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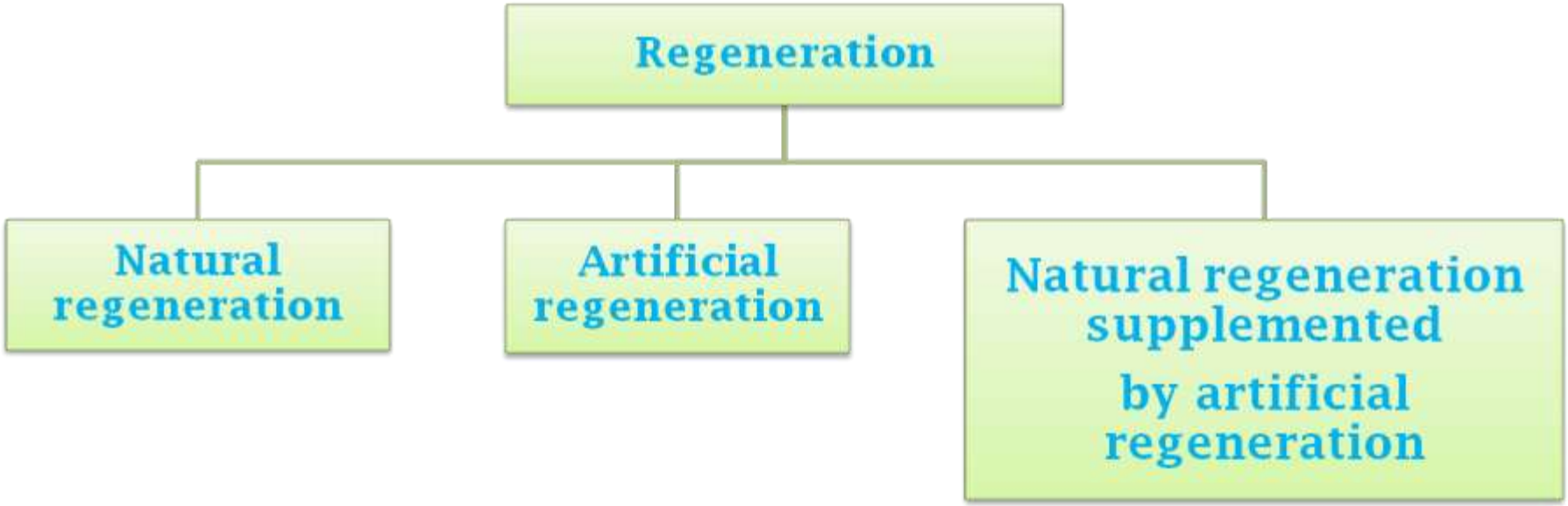
NATURAL REGENERATION
&
ARTIFICIAL REGENERATION

REGENERATION

Regeneration is 'the renewal of a forest crop by natural or artificial means'




Natural regeneration

WHAT IS NATURAL REGENERATION?

Natural regeneration refers to the ‘ natural process by which plants replace or re-establish themselves ’

TWO MAIN SOURCES:

1.From seed

2.From vegetative part

NATURAL REGENERATION FROM SEED DEPENDS UPON:

Seed production

Seed dispersal

Germination

Establishment

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SEED PRODUCTION

- Natural regeneration from seed is the production of adequate quantities of fertile seed by the trees of the area.

THE PRODUCTION OF SEED DEPENDS UPON

1. Seed year
2. Age of trees
3. Size of crown
4. Climate
5. External factors

SEED YEAR

A year in which a given species bear seed abundantly

Species	Interval in year between	
	Moderate seed year	Good seed year
Shorea robusta	2	3-5
Terminalia tomentosa	2	3-4
Pinus wallichiana	2	2-3
Pinus roxburghii	3	4-5
Cedrus deodara	3	7-8
Abies pindrow	6	10

SIZE OF CROWN

- As a general rule, the bigger the crown, the larger the production of seed
- While selecting seed bearers for natural regeneration, middle-aged mature tree with well developed crown should be selected

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CLIMATE

- In the hill the trees growing towards the lower limit of the altitudinal zone of their species produce more seeds than those growing towards the upper limit.
- Hot dry years are generally followed by heavy seed year on account of increase in photosynthesis.
- Heavy storms at the time of pollen dissemination reduced changes of good seed production

EXTERNAL FACTORS

- Injury by fire
- Insect attack

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SEED DISPERSAL

- The seed produced by the trees is dispersed by many agency.

