

Clones in Vegetatively Propagated Crops

Vikas Gill^{1*}, Surya Bama²,
Ritu³ and Yugvinder¹

¹Department of Vegetable
Science, CCS Haryana
Agricultural University, Hisar

²Department of Horticulture
Amity Institute of Horticulture
Studies & Research, Noida

³Department of Agricultural
Economics, CCS Haryana
Agricultural University, Hisar



Open Access

*Corresponding Author

Vikas Gill*

E-mail: gillvikas44@gmail.com

Article History

Received: 15. 09.2021

Revised: 23. 09.2021

Accepted: 27. 09.2021

This article is published under the
terms of the [Creative Commons
Attribution License 4.0](https://creativecommons.org/licenses/by/4.0/).

INTRODUCTION

Clone: A clone is a group of plants produced from a single plant through asexual reproduction.

The crop plants can either be propagated by seeds or by vegetative parts. The vegetative propagation is resorted due to:

1. Lack of seed - *e.g.* Ginger, turmeric
2. There is short viability of seed- *e.g.* Sugarcane
3. The seed production is very rare- *e.g.* Banana
4. Seeds are produced under special conditions only- *e.g.* Sugarcane, Carrot, Potato

Characteristics of clones:

1. All the individual belonging to a single clone are identical in genotype
2. The phenotypic variation within a clone is due to environment only
3. The phenotype of a clone is due to the effects of genotype (g), the environment (e) and the genotype x environment interaction ($G \times E$), over the population mean (M).
4. Theoretically clones are immortal. They deteriorate due to viral/bacterial infection and mutations.
5. Clones are highly heterozygous and stable
6. They can be propagated generation after generation without any change.

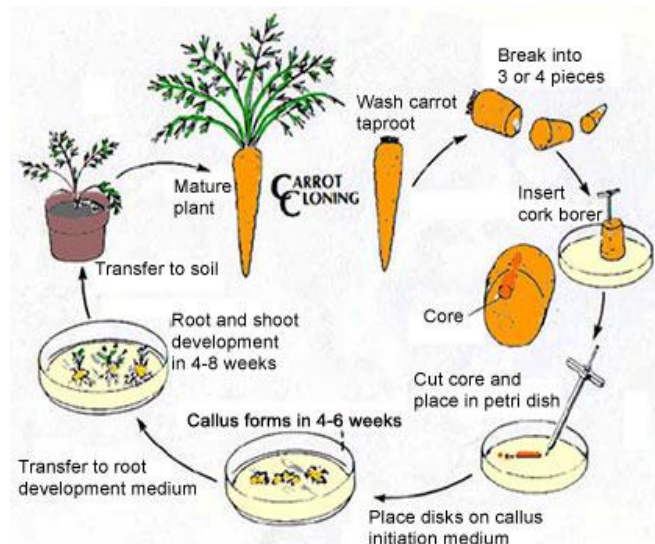
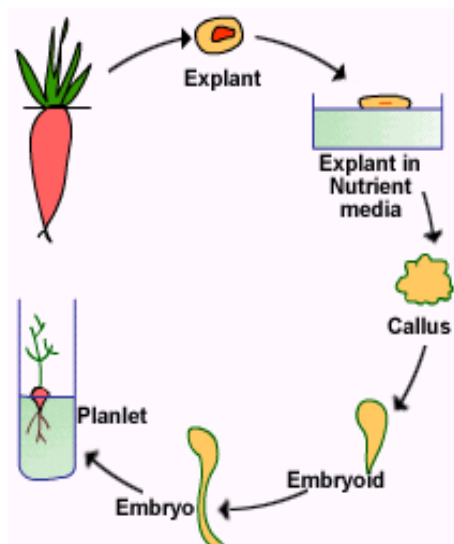
Characteristics of Asexually/ Vegetatively propagated crops:

1. Majority of them are perennials- *e.g.* Sugarcane and most of the fruit trees. The annual crops are mostly tuber crops - *e.g.* Potato, Cassava, Sweet potato
2. Many of them show reduced flowering and seed set
3. They are invariably cross pollinated
4. These crops are highly heterozygous and show severe inbreeding depression upon selfing - *e.g.* Carrot

- Majority of asexually propagated crops are polyploids - e.g. Sugarcane, Potato and Sweet Potato
- Many species are interspecific hybrids- e.g. Banana, Sugarcane

Importance of a clone

- Owing to heterozygosity and sterility in many crops clones are the only means of propagation.
- Clones are used to produce new varieties.
- Clones are very useful tools to preserve the heterozygosity once obtained. In many crops the superior plants are maintained. (Mango, orange, apple, sugarcane)



Various methods of cloning in plants

- ✓ Leaf cutting
- ✓ Stem cutting
- ✓ Root cutting
- ✓ Grafting
- ✓ Runners
- ✓ Budding
- ✓ Suckers
- ✓ Plant divisions

Sources of Clonal selection:

- Local varieties
- Introduced material
- Hybrids and
- Segregating populations

Clonal selection: The various steps involved in clonal selection are briefly mentioned below.

