productivity in association with other sectors and finally eradicating hunger from the world.

Simply, Plant breeding is the science of changing the traits of plants in order to produce desired characteristics. It has been used to improve the quality of nutrition in products for humans and animals. Plant breeding can be accomplished through many different techniques ranging from simply selecting plants with desirable characteristics for propagation, to methods that make use of knowledge of genetics and chromosomes, to more complex molecular techniques. Genes in a plant are what determine what type of qualitative or quantitative traits it will have. Plant breeders strive to create a specific outcome of plants and potentially new plant varieties which can meet the growing demand of foods with proper nutrition and quality for the sustainable period of time.

If we see the history, plant breeding started with the dawn of sedentary agriculture when there were very few agricultural plants far-flung over the world, and particularly a very first domestication of the agricultural plants, a practice which is estimated to date back 9,000 to 11,000 years. Initially, early farmers simply selected food plants, which were distinctive and new varieties with desirable characteristics that arose from sudden mutation or novel variations and either consciously or unconsciously employed these as progenitors for subsequent generations, resulting in an accumulation of valuable traits over time. Even at that early period, many plant scientists were making different researches to find out and develop the plant varieties which could improve the crop production through plant breeding. Finally, this came possible after Gregor Mendel, established his own law, "law of inheritance" through the experiment on plant hybridization forming the basis of new science of genetics. Modern plant breeding is applied genetics, but its scientific basis is broader, covering molecular biology, cytology, systematics, physiology, pathology, entomology, chemistry, and statistics (biometrics). It has also developed its own technology.

There are various techniques of plant breeding, one of the major techniques involves, selectively propagation of the plant varieties with desirable characteristics and culling out of those with less desirable characteristics while another technique involves inbreeding between or among the closely related plant species with a motto to produce plants with new traits/genes from one variety or line to the new genetic background that can yield high

with maintained quality, high vigour, and adaptability. For example, a mildew-resistant pea may be crossed with a high-yielding but susceptible pea, the goal of the cross being to introduce mildew resistance without losing the high-yield characteristics. Thus, fulfilling the growing demand of foods through plant breeding. Classical breeding relies largely on homologous recombination between chromosomes to generate genetic diversity. The classical plant breeder may also make use of a number of in vitro techniques such as protoplast fusion, embryo rescue or mutagenesis to generate diversity and produce hybrid plants that would not exist in nature. Traits that breeders have tried to incorporate into crop plants include:

1. Improved quality, such as increased nutrition, improved flavor or greater beauty
2. Increased yield of the crop
3. Increased tolerance of environmental pressures (salinity, extreme temperature, drought)
4. Resistance to viruses, fungi and bacteria
5. Increased tolerance to insect pests
6. Increased tolerance of herbicides
7. Longer storage period for the harvested crop

Most of these have already been achieved, if we get succeeded in developing all those in a single variety, then the world will surely be with zero hunger. Many attempts have been made by number of plant breeders, in 1926-1940, before the world war-II, the Italian breeders had bred the hybrids of wheat to increase the crop production during the period so-called "Battle for grains". Heterosis were also used by many breeders to produce various hybrids in maize. In 1933 another important breeding technique, cytoplasmic male sterility (CMS), was developed in maize. These early breeding techniques resulted in large yield increase in the United States in the early 20th century. Similar yield increases were not produced elsewhere until after World War II, the Green Revolution increased crop production in the developing world in the 1960s. Plant breeding was also one of the crucial part for green revolution in developing highly fertilizer responsive and high yielding dwarf variety of wheat which served to the millions of starving population of the world. Various techniques were developed for plant breeding purpose to develop improved varieties to increase crop production after the world war-II, Colchicine treatment like in *Triticum aestivum* developing process, embryo rescue technique has been used to produce new rice variety for Africa, an interspecific cross of Asian rice (*Oryza sativa*) and African rice (*Oryza glaberrima*), hybrids of different

crops were produced by the technique of mutation breeding using transposons, radiations, EMS and DMS, chromosomal engineering was also introduced in developing different hybrid varieties by changing in chromosomal number to develop desired characters. After the world war-II, large area of fertile lands, resources, were destroyed, there was huge loss of manpower, there were no people to work on production process, rate of food production was very low, people in many parts of the world were being victimized by the brunt of famine. At that time, many scientist working on plant breeding developed number of techniques as mentioned above, to meet the demand of food, by producing highly responsive and high yielding crops. Not all the plants produced by classical breeding techniques are useful, some genetically modified plants have been unsuitable for human consumption, for example the poison solanine was unintentionally increased to unacceptable levels in certain varieties of potato through plant breeding. Thus, as a modern science of plant breeding different techniques like marker assisted selection, in which location and function of various gene is identified in a genome, reverse breeding and double haploids and genetic modifications have been developed to produce the healthy and quality crops. Use of molecular biology and biotechnology have further simplified the process of plant breeding.

All these attempts being made in the field of plant breeding from past up to now, is just to secure our food for future and feed the present population with enough balanced and nutritious diet. Plant breeding has been the great boon, for all the human kind. The role and significance of plant breeding is increasing day to day as it helps in the production of higher yielding varieties. For the production of sufficient crops, not only fertilizers and fertile land is enough, high yielding, improved and healthy varieties are also required which is provided by the plant breeding techniques. Area and fertile land alone, can do nothing at all, if there are no sufficient plants to grow on. The present farmers need to grow crops in high scale to meet all the industrial as well other demands of the crops, for this large number of plants are required, further these all plants must be diseases and pest resistance, they should be highly responsive to the applied fertilizers on the soil, should grow well and yield more within the short period of time, these all have been made possible by the different techniques of plant breeding. Plant breeding, helps to develop various variety of crops with desired agronomic characters, and are modified according to the climatic conditions of growing region and made photo and thermos sensitive, moisture stress and salt tolerance accordingly, which eventually facilitates in higher yield of crops. On the other

hand, development of new season variety with non-shattering characteristics, determination of growth habitat of particular variety and dormant behavior is must for efficient crop production with maximum profit which is made possible by the different breeding techniques. Furthermore, through the techniques of plant breeding, we can eliminate undesired and toxic characteristics from the particular variety and propagate only desired characters, with wider adaptation. Development of varieties with high weed competitiveness, high water using efficiency, also provides great aid in the crops production process. But plant breeders should not be so directed to feed the present population only, instead they should be far sighted and develop the crop varieties for future agriculture to thrive, by making necessary changes according to the arising global issues and changing climates, to secure the foods for future generations.

Plant breeding on its own, is playing vital role in the food production process but we can't feed the world just by breeding plants, other aspects related to the crop production, like developing of new agricultural tools and machineries for inter-agricultural practices, development of efficient irrigation techniques, formulation of different fertilizers with less harmful impacts on environment, in addition, bio-fertilizers, bio-herbicides should be promoted and developed in large scale. We can't grow enough, just by developing all these factors of production, they must be accessible to all farmers and producers globally. The farmers must be taught with different techniques of cultivation, how and when to use and which variety to use, with what proportions of fertilizers, in which season, then only the production of enough crops to feed the world will be possible. Thus, investment should be promoted on all the sectors of food production equally. Last but not the least, if we see the present situations, the foods and crops produced are being used to manufacture different shampoos, soaps, and many other aesthetic goods contemporarily, millions of people are still striving for a single grain of rice. There is more nutrient in the shampoo of a rich man than in a poor man's plate. Plant breeding shouldn't be developing to serve rich but to feed the hunger.

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