Clonal Selection

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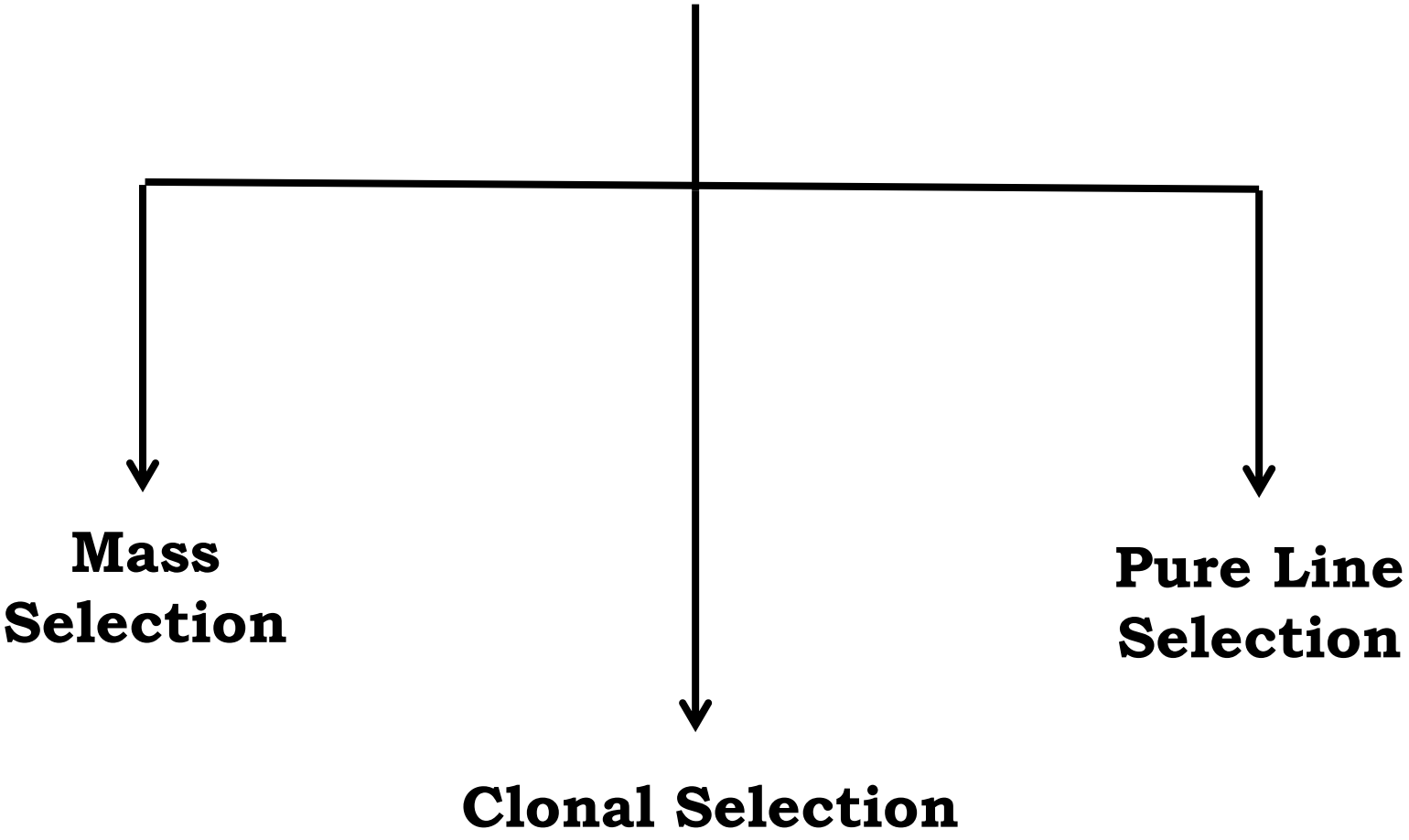
SELECTION



CLONE

What is a clone?

- Progeny of a single plant obtained by asexual reproduction.
- A clone is an exact genetic copy of an individual.
- Clonal crops: Crops which are propagated asexually or by vegetative means.

Features of Clones

- Homogeneous constitution :- Plants of a clone have similar genetic constitution.
- Heterozygosity :- Phenotypically similar but heterozygous.
- Lack of genetic variation :- Phenotypically variation present within a clone is due to environmental effect not genetically.

$$P=G+E+GE+mu$$

- Immortality :- Maintained by asexual reproduction
- Vigorous growth :- Clonal selection is useful in conserving the heterosis far a long period of time.
- Wider Adaptation :- Due to high level of heterozygosity than pure lines.

