



## BREEDING AND IMPROVING VEGETABLES

### BREEDING

- Breeding of any plant require fundamental knowledge of:
  - Genetics
  - Plant breeding
  - Botany

Additional knowledge of:

Pathology

Entomology

Plant physiology.etc,is also required.



## BREEDING

- Breeder is expected to be familiar with
  - Breeding system
  - Sex expression
  - Genetic architecture of vegetables crops.

**BREEDING SYSTEM:** breeding system is the mechanism of reproduction of a particular crop such as pollination, fertilization, fertility and incompatibility systems.

**GENETIC ARCHITECTURE:** is the pattern of inheritance of characters.

## BREEDING SYSTEM IN VEGETABLES CROPS

- Depending upon the mode of reproduction of vegetables crops
- **Vegetatively propagated:**
  - Underground stem ( rhizome in ginger, tubers in potato, bulbs in onion, clove of garlic and corms in colcasia)
  - Stem cuttings (pointed gourds, sweet potato)

### **Sexually propagated:**

Different vegetables may be classified into three groups:

- 1) Highly Self pollinated (Autogamous): Beans( french dolichos, cluster, asparagus), garden pea, fenugreek, and tomato.....extent of cross pollination is less than 5%.
- 2) Often cross pollinated: Limabean, brinjal, okra, capsicum and chillies.....extent of cross pollination may be from 5 to 25%.

## BREEDING SYSTEM IN VEGETABLES CROPS

- 3) Highly cross pollinated:
- i) wind pollinated (anemophilus): amaranth, spinach, and garden beet.
- ii) insect pollinated (entomophilus): all cucurbits, all cole crops, radish, turnip, carrot and onion.

The amount of self or cross pollination is a virtue of certain built-in-mechanisms in plants. they are

- Self pollinated
- Cross pollinated

## SELF-POLLINATED

- **CLEISTOGAMOUS:** flower are closed at the time of pollination...lettuce
- Before the flowers open, the stigma is completely covered and in most cases pollination takes before or immediately at anthesis....peas and beans
- **CHASMOGAMOUS:** pollination follows the opening of flowers. Often inserted position of pistil and dehiscence pattern helps in self pollination.....tomato, brinjal and chillies.
- Capsicum are self pollinated due to the coincidence of pollination and opening of flowers.

## CROSS-POLLINATED

**HOMOGAMOUS:** self pollination is discouraged due to relative position of stigma and anthers...heterostyl...brassica group.

**DICHOGAMOUS:** i) gynoecium maturing earlier than androecium....protogynous....as in brassica crops

ii) androecium maturing earlier than gynoecium...protandrous...as in carrot and onion

**HERKOGAMY:** stigma becomes receptive only when a membrane enclosing it is ruptured .....stripping by insects as in lima beans.

**SELF INCOMPATIBLE:** i) gametophytic self incompatibility in leguminosae and solanaceae.

ii) sporophytic self incompatibility in crucifers and compositae.

**Male sterility:** i) positional (functional) sterility....where an anther fails to dehiscence as in closed anther...mutants of tomato.

## CROSS-POLLINATED

ii) genic (single recessive gene) causing pollen sterility as in squash, pumpkin, muskmelon, brussels sprouts, sprouting broccoli, cabbage, cauliflower and lettuce.

iii) Plasmic and genic interaction in onion, garden beet, carrot (unstable) and corn.

- Cytoplasmic as in onion.
- Staminal sterility as in gynodioecious cucumber

## CROSS-POLLINATED

### 2) DIOECIOUS

Male and female flowers on separate plants as in asparagus, spinach, pointed gourd

### 3) MONOECIOUS

male and female flowers are present on the same plant, e.g. cucurbits. here andromonoecious, gynomonoecious and trimonoecious conditions help in better cross-pollination, and self pollination to a limited extent.

## BREEDING METHODS

### ○ ASEXUALLY PROPAGATED CROPS

- These crops as a rule are heterozygous, e.g. potato.
- Clonal selection, hybridization, mutation and polyploidization are the methods usually adopted. Any desirable variation obtained is maintained vegetatively.
- In case of potato, where sexual reproduction is normal, hybridization and selection is useful as any desirable progeny could be clonally propagated.
- Clonal selection is done in crops which are exclusively propagated by vegetative means.
- Natural or induced mutations enhance variation in such plants.
- Much of the improvement made in sweet potato is made by selection of a favorable mutant.

## SEXUALLY PROPAGATED CROPS

### 1. self-pollinated

Single plant selection, hybridization followed by pedigree method of selection, back-crossing and heterosis breeding are the procedures adopted in these crops.

Self pollination leads to homozygosity and inbreeding will not cause any loss of vigour in these crops.

Selection within a pure line is, therefore, likely to be ineffective.

Single plant selection can give rise to a new cultivar in a population of old or unselected cultivars.

Back-crossing is used for bringing in some specific characters like disease or pest resistance, nutritive quality, etc.

Hybridization will create variability. Hybrid vigour is often found when different pure lines are crossed.

- The economic feasibility of hybrid cultivars in these crops depend upon cost of producing hybrid seeds in relation to the value of increased yield.

## SEXUALLY PROPAGATED CROPS

- Hand pollination is necessary in all these crops even if male sterile lines are available.
- Thus, possible in those crops where
  - i) Many seeds are produced by each pollinated flower
  - ii) less quantity of seeds are required per unit area.
- Therefore, hybrid seed production is economical only on tomato, brinjal, capsicum, watermelon and muskmelon.

## SEXUALLY PROPAGATED CROPS

Mass selection or modified methods of mass selection based on progeny tests such as:

- Line breeding
- Mass pedigree method
- Family breeding
- Recurrent selection and reciprocal recurrent selection
- Inbreeding
- Selfing followed by massing
- Convergent improvement
- Back-crossing
- Hybridization
- Heterosis breeding

## SEXUALLY PROPAGATED CROPS

- Development of synthetics and composites are the general methods in this group. methods may adopted taking into consideration:
  - ❖ Self incompatibility
  - ❖ Dioecious sex forms
  - ❖ Biennial or perenial growth habit in any particular crop

## SEXUALLY PROPAGATED CROPS

### CROSS POLLINATED

In crops like onion and cabbage inbreeding depression is pronounced, whereas in cucurbits this is mostly absent.

In crops like cucurbits, homozygous cultivars can be used directly for hybrid seed production as in case of self pollinated crops.

In crops like cabbage and onion, inbred lines are used for hybrid seed production.

Cross-pollination mechanisms are inherent in these crops like dioecy, monoecy, self incompatibility as well as genetic or cytoplasmic pollen sterility, coupled with entomophilous or anemophilous nature of many these crops have made the hybrid seed production economical.

## SEXUALLY PROPAGATED CROPS

### 3) often cross pollinated

The breeding method employed will vary depending upon the percentage of crossing or selfing and the inbreeding depression.

Cross pollination is avoided to maintain purity in this group of crops.

Classifying the breeding methods strictly for a particular group of crops based on breeding system is only a guideline based on certain principles.

It is not a rigid system, breeding methods like

- Introduction
- Hybridization
- Mutation or polyploidization

Are equally applicable to both the group