

Quality Breeding: Future Perspective for Nutritional Security

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Introduction

Genetic improvement of crop plants in relation to various quality attributes is called quality breeding for which knowledge of proper growth pattern of crop plant and metabolism of target quality trait is required. Quality refers to the degree of excellence for a specific use and depends on the use of produce. Quality traits differ from crop to crop. Quality improvement of crop plants is a significant component of plant breeding which can contribute in nutritional and food security.

Types of quality

Quality means different things to different people.

- **Market Quality:** It refers to the fitness of the quality product for the consumer and the appearance of the produce. It will also depend on flavor, firmness, uniform shape, size, and color of the grain/ produce.
- **Industrial quality:** It refers to the suitability of the products for different industrial uses. It includes traits like the baking quality of wheat for bread, malting quality of barley for beer, canning quality in fruits for wine, crushing quality in sugarcane for sugar and ethanol.
- **Nutritional quality:** It refers to the suitability of the product for animals and human consumption. It mainly depends upon the quality and quantity of the proteins whereas protein quality depends on amino acids quantity. It also depends upon other characteristics like vitamin contents, mineral content, and the absence of anti-quality factors. For example, in cereals lysine should be enhanced, in pulses methionine and tryptophan should be enhanced.

Quality trait

A trait that defined some aspects of product quality is known as a quality trait. It varies from crop to crop and depends on the plant part used as an economic product. On this basis, it can be classified into different types.

- **Morphological quality traits:** These traits are related to product appearance. This is mainly concerned with the shape, size, and color of produce.
- **Organoleptic traits:** These traits are related to the palatability of produce which includes traits like the taste, aroma (fragrance), juiciness, softness smell, etc. These traits are also detected by the consumer and are important for deciding consumer preference for a specific product.
- **Biological quality traits:** These traits decide the actual usefulness of produce when consumed by experimental animals. It mainly depends upon the digestibility of protein and includes traits like biological value and protein efficiency ratio. Biological value refers to the ratio of nitrogen in percent retained in the body of the animal to the total protein nitrogen absorbed by it from the diet. Protein efficiency ratio (PER) refers to gain in body weight in grams of an animal from consumption of 1 gram of protein.
- **Other quality traits:** The quality traits that do not come under the above-mentioned categories are known as other quality traits. It includes traits like cooking quality in rice, keeping quality in fruits and vegetables, and fiber strength in cotton.

Desirable important quality traits in different crops

Wheat

- Amber grain color.
- Medium to bold grain size.
- Hard, vitreous grain texture.
- Lustrous appearance.
- High lysine content.
- Good baking quality.

Rice

- White grain color.
- Fine and long slender grains.
- Good taste and aroma.
- High Milling and hulling recovery.

- Good cooking quality.
- High protein and lysine content.
- High head rice content.

Maize

- Bold, Flint grains with attractive yellow/white grain color.
- High Lysine and tryptophan content.
- High oil and sugar content.

Sorghum

- White grains of attractive yellow/white grain color.
- High protein and lysine content.
- Low HCN content.

Barley

- Low protein content because increased protein content will produce increased haze which results in bitter taste.
- High oligosaccharides content.

Pulses

- Attractive shape, size, and color of grains.
- High protein content.
- High methionine and tryptophan content.
- Less flatulence.

Oilseeds

- Attractive shape, size, and color of grains.
- Free from anti-nutritional factors.
- Should contain more PUFA.

Sugarcane

- Moderate hardness
- Low internodes.
- Low fiber content.
- Uniform maturity.

Cotton

- Fiberlength and strength.
- Fitness of fiber.
- Color of fiber.
- Uniform maturity.

Tobacco

- For cigar and pipe making: short and thin leaves with less branched veins.
- For cigarette making: thick leaves with low nicotine content.
- For bidi and hukka: High nicotine content and high sugar level.

Forage Crop

- Greater nutritive value.
- More Patability.
- Free from toxic substances like HCN.

Vegetables

- High vitamin and mineral content.
- Good taste.
- Better keeping/storage quality.
- Better cooking quality.

Medicinal and Aromatic Plants

- High content of active substance.

Major problems in breeding for nutritional quality

- Priority of quantity over quality.
- Negative correlation between yield and protein content.
- Negative correlation between protein and lysine content.
- Poor stability of protein and lysine content.
- Low heritability of quality traits.
- Lack of proper field screening techniques.
- Pricing policy of the government.

Prospects for improving the nutritional quality

- Negative correlation between yield and protein content can be altered by breeding by doing interfamily selection for higher yield and intra family selection for higher protein content.
- Negative correlation between yield and protein content can be manipulated by recurrent selection and mutation breeding. Mutant genes are available in different crops for better quality traits. For example, opaque 2 & flory 2 genes in maize and hiporly gene in barley.
- Rapid and non-destructive methods along with genetic markers can be utilized for the improvement of quality traits.

Important considerations in breeding for nutritional quality

- Improved quality should not be at the cost of yield, so we have to develop high-yield and good-quality varieties to safeguard the farmers as well as consumers.
- Incorporation of quality traits should be integrated with normal breeding procedures for yield.
- There should be close interaction between breeders and nutritionists.
- In case of absence of desired quality trait suitable transgene could be used.

Major objectives in quality breeding

- To breed for the better chemical composition of protein, vitamins, minerals, etc.
- To breed for a better quality of proteins and oils of high lysine content and PUFA respectively.
- Reduction of anti-equality factors.
- Exploitation of genetic variability present in particular crops.

Conclusion

Quality breeding could be proved as most cost effective and efficient way of countering the emerging problem of nutritional security through qualitative improvement of crop plants.