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Vegetable Grafting for Disease Resistance

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Grafting is the combination of two identical formulation of plants which grow as one plants. **Vegetable grafting** is a modern technique used to control soil pathogens in which vegetative growth of weak root combination is grafted on selected root stock of disease and pest resistance and adoptive to environmental changes.

History

- The production of grafted vegetable plants first began in Japan and Korea in the late 1920swatermelon (*Citrullus lanatus*Matsum.et Nakai*)* grafted onto pumpkin (*Cucurbita moschata*) root stock. (Lee 1994)
- Soon after, watermelons were grafted onto bottle gourd (*Lagenaria siceraria*) root stocks.
- Eggplant (*Solanum melongena*) was grafted on to scarlet eggplant (*Solanum integrifolium*Poir.) in the 1950s.
- Later grafting was introduced to North America from Europe in the late 20th century and now it is attracting growing interest.

Benefits from growing of grafted vegetables

- Resistance/ tolerance to biotic stress and abiotic stress.
- Enhanced nutrient and water uptake
- Improved plant growth
- Increasing yield
- Root stock effect on fruit quality
- Rapid deployment of new genetic sources.

Benefits from growing of grafted vegetables on disease resistance

- Resistance/tolerance to biotic stress(soilborne diseases)
- Fusarium wilt: cucumber,watermelon, musk melon, tomato
- Fusarium crown and root rot: tomato, cucumber, watermelon
- Verticillium wilt: tomato, eggplant, watermelon
- Phytophthora blight: pepper
- Bacterial wilt: tomato, egg plant
- Root-knot nematode: tomato, egg plant, pepper

Disadvantages of grafting

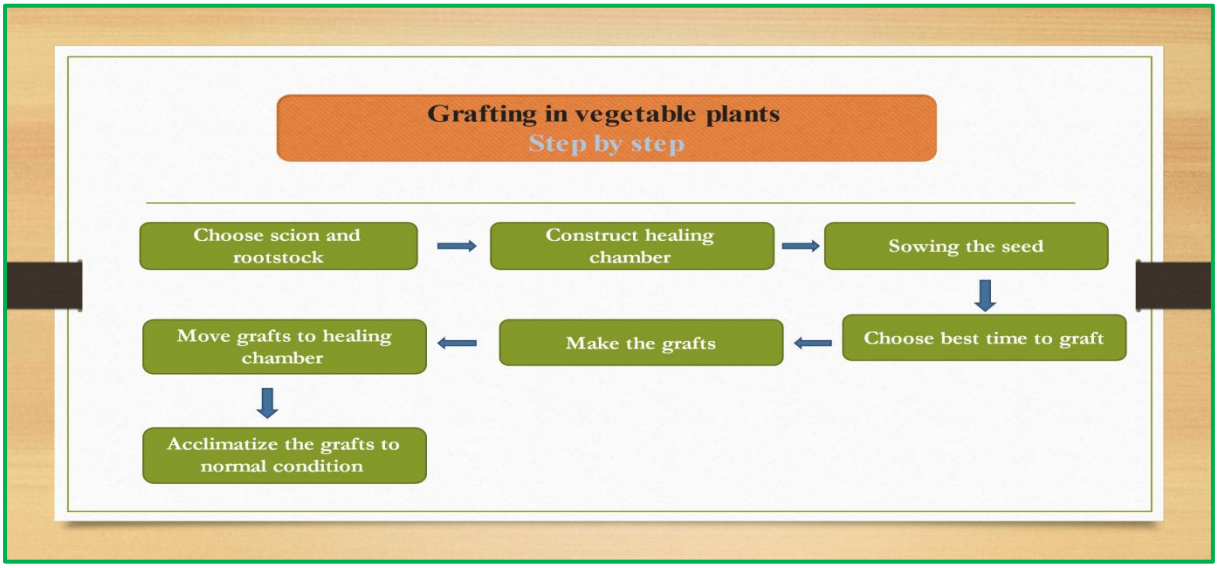
- More labour required
- High cost of grafting seedlings

- Fruit quality could be down, not all rootstocks are good
- Life span of grafted plants is short
- Grafting incompatibility
- Special skill is required

