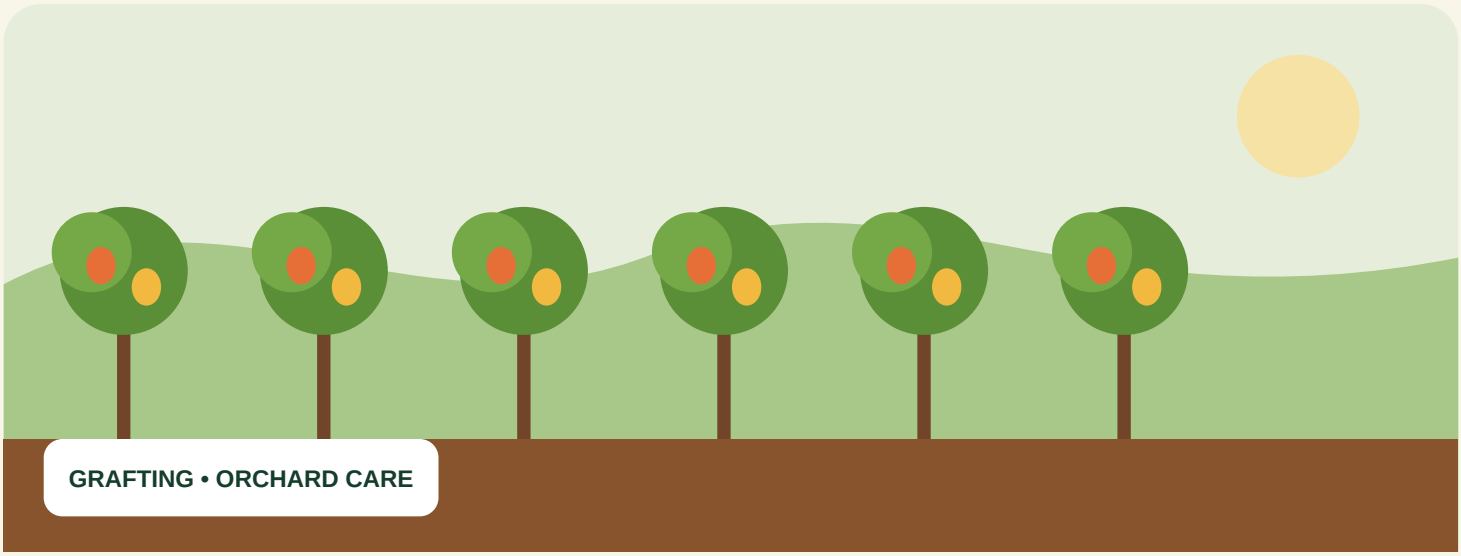
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ARTICLE 3

Advancements in Mango (Mangifera indica L.) Propagation: A Comparative Analysis of Vegetative Grafting and Field Establishment

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ARTICLE OVERVIEW

Reviews mango propagation methods including inarching, veneer grafting, epicotyl (stone) grafting, and soft-wood grafting. It also explains field establishment practices such as planting seasons, spacing, pit preparation, and orchard management to improve tree survival and commercial productivity.

MANGO PROPAGATION • GRAFTING • ORCHARD ESTABLISHMENT

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ADVANCEMENTS IN MANGO (*Mangifera indica* L.) PROPAGATION: A COMPARATIVE ANALYSIS OF VEGETATIVE GRAFTING AND FIELD ESTABLISHMENT

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Abstract:
Mango (*Mangifera indica* L.) cultivation relies heavily on efficient propagation and systematic field establishment to ensure high-yielding, uniform orchards. This article reviews the biological constraints of sexual propagation, notably the rapid loss of seed viability within 4 to 5 weeks and the genetic variation inherent in monoembryonic varieties. To overcome these limitations, vegetative propagation methods such as inarching, veneer grafting, epicotyl (stone) grafting, and soft-wood grafting are analyzed regarding execution, success rates, and operational advantages. Furthermore, structured orchard establishment protocols are outlined, emphasizing regional planting timelines (such as the Upghat and Konkan configurations), variety-specific spacing matrices, and systematic pit preparation including solarization and soil enrichment. Combined, these nursery and field practices form a technical framework for optimizing early tree survival, inducing canopy dwarfism, accelerating fruit bearing, and maximizing commercial mango productivity.
Keywords: Mango propagation, Grafting, Rootstocks, and Orchard.

