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Plant breeder: A Significant contributor to Agricultural Science

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Abstract:

Plant breeders form a critical link in the development of new crops and crop varieties that contribute to the solutions of human common threats including food insecurity, climate change and sustainable environment. They have considerably contributed to the improvement of crop productivity; breeding new varieties with resistance to diseases; and improving plant's tolerance to different climatic conditions. In this article, the author seeks to explain how plant breeders have distinguished themselves to be useful in today's agriculture and food systems worldwide. Some of the benefits attained from the progress of plant breeding include the creation of high yielding varieties for crops, a factor that has been useful in the provision of food for the ever growing global population. In this way, helping the development of agricultural crops, plant breeders influence not only the quantity of production, but also the quality and nutritional value of crops. Also it is reported that breeding for resistance to pest infestations diseases and environmental stress has minimized the use of chemicals thereby increasing sustainable agricultural practices. This paper presents several focusing points on what plant breeders do and why their work is much more than the production of food crops only. Other preservation strategies include the seed banks and genetic resources which assist in the preservation of different gene pools for crop crops for the benefit of the long term agiculture. In addition, breeders are working on producing cultivars that are able to utilise water and minerals more effectively while promoting environmentally sustainable and less input-intensive agricultural systems. In recent times with developments in molecular biology, genomics and digital technology an enhanced screening and selection process is possible. These innovations have led to the advancement in the production of crops that are able to meet the climate change challenges

and therefore plant breeding has become most important in the future production requirements. Nonetheless, plant breeders remain undeterred through the uncertainties which include limited funding, regulations that obstruct the production of biotechnology plants, and public concerns about biotechnology plants. Among their functions, a very significant role implies the provision of a steady need in food products in the future, which places them as significant actors in the development of the global agricultural sector.

Introduction:

Traditional plant breeding has been recognised as a key thant in the enhancement of agriculture for many years; it involves coming up with crops that are of great relevance in society. Since the beginnings of civilization, people have been selecting plants to form improved varieties with higher yields, better tastes and being better suited to the environment. Modern plant breeders are now the real scientists in the field involved in resolving some of the most significant problems of the modern agriculture, food supply, environment, and sustainability.

Today the population of the world is increasing tremendously and according to the United Nations it is said that it will reach 9.7 billion by the year 2050 and this is why the requirement of food is always on the rise. Alone the traditional methods of farming and production of foods cannot suffice the increasing demand for foods that are produced in this way. Here, there comes the role of plant breeders who genetically modify crops and come up with high yielding and more tolerant crops for better yield in relatively small area of land. Through conscious breeding for desirable characteristics, they brought about changes on crop plants such as wheat, rice and maize making them staple foods for a large population of the world's population. Besides, plant breeders have a central role in the eradication of crop diseases and pests. Every year millions of tons of crops are destroyed by diseases or pests, which is a great concern to food security around the world. Plants with natural resistance are then bred by plant breeders thereby cutting losses due to the mentioned threats and at the same time use minimal chemical pesticides which are not good for health and also the environment.

There is another area where plant breeders are making a difference and that is through tackling

the effect of climate change. There is shift in the climate characteristics with high temperatures changes in rainfall rates and increase in occurrence of severe weather conditions hence exposing crops to more challenges. Selecting varieties that are able to endure harsh climatic conditions of dryness, heat or flooding is being worked on vigorously by plant breeders so that the food production levels can stabilize despite the climatic shenanigans. Besides raising yields and guaranteeing plant stability, plant breeders also play their part in preserving the Earth's sustainability through division of species. That is because genotype differential is the cornerstone to building sustainable systems that can adapt to new threats affecting various crop varieties. Collections and seed banks are created by breeders so that the future generations have a variety of materials for forming new varieties. Molecular biology and some advanced techniques like genome editing – CRISPR have produced a revolution in plant breeding. These tools enable gene adjustments on plants and help in increasing the rate of crop improvement, especially in terms of the desirable traits. In this article, our focus will be on the eradicable role played by plant breeders in the sphere of agricultural science and the importance of their work in making agricultural production deservingly stable, safe and protected in the nearest future.