Clone vs Pure Line

Comparison of a Pureline and a Clonal Variety

Sl. No.	*Particulars*	*A Pure line*	*A Clone*
1.	Relevant to	Self pollinated crops	Asexually propagated species
2.	Genetic constitution	Homozygous and homogeneous	Heterozygous and homogeneous
3.	Quality of produce	Highly uniform	Highly uniform
4.	Component genotypes	Identical	Identical
5.	Selection	Not effective	Not effective
6.	Time taken to release new variety	8-10 years	8-10 years
7.	Adaptation of variety developed	Narrow	Wide
8.	Vulnerability to new race of a disease	High	High
9.	Exact reconstitution	Not possible	Not possible
10.	Maintenance by	Natural self pollination	Asexual propagation

Clone vs Pure Line vs Inbred

Compairision among Clones, Purelines and Inbreds

Particulars	Clone	Pureline	Inbred
Mode of pollination	Cross pollination	Self pollination	Cross Pollination
Natural mode of reproduction	Asexual	Sexual	Sexual
Genetic makeup of plant population	Heterozygous	Homozygous	Hetrozygous
Obtain through	Asexual reproduction from a single plant	Natural S.P. from a single homozygous plant	Artificial self pollination and selection for several generation
Maintained through	Asexual reproduction	Natural self pollination	Artificial self pollination or Close Inbreeding
Used as a variety	Yes	Yes	No (Used for Hybrid and synthetic Hybrid development)
Genetic makeup of plant with in an entity	Heterozygous	Homozygous	Almost Homozygous

Clonally propagated crops

- *Saccharum officinarum* (Sugarcane)
- *Solanum tuberosum* (Potato)
- *Ipomoea batatas* (Sweet potato)
- *Curcuma longa* (Turmeric)
- *Zingiber officinale* (Ginger)
- *Manihot esculenta* (Cassava)
- *Dioscorea* spp. (Yam)
- *Colocasia esculenta* (Taro)

Clonally propagated crops

- *Mangifera indica* (Mango)
- *Litchi chinensis* (Litchi)
- *Pyrus communis* (Pear)
- *Prunus persica* (Peach)
- *Musa paradisiaca* (Banana)
- *Citrus* spp. (Citrus fruits)
- *Malus pumila* (Apple)
- *Vitis vinifera* (Grape)

CLONAL SELECTION

What is a clonal selection?

- A procedure of selecting superior clones from the mixed population of asexually propagating crops is referred to as clonal selection.

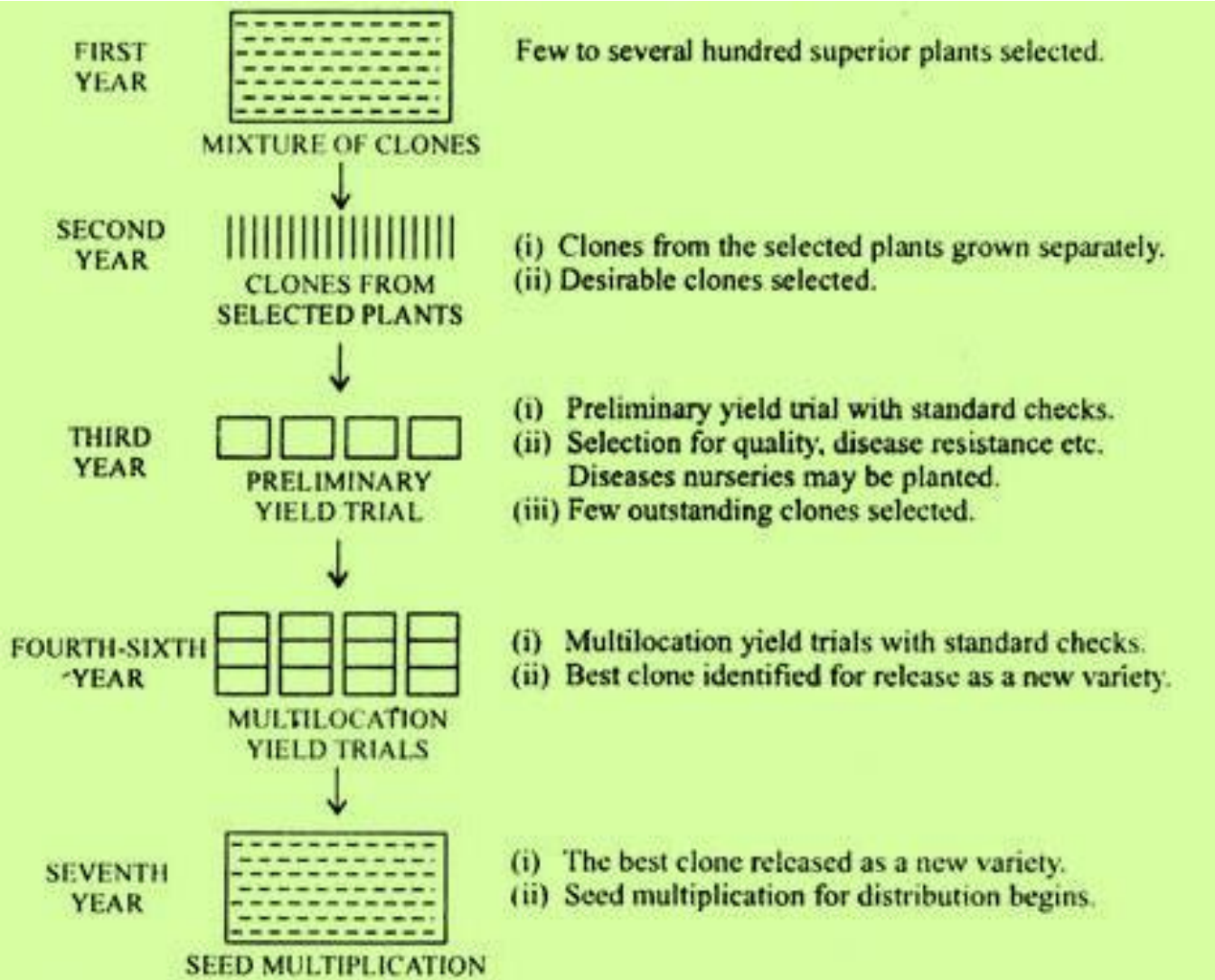
Data on the 11 most important clonally propagated crops on a global basis