Propagation:

Mango can be raised from seed or vegetative propagation. Propagation from seed though easy and cheap, it is unable to perpetuate characters of the parent tree because most commercial varieties in India are cross-pollinated and mono-embryonic plants which take more time to bear fruits.

Mango seeds (stones) loose their viability in a short period of time. It is only 4 to 5 weeks after extraction from fruit and it lost completely after 70 days. About 80% stones germinate when sown within a month of extraction.

Rootstock

1. Sour mangoes or semi wild varieties of *Mangifera indica*
2. Ceylon wild mango *Mangifera zeylanica*

Mango varieties fall in to two categories

1) Monoembryonic varieties:

All most all commercial varieties belong to this category but do not come true-to-type from seed and are therefore raised by asexual methods.

2) Polyembryonic varieties:

These comes true-to-type from the seed since the zygotic embryo is crowed out by the surrounding nucellar embryo and get degenerated giving rise to nucellar seedlings only. Polyembryonic types are suited for developing genetically uniform clonal rootstocks. Polyembryonic rootstocks have shown promise in producing plants of uniform size and vigour. Apart from this, they are useful in inducing dwarfing and early bearing.The polyembryonic varieties are Bappakai, Olure, and Villiacolumban etc.

For rising of seedlings the seeds of polyembryonic varieties or wild genotypes are used as rootstocks. Fresh seed/ stones should be collected. These should be washed thoroughly with water to remove adhering pulp. Light seed stones which float in water should be discarded. Bigger, plumpy seed/stones, free from stone weevil attack should be selected for sowing. These seed stones should be dipped in 0.2% Bavistin solution for five minutes and treated with 1% organo-mercurial compound before sowing.

For sowing of seed/stones, raised beds of size 1 m width, 6 m length and 15 cm height are prepared. A wel-rotton FYN @ 30 tonnes/ha is applied, while preparing beds. In the month of June-July, the stones are placed side by side in flat position and then covered with about 6-7% layer of soil + FYN (1:1). Removal of seed coat and sowing the stone with plumule pointing upwards results in early germination.

Irrigation of beds is done twice in a day in summer season, and as and when required during rainy season.Seed stones germinate in about 12-15 days and continue upto 21 days.When the seedlings attain the age of 2-3 months, they are transplanted in pots/poly bags, where these are nursed to prepare for grafting.

Vegetative propagation:

Mango plants for commercial orchards are raised in nurseries by vegetative methods. Various methods employed in mango propagation are described below:

