Agri Articles
(e-Magazine for Agricultural Articles)
Volume: 04, Issue: 02 (MAR-APR, 2024)
Available online at http://www.agriarticles.com
©Agri Articles, ISSN: 2582-9882

Vegetable Grafting

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Plant grafting is a propagation technique where two portions of plant with similar organic texture are joined to continue their development as a single plant. The production of grafted plant first began in japan and korea in the late 1920s when watermelon (*Citrullus lanatus*) was grafted on bottle gourd rootstock, later on the scions of eggplant were grafted in large scale on rootstocks of scarlet eggplant (*Solanum integrifolium*) to avoid injury caused by soil-borne diseases such as verticillium wilt, fusarium will, bacterial wilt and nematodes. Grafting is now commercially practiced especially in greenhouse grown crops viz., watermelon, cucumber, muskmelon, bitter gourd, tomato and eggplant in Japan, Korea and other European countries.

Objectives

The main objective of grafting is to avoid soil-borne diseases viz., fusarium wilt, bacterial wilt and nematodes. Currently grafting is used for induction of disease resistance especially caused by soil pathogens, low temperature tolerance, salt tolerance, flood tolerance, drought tolerance, enhancing nutrient and water uptake and high temperature tolerance. It is also used for cultivar change and repair or invigoration of older established plant, studying the transmission of signals affecting vernalization and photoperiod, transmission of virus into indicator plants and elimination of viruses.

Different grafting methods

1. Hole insertion grafting (HIG)
2. Tounge approach grafting (TAG)
3. Splice grafting (SG)
4. Cleft grafting (CG)
5. Pin grafting (PG)
6. Tube grafting (TG)
7. Slant cut grafting
8. Flat grafting,
9. Saddle grafting
10. Mechanized grafting (Robots)

Requirements for vegetable grafting

Selected rootstock and scion should have same diameter for successful union and to overcome graft incompatibility problem. Grafting should be done at 2-3 leaf stage. The seed of scion cultivar should be selected based on purity, viability, yield, fruit quality and market demand. Similarly, rootstock cultivars should be selected based on purity, viability, resistance to diseases, compatibility with the scion cultivar and adaptability to local soil and other environmental conditions. Grafting blade, pins should be contamination free. Temperature of

25-30˚c, relative humidity of 85-90 % and low light intensity is maintained for healing process. Grafting seedlings are kept for 7-10 days for acclimatization as hardening treatment.

Applications of vegetable grafting

The effectiveness of grafting in imparting tolerance to vegetable crops against abiotic and biotic stresses has been attributed to several improved traits of grafted plants:

- More vigorous root system apparatus
- Improved water and nutrient uptake
- Enhanced photosynthetic efficiency and water relations
- Stronger antioxidative defense system
- Heightened hormonal signaling
- Large and long-distance movement of mRNAs, small RNAs and proteins
- To impart insect – pest and disease resistance
- To enhance nutrient and water uptake
- To avoid nematode infestation
- To minimize the autotoxic effect
- To provide cold hardiness
- To impart flood tolerance
- To impart drought tolerance
- To impart salt tolerance
- Impact on quantitative and qualitative traits
- Manipulation in flowering and harvesting period
- Influence on sex expression

Suitable rootstocks for vegetable grafting

Scion	Rootstock
Cucumber	*Cucurbita moschata, Cucurbita ficifolia* (fig-leaf gourd), *Cucurbita maxima, Sicyos angulatus* (bur cucumber)
Muskmelon (for open field)	*Cucurbita, spp., C. Moschata x C. Maxima, cucumis melo*
Muskmelons (for greenhouse)	*Cucumis melo, Benincasa hispida, cucurbita spp., C.moschata x C. Maxima*
Watermelon	*Lagenaria siceraria, cucurbita., Beincasa hispida*
Bitter gourd	*Cucurbita moschata, Lagernaria siceraria, Luffa cylindrical*
Tomato	*Lycopersicon pimpinellifolium, Lycopersicon esculentum, Solanum, nigrum*
Brinjal	*Solanum torvum, Solanum interifolium, solanum melongena solanum nigrum*

Healing and Acclimatization: Acclimatization is essential for healing and survival of grafted plants. Acclimatization involves healing of the cut surface and hardening for field or greenhouse survival. Maintenance of proper moisture content before and after grafting is critical for the production of uniform grafted seedlings. After grafting, keeping the grafted plants in dark for seven days at about 28-30°C and with more than 95% relative humidity promotes the survival ratio. Gradually, the relative humidity is then lowered and the light intensity is increased. During healing and acclimatization, it is important to keep a constant air temperature in the tunnel, in order to maintain high humidity. Grafted plants are usually healed and acclimated in a plastic tunnel which is covered with materials which provide shade and maintain inside humidity.

After healing maintain the light level to 3000-5000 Lux. Before grafting the scion and rootstock should be exposed to sunshine for two to three days and water should be withheld from plant to avoid spindly growth. All these improves the survival rate of grafted plants.

Time requirement: The total time requirement for production of grafted plants of vegetables depends upon the species and methods employed. However in general 5 to 6 week time is sufficient for successful graft union.

Limitations: Beside several beneficial manifestations, there are certain limitations associated with grafting technology such as

- Additional seeds for rootstocks
- Experienced labour needed
- Wise selection of scion/rootstock combinations
- Different combinations for cropping season
- Different combinations for cropping methods
- High price of seedlings
- Increased infection of seed-borne diseases
- Excessive vegetative growth
- Fruit harvesting may be delayed
- Inferior fruit quality (taste, colour and sugar contents)
- Increased incidence of physiological disorders
- Symptoms of incompatibility at later stages
- Different cultural practices should be applied
- Higher prices of grafted seedlings

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