BREEDING STRATEGIES - CLONAL SELECTION

Clone

A clone is a group of plants produced exclusively from a single individual plant through asexual reproduction. Most of the fruit plants are propagated asexually which consist of large number of clones that is why these plants are known as a group of plants derived from a single plant by vegetative means. In other words all the vegetative progenies of a single plant make a clone.

Characteristics

_ Clones are stable- They retain their original traits just like pure line variety

_ Theoretically clones are immortal i.e. A clone can be maintained indefinitely by asexual reproduction. However, these are very much susceptible to diseases or insect pests depending upon the species and cultivars.

_ Homogeneous-Individual plant of a clone is a mitotic derivative of the same plant and therefore homogeneity in phenotype is the major feature of clones. A group of individual plants derived from the same tissue of the original mother plant carries the same genotype. Phenotypic variation if any in clones is due to environmental impact.

_ Continuous inbreeding of clones which are heterozygous might lead to severe loss in vigour

_ The phenotype of a clone is due to effect of gene (G), environment (E) and GxE interaction over the population mean (h). Therefore P=h+G+E+GE

_ Clones are maintained by asexual reproduction, but pure lines and inbreds are maintained by self-pollination or close inbreeding

Genetic variation within clones

Genetic variation within clones may be due to mutation, mechanical mixture and sexual reproduction.

a. Mutation

Somatic mutations are also known as bud mutations. The frequency of mutations is generally very low. A mutant allele would be homozygous only when (i) both the alleles in the cell mutate at the same time producing the same mutant allele, or (ii) the mutant allele is already in the heterozygous condition in the original clone. Dominant bud mutations express themselves more frequently than the recessive ones, as recessive mutation get expressed only under homozygous conditions. Bud mutations often produce chimeras, i.e., individuals containing cells of two or more genotypes. However, it is not a great problem because normal plants, i.e., non chimeras, may be produced from chimeras by several

techniques.

b. Mechanical mixture

Mechanical mixture produces genetic variation within a clone, similar to the manner as seen in pure lines.

c. Sexual reproduction

Occasional sexual reproduction leads to segregation and recombination. The seedlings obtained from sexual reproduction are genotypically different from the asexual progeny.

Clonal degeneration

The loss in vigour and productivity of clones with the passing of time is known as clonal degeneration and it may be due to mutation and infection of virus and bacteria.

Clonal selection

The phenotypic value of a plant or a clone is due to its genotype (G), the environment (E) and the genotype x environment interaction (GE). Of these, only the G effects are heritable and stable. Therefore, a selection for quantitative characters based on single plant observation may not hold good. A selection for polygenic characters like yield on the basis of unreplicated clonal plots would also often be misleading and unreliable. The value of clone can be reliably estimated only through replicated yield trials. However, selection for highly heritable characters, such as plant height, days to flowering, colour, disease resistance, etc., is easy and effective even on the basis of single plant or plot. The various steps involved in clonal selection are briefly described below and are depicted.

Step I	From a mixed population of vegetatively propagated crop, few to several hundred superior plants are selected on the basis of yield, maturity, plant height, disease resistance, days to flowering etc.	**I Year**
Step II	Clones from the selected plants are grown separately. Based on the morphological characters superior clones are selected.	**II Year**
Step III	Selected clones are grown along with a standard check and preliminary yield trial is done. Few outstanding clones are selected on the basis of these trials.	**III Year**
Step IV	Selected clones in step III are put to multi-location yield trials. Superior clones are identified for release of a now variety.	**IV to VI Year**

First year: From a mixed variable population, a few hundred to few thousand desirable plans are selected. A rigid selection can be done for simply inherited characters with high heritability. Plants with obvious weakness are eliminated. In fruit plants, it is difficult to get large

number of individual selections. In such case, few plants may be selected.

Second Year: Clones from the selected plants are grown separately, generally without replication. This is because of the limitation in propagation material in each clone, and also because of the large number of clones involved. The characteristics of clones will be clear now
than in the previous generation when the observations were based on single plant. The inferior
clones are eliminated at this stage. The selection is based on visual observation and on the breeder's judgment of the value of clones. Fifty to one hundred clones are selected on the basis of
clonal characteristics.

Third year: Replicated preliminary yield trial is conducted. A suitable check is included for comparison. Few superior performing clones with desirable characteristics are selected for
multi location trials. At this stage, selection for quality is done. If necessary, separate disease
nurseries may be planted to evaluate disease resistance of the selected clones.

Fourth to Seventh years: Replicated yield trials are conducted at several locations along with a suitable check. The yielding ability, quality and disease resistance etc. of the clones are
rigidly evaluated. The best clones that are superior to the check in one or more characteristics are
identified for release as varieties.

#ineteenth year: The superior clones are multiplied and released as varieties.

