TRENDS IN AGRICULTURE SCIENCE
Vol.3 Issue 09 September 2024, Page: 2192-2195

Abstract

Fortification of crops with nutrients: Novel technology to alleviate nutrient deficiency in common people

J.Bhuvaneswari [1], T.Sampathkumar [2] and S. Anitta Fanish[3]
[1]Assistant Professor (Agronomy), VOC Agricultural College and Research Institute, Killikulam – 628252
[2]Assistant Professor (Agronomy), Agricultural College and Research Institute, Madurai – 625104
[3]Assistant Professor (Agronomy), Department of pulses, TNAU, Coimbatore – 641 003
DOI:10.5281/TrendsinAgri.13840059

Fortification of nutrients refers to the process of adding essential vitamins and minerals to foods to enhance their nutritional value. This is commonly followed to address nutritional deficiencies in populations or to ensure that people are getting adequate nutrients that might be lacking in their regular diets.

Common Examples of Nutrient Fortification

1. **Iodized Salt**: Iodine is added to salt to prevent iodine deficiency, which can lead to thyroid problems.
2. **Fortified Cereals**: Breakfast cereals are often fortified with iron, vitamin D, and B vitamins like folic acid.
3. **Milk Fortification**: Milk is commonly fortified with vitamin D to help improve calcium absorption and prevent bone disorders like rickets.
4. **Fortified Flour**: In many countries, flour is fortified with folic acid and iron to prevent neural tube defects in babies and to combat anaemia.

Benefits

- **Prevents Deficiencies**: It helps prevent diseases caused by nutrient deficiencies such as anemia, rickets, and neural tube defects.
- **Improves Public Health**: Fortification is particularly important in areas where people have limited access to a diverse diet.
- **Enhances Nutritional Quality**: Even if people consume a processed or less varied diet, fortification ensures they still get vital nutrients.

Types of Fortification

1. **Mass Fortification**: Adding nutrients to staple foods consumed by the general population (*e.g.,* flour, rice, milk).
2. **Targeted Fortification**: Adding nutrients to foods intended for specific groups, such as infant formulas or foods for pregnant women.
3. **Market-driven Fortification**: Fortification done by food manufacturers to appeal to health-conscious consumers (*e.g.,* fortified snacks and beverages).

Published: 25 September 2024
ISSN: 2583-7850

Challenges

- **Over-fortification**: Excessive intake of certain nutrients can cause adverse effects, so it's important to monitor levels.
- **Cost**: Fortifying foods can increase production costs, which may be passed on to consumers.
- **Public Awareness**: Consumers need to be aware of the benefits of fortified foods to make informed dietary choices.

Nutrient fortification in crops, also known as **biofortification or agronomic fortification**, is a strategy used to improve the nutritional quality of crops through biological and agronomic means. This process aims to increase the concentration of essential vitamins and minerals in staple crops to address nutrient deficiencies, particularly in regions where access to diverse diets is limited.

Methods of Biofortification

1. **Conventional Breeding**: Traditional breeding techniques are used to select and cross plants with naturally higher nutrient content. Over generations, these traits are enhanced to produce crops with increased levels of vitamins and minerals.
    - Example: Breeding maize varieties with higher levels of provitamin A.
2. **Genetic Engineering**: Genes responsible for the production or accumulation of specific nutrients are introduced into plants to enhance their nutrient content.
    - Example: The development of **Golden Rice**, which is genetically modified to produce more provitamin A (beta-carotene) to combat vitamin A deficiency.
3. **Agronomic Biofortification**: This involves the use of fertilizers or soil management practices to increase the nutrient content in crops. Micronutrients like zinc, iodine, or selenium can be added to soil or applied through foliar sprays to boost the nutrient content of the crops.
    - Example: Adding zinc and Iron fertilizers to soil or foliar application to increase zinc and iron levels in targeted crops.

Key Nutrients Targeted for Fortification

1. **Iron**: Iron deficiency leads to anemia, a major global health issue. Biofortified crops like iron-rich beans, millet, and rice can help address this problem.
2. **Zinc**: Zinc deficiency affects growth, immune function, and cognitive development. Biofortified rice, wheat, and maize with higher zinc content can improve zinc intake.
3. **Vitamin A**: Provitamin A biofortification, like in Golden Rice and orange-fleshed sweet potatoes, helps combat vitamin A deficiency, which causes blindness and immune dysfunction.
4. **Folic Acid**: Biofortified crops, such as certain varieties of maize and cassava, have higher folate levels to reduce the risk of neural tube defects.
5. **Proteins and Amino Acids**: Some crops, like biofortified maize and beans, are bred to have improved protein quality and higher levels of essential amino acids like lysine.

Examples of Biofortified Crops

1. **Golden Rice**: Genetically engineered rice enriched with beta-carotene to address vitamin A deficiency.
2. **Orange-fleshed Sweet Potato**: A variety of sweet potato bred to have higher levels of beta-carotene, a precursor of vitamin A.
3. **Iron-fortified Beans**: Beans bred through conventional methods to contain higher levels of iron.
4. **Zinc-rich Wheat and Rice**: Crops that have been biofortified to provide higher levels of zinc.

Published: 25 September 2024
ISSN: 2583-7850

5. **Cassava**: Fortified with higher levels of vitamin A and iron to help fight deficiencies in regions where cassava is a dietary staple.