Different rootstocks for grafting of vegetables

Scion	Rootstocks
Cucumber	*Cucurbita moschata, Cucurbita ficifolia, Cucurbita maxima*
Melons	*Cucurbita Spp, Cucumis melo, Cucurbita moschata x Cucurbita maxima, Benincasa hispida*
Watermelon	*Citrulus lanatus, Cucurbita maxima, Cucurbita moschata, Cucurbita moschata x Cucurbita maxima, Lagenaria siceraria*
Bittergourd	*Cucurbita moschata, Lagenaria siceraria, Luffa aegyptiaca*
Tomato	*Lycopersicon pimpinellifolium, L.esculentum, Solanum nigrum*
Egg plant	*Solanum torvum, Solanum integrifolium, Solanum melongena, Solanum nigrum*

Crop	Objective
WATERMELON	Low temperature tolerance,drought tolerance,tolerance to fruit fly, Improving yield & quality of watermelon.tolerance to fusarium wilt,powdery mildew.
CUCUMBER	Low temperature tolerance,drought tolerance,tolerance to fruit fly, Improving yield & quality of ,tolerance to fusarium wilt.
TOMATO	Tolerance to wilt(bacterial,fungal,nematode), Improving yield & quality ,tolerance to rootknot nematode & abiotic stress.
BRINJAL	Tolerance to wilt(bacterial,fungal,nematode), Improving yield & quality ,tolerance to rootknot nematode & abiotic stress. Heat tolerance .
CHILLI	Heat tolerance capsicum production, improved yield and quality
OKRA	Tolerance to yellow vein mosaic virus

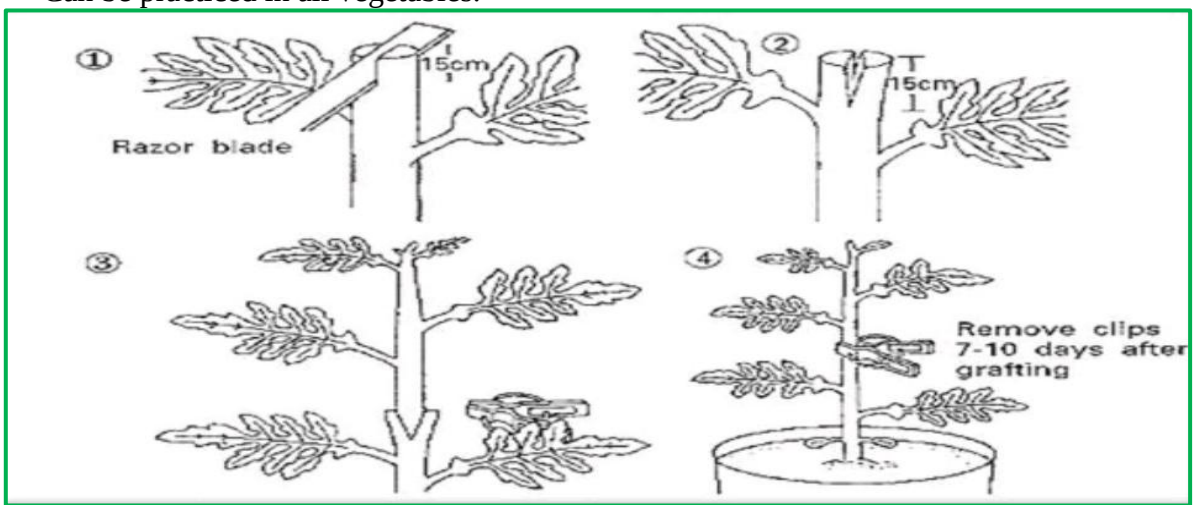


Various methods of grafting

- Cleft grafting
- Tongue approach grafting
- Hole insertion grafting
- Slant cut grafting
- Tube grafting

