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Development of Bio- Fortified Vegetable Varieties by Utilizing Different Breeding Methods

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SUMMARY

Humans require around 40 known nutrients in adequate amounts to live healthy and productive lives). nutrients play important roles in humans and maintain physical and mental development. For humans, agricultural outputs are the primary source of nutrients, especially for those residing in developing countries. These nutrient deficient agricultural outputs cannot sustain healthy lives and can lead to nutrient disorders. Biofortification of crop plants can provide enough calories to meet the energy requirement along with providing all the essential nutrients needed for healthy life.

INTRODUCTION

Biofortification" or "biological fortification" explains nutritionally enhanced food crops with higher bioavailability to the human. Approximately 792.5 million people worldwide are assessed to be malnourished by the United Nations Food and Agriculture Organization, of which 780 million reside in developing nations. Besides this, almost two billion people in the world suffer from hidden hunger which is caused by an inadequate intake of essential micronutrients in the daily diet despite increased food crop production . So far, our agricultural system has not aimed to promote human health; instead, it only focuses on increasing yield and crop productivity. Now agriculture is shifting from high yielding crops to nutrient-rich food crops in required quantities. In order to provide people with crops rich in micronutrients, a long-term and sustainable approach is - crop variety biofortification.

Biofortified vegetables of essential micronutrients can be achieved by

- Conventional Breeding
- Transgenic
- Agronomic methods

Agronomic Biofortification

Agronomic biofortification is the process of increasing the density of nutrients, vitamins and minerals in a crop by means of adopting proper agronomic practices and can be considered as an effective strategy for supplementation of micronutrients powders and enhancing dietary diversity.

The major advantages of agronomic biofortification are:

- It is practiced on crop cultivars already being cultivated by the farmers and have good consumer acceptability of the produce
- Enhanced micronutrient concentration in grain and other parts of the crop can be achieved in the same year
- Very less amount of micronutrient is needed when the foliar application is followed
- No investment is needed for new seed

Agronomic biofortification can be done by :

- Crop rotation
- Inter cropping
- Proper pest management
- Proper drying and storage
- Maintaining soil health physical, chemical, and biological properties
- Balanced and integrated nutrient management

Conventional Breeding

The conventional breeding is based on natural variation and can a alternative to genetic engineering The technique of altering a plant's features to generate desired characteristics is known as conventional breeding. The production of crop varieties that emphasize distinctive and superior features is the aim of plant breeding.It has been applied to raise the standard.

Introduction:

It is a process of introducing plants in the new locality from their own growing locality which may involve wild or totally new variety of crops for the area

Sweet Potato	CIP-440127 from CIP, Peru - Carotene content is 6.2 – 7.6 mg/100g ST-14 from Japan-Carotene content is 13.2 – 14.4 mg/100g
Beetroot	Detroit Dark Red from USA -Anthocyanin
Carrot	Zeno from Germany - Deep orange- carotene rich

Selection:

Potato	Kufri Neelkanth clonal selection MS/89-1095 x CP3290- Anthocyanin content is 100µg/100g
Tomato	Phule Kesari- Rich in beta-carotene (5.93 mg/100g) content Phule Jayshree- Rich in beta-carotene content
Sweet potato	Bhu Krishna High anthocyanin (90.0 mg/100g), Sree Kanaka- High beta carotene Bhu Sona- High beta-carotene
Cauliflower	Pusa Beta Kesari-1 Country's first biofortified variety- high beta carotene (800-1000 µg/100g)
Amaranthus :	Pusa Lal Chaulai, Arka Arunima

Hybridization

It is the method of producing new crop varieties by crossing two genetically different parents.

Inter varietal hybridization

Brinjal : Punjab Sadabahar (Jap. Long x R-34)- Blackish purple(Anthocyanin)
Arka Jyoti(IIHR-20 x Crimson Red)- Crimson Red (Carotene)
Durgapur Lal(Sugar baby x K3566)- Dark Red(Carotene)

Inter specific hybridization

Amaranthus Pusa Kiran- Iron content (38.5 mg/100g)
Okra: Kashi Lalima- Anthocyanin: 3 mg/100g
Bitter gourd: Pusa Hybrid 4- Iron: 18.28 mg/100g

Carrot: Kashi Arun- Lycopene: 7.5 mg/100g
Tomato: Pusa Rohini- Vitamin C: 31.2 mg/100g

Transgenic Approaches for Biofortification

In the absence of genetic variation in nutrient content among varieties, breeders have nothing to work with. This is where transgenic approaches can be a valid alternative. The ability to rapidly identify and characterize gene function and then utilize these genes to engineer plant metabolism has been a driving force in recent bio fortification efforts.
Example is to alter Or gene in cauliflower etc.

Different gene transfer methods include :

Particle gun	Ultrasound mediated.
Microinjection and macro-injection.	PEG mediated gene transfer.
Liposome mediated transformation.	Calcium phosphate co precipitation
Electroporation.	Agrobacterium mediated transformation (use of Ti or Ri plasmid as vectors).
Virus mediated gene transfer (by employing Caulimovirus or Geminivirus Vectors)	

CONCLUSION

Biofortification is a one-time investment and is a cost-effective, long-term, and sustainable approach in fighting hidden hunger. Food security will also be increasingly difficult in the next decades due to the possibility of a significant population rise in the developing countries and changing climate circumstances. Therefore, one of the primary objectives of institutions like the World Health Organization and the Consultative Group on International Agricultural Research (CGIAR) is the creation of high-yielding, nutritionally enhanced biofortified crops.

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Varietal description Institutional wise