1. **By wind**-Conifers, Casuarina, Dalbergia,etc.
2. **Water** -Teak, most mangrove species,etc
3. **Gravity** -Oaks,Aesculus,Juglans regia,etc
4. **Birds** -Mulberry,Trema,prunus,etc
5. **Animals** -Acacia arabica, prosopis juliflora,etc.

GERMINATION

- After dispersal, a lot of seed is destroyed by insects, birds and rodents. They deposited in soil.

GERMINATION OF SEED DEPENDS UPON

1. Internal factors
2. External factors

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INTERNAL FACTORS

1. *Permeability to water*
2. *Permeability to oxygen*
3. *Development of embryo*
4. *After-ripening*
5. *Viability*
6. *Size of seed*
7. *Germination capacity*
8. *Germination energy*
9. *plant percent*

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PERMEABILITY TO WATER

Moisture is very essential for germination. If the seed has hard seed coat, it prevent moisture reaching the seed embryo and therefore prevents germination.

PERMEABILITY TO OXYGEN

Oxygen is necessary for germination. Factors which inhibits moisture reaching the seed, also prevent oxygen reaching it.

DEVELOPMENT OF EMBRYO

The embryo should be fully developed at the time of seed fall eg. *Fraxinus floribunda*

AFTER-RIPENING

If the embryo is fully developed, seed, sometimes do not germinate because the embryo is not chemically ready for germination. Such seeds germinate after ripening

E.g. *Juniperus macropoda*

VIABILITY

Potential capacity of a seed to germinate

E.g. Under natural condition sal seeds remain viable for about a week. If monsoon is delayed most of the seeds that fall on dry ground and die

SIZE OF SEED

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The Size of seed, affect natural regeneration because while very minute seeds are washed away with the rain water, very big seeds do not get properly covered by soil or humus and so do not germinate.

CONIFERS

Species	Seeds/gm
Abies pindrow	17
Cedrus deodara	9
Cupressus torulosa	240
Pinus roxburghii	9
P. wallichiana	16
Picea smithiana	63

BROAD - LEAVED

Species	Seeds
Albizzia lebbeck	7400/kg
A.procera	23/gm
Gmelina arborea	1764/kg
Dalbergia sissoo	53/gm
Pterocarpus marsupium	1623/kg
Toona ciliata	247/gm

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EXTERNAL FACTORS

1. Moisture
2. Air
3. Temperature
4. Light
5. Seed bed

SEEDLING ESTABLISHMENT

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- Establishment is defined as the development of a new crop, to a stage when young regeneration is considered safe from normal adverse influences such as frost, drought and weeds.

FACTORS AFFECTING ESTABLISHMENT

1. Development of roots
2. Soil condition
3. Light
4. Climatic factors
5. Competing weed growth
6. Grazing, browsing and burning
7. Drip
8. Composition of the crop

NATURAL REGENERATION FROM VEGETATIVE PART

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- Vegetative reproduction is defined as asexual reproduction in plants from some part of the plant body. Of trees by coppice or root sucker or from root.

METHODS OF VEGETATIVE REPRODUCTION

1. Coppice
2. Root sucker

NATURAL REGENERATION BY COPPICE

Coppice shoot

A shoot arising from an adventitious bud at the base of a woody plant that has been cut near the ground or burnt back

Obtained by

Seedling Coppice

- Shoot coppice arising from the base of seedling that have been cut or burnt back
- Cutting back woody shoots

Stool Coppice

- Shoot coppice arising from the stool or a living stump
- Shoot arising from the adventitious buds of a stump of felled trees

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FACTORS AFFECTING NATURAL REGENERATION BY COPPICE

- Species
- Age of trees
- Season of coppicing
- Height of stump and method of cutting it
- Rotation
- Silvicultural system