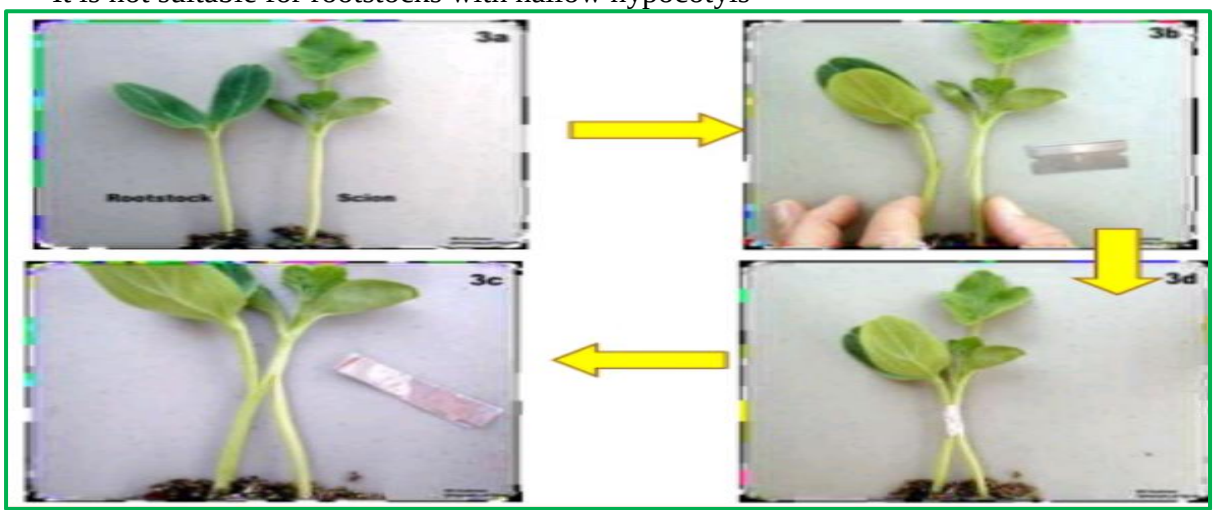
Cleft grafting

- It is simple and easy method.
- It is suitable for rootstocks with wide hypocotyls.
- Can be practiced in all vegetables.



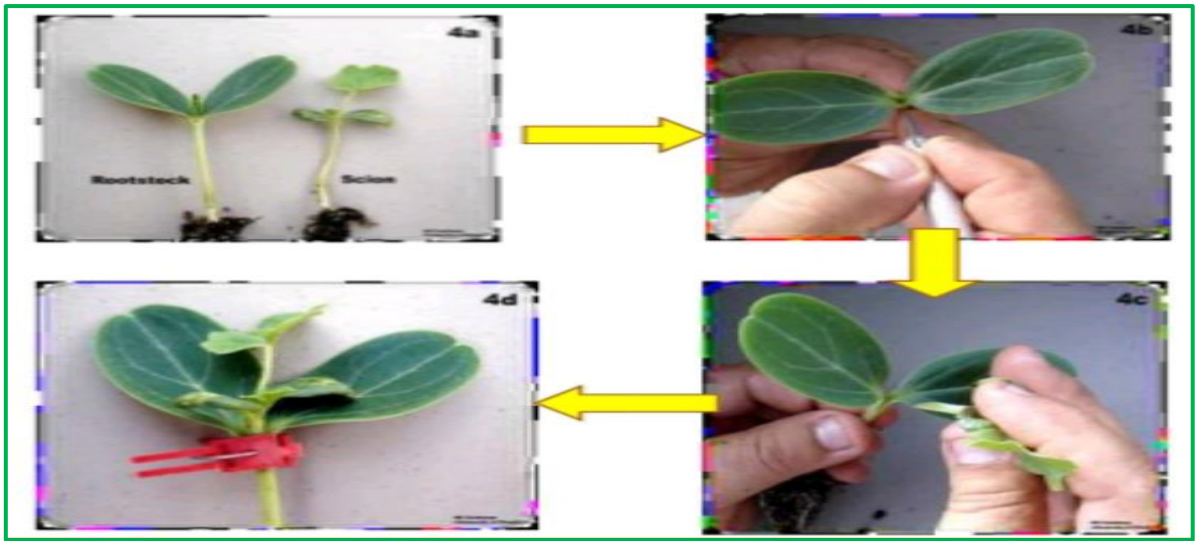
Tongue approach/approach graft

- Most widely used by farmers and small nurseries
- This method requires more space and labor compared to other methods
- Grafted seedlings have a uniform growth rate
- It is not suitable for rootstocks with hallow hypocotyls



