



FACULTY OF AGRICULTURAL SCIENCES & ALLIED INDUSTRIES

Plant ideotypes/ crop ideotypes

Crop ideotype refers to model plants or ideal plant type for a specific environment. In broad sense an ideotype is a biological model which is expected to perform or behave in a predictable manner within a defined environment. More specifically, crop ideotype is a plant model which is expected to yield greater quantity of grains, fibre, oil or other useful product when developed as a cultivar. The term ideotype was first proposed by Donald in 1968 working on wheat.

Features of crop ideotypes

The crop ideotype consists of several morphological and physiological traits which contribute for enhanced yield or higher yield than currently prevalent crop cultivars. The morphological and physiological features of crop ideotype differ from crop to crop and sometimes within the crop also depending upon whether the ideotype is required for irrigated cultivation or rainfed cultivation. Ideal plant types or model plants have been discussed in several crops like wheat, rice, maize, barley, cotton and beans. The important features of ideotype from some crops are

Wheat

The term ideotype was coined by Donald in 1968 working on wheat. He proposed ideotype of wheat with following main features:

- A short strong stem. It imparts lodging resistance and reduces the losses due to lodging.
- Erect leaves. Such leaves provide better arrangement for proper light distribution resulting in high photosynthesis or CO₂ fixation.
- Few small leaves. Leaves are the important sites of photosynthesis, respiration and transpiration. Few and small leaves reduce water loss due to transpiration.
- Larger ear. It will produce more grains per ear.
- An erect ear. It will get light from all sides resulting in proper grain development.
- Presence of awns. Awns contribute towards photosynthesis.
- A single culm.

The concept of plant type was introduced **in rice breeding** by Jennings in 1964, through the term ideotype was coined by Donald in 1968. He suggested that in rice an ideal or model plant type consists of

- Semi dwarf stature
- High tillering capacity and
- Short, erect, thick and highly angled leaves
- More panicles /m²,
- High (55% or more) harvest index. Now emphasis is also given on physiological traits in the development of rice ideotype.

MAIZE

In 1975, Mock and Pearce proposed ideal plant type of maize.

- Stiff-vertically-oriented leaves above the ear.
- Maximum photosynthetic efficiency.
- Efficient translocation of photosynthate into grain.
- Short interval between pollen shed and silk emergence.
- Small tassel size.
- Photoperiod insensitivity
- Cold tolerance
- Long Grain -filling period

BARLEY

Rasmusson (1987) reviewed the work on ideotype breeding and also suggested ideal plant type of six rowed barley.

- Short stature
- Long awns
- High harvest index
- High biomass.
- Kernel weight and kernel number were found rewarding in increasing yield.

COTTON

- Ideotype for irrigated cultivation
- Short stature (90-120 cm)
- Compact and sympodial plant habit making pyramidal shape
- Determinate in fruiting habit with unimodal distribution of bolling
- Short duration (150-165 days)
- Responsive to high fertilizer dose

- High degree of inter plant competitive ability
- High degree of resistance to insect pests and diseases, and
- High physiological efficiency.
- Earliness (150-165 days)
- Fewer small and thick leaves
- Compact and short stature, indeterminate habit
- Sparse hairiness,
 - Medium to big boll size
- Synchronous bolling
- High response to nutrients
- Resistance to insects and diseases.

FACTORS AFFECTING IDEOTYPES

There are several factors which affect development of ideal plant type. These are briefly discussed below:

Crop Species

Ideotype differs from crop to crop. The ideotype of monocots significantly differs from those of dicots. In monocots, tillering is more important whereas in dicots branching is one of the important features of ideotype.

Cultivation

The ideotype also differs with regard to crop cultivation. The features of irrigated crops differ from that of rainfed crop. The rainfed crop needs drought resistance, fewer and smaller leaves to reduce water loss through transpiration. In dicots, indeterminate types are required for rainfed conditions, because indeterminate type can produce another flush of flowers if the first flush is affected by drought conditions.

1. Socio-economic Condition of Farmers

Socio-economic condition of farmers also determines crop ideotype. For example, dwarf Sorghum is ideal for mechanical harvesting in USA, but it is not suitable for the farmers of Africa where the stalks are used for fuel or hut constructions.

2. Economic Use

The ideotype also differ according to the economic use of the crop, for example, dwarf types are useful in Sorghum and pearl millet when the crop is grown for grain purpose. But when these crops are grown for fodder purpose, tall stature is desirable one. Moreover, less leafy types are desirable for grain purpose and more leafy genotypes for fodder purpose. The larger leaves are also desirable in case of fodder crop.