The Controlling Factors

SEED SUPPLY

SOIL CONDITION

COMPETITION

PREDATION OF YOUNG PLANTS

NATURAL HAZARDS AND CONTROLS

SEED SUPPLY

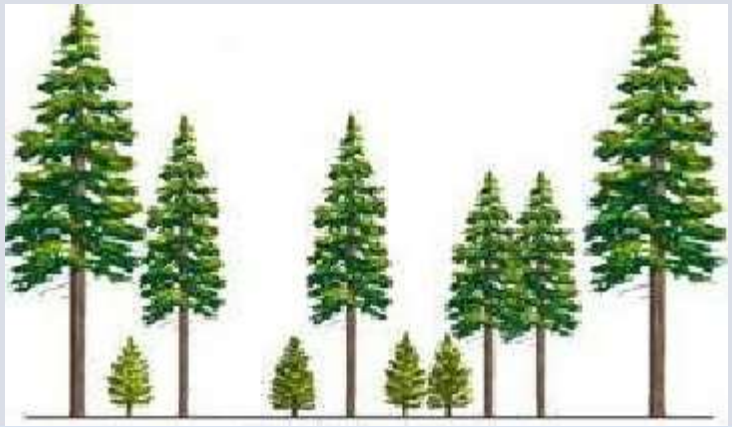
- seed of poor viability.
- Absence of fertile plants with viable seed
- predation by insects,
  birds and mammals
- Lack of pollinators
- Seasonal variations

SOIL CONDITION

- Soil compaction
- Loss of topsoil
- Unstable site
- Salinity
- Lack of water holding capacity
- Poor aeration

COMPETITION

- Competition from other trees species
- Competition from weeds: eg. Strobilanthes and Petalidium in Teak
- Parent plant allelopathy : eg *Eucalyptus*
- Fungal attack



PREDATION OF YOUNG PLANTS

- Insects or other invertebrates: Caterpillars, crickets, beetles, mites, nematodes, and other invertebrates eat seeds and seedlings
- Stock: cattle, sheep, horses and goats
- Native wildlife: Deer, hares, Elephant and Bison

NATURAL HAZARDS AND CONTROLS

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- Fire,
- Flood,
- Wind,
- Drought,
- Temperature extremes (eg frosts)

Natural Regeneration

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Advantages

- Preservation of locally adapted populations
- Preservation of high genetic variability
- Good adaptation to micro-sites
- Undisturbed root development
- Mostly low cost
- Low investment risk

Natural Regeneration

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Disadvantages

- Inability to change genetic stock
- Irregular regeneration density and tree species composition
- High management intensity and complexity
- Long risk period


Artificial regeneration

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ARTIFICIAL REGENERATION?

Artificial regeneration is defined as ‘ the renewal of a forest crop by sowing, planting or other artificial methods ’

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Objects

- Reforestation:

  Restocking of a felled or otherwise cleared woodland by Artificial means

- Afforestation:

  Establishment of a forest by Artificial means on an area from which forest vegetation has always long bean absent

ESSENTIAL PRELIMINARY CONSIDERATION

Selection of site

Choice of species

Choice of method of artificial regeneration

Spacing

Arrangement *of staff and labour*

Vegetative propagation

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SITE SELECTION

- Spp. to be raised are already known
- Spp. With particular use
- Local vegetation is the best indicator

CHOICE OF SPECIES

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- Climate and micro – climate
- Soil conditions

- Object of management
- Consumers requirement

- Availability of suitable exotic
- Ease of establishment
- Cost
- Effect on site

NURSERY PRACTICES USED TO INFLUENCE SEEDLING QUALITY

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- Seedbed density
- Control insects and disease
- Control competition
- Irrigate and fertilize
- Inoculate with mycorrhizae
- Top prune

Casuarina equisetifolia

Casuarina junghuniana

Clonal origin seed origin

CHOICE OF METHOD OF ARTIFICIAL REGENERATION

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Sowing seeds (Broad-cast sowing, Line sowing, Stripe sowing, Patch sowing, Dibbling)

- Seedlings
- Cutting

TYPE OF PLANTING	ADVANTAGE	DISADVANTAGE
SOWING	Less cost, easy work	Large quantity of seed is required, Seedling mortality is high
PLANTING	Less material is required, less damage by animals	Planting is costlier, requires more labour

Spacing

- Spacing is varies with sp to sp

Factors governing spacing

- Rate of growth
- Habit of branching
- Cost
- Height of planting material
- Site factors
- Inter-cultivation
- Market for small-sized timber
- Fruit production as objective

Arrangement of staff and labour

Mechanization

- Soil preparation (Ploughing, Harrowing,Ridging)
- Digging pits for fence posts
- Transport
- Fire protection