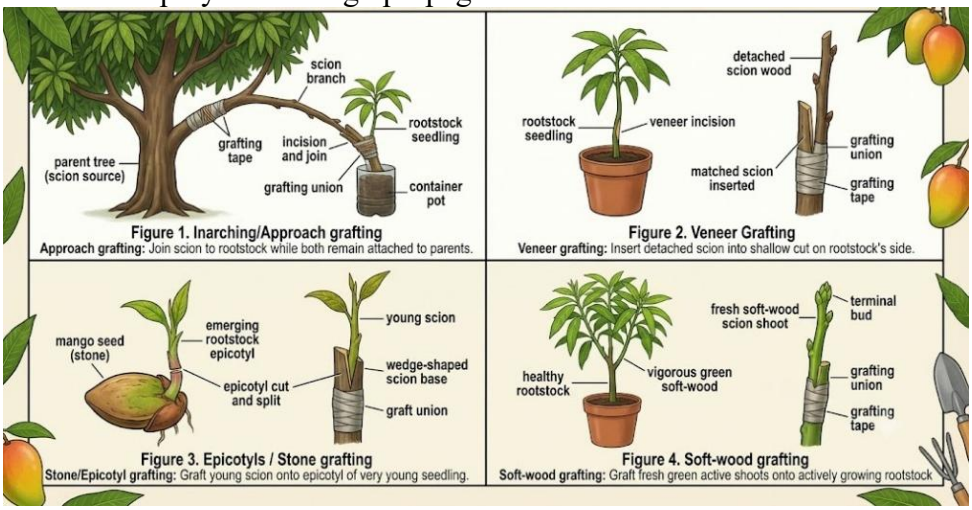


Figure 1. Inarching/Approach grafting
Approach grafting: Join scion to rootstock while both remain attached to parents.

Figure 2. Veneer Grafting
Veneer grafting: Insert detached scion into shallow cut on rootstock's side.

Figure 3. Epicotyls / Stone grafting
Stone/Epicotyl grafting: Graft young scion onto epicotyl of very young seedling.

Figure 4. Soft-wood grafting
Soft-wood grafting: Graft fresh green active shoots onto actively growing rootstock

1) Inarching/Approach grafting:

The method of inarching or approach grafting is quite cumbersome and time consuming but is still the leading method of commercial propagation of mango plants. Though it gives 90-95% success, it has following major disadvantages.

i)It is a cumbersome method as the rootstocks have to be carried to the mother plant for grafting.

ii)It is laborious and time consuming.
iii) The inarched plants have to be irrigated and looked after at least 3 months at various old plants around the mother tree.
iv) A long scion shoot is required for grafting and hence less number of grafts can be prepared per tree.
v) Inarched plants usually get pot bounded and hence mortality on transplanting is high.
vi)It is costly method as compared to other vegetative propagation methods.

The method commonly consists of uniting the selected shoot (scion) of a desired parent tree (mother plant) to the potted or transplanted seeding (root stock) by approach grafting. The scion unites with the rootstock while it is still growing on its own roots.

Inarching should be done during the growing period when the tree is in active sap flow or active growth period. The end of the monsoon in heavy rainfall areas and early monsoon in light rainfall areas is the best period for Inarching (July to Feb.)

A thin slice of bark and wood, about 5 cm in length, 7.5 mm in width, 2 mm deep and at a height of 15 to 25 cm from soil surface on the rootstock is removed. A similar cut is made on the scion shoot. The ends of these cuts should be round and not angular. The cut surfaces of both, i.e. stock and scion are made to coincide facing each other so that there remains no hollow space between the two. These are then tightly tied by polythene/ alkathene strips of about 1.5 cm in width and preferably of 200 gauge thickness which has proved to be a good tying material.

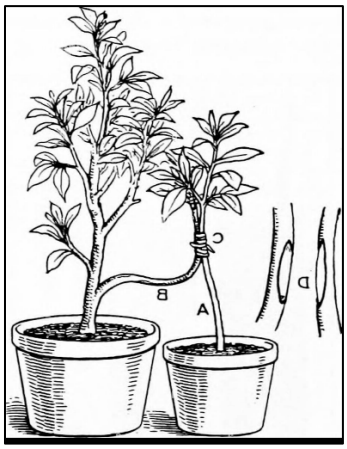


Figure 1. Inarching/Approach grafting

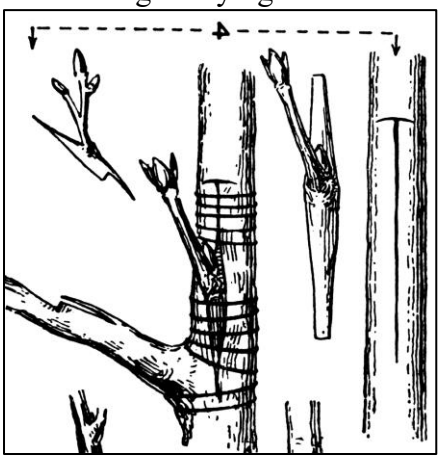


Figure 2. Veneer Grafting

2) Veneer Grafting:

This is a method of propagation which possess promise for mass scalecommercial propagation. The method is simple, more economical, adoptedwith higher degree of success and is ideal for establishing in situ orchards.