The Role of Plant Breeders in Agricultural Innovation

Plant breeders play a central role in implementing change in agriculture through breeding new crop varieties that can feed the constantly growing population globally while at the same time combating effects of climate change, pest and diseases. Artificial selection by breeders in crop plants mean choosing and developing advantageous characteristics and behold, the technique has greatly increased crop yield, quality, and resistance to adverse conditions.

It can also be argued that one of the major achievements of plant breeders is to bring high yield varieties. They have also improved through breeding and hybridization the yield of the basic crops including wheat, rice and maize that are crucial ingredients of food security in the world. Such innovations have been useful in feeding the world's population, especially those areas that are characterized by high population densities and low land availability for cultivation. Besides yield enhancement, plant breeders have equally recorded significant success towards breeding

for disease/pest resistant varieties. Furtherever pests and diseases attack on crops and alters food production, hunger and economic instability occurs. The use of biotechnology and production of crops with genetic resistance means that breeders are able to cut on the use of chemical pesticides and herbicides ; this therefore makes farming environmentally friendly and also cut down on the cost of production from the farmer's end. Climate change is still another area of concentration in today's plant breeding. Plant breeders are creating crops that can withstand drought, heat and other adversities in climate so as to check fluctuations in crop production. The climate resilient varieties are important in ensuring that food production is sustained in places that are prone to effects of weather factors.

Aside from increasing yield and stress tolerance, plant breeders are also achieving one of the major goals of increasing the nutritional quality of plants. They are in a way fighting malnutrition and enhancing public health by raising density of vitamins, minerals and other nutrients in staple crops.

The Role of Plant Breeders in Agricultural Innovation

Plant breeders are the key players in the production of crops to feed the increasing world population and in doing so they have to take into consideration diseases, pests and unfavorable conditions of the environment. Another area in which the plant breeders have significantly contributed or played an important role is in the production of high yield crops. By using the process of genetic manipulation that works through selective breeding, they have improved yields on such basic foods as wheat, rice, and maize that are vital in human food basket. Both of these high-yield varieties have been essential in supporting food yields for billions of people around the globe. Besides increasing yields, which remains the key concern of plant breeders, they also aim at increasing disease and pest resistance in plants. This they have been able to incorporate resistant traits hence less or negligible use of chemical pesticides thereby encouraging better and sustainable use of resources in agriculture. It does not only preserve the crop yields but also helps in maintaining the health or the respective agriculture ecosystems. In addition, plant breeders are producing crops that are capable of withstanding stress conditions

such as drought and climate change. They are using genetic enhancement techniques and normal breeding strategies to produce plants that will be able to grow under different and unfavourable environmental conditions thus guaranteeing food production in the changed climate.

Technological Advances in Plant Breeding

Technological advancement has brought a change in the process of plant breeding to make it more accurate and productive. This is so because molecular biology combined with genomics and computational biology makes it easier for breeder to come up with crops which meet today's agriculture requirements. They include molecular breeding: perhaps one of the greatest breakthroughs in the field in the recent past. It entails use of specific DNA sequences which are known to be associated with certain qualities, which means that breeders can select plants that meet certain qualities at the genetic level. This breed technology increases the rate of breeding enabling the development of better crop varieties in a short span of time. Furthermore, to reduce time taken for the development of new varieties, marker-assisted backcrossing assists in putting the favourable QTL into the elite lines with high yield. The other is genomic selection where the whole genome of a plant is scanned in order to preview its potential for yielding desirable genes. This approach makes it more efficient to deal with such traits as yield, drought tolerance and disease resistance in breeders.

Another example of technology today is Genome editing tools like CRISPR has made precision even better. These tools facilitate the breeding process by modifying the genome of the plant thus making it possible to alter certain genes known to be causal to these traits. This technology saves time which was earlier required to bring about new varieties and will allow for breeding crops with increased resistance to pests, diseases and other environmental factors and improved nutritional values. However, there is the utilization of digital and Computational tools as other keys to this breakthrough. Thus, phenotyping – the evaluation of the physical characteristics of a plant – has been advanced through the use of such technologies as automation and AI. These tools enable breeders to look for answers in large compiling sums of data and possible outcomes and make faster decisions that result in bringing better varieties to the market.

