

23. Hybrids

They are the first generation from crosses between two pure lines, inbreds, open pollinated varieties of other populations that are genetically not similar.

Pure line hybrids: Tomato.

Inbred hybrids: Maize, bajra.

Kinds of hybrids

1. Single cross hybrids

$A \times B$

Crossing two inbreds or pure lines.

2. Three way cross hybrid

$(A \times B) \times C$

A cross between a single cross hybrid and an inbred.

3. Double cross hybrid

$(A \times B) \times (C \times D)$

cross between two F_1 s.

4. Double Top Cross hybrid

Double Cross hybrid crossed with open pollinated variety.

Operation in production of hybrids.

In production of hybrids inbreds are preferred rather than open pollinated varieties for the following reasons.

1. Inbreds can be maintained without a change in the genotype. Whereas open pollinated variety cannot be maintained pure. They may alter genotypically due to natural selection etc.
2. The hybrids derived from inbreds will be uniform where as it may not be in case, of open pollinated variety.
3. The inbreds are homogenous and their performance can be predicted where as open pollinated variety are heterogenous and their prediction in performance cannot be made.

Development of inbreds

1. By inbreeding, selfing etc.
2. Development of inbreds from haploids - rice, sorghum, maize.

Evaluation of inbreds

a) Phenotypic evaluation

Based on phenotypic performance. Highly suitable for characters with high heritability. .

b) Top cross test

Top cross test provides a reliable estimate of GCA. The selected inbreds will be crossed to a tester parent with wide genetic base i.e. open pollinated variety. The cross progenies will be evaluated in replicated progeny rows. Based on results better inbreds can be selected.

c) Single cross evaluation

The developed inbreds can be crossed and the single crosses can be estimated in replicated trial. Outstanding hybrids tested over years in different locations, then released.

d) Prediction of double cross performance

"The predicted performance of any double cross is the average performance of the four non parental single crosses involving the four parental inbreds".

Inbreds : A, B, C, D.

6 possible single crosses = A x B, A x C, A x D, B x C, B x D, C x D.

From these 3 double crosses produced = (A x B) x (C x D)

(A x C) x (B x D)

(A x D) x (B x C)

The performance of these any one double cross can be predicted from performance of the four single crosses not involved in producing that particular hybrid.

(A x B) x (C x D)

A x C

A x D

B x C

B x D

Average

Production of Hybrids

Methods

I. Hand emasculation and dusting - Cotton, Tomato, Chillies, Bhendi

2. Use of male sterile lines

- a) Cytoplasmic male sterility - ornamentals
- b) Genic male sterility - Redgram, Castor.
- c) Cytoplasmic - genic male sterility Jowar, Bajra, Rice

3. Use of self in compatibility

By planning cross compatible lines hybrids are produced. Here both are hybrids.
E.g. Brassicas.

Success of hybrids

- a) Easy hand emasculatation
- b) Abundant seed set to compensate cost of hand emasculatation.
- c) Stable male sterile lines.
- d) Effective restorers.
- e) Effective pollen dispersal.

Synthetic Varieties

A synthetic variety is produced by crossing in all combinations a number of inbreds (4-6) that combine well with each other. The inbreds are tested for their GCA. Once synthesised, a synthetic is maintained by open pollination. The lines that make up a synthetic may be usually inbred line but open pollinated variety, or other population tested for general combining ability are also be used.

Synthetic varieties are common in grasses, clover, maize and sugar beets. The normal procedure is equal amounts of seeds from parental lines (Syn_0) is mixed and planted in isolation. Open pollination is allowed. The progeny obtained is Syn_1 . This is distributed as synthetic variety or it may be grown in isolation for one more season and Syn_2 is distributed.

Merits

- 1. Less costly compared to hybrids.
- 2. Farmer can maintain his synthetic variety for more seasons which is not possible in hybrids.
- 3. Because of wider genetic base the synthetics are more stable over years and environments.
- 4. Seed production is more skilled operation in hybrids where as it is not so in synthetics.

Demerits

- 1. Performance is little bit lower compared to hybrids because synthetics exploit only

GCA while hybrids exploit both GCA and SCA.

2. The performance may not be good when lines having low GCA are used.

Composites

It is produced by mixing seeds of phenotypically outstanding lines and encouraging open pollination to produce crosses in all possible combinations among mixed lines. The lines used to produce a composite are rarely tested for combining ability. So the yield of composite varieties cannot be predicted easily. Like synthetics, composites are commercial varieties and are maintained by open pollination.

Composites were released in maize - Amber, Jawahar, Kissan.

Synthetic

Parental components are generally inbreds tested for their GCA

No of parental lines are limited to 4 - 6 inbreds

Synthetic produced with inbreds can be reconstituted

Yield performance can be predicted

Composite

It is not so in composite. The lines are not tested for their GCA.

No such limit

It is not possible

Cannot be predicted

Poly Cross Test

This is done to estimate the GCA in crops where production of inbred is not possible. This is followed generally in grasses. Poly cross test is based on seeds obtained by random mating among the clones. Each clone is planted at different date to facilitate random mating. Polycrosses are generally not perfect since mating may not be at random.

Combining ability

Ability of a strain to produce superior progeny when crossed with other strains.

General combining ability

Average performance of a strain in a series of cross combinations. The GCA is estimated from the performance of F_1 S from the crosses. The tester will have a broad genetic base.

Specific combining ability

Deviation in performance of a cross combination from that predicted on the basis of general combining ability of the parents involved in the cross. The testing will be on inbred.