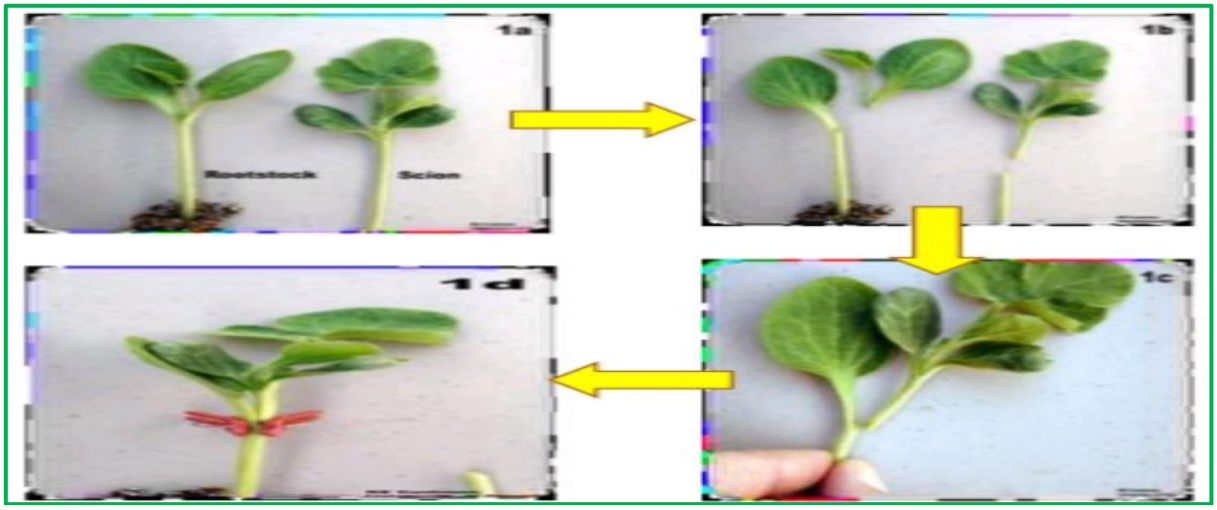
Hole insertion /top insertion grafting

- This is most popular in cucurbits.
- When scion and rootstock have hallow hypocotyls,this method is preferred.
- One person can produce 1500 or more grafts/day.
- To achieve a high rate of success, relative humidity should be maintained at 95%.
- After healing temperature should maintain at 21-36 c up to transplanting.



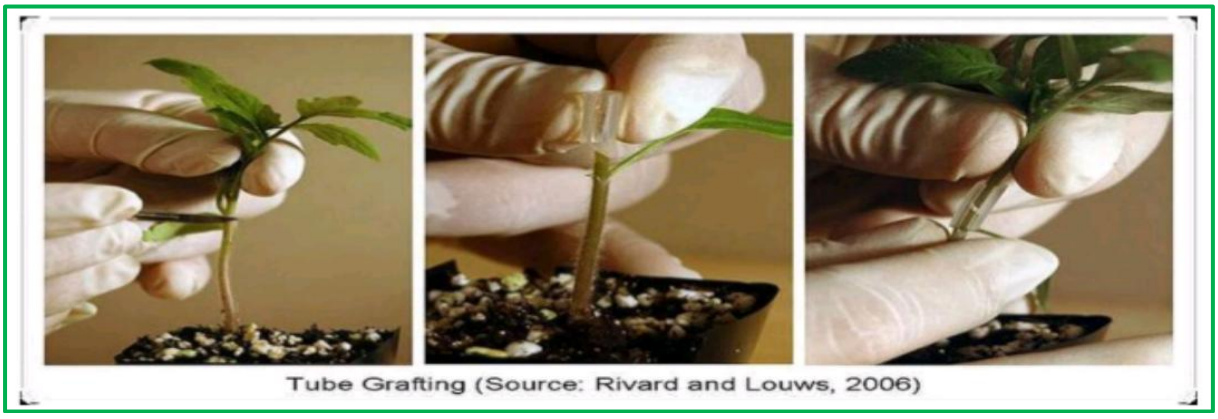
Slant grafting

- It is applicable to most vegetables.
- It has been developed for robotic grafting
- Grafted plants should be maintained in the dark at 25 c and 100% humidity for three days for graft union



Tube grafting

- It is similar to slant grafting except that in this method root stock and scion joined are held with an elastic tube instead of clips.
- It is more popular in tomato and brinjal.


Tube Grafting (Source: Rivard and Louws, 2006)

Automated grafting

- The first semiautomatic cucumber grafting system was commercialized in 1993
- A simple grafting machine can produce 150 -600 grafts /hour with 2 operators , whereas manual grafting techniques produce about 1000 grafts /person/day
- A fully automated grafting robot performing 750 grafts/hour with a 90-93% success rate.

Future prospects

- Identification of compatible multi-disease resistant rootstocks
- Easy of producing organically grown vegetables
- Increased grafting success requires close contact between scion and rootstock vascular bundles, root stock and scion compatibility and proper environmental conditions to facilitate rootstock and scion union.
- In this study, we evaluated that bacterial wilt was effectively when CRA 66 and Hawai 7996 were used as rootstocks for German johnson heirloom cultivar.
- For fusarium wilt they used Maxifort and Robusta respectively for controlling
- This indicates the importance of grafting with resistant rootstocks in managing the bacterial wilt and fusarium wilt pathogens in severely infested fields.