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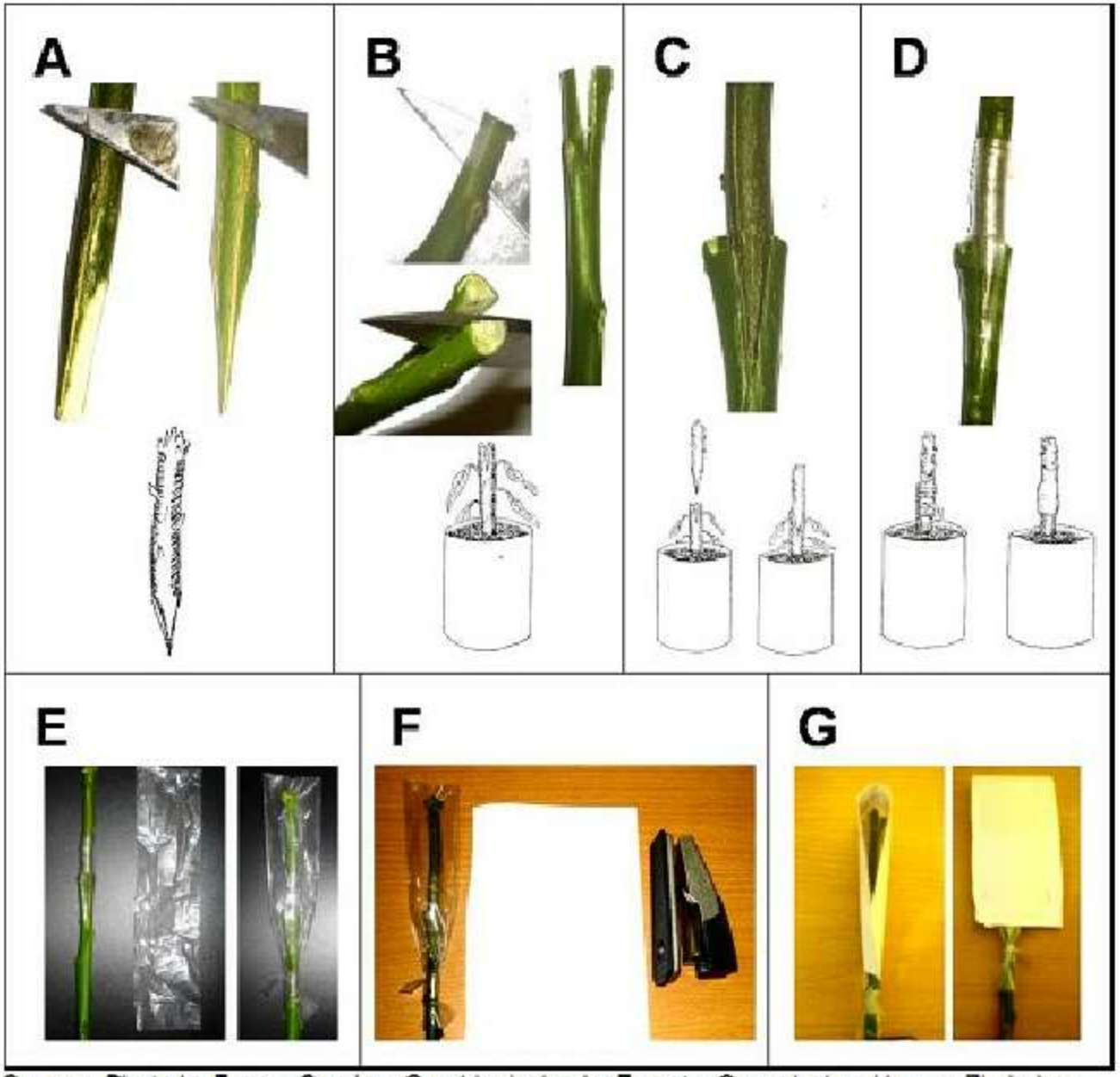
Vegetative propagation

- **CUTTINGS** — Any portion removed from the parent plant
- **GRAFTING** — An art of joining parts of plants together in such a way that they will readily unite and continue to grow as one plant
- **BUDDING** — Budding is a variation of grafting in which the scion is a dormant bud with a small patch of attached bark
- **LAYERING** — Formation of roots on branches while they are still attached to the tree

Grafting in oil seed tree species

Schematic 24: Green Cleft Grafting



Source: Photo by Ferenc Sandor. Graphic design by Forestry Commission, Harare, Zimbabwe

