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Bio-fortified Vegetable Crop: Strengthening Food and Nutrition Security

*Tania Seth[1], Ruma Das[2], Abhipsa Panda[3] and Subhalaxmi Dei[3]
[1]Scientist, ICAR-Central Institute for Women in Agriculture, Bhubaneswar, Odisha, India
[2]Scientist, ICAR- NBSS & LUP, Regional Centre, Kolkata, West Bengal, India
[3]M.Sc. Scholar, Department of Vegetable Science, College of Agriculture, OUAT, Bhubaneswar, Odisha, India
*Corresponding Author's email: taniaseth.19@gmail.com

Malnutrition or under-nutrition caused by the deficiency of essential vitamins and minerals, continues to affect millions of people worldwide, particularly in developing countries. Micronutrient deficiency, often termed "hidden hunger", affects more than two billion people globally, especially in low- and middle-income countries. The food availability has increased over time, food quality frequently remains inadequate. Bio-fortification increases the nutrient density of food crops using conventional plant breeding, agronomic practices, or modern biotechnology, thereby helping reduce vitamin and mineral deficiencies (Nestel et al., 2006). Bio-fortified vegetable crops provide a viable and sustainable solution to this problem by increasing the nutritional value of commonly consumed vegetables. Therefore, consumption of bio-fortified vegetable crops can improve micronutrient intake of an individual assuming similar micronutrient bioavailability (La Frano et al., 2014) and retention after cooking, processing and storage (De Moura et al., 2015).

Bio-fortified Vegetable Crop Varieties

Vegetables are already known for their health benefits, but bio-fortified vegetables take this advantage a step further. Regular consumption of nutrient-enriched vegetables can help reduce malnutrition, improve immunity, enhance cognitive development in children, and support overall health. Bio-fortified crops are especially important for women and children, who are more vulnerable to micronutrient deficiencies. Indian Council of Agricultural Research, India developed several bio-fortified varieties of tuberous vegetables and cauliflower. Bio-fortified vegetables varieties contain higher levels of essential nutrients such as iron, zinc, vitamin A and other micronutrients. These crops enable the rural populations to supplement the nutritional benefit from the low cost diet with minimum resources (Yadava et al., 2022). Bio-fortified vegetable crops are rich in pigments and numerous health promoting phytonutrients (Luthra et al., 2026).

Vegetable Crops	Variety	Characteristics	Released by
Potato	Kufri Manik	✚ Rich in anthocyanin (26.66 mg/100g FW) ✚ Tuber yield: 23.0 t/ha ✚ Maturity: 90-100 days ✚ Suitable for Punjab, Eastern UP, Bihar, WB and Assam	ICAR-Central Potato Research Institute, Shimla

	Kufri Neelkanth	↓ Rich in anthocyanin (1.12 mg/100g FW) ↓ Tuber yield: 36-38 t/ha ↓ Maturity: 90-100 days ↓ Suitable for Punjab, Haryana, UP	
	Kufri Jamunia	↓ Rich in anthocyanin (32.36 mg/100g FW) ↓ Tuber yield: 32-35 t/ha ↓ Maturity: 90 days ↓ Suitable for Northern, Central and Eastern plains of India	
Sweet potato	Bhu Sona	↓ Rich in provitamin-A (14.0 mg/100g) ↓ Tuber yield: 19.8 t/ha ↓ Suitable for Odisha	ICAR-Central Tuber Crops Research Institute, Thiruvananthapuram
	Bhu Krishna	↓ Rich in anthocyanin (90.0 mg/100g) ↓ Salinity stress tolerant ↓ Suitable for Odisha	
Greater yam	Sree Neelima	↓ Rich in anthocyanin (50.0 mg/100g), crude protein (15.4%) and zinc (49.8 ppm) ↓ Tuber yield: 35.0 t/ha ↓ Maturity: 240-270 days ↓ Suitable for Kerala	ICAR-Central Tuber Crops Research Institute, Thiruvananthapuram
	Da 340	↓ Rich in anthocyanin (141.4 mg/100g), iron (136.2 ppm) and calcium (1890 ppm) ↓ Tuber yield: 80.0 t/ha ↓ Maturity: 240-270 days ↓ Suitable for Kerala	
Cauliflower	Pusa Beta Kesari 1	↓ Rich in provitamin-A (8.0-10.0 ppm) ↓ Curd yield: 40.0-50.0 t/ha ↓ Suitable for NCR of Delhi	ICAR-Indian Agricultural Research Institute, New Delhi

Advantages for Farmers and Consumers

Bio-fortified vegetables benefit both producers and consumers. Farmers can cultivate these varieties using standard agricultural practices with minimum inputs. The bio-fortified vegetables are also providing improved yield, pest resistance, and climate resilience, making them suitable for diverse agro-climatic conditions. Consumers, on the other hand, receive better nutrition from everyday meals without changing dietary habits. The demand of the bio-fortified vegetable crops among the consumers is also increasing.

Role in Nutrition-Sensitive Agriculture

Promoting bio-fortified vegetables aligns with nutrition-sensitive agriculture approaches that aim to link farming systems directly with nutritional outcomes. Integrating these crops into

nutri-gardens, school nutrition programs, and community farming initiatives can significantly enhance household nutrition security. Women farmers, in particular, play a crucial role in cultivating and promoting these nutrient-rich vegetables at the household level. By promoting the cultivation of these nutri-rich vegetables in the nutri-gardens helps in improving the nutritional status of the household.

Challenges and Way Forward

Despite their benefits, awareness about biofortified vegetables remains limited. The non-availability of good quality planting material of these bio-fortified vegetable varieties is another major hindrance for wide scale promotion of these crops. Strengthening extension services, conducting demonstrations, and integrating these crops into government nutrition programs can help scale their adoption. Collaboration among researchers, policymakers, and farmers is essential to ensure wider availability and acceptance.

Conclusion

Biofortified vegetable crops represent a cost-effective, sustainable, and farmer-friendly strategy to combat hidden hunger. By encouraging the cultivation and consumption of bio-fortified vegetable crops can play a significant role in achieving food and nutrition security. Promoting these crops in mid-day meal of anganwadis and schools also helps in alleviating malnutrition among children and adolescent girls.

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