Global Impact of Plant Breeders

Professional plant breeders have played a positive role on the global agricultural food systems, food security, economic growth and development in addition to their important role in addressing food production challenges and the care for the natural resources. Their work has played a significant role in the development of the current Agricultural practices across the world making sure that the increasing global population is fed appropriated nourishing food. Another very important achievement made by plant breeders is the high-yielding varieties of crops. These innovations especially for the major crops such as the wheat, rice and maize have revolutionalized and enhanced agricultural production. The Green Revolution spear headed by the development of high-yielding and disease resistant production varieties enhanced food production and reduced hunger in many third world countries especially in Asia and Latin America. Thanks to this change the phenomenon of general famine was prevented, and the economic development of many territories began.

Secondly, plant breeders have also contributed much towards developing plants that can produce more yields per unit area as well as those that can withstand stress factors in the environment. With threats like abiotic stress incidents like drought, flood, and extremely high temperatures pressing on because of climate change continue to pressure farmers, breeders have not been idle and have developed varieties suited for these conditions. Maize for the African region developed for drought conditions and rice for the Asian region developed for flood condition are two real examples of plant breeding solutions that are trying to solve regional constraints to production. Plant breeders are also involved in the conservation of the biological diversity to develop plants with a unique genetic stock for future breed improvements. This is especially so in matters of protection of agricultural systems from new pests, diseases and other environmental factors. So, breeders keep collections and use more different types of genetics resources were keep the adaptability of crop to the later generation. In addition, plant breeding helps towards sustainable agriculture because through breeding different crops a plant breeder comes up with crops that are genetically designed with less demands for water, fertilizers and pesticides. Apart from that,

these advancements make farming environmentally friendly making food systems across the globe more sustainable.

Challenges Faced by Plant Breeders

Plant breeders are certainly some of the most invaluable contributors to the development of agricultural science, however, they encounter numerous problems that limit their potential of modern crop improvement. The challenges they include include; funding, public perception, regulatory issues and the fact that breeding for such conditions poses a challenge due to the differing environment in which plants may be produced. Possibly the greatest challenge that plant breeders encounter is the problem of inadequate funding to support their work. Developing new crop varieties is a time consuming activity, that may take between 8–12 years or even more and therefore, it demands cost commitment. However, many programmes of breeding including those in developing nations have a challenge of inadequate funding. Among them is lack of finances which constrains the pace of identifying new breeding techniques and, in turn, the rate of introducing new plant varieties to the market, including those capable of tackling the world's pressing issues, including food scarcity and climatic change.

Legal barriers are another major concern for the main ideas, especially in relation to developing improved breeds, including through the use of GM and genome editing. Most of the world's nations has stringent policies that slow down or put conditions to the release on the market of genetically modified crops, despite the fact that some of them have benefits for growers or are more sustainable. The enforcement of these regulations can therefore be costly and time consuming this slows down the instrumental growth of new technologies in plant breeding. Another challenge is the social acceptance of the above techniques particularly the modern breeding techniques such as genetic modification of crops. This usually leads to resistance when the new crop varieties, which are genetically modified, are introduced into the market despite the numerous advantages that come along with the new crop varieties such as disease resistance, nutritional quality or improved environmental performance. It re-emphasises that the communication of scientific advancement to the public, an area that has often been criticised for

falling short, is an ongoing important challenge for plant breeders and agricultural scientists.

Last but not the least is the reason of the variation in breeding for highly variable environment which is hardest. Climate change is changing conditions for crop growth, and a breeder has to have a plant that will respond well in different or differing conditions. This can only be done with advanced tools and adequate genetic knowledge increasing the complexity of plant breeding. The progress of these issues is essential to enable the plant breeders to continue with their roles in the provision of food security as well as sustainable agriculture all over the world.