Species	Planting material	World production†	Area harvested†	Polyploidy
Potato (*Solanum tuberosum*)	Sprout tubers	315 $\times 10^6$ t	18.8 $\times 10^6$ ha	2x, 3x, 4x, 5x
Cassava (*Manihot esculenta*)	Hardwood cuttings	226 $\times 10^6$ t	18.6 $\times 10^6$ ha	2x
Sweet potato (*Ipomoea batatas*)	Sprout cuttings	124 $\times 10^6$ t	9 $\times 10^6$ ha	6x
Yam (*Dioscorea* spp.)	Root tubers	51 $\times 10^6$ t	4.6 $\times 10^6$ ha	3x–10x
Taro (*Colocasia esculenta*)	Corms	12 $\times 10^6$ t	1.8 $\times 10^6$ ha	4x
Sugar cane (*Saccharum officinarum*)	Cane stalks	194 $\times 10^6$ t ‡	20.4 $\times 10^6$ ha	8x
Banana and Plantain (*Musa* × *paradisiaca*)	Corms	105 $\times 10^6$ t	9.6 $\times 10^6$ ha	3x
Citrus fruit (*Citrus* spp.)	Bud stick grafting on rootstocks	89 $\times 10^6$ t	5.6 $\times 10^6$ ha	2x, 3x+1, 4x-3
Grapes (*Vitis vinifera*)	Hardwood cuttings	69 $\times 10^6$ t	7.4 $\times 10^6$ ha	6x
Apple (*Malus pumila*)	Bud stick grafting on rootstocks	64 $\times 10^6$ t	4.8 $\times 10^6$ ha	2x, 3x
Strawberry (*Fragaria grandiflora*)	Adventitious shoots	4 $\times 10^6$ t	0.26 $\times 10^6$ ha	8x

NOTES: † FAOStat 2006 at faostat.fao.org, ‡ Sucrose production.

Steps in Clonal Selection

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**



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.

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

1. Both the alleles in the cell mutate at the same time producing the same mutant allele, or
2. 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.

Merits and Demerits of Clonal Selection

Merits

- ✓ Variety evolved by this method retains all the characters of the parental clones for several years.
- ✓ Varieties are highly uniform like pure lines. They are highly stable because there is no risk of deterioration due to segregation and recombination.
- ✓ Effective method for genetic improvement of asexually propagated crops.
- ✓ Useful in isolation the best genotype from a mixed population of asexually propagated crops.
- ✓ The selection scheme is useful for maintaining the purity of clone.

Demerits and Limitations

Demerits:

1. Varieties developed by clonal selection are highly prone to new races of a disease.
2. Clonal selection cannot create new variability and, therefore genetic makeup cannot be improved by this method without hybridization.

Limitations:

1. There is limited chance of getting new and useful type of variability.
2. The multiplication rate is low.
3. It is only useful for vegetatively propagated plants.

Achievements of Clonal Selection

India: Success achieved in Potato, sugarcane, banana, citrus and grapes.

Varieties developed through clonal selection

Potato: Kufri Red and Kufri safed in potato
Mango: Ko 11, Ko 22 and Neelam
Banana: Bombay green, Pride monthan and High gate

Varieties by developed by interspecific hybridization followed by clonal selection

Sugarcane: Co 541, CoS 510, Co 1148, Co 1158
Potato: Kufri Sinduri, Kufri Kuber, Kufri Kundan, Kufri Chamatkar

Megha Turmeric-1

- Developed through clonal selection from the local genotype Lakadong.
- Tolerant to leaf blotch and leaf spot.
- Maturity: 300-315 days.
- Average yield: 27-30 t/ha.
- Curcumin content 6.8%.
- Dry matter content: 16.40 %

Thank you