Benefits of Biofortification

- **Improves Nutrition**: Biofortified crops help reduce micronutrient deficiencies, particularly in low-income populations dependent on staple crops.
- **Sustainable**: Unlike food fortification, biofortification requires fewer external inputs like industrial fortification processes. Once developed, biofortified crops can be grown year after year.
- **Accessible**: Biofortified seeds are distributed to farmers who can grow nutritionally improved crops, reaching even rural areas where fortified processed foods may not be available.

Challenges

- **Adoption**: Farmers and consumers need to be convinced of the benefits of biofortified crops. This may involve changing long-standing agricultural and dietary practices.
- **Cost of Development**: Developing biofortified crops, especially through genetic engineering, can be costly and time-consuming.
- **Regulation and Acceptance**: Genetically engineered crops face regulatory challenges and public skepticism in many countries.

Agronomic fortification (also known as agronomic biofortification) refers to the practice of enhancing the nutritional quality of crops through agricultural techniques, such as the application of mineral fertilizers to the soil or foliage. This method aims to increase the concentration of essential nutrients like zinc, iron, and selenium in edible parts of the plants. It differs from genetic biofortification, as it does not involve breeding or genetic modification, but rather focuses on nutrient management during crop production.

Key Aspects of Agronomic Fortification

1. **Soil and Foliar Application of Nutrients**: Essential minerals like zinc, iron, and selenium are applied to the soil or sprayed directly onto the leaves of crops during their growth stages. This allows plants to absorb and accumulate these nutrients in their edible tissues.
2. **Improving Nutritional Content of Staple Crops**: Many staple crops, such as rice, wheat, and maize, are naturally low in certain micronutrients. Agronomic fortification helps enhance the micronutrient levels in these crops, improving their overall nutritional value without altering the plant's genetic makeup.
3. **Fast and Flexible Approach**: Agronomic fortification is relatively quicker to implement compared to breeding-based biofortification, as it leverages existing crop varieties and can be applied during regular farming practices. It is also adaptable to different crop species and environmental conditions.
4. **Enhancing Soil Fertility**: By enriching the soil with specific nutrients, agronomic fortification can also improve soil health and fertility, leading to better crop yields alongside improved nutritional quality.
5. **Addressing Nutrient Deficiencies in Regions**: In areas where populations rely on staple crops as their primary food source and suffer from micronutrient deficiencies, agronomic fortification can be an effective short-term solution to improve human nutrition.

Common Nutrients Used in Agronomic Fortification

- **Zinc**: Vital for immune function and DNA synthesis; often applied to cereals like wheat and rice.
- **Iron**: Critical for preventing anemia; foliar sprays can enhance iron content in various crops.

Published: 25 September 2024
ISSN: 2583-7850

- **Selenium**: Important for thyroid function and antioxidant defense; applied to wheat and other grains.

Benefits:

- **Quick Nutritional Gains**: Agronomic fortification can provide immediate benefits in improving crop nutrition in the current growing season.
- **Cost-Effective**: By using fertilizers already employed in farming, the method requires minimal changes in agricultural practices.
- **Sustainable**: It can be integrated into existing farming systems without major infrastructure or technological investments.

Agronomic fortification is particularly valuable in areas where both soil nutrient deficiencies and malnutrition are prevalent.

Biofortification is the process of improving the nutritional quality of food crops through conventional breeding, genetic engineering, or agronomic practices to increase their content of essential vitamins and minerals. The goal of biofortification is to address micronutrient deficiencies, particularly in regions where people rely heavily on staple crops for their diet.

Key Points of Biofortification:

1. **Enhanced Nutrient Content**: Biofortified crops are developed to contain higher levels of nutrients such as iron, zinc, vitamin A, and folate, which are commonly lacking in diets in many parts of the world.
2. **Health Benefits**: By increasing the micronutrient levels in staple crops (e.g., rice, wheat, maize, beans, sweet potatoes), biofortification helps reduce malnutrition-related diseases like anemia, blindness, and stunted growth, especially in developing countries.
3. **Sustainable Solution**: Unlike food fortification (where nutrients are added during food processing), biofortified crops naturally contain higher nutrient levels. This makes it a more sustainable, long-term solution for improving nutrition without requiring constant external inputs.
4. **Cost-Effective**: Once biofortified crops are developed, they can be grown, harvested, and consumed like traditional crops, providing a low-cost method to deliver improved nutrition to large populations.

Examples of Biofortified Crops:

- **Golden Rice**: A genetically modified rice variety that contains beta-carotene, a precursor to vitamin A.
- **Iron-Enriched Beans**: Beans bred to contain higher levels of iron to combat anemia.
- **Zinc-Rich Wheat**: Wheat varieties bred to have higher zinc content to support immune function.
- **Orange-Fleshed Sweet Potato**: Rich in vitamin A, these sweet potatoes help address vitamin A deficiencies in diets.

Conclusion

Biofortification is a powerful tool for reducing hidden hunger (micronutrient deficiencies) and improving the overall health and well-being of populations, particularly in areas where food variety is limited. Biofortification is seen as a complementary strategy to other nutritional interventions like dietary diversification and food fortification, aiming to improve health outcomes on a global scale.

Published: 25 September 2024
ISSN: 2583-7850