

## Degrees of inbreeding depression:

Inbreeding depression may range from very high to very low or it may even be absent.

The ID is grouped into 4 categories:-

- **High inbreeding depression** : Eg : alfalfa and carrot show very high ID. A large proportion of plants produced by selfing show lethal characteristics and do not survive.
- **Moderate inbreeding depression** : Eg : Maize, Jowar and Bajra etc. show moderate ID. Many lethal and sublethal types appear in the selfed progeny, but a substantial proportion of the population can be maintained under self-pollination.
- **Low inbreeding depression** : Eg : Onion, many Cucurbits, Rye and Sunflower etc. show a small degree of ID. A small proportion of the plants show lethal or subvital characteristics. The loss in vigour and fertility is small ; rarely a line cannot be maintained due to poor fertility.
- **Lack of inbreeding depression** : The self-pollinated species do not show ID, although they do show heterosis. It is because these species reproduce by self- fertilization and as a result, have developed homozygous balance.

## Procedure for development of inbred lines and their evaluation:

- Development of inbred lines: Inbred lines are developed by continues self fertilization of a cross-pollinated species. Inbreeding of an OPV leads to many deficiencies like loss of vigour, reduction plant height, plants become susceptible to lodging, insects and pests and many other undesirable characters appear.
- After each selfing desirable plants are selected and self pollinated or sib pollinated. Usually it takes 6-7 generations to attain near homozygosity. An inbred line can be maintained by selfing or sibbing. The purpose of inbreeding is to fix the desirable characters in homozygous condition in order to maintain them without any genetic change.
- The original selfed plants is generally referred as  $S_0$  plant and the first selfed progeny as  $S_1$  second selfed progeny as  $S_2$  as so on. The technique of inbreeding requires careful attention to prevent natural crossing.

**Evaluation of inbred lines:** After an inbred line is developed, it is crossed with other inbreds and its productiveness in single and double cross combination is evaluated. The ability of an inbred to transmit desirable performance to its hybrid progenies is referred to as its combining ability.

- **GCA :** The average performance of an inbred line in a series of crosses with other inbred lines is known as GCA.
- **SCA :** The excessive performance of a cross over and above the expected performance based on GCA of the parents is known as specific combining ability

Thus GCA is the characteristic of parents and SCA is characteristic of crosses or hybrids. The inbreds are evaluated in the following way.

**Phenotypic evaluation:** It is based on phenotypic performance of inbreds themselves. It is effective for characters, which are highly heritable i.e. high GCA. Poorly performing inbreds are rejected. The performance of inbreds is tested in replicated yield trials and the inbreds showing poor performance are discarded.

**Top Cross test:** The inbreds, which are selected on phenotypic evaluation, are crossed to a tester with wide genetic eg. an OPV, a synthetic variety or a double cross.

- A simple way of producing top cross seed in maize is to plant alternate rows of the tester and the inbred line and the inbred line has to be detasselled.
- The seed from the inbreds is harvested and it represents the top cross seed. The performance of top cross progeny is evaluated in replicated yield trials preferably over locations and years.
- Based on the top cross test about 50% of the inbred are eliminated. This reduces the number of inbreds to manageable size for next step. Top cross performance provides the reliable estimate of GCA.

**Single cross evaluation:** Outstanding single cross combinations can be identified only by testing the performance of single cross. The remaining inbred lines after top cross test are generally crossed in diallel or line x tester mating design to test for SCA.

- A single cross plants are completely heterozygous and homogenous and they are uniform. A superior single cross regains the vigour and productivity that was lost during inbreeding and can be more vigorous and productive than the original open pollinated variety.
- The performance of a single cross is evaluated in replicated yield trial over years and location and the outstanding single cross identified and may be released as a hybrid where production of single cross seed is commercially feasible. In case of maize the performance of single cross is used to predict the double cross performance.
  - ✓ Number of single crosses with reciprocals =  $n(n-1)$ ,
  - ✓ Number of single crosses without reciprocals =  $n(n-1)/2$

## PRE BREEDING AND WIDE HYBRIDIZATION

**Pre breeding:** The process of initial introgression of traits from an undomesticated source or agronomically inferior source to a domesticated or adopted genotype is called as prebreeding.

- Modern cultivars i.e. high yielding varieties lead to development of uniformity which has reduces crop genetic diversity. So it is high time to diversity the genepool.
- The desired gene may be present in unwanted genepool but the transfer of gene will lead to linkage drag. Hence, the exotic germplasm often cannot be used directly in cultivar development.
- Instead the material are gradually introduced into cultivar development programme through crossing and selection of intermediates with new traits while maintaining a great amount of adopted traits.
- The traditional techniques used are hybridisation followed by back crossing or cyclical population improvement techniques. E.g. :-  $\beta$  carotene in tomato is obtained from *Lycopersian hirsutum*.

**Wide hybridization:** Hybridization between individuals from different species belonging to the same genus or two different genera, is termed as distant hybridization or wide hybridization, and such crosses are known as distant crosses or wide crosses.

- Distant hybridization consists of two types of hybridization:
- **Interspecific hybridization :-** When individuals from two distinct species of the same genera are crossed, it is known as inter specific hybridization. Eg. *Oryza sativa* x *O. perennis*
- **Intergeneric hybridization:-** When individuals being crossed belong to two different genera, it is referred to as intergeneric hybridization. E.g. Wheat x rye.
- **Objective:-** To transfer some desirable character from wild relatives that are not available in cultivated varieties. E.g. Many disease resistance and, insect resistance genes