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Bio-fortification in Relation to Nutritional Security and Soil Health

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Fortification

Fortification" as "the addition of one or more essential nutrients to a food whether or not it is normally contained in the food, for the purpose of preventing or correcting a demonstrated deficiency of one or more nutrients in the population or specific population groups.

What is Bio-fortification?

Biofortification is defined as an agricultural strategy aimed to augment the micronutrient content in edible parts of major staple food crop for better intake in human dietary system through a more sustainable, economically feasible and ecologically sound approach to combat malnutrition and under nutrition problems.

Biofortification is the idea of breeding crops to increase their nutritional value. This can be done either through conventional selective breeding, or through genetic engineering. Biofortification differs from ordinary fortification because it focuses on making plant foods more nutritious as the plants are growing, rather than having nutrients added to the foods when they are being processed. This is an important improvement on ordinary fortification when it comes to providing nutrients for the rural poor, who rarely have access to commercially fortified foods. As such, biofortification is seen as an upcoming strategy for dealing with deficiencies of micronutrients in low and middle-income countries. In the case of iron, WHO estimated that biofortification could help curing the 2 billion people suffering from iron deficiency-induced anaemia.

Biofortification is the process of increasing the content and/or bioavailability of essential nutrients in crops during plant growth through genetic and agronomic pathways. Biofortification can be broadly divided as agronomic and genetic biofortification.

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Biofortification ultimately aims to produce nutritious and safe foodstuffs for human consumption in sustainable and cost-effective manner. It has also been reported to impart tolerance to abiotic stress and improved resistance towards pests and diseases. Biofortification is mainly focused on starchy staple crops like rice, wheat, maize, sorghum, millet, sweet potato and legumes, because they dominate diets worldwide – especially among groups vulnerable to micronutrient deficiencies – and provide a feasible means of reaching malnourished populations with limited access to diverse diets, supplements, and commercially fortified foods.

Agronomic fortification is the process of providing nutrients to plants (eg. by applying Zn and Fe-fertilizers to soil and foliar) appears to be important to ensure success for increasing Zn and other micronutrients concentration in grain. Agronomic biofortification is carried out through soil and foliar administration of effective Zn sources at the right rate, time, and growth period while genetic biofortification involves development of new varieties with enormous accumulating ability for Zn in edibles. Among cereals crops like rice, wheat and maize has been found to be the most promising crops for increasing zinc content in grains through foliar zinc fertilization. It is also essential for keeping sufficient amounts of available zinc in soil solution and in leaf tissue, which greatly contributes to the maintenance of adequate root zinc uptake.

Why to fortify….?

Fortification is adding vitamins and minerals to food to prevent nutritional deficiency.

- Iron, riboflavin, folic acid, zinc and vitamin B_{12} help prevent nutritional anemia which improves productivity, maternal health and cognitive development.
- Zinc help is children develop, strengthen immune system and lessen complications from diarrhea.
- Niacin (Vit-B_5) is prevents the skin disease known as pellagra. Thiamin (Vit- B_1) prevents the nervous system disease known as beriberi.
- Vitamin D helps bodies absorb calcium which improve bone health. Vitamin B_{12} maintains the function of brain and nervous system.

What is Agronomic and Genetic fortification?

Agronomic biofortification is achieved through micronutrient fertilizer application to the soil and/or foliar application directly to the leaves of the crop. It is often considered as a short-term solution to increase micronutrient availability and mainly to complement genetic biofortification. Micronutrients follow a path from the soil through the crop and food into the human body. Several critical factors determine the success of agronomic biofortification to alleviate micronutrient deficiencies among humans. These factors depend on nutrient bioavailability at different stages: the presence and bioavailability of soil nutrients for plant uptake (soil to crop), nutrient allocation within the plant and re-translocation into the harvested food (crop to food),bioavailability of nutrients in prepared food for humans and the physiological state of the human body which determines the ability toabsorb and utilize the nutrients (food to human).

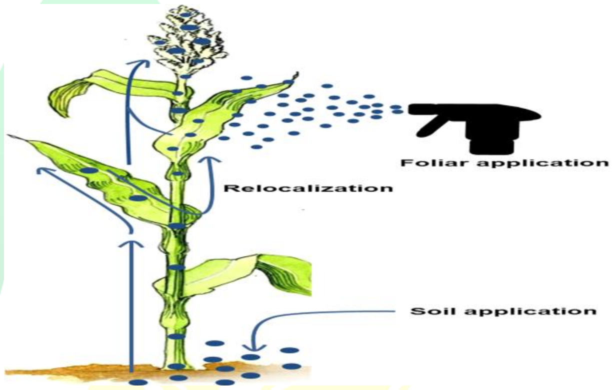

Fig.1. Agronomic biofortification is the application of micronutrient-containing mineral fertilizer (blue circles) to the soil and/or plant leaves (foliar), to increase micronutrient contents of the edible part of food crops.

Cereal grain micronutrient content can be enriched through agronomic biofortification, which is a fertilizer-based application method to soil or to plant foliar. Soil agronomic biofortification is easy and can be quite cost-effective. It is a short time solution, important to complement the genetic biofortification, particularly when the soil in the target region is limited to a readily available pool of micronutrient. Agronomic and genetic fortification is the development of nutrient-dense staple crops using the best conventional agronomic practices and modern biotechnology, without sacrificing agronomic performance and important consumer-preferred traits Bio fortification, an upcoming strategy for developing micronutrient-enriched staple food crops to alleviate human micronutrient deficiencies, has been increasingly considered along with traditional strategies such as medical supplementation, food fortification, and dietary diversification during the last two decades. Because of the close connection of Zn flow among the soil-crop-human continuum (Zn-biofortified staple food obtained by using either genetic (breeding) or agronomic strategies can be daily consumed by resource-poor rural residents to increase their Zn nutrition and health status.

Benefit of Seed Enriched With Zinc:

- Improving abiotic stress tolerance
- Better seed viability and seedling vigor
- Improving human nutrition
- Decreasing seeding rate
- Increase resistance to disease
- Higher yield under Zn deficiency

Nutritional Security

- 'Nutritional Security' can be defined as adequate nutritional status in terms of protein, energy, vitamins and minerals for all household members at all times.
- The concern of nutritional security has gain momentum in the word at the same pace as food security.
- To ensure nutritional security, linkage of agriculture to nutrition and revisiting policy formulation in agriculture, nutrition and health is needed.
- Among agronomic managements, grain bio-fortification is proved to improve concentration of micronutrients in cereals grains.
- Improving the nutritional content of their agricultural produces could be the best and sustainable way of ensuring nutritional security.

Conclusion:

Technological interventions such as breeding, microbiological, fortification aspects all stands but reliability and feasibility of the process for wider adoption by farmers and availability of biofortified foods to rural is achieved highly through agronomic biofortification.