For conducting this operation a downward and inward cut 30-40 mm long is made in the smooth area of the stock at a height of about 20 cm. At the base of the out, a small shorter cut is given to intersect first so as to remove the piece of wood and bark. The scion stick is given a long slanting cut on one side and small short cut on the other so as to match the cuts of the stock. The scion is inserted in the stock so that the cambium layers come on the longer side. The graft union is then tied with polythene strip.

The scion wood to be used for veneer grafting requires proper preparation. The desired shoots should be defoliated about 7 to 10 days prior to grafting so that the dormant buds in the axils of leaves become swollen and helps in increasing the percentage of success in grafting.

3) Epicotyls / Stone grafting:

The grafts prepared by this method require less time and are cheap as compared to inarching, veneer grafting or budding. Success is usually as high as 75 to 80%.

For grafting, sprouting mango stones of 8 to 15 days age used as rootstocks and semi-mature terminal shoots of 12-15 cm length which has passed the purple coloration stage as scion. The grafting is done either by cleft/whip wedge method,polythene strip of 200 gauges is used for tying the grafts. Immediately after grafting,the grafts are planted in polythene bags filled with soil and FYN (1:1) mixture and should be placed in polyhouse in nursery for 12-14 days where high humidity (more than 80%) is maintained. The grafts are then potted and kept in green house or in shady place before final transfer to field.

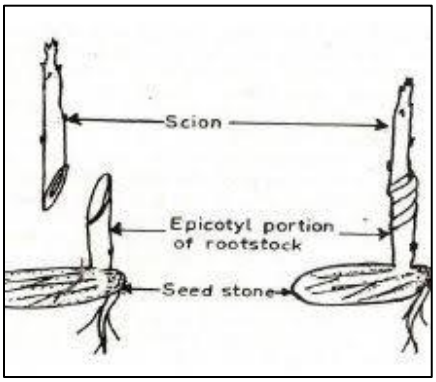


Figure 3. Epicotyls / Stone grafting

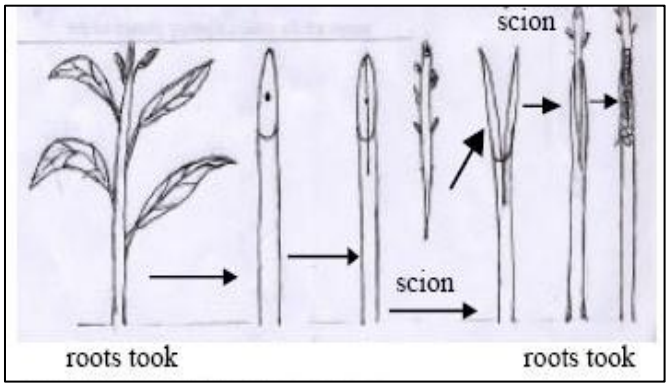


Figure 4. Soft-wood grafting

4) Soft-wood grafting:

The technique of soft wood grafting is similar to that of cleft or wedge grafting. Grafting is done on newly emerged flush having bronzed coloured leaves and stem. The leaves on the stocks should kept while grafting, otherwise the success declines. The technique has proved to be successful in establishing mango orchards '*in situ'* in dry tracts where mortality of nursery raised grafts is very heavy.

The scion wood to be used, should be defoliated 10 days prior to thegrafting and having same thickness as that of terminal shoot. The grafts should be secured firmly using 1.5 cm wide and 45 cm long 200 gauge polythene strip. June-August is the best months for soft wood rafting.

PLANTING:

(i) Planting time/ season: Prior to planting, field should be deeply ploughed, harrowed and leveled. The best time for planting is during the monsoon when there is sufficient moisture in the atmosphere.