Schematic 12: Chip-budding

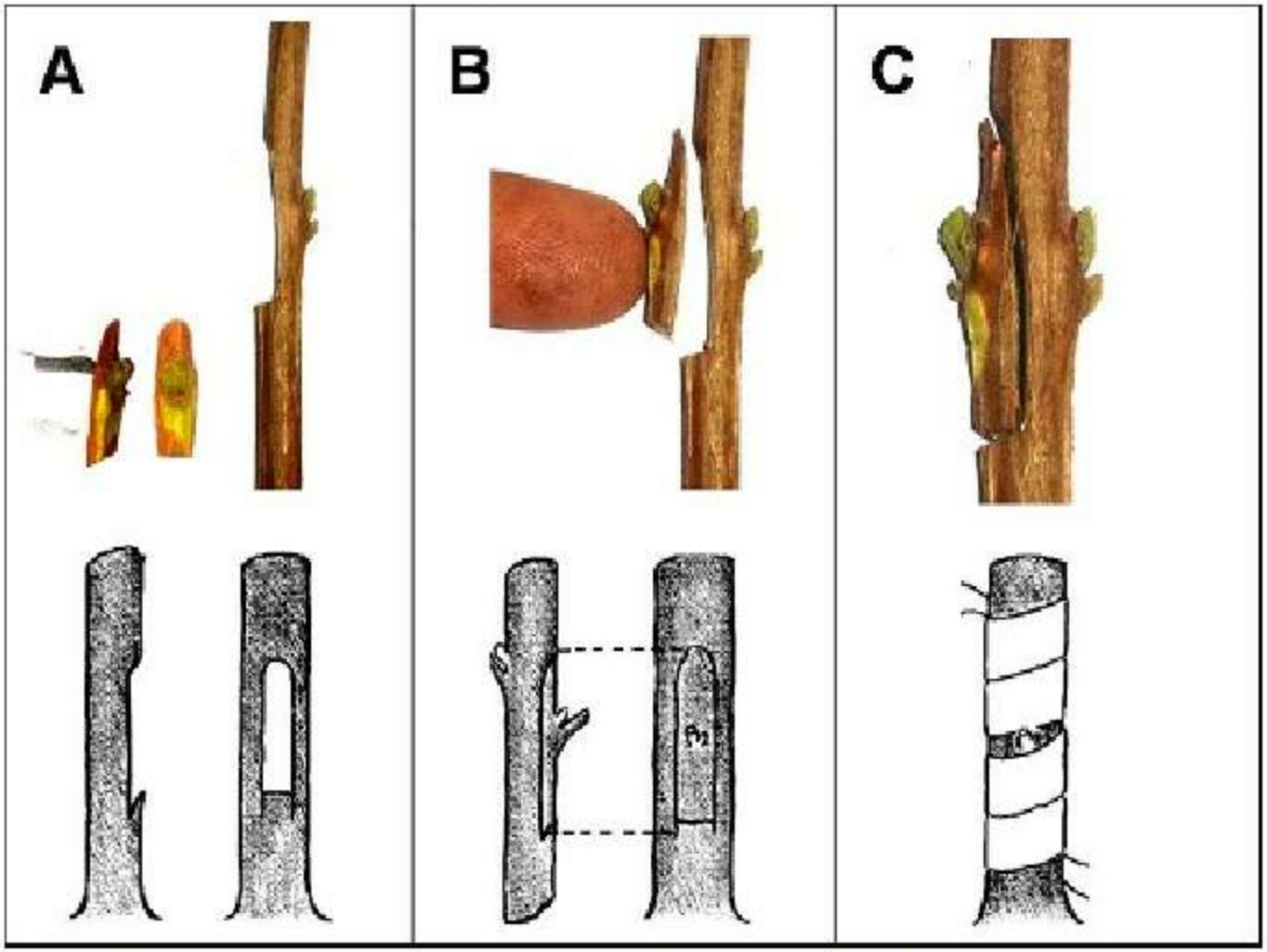
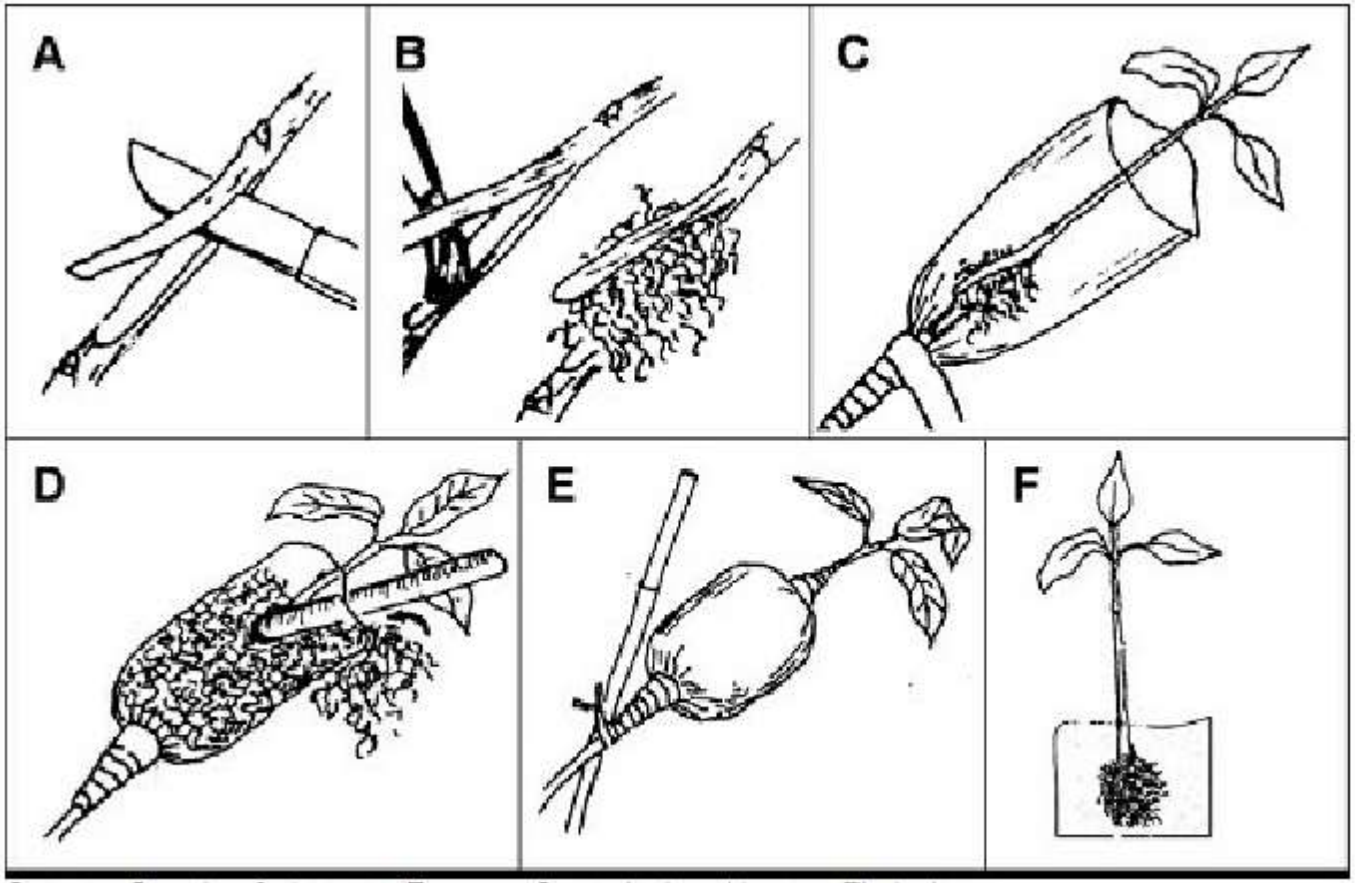


Photo by Ferenc Sandor. Graphic design by Dr. Cselotei-Dr. Nyujto-Csaki, Horticulture, Mezogazdasagi Kiado, Budapest, Hungary (1985)



Source: Growing fruit trees. Forestry Commission, Harare, Zimbabwe

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Factors affecting the choice between AR & NR

- Risk of loss and determination of soil
- Crop composition
- Genetic consideration
- Risk of damage by pests
- Flexibility of operation
- Density of stocking
- Yield
- Time factor
- Cost

Artificial Regeneration

Advantages

- Controlled plant density
- Predictable seedling production
- High flexibility
- Low management intensity
- Option of introducing improved seed or plant material
- Changing species and/or varieties

Artificial Regeneration

Disadvantages

- Labors-intensive
- Temporarily disturbed root development
- Less adapted to micro-sites
- Cost-intensive

WHY WE GO TO NATURAL REGENERATION INTO ARTIFICIAL REGENERATION

- **Quality planting stock**
- More production
- Meet the industrial demand
- silvicultural operation
- Resistant varieties
- Reduced rotation age
- Multiply suitable spp
- Clonal propagation

Quality planting stock


THANK U...!