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Biofortification in horticultural crops: The ultimate aim to sufficient and diverse diet for population.

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Abstract

As global populations continue to expand and dietary diversity remains a critical concern, the concept of biofortification in horticultural crops emerges as a promising solution. Biofortification aims to enhance the nutritional content of crops through conventional breeding or biotechnological interventions, with a primary focus on essential vitamins, minerals, and phytonutrients. This Article explores the significance of biofortification in horticultural crops as a means to address malnutrition and provide populations with sufficient and diverse diets. The article begins by outlining the prevalent challenges related to malnutrition and the inadequacy of traditional food systems in meeting the nutritional needs of a growing global population. It then delves into the concept of biofortification, elucidating the techniques and strategies employed to enhance the nutritional value of horticultural crops. The discussion highlights the role of key nutrients, such as vitamin A, iron, zinc, and folate, in combating micronutrient deficiencies and their impact on human health. Furthermore, the article emphasizes the suitability of horticultural crops for biofortification due to their diverse genetic pool and adaptability to various agro ecological conditions. Case studies and examples of successful biofortification programs in horticultural crops, including orange-fleshed sweet potatoes and biofortified maize, are presented to illustrate the practical implementation and outcomes of these initiatives.

Key Words: - Biofortification, Agro ecological, Diets, Human health, Phytonutrients

Introduction

A relatively long-term, sustainable, and affordable way to increase the number of micronutrients in food crops is through biofortification, which is the process of breeding nutrients into the crops.

This approach will assist those with improved nutritional status in maintaining it, as well as reduce the proportion of severely malnourished individuals who need supplemental therapies for treatment. Putting the micronutrient-dense trait into cultivars that already have desirable agronomic and consumer traits-like high yield-is the goal of the biofortification strategy. The daily adequacy of micronutrient intakes by individuals throughout their life cycle can be increased by biofortified staple foods.

Minerals and Vitamins

In the context of the human diet, minerals are inorganic chemical elements needed for the accumulation of electrolytes as well as other biological or biochemical processes. Although there are 16 essential elements, only very rare conditions will result in a deficit because 11 of these minerals are needed in such minute amounts and are found in such high concentrations in food and water. Deficiency is easily caused by a repetitive diet because the remaining five are found in limited amounts in numerous foods. When diets are mostly composed of staple foods, deficiencies might develop.

Iodine

A significant sign of iodine deficiency is goiter, which is caused by a low thyroxine level, which encourages the thyroid gland to grow and generate thyroid-stimulating hormone. With over 50 million cases of goiter and over two million cases of cretinism, India is one of the most seriously affected countries in the world.

Iron

The human body needs iron for a variety of vital processes. Iron is consequently necessary for the body's transportation of oxygen and metabolism of energy. It also helps a variety of nonheme enzymes, including ribonuclease reductase, function catalytically. The deficiency of iron cause anemia.

Zinc

Thousands of proteins require zinc in order to function. Approximately 100 enzymes require zinc as a cofactor, and many contain zinc prosthetic groups. Prolonged diarrhea, wasting, skin rashes, and hair loss are indicators of a severe zinc shortage. Lack of the mineral in childhood and adolescence can cause delays in growth, sexual development, and psychomotor development. It seems to be especially significant during times of rapid growth.

Calcium

The most prevalent mineral in the human body, it is crucial to structural integrity. But like zinc, calcium is a crucial signaling chemical and an enzyme cofactor. It is essential to the blood clotting cascade. A deficit in calcium can have a severe effect on bone health; if it develops in childhood, it can lead to rickets; if it continues into old life, it can cause osteoporosis.

Selenium

It can be present in two unique amino acids known as selenocysteine and selenomethionine, which are the primary functional components of selenoenzymes. Those whose duty it is to remove mineral ions from other proteins. It is an antioxidant with health benefits such as cancer and heart disease prevention.

Vitamin A

It is an important vitamin of human diet. its cause blindness and increased risk of disease and death for small children and pregnant women.

Folate

Deficiency linked to abnormal neural tube development in infants as well as an increased risk of maternal death and birth problems.

Types of Biofortification in Horticultural crops

Biofortification has been suggested as a long-term alternative to conventional procedures for enhancing mineral nutrition because conventional interventions have limited effects. Enhancing the mineral nutritional properties of crops at the source is the goal of biofortification, which includes methods to raise the levels of minerals and their bioavailability in the edible portions of staple crops.

Plant breeding

The goal of plant breeding indicates is to use natural genetic variation in staple crops to increase the amount and bioavailability of micronutrients. The approaches used in breeding involve identifying genetic variation that influences heritable mineral qualities, assessing the stability of those traits under various circumstances, and determining whether it is feasible to breed for higher mineral content in edible tissues without compromising yields or other quality attributes.

Conventional Plant Breeding

Yet, conventional breeding is limited since it can only make use of the genetic variability that is already present and observable in the crop being enhanced in terms of its nutritional value, eating quality, and agronomic qualities, or sporadically in the wild types that can cross with the crop.

Genetic engineering

Genetic engineering presents a viable alternative for raising the concentration and bioavailability of micronutrients in the edible crop tissues when there is insufficient variation among genotypes for the desired trait within the species or when the crop itself is unsuitable for conventional plant breeding. The issue of foreign genes being transferred to non-target species, sometimes known as the "gene flow" environmental problem, is one of the primary problems. Transgenes can target specific pathways for reconstruction, or they can target the redistribution of micronutrients among tissues or improving the biochemical pathway efficiency in edible tissues.

Tissue Cultures

All forms of plant cells, tissues, and organs cultured under aseptic conditions is known as plant tissue culture. Transferring desired features related to nutritional enhancement can be achieved by developing distant crosses between cultivated and wild species via tissue culture. When propagating fruit crops like bananas and tuber crops, this method proves to be commercially effective. Agronomic features, reduced concentration of anti-nutritional component, or higher nutritional value are the results of screening optimal Soma clones in these crops.

Conclusion

Malnourishment cannot be solved by biofortified crops, either by traditional breeding techniques or contemporary biotechnological means. A balanced and sufficient diet for everyone on the planet continues to be the ultimate goal of global nutrition. The lives and health of millions of people, particularly the most vulnerable, can be significantly improved by biofortified crops, which can supplement current micronutrient therapies.

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