



Ideotype Breeding

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Concept of Ideotype in plant breeding was introduced by Donald in 1968 while working on wheat to describe idealized appearance of a variety. It literally means “a form denoting an idea”. According to Donald, “Ideotype is a biological model which is expected to perform or behave in a particular manner within a defined environment”. A crop ideotype is a plant model, which is expected to yield a greater quantity or quality of grain, oil, or other useful product when developed as a cultivar. The term ideotype has following synonyms: model plant type, ideal model plant type, and ideal plant type.

Main points related to Ideotype

(a) It refers to ideal or model plant type. (b) It includes morphological, physiological and biochemical traits. (c) It expected to give higher yield than old ones (d) Ideotype is designed according to climatic situation, national policy, market requirement, edaphic factors, and type of stress. (e) The development of Ideotype is continuous process. (f) It varies from species to species. (g) Its development is difficult.

Features of Ideotype Breeding

- 1. Emphasis on individual trait:** This enhances yield.
- 2. Includes yield enhancing traits:** Which have positive association with yield.
- 3. Exploits physiological variations:** Such as photosynthetic efficiency, photorespiration, and nutrient uptake etc.
- 4. Slow progress:** Because incorporation of various desirable traits from different sources into a single genotype takes long time.
- 5. Selection:** Focused on individual trait which enhances yield.
- 6. Designing of model:** Phenotype of new variety to be developed is specified in advance.
- 7. Interdisciplinary approach:** It involves scientists from different disciplines such as Genetics, Plant Breeding, Physiology, Entomology, Pathology, and Biochemistry etc.
- 8. A continuous process:** Because new ideotypes have to be developed to meet changing and increasing demands.

Steps involved in Ideotype Breeding

- (1). Development of Conceptual Model:** Specifying plant height, maturity duration, leaf size, leaf number, photosynthetic rate etc.
- (2). Selection of Base Material:** Should have broad genetic base and wider adaptability.
- (3). Incorporation of Desirable Traits:** Combining of various morphological, physiological and biochemical traits depending upon the positive association with yield.
- (4). Selection of Ideal Plant Type:** Plants combining desirable morphological, physiological and biochemical traits specified in conceptual model and performing in desired direction are

judged through visual observation by scientists of different disciplines and desired plant type is achieved.

Factors affecting Plant Ideotype

(a) Crop Species (b) Cultivation (c) Socio- economic condition of farmers (d) Economic use.

Important Features for Some Crop Ideotypes

(a) **Wheat (By Donald 1968):** A short strong stem, erect leaves, few small leaves, larger ear, an erect ear, presence of awns, and a single cul.

(b) **Rice (By Jennings in 1964):** Semi dwarf stature, high tillering capacity, short, erect and thick highly angled leaves.

(c) **Maize (By Mock and Pearce in 1975):** Low tillers, large cobs, angled leaves for good light interception.

(d) **Barley (Rasmusson in 1987):** Short stature, long awns, high harvest index, and high biomass, kernel weight and kernel number.

(e) **Cotton (Singh *et al.*, 1974):** Compact plant habit, pyramidal shape, determinate growth, short duration, responsive to fertilizer dose, high degree of inter plant competitive ability, high degree of resistance to insect-pests and disease, and high physiological efficiency.

(f) **Sorghum and Pearl Millet (Swaminathan in 1972):** Superior population performance, high productivity per day, high photosynthetic ability, low photorespiration, photo and thermo-insensitivity, high response to nutrients, high productivity per unit of water, multiple resistance to pest and diseases, better protein quantity and quality, crop canopies that can retain and fix maximum of carbon dioxide and suitability for mechanization.

Achievements of Ideotype Breeding

(1). **In rice:** Erect, short and thick leaves, dwarf stature, light leaf sheath, high tillering capacity, responsiveness to high nitrogen doses and high harvest index.

(2). **Wheat:** short and stiff straw, insensitivity to photoperiods, high response to nitrogen application, high harvest index, and resistance to rust complex.

(3). **Sorghum and Pearl Millet:** Short stature and suitability to mechanical harvesting

(4). **Cotton:** Earliness, short stature, compactness, and semi spreading habit.

Merits of Ideotype Breeding

1. An effective method of enhancing yield and improving quality by exploiting morphological and physiological variation

2. Each morphological and physiological trait is specified and contributes to enhance the yield.

3. It involves experts from different disciplines during varietal development which leads to the best version of newly developed variety.

4. Effective method for breaking yield barriers.

5. Efficient method for developing cultivars for specific environment or range of environments.

Demerits of Ideotype Breeding

1. Incorporation of several traits into a single genotype is difficult task.

2. Slow method of cultivar development

3. It is not a substitute of traditional breeding.

4. New Ideotypes have to be developed to meet the changing and increasing demands of economic products.

References

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