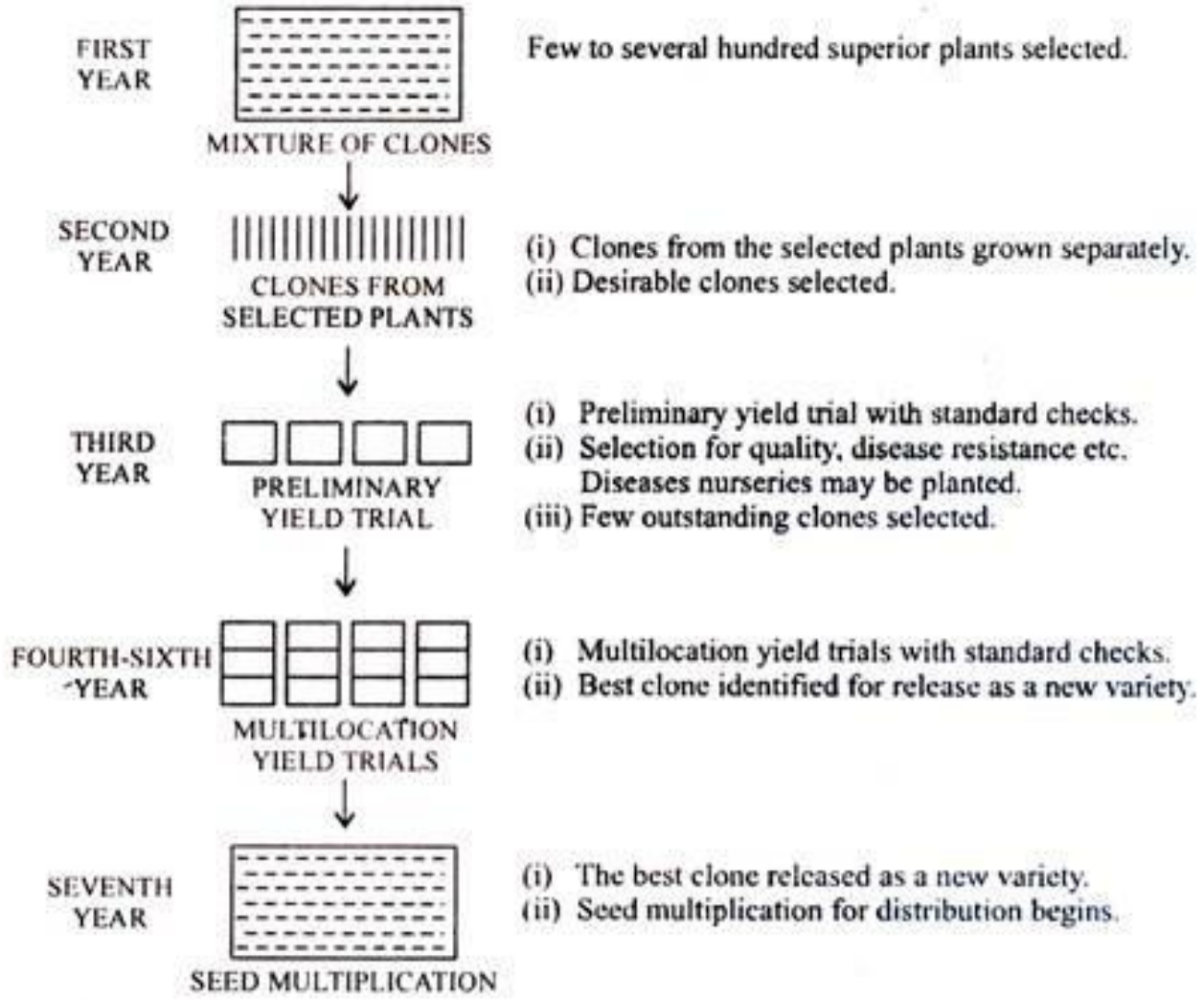

Fig. 5. Procedure of clonal selection in asexually propagated crops. This method of selection applies to a crop in which one generation does not take more than one year.

Advantages

i) Clonal selection is an easy and less time consuming method.

ii) Easy maintenance because there is no problem of out crossing and loss of seed viability. Variation occurs due to somatic mutation only which can be managed by removal of undesired plants.

iii) Heterotic clones on selection may be used as permanent hybrids. Heterosis can be exploited for longer time without production of hybrid seed every year (for vegetatively propagated vegetable crops).

iv) Clonal selection is the only method of breeding in vegetatively propagated fruit plants.

Limitations

_ There is limited chance of getting new and useful type of variability

_ The multiplication rate is low.

_ It is only useful for vegetatively propagated plants.

Achievements

Clone No.51 from Dashehari, MA-1 from Alphanso, Tommy Atkin from Haden. Pusa Surya from Elden in mango, Pusa Seedless from Thompson Seedless of grape etc

Differences between Pure line and Clone

S. No.	Particulars	Pure line	Clone
1.	**Occurrence**	In self pollinated crops	In asexually propagated crops
2.	**Genetic Constitution**	Homogenous consisting of homozygous plants	Homogenous consisting of heterozygous plants
3.	**Maintenance**	Produced by natural self-pollination	Produced by vegetative propagation.
4.	**Type of Progeny**	Progenies of a single self fertilized individual	Progenies of a single vegetatively propagated usually heterozygous individual.
5.	**Adaptation**	Narrow	Wide
6.	**Utilization**	Utilised as improved variety and parents for hybridization	As variety and in hybridization also.