Conclusion

This is why plant breeders and other men and women involved in the development of new plant varieties are at the cutting edge of agriculture responding to daunting questions of malnutrition, soil degradation, most extensive natural calamities, and climatic changes. Their work has had a profound impact on world agriculture by creating GM, High-yield, Disease and climate resistant crops planted on more than if a half of the worlds' populations' food. Through foasing characteristics which are conducive to growth of certain organs instead of the harm one, the farmers have applied improvement in plant breeding to increase food production on limited piece of land while at the same time using less hazardous chemicals. Recent developments in plant breeding including molecular breeding, genomic selection, and genome editing has brought a great change within the field in the sense that breeders are now in a position to develop new improved crop varieties than ever with higher efficiency. Such changes enable the breeders to come up with an array of complications ranging from pest resistance, stress which is occasioned by drought, and efficient nutrient utilization, all of which are more demanding due to climate change and a growing population.

Nevertheless, plant breeders encounter some challenges as follows Subheadings The above areas prove that plant breeders are valuable in playing the following roles Despite their important roles, plant breeders encounter the following challenges. There are barriers to funding, legislative restrictions, and people's distrust of several advanced methods, especially in the field of GMOs. Further, the fact that breeding has to be done for various and more often changing environments

increases the challenge. Challenges can be overcome by scientific solutions, awareness and by having supportive policies and measures in the society. As the global population increases and climate conditions turn even more volatile in the future, the part of plant breeders in improving yields and developing new varieties to meet the demands of people will remain necessarily crucial. It is encouraging to note that interdisciplinary research and development, as well as the application of relevant advances in biotechnology, offers breeders, scientists, and growers the avenues necessary for maintaining – and enhancing – crop yield, production, utilization, and the sustainability of crop germ plasm both locally and globally. Consequently, we are compelled to admit that plant breeders are extremely valuable members of the agricultural community. These efforts are progressive not only because they determine the trends in the development of food production, but because they contain the answers to many of today's problems in agriculture. They will therefore remain relevant in providing food to the growing population of world and ensure proper conservation of environment for the upcoming generations.

References

- Acquaah, G. (2012). Principles of plant genetics and breeding (2nd ed.). Wiley-Blackwell.
- Allard, R. W. (1999). Principles of plant breeding (2nd ed.). John Wiley & Sons.
- Baenziger, P. S., Russell, W. K., Graef, G. L., & Campbell, B. T. (2006). Improving lives: 50 years of crop breeding, genetics, and cytology (C-1). Crop Science, 46(5), 2230-2244.
- Ceccarelli, S., Grando, S., & Baum, M. (2007). Participatory plant breeding in water-limited environments. Experimental Agriculture, 43(4), 411-435.
- Chen, M., Shelton, A., & Ye, G. (2011). Insect-resistant genetically modified rice in China: From research to commercialization. Annual Review of Entomology, 56, 81-101.
- Elshire, R. J., Glaubitz, J. C., Sun, Q., Poland, J. A., Kawamoto, K., Buckler, E. S., & Mitchell, S. E. (2011). A robust, simple genotyping-by-sequencing (GBS) approach for high diversity species. PLoS One, 6(5), e19379.

- Fischer, R. A., & Edmeades, G. O. (2010). Breeding and cereal yield progress. Crop Science, 50(Supplement_1), S85-S98.
- Govindaraj, M., Vetriventhan, M., & Srinivasan, M. (2015). Importance of genetic diversity assessment in crop plants and its recent advances: An overview of its analytical perspectives. Genetics Research International, 2015, 431487.
- Ortiz, R. (2010). Plant breeding in the genomics era. Springer Science & Business Media.
- Peng, J., Richards, D. E., Hartley, N. M., Murphy, G. P., Devos, K. M., Flintham, J. E., ... & Harberd, N. P. (1999). 'Green revolution' genes encode mutant gibberellin response modulators. Nature, 400(6741), 256-261.
- Tester, M., & Langridge, P. (2010). Breeding technologies to increase crop production in a changing world. Science, 327(5967), 818-822.
- Varshney, R. K., Graner, A., & Sorrells, M. E. (2005). Genomics-assisted breeding for crop improvement. Trends in Plant Science, 10(12), 621-630.