First year:

From a mixed variable population, few hundred to few thousand desirable plants are selected. Rigid selection can be done for simply inherited characters with high heritability. Plants with obvious weakness are eliminated.

Second year:

Clones from the selected plants are grown separately, generally without replication. This is because of the limited supply of propagating material for each clone, and because of the large number of the clones involved. Characteristics of the clones will be more clearer now than in the previous generation. Based on the observations the inferior clones are eliminated. The selection is based on visual observations and on judgement of the breeder on 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 clones.

Fourth to eight years:

Replicated yield trials are conducted at several locations along with 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.

Ninth year:

The superior clones are multiplied and released as varieties.

Advantages:

1. Varieties are stable and easy to maintain
2. Avoids inbreeding depression
3. Clonal selection, combined with hybridization generates necessary variability for several selections.
4. Only method to improve clonal crops
5. Hybrid vigour is easily utilized selection may be used in maintaining the purity of clones.

Disadvantages

1. Selection utilizes the natural variability already present in the population.
2. Sexual reproduction is necessary for creation of variability through hybridization.
3. Applicable only to the vegetatively propagative crops.

Problems in Breeding asexually propagated crops

1. Reduced flowering and fertility
2. Difficulties in genetic analysis
3. Perennial life cycle.

Genetic variation within a clone

Genetic variation within a clone may arise due to:

1. Mutation
2. Mechanical mixture
3. Sexual Reproduction

1. Mutation: The frequency is generally very low (10^{-5} to 10^{-7}). Ordinarily dominant mutations would be expressed in the somatic tissue. A mutant allele would be homozygous only when:

- i) Both the alleles in a cell mutate at the same time producing the same mutant allele or
- ii) The mutant allele is already in heterozygous condition in the original clone. Though rare, both these events are possible. Bud mutations may often produce chimeras *i.e.* an individual containing cell of two or more genotypes.

But mutations make possible selection of buds to establish new desirable clones, the process being known as Bud selection. It is of some importance in improvement of perennial crops like fruit trees or of those crops where flowering does not take place. It requires large number of plants to be observed and several trained persons to detect the mutant buds. Hence the bud selections are practiced in commercial plantations.

2. Mechanical mixtures: Mechanical mixtures produce genetic variation within a clone much in the same way as in the case of purelines.

3. Sexual reproduction: Occasional sexual reproduction would lead to segregation and recombination. The seedlings obtained from sexual reproduction would be genotypically different from the asexual progeny. It is evident that only clones would tend to become variable atleast in annuals and biennials. *E.g.* Potato

Clonal degeneration: The loss in vigour and productivity of clones with time is known as clonal degeneration and results due to:

1. Mutation
2. Viral diseases
3. Bacterial diseases

Comparison among clones, purelines and inbreds

S. No.	Particular	Clones	Purelines	Inbreds
1	Mode of pollination in crop species where they occur	Cross-pollination	Self-pollination	Cross-pollination
2	Natural mode of reproduction in such species	Asexual (in most of the cases)	Sexual	Sexual
3	Genetic make-up of the plants in natural population of such species	Heterozygous	Homozygous	Heterozygous
4	Obtained through	Asexual reproduction from a single plant	Natural self-pollination from a single homozygous plant	Artificial self-pollination (or other form of inbreeding) and selection for several generation
5	Maintained through	Asexual reproduction	Natural self-pollination	Artificial self-pollination or close inbreeding
6	All the plants in a single entity are genotypically	Identical	Identical	Almost identical
7	Used directly as a variety	Yes	Yes	No (Used in developing hybrid or synthetic varieties)
8	The genetic make -up of plants within an entity	Heterozygous	Homozygous	Almost homozygous
9	Organisms where found	Plants	Plants	Plants and animals

Achievements

I. Through clonal selection:

Potato

1. Kufri Red from Darjeeling Red Round
2. Kufri Safed from phulwa
3. Bombay Green banana is a bud selection from dwarf Cavendish: pidi monthan from Monthan

II. Through hybridization:

Potato: Kufri Alankar, Kufri Kuber, Kufri Sindhuri, Kufri Kundan, Kufri Chamatkar, Kufri Jyothi (late blight resistant), Kufri Sheetman (frost resistant).

Sugarcane: Co 1148, Co 1158, CoS 510, Co 975, Cos 109, Co 541.

Banana: High gate from Gross Michel

Citrus: Robertson Navel Orange

Sweet oranges: Yuvaraj blood Red

Turmeric: Kesari, Kasturi