1. **Upghat area:** June-July- To take maximum advantage of monsoon rains for proper establishment of grafts.
2. **Konkan area:** August-September – After heavy rains in Konkan which would damage the grafts.

(ii) Planting method: Various systems are adopted for mango cultivation viz., Square, Rectangular, Quincunx, Hexagonal and Contour. Of these, the square method is most popular.

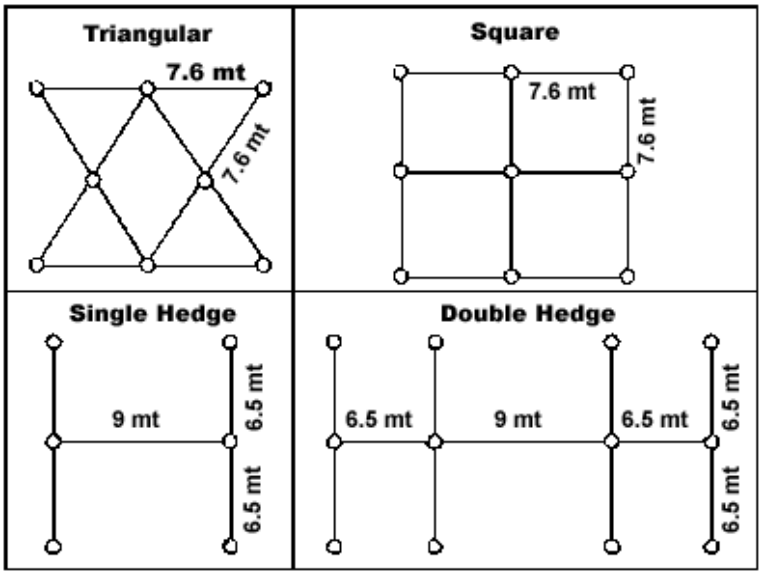


Figure 5. Planting systems

(iii) Planting distance:

1. 10x10 m : For varieties like Alphonso, Kesar, Pairi etc.
2. 7x7 m : For varieties like Neelum, Totapuri etc.
3. 5x5 m : For commercial varieties developed on dwarfing rootstock like Villiacolumban
4. 2.5x2.5m : For varieties like Amrapali.

(iv) Preparation of pits:

1. The pits of 1x1x1 m should be dug at desired distance in summer season and allow to expose to the sun for weathering action for a period of at least one month prior to planting.
2. The pits should be refilled with the original soil mixed with well rotten FYM(1:3) + 2 to 3 kg SSP per pit at the bottom. If the soil is having infestation of white ants, grubs and termites then mix 100-150 g of Lindane per pit.
3. The plant with its ball of earth should be taken out. The grafts are then planted in upright manner in the centre of the pits taking due care that the graft union remain above the soil surface.The plant can then be placed with the help of a planting board in the center of the pit by excavating as much soil as necessary to accommodate the root ball. The moist soil of the pit is then pressed all around the root ball.
4. The small basin is made and the plant is properly watered. The grafts should be staked with a bamboo pole to prevent lodging and damage to graft joints by strong wind.

Conclusion

In conclusion, the successful commercial cultivation of mango necessitates a shift from highly variable sexual seed propagation toward controlled vegetative techniques and standardized field management. While traditional methods like inarching offer high survival rates, modern clonal techniques like veneer, epicotyl, and soft-wood grafting provide scalable, economically viable alternatives that optimize labor and scion utilization. The systematic execution of orchard establishment characterized by disciplined pit solarization, tailored nutritional refilling, and strategic variety-specific spacing ensures robust early root development and resilience against

localized environmental stresses.Future applications of these methodologies lie in the refinement of high-density planting (HDP) frameworks using specialized polyembryonic dwarfing rootstocks like Villiacolumban. Additionally, expanding *in situ* soft-wood grafting protocols offers an adaptive strategy for establishing productive mango orchards in arid, marginal, or degraded tracts where conventional containerized nursery transplants suffer high field mortality.