Article: RT0328

Biotica Research Today

Vol 2:9 930/932

2020

Vegetable Grafting: A Novel Technique to Enhance Yield and Quality in Vegetable Crops

Jayanth S.[1] and Navya Vishweshwar Bhat[2*]

[1]Dept. of Vegetable Science, ASPEE College of Horticulrure and Forestry, NAU, Navsari, Vejalpore, Gujarat (396 450), India

[2]Dept. of Fruit Science and Horticulture Technology, OUAT, Surya Nagar, Bhubaneswar, Odisha (751 003), India

Open Access

Corresponding Author

Navya Vishweshwar Bhat

e-mail: navya.vbhat@gmail.com

Keywords

Grafting, Quality, Stress, Yield

How to cite this article?

Jayanth and Bhat, 2020. Vegetable Grafting: A Novel Technique to Enhance Yield and Quality in Vegetable Crops. Biotica Research Today 2(9): 930-932.

Abstract

Vegetable cultivation is seriously affected by the tremendous increase in population causing shrinkage of cultivable land and biotic and abiotic stresses due to changing climate. Vegetable grafting is a novel technique to develop resistant and superior quality vegetables through the union of scion of desirable quality with the rootstock of desirable tolerance level. To attain success in vegetable grafting a potential rootstock that is compatible and appropriate to impart tolerance should be selected which is genotype specific. Furthermore, the grafted plants are placed in healing chamber with high RH of 80-95 % at 25-30 °C and also are hardened before transplanting. An increase in yield upto 80% in Solanaceae and up to 60-90 % in cucurbits has been witnessed through vegetable grafting. Though vegetable grafting is labour and skill demanding, it has emerged as a successful technique to withstand various stresses even nematode infestation which is otherwise not easily controlled.

Introduction

India is the second largest producer of vegetables next to China and the production and productivity also surpasses that of fruit crops. The recommended per capita consumption of vegetables is 300 g against the availability of 230 g currently. The rapid increase in population accompanied with shrinkage in agricultural land has caused a tremendous shortage of vegetables. However, the production and quality is also seriously affected by biotic and abiotic stresses along with changing climate. In addition to this a large migration of population to urban areas has always demanded for regular and good quality vegetables. Hence, constant research are undertaken to overcome the drawbacks and produce good quality vegetables in limited land with available resources. Certain novel techniques thus developed helps in attaining this goal. One such technique is Vegetable grafting which is quite a simple technique to develop resistant and superior quality vegetables.

Vegetable grafting is a scientific method of propagation involving the union of scion of desirable quality with the rootstock of desirable tolerance level. The history of vegetable grafting dates back to early 20th century which was initiated and popularised in Japan and Korea. Grafting was initially done in cucurbits to impart resistance to soil borne diseases and eventually was adopted in other crops like tomato, brinjal *etc*. Japan, Korea and China have emerged as the leading producer of grafted seedlings (FAO 2012) by adopting mechanised systems to rapidly produce the grafted seedlings. This novel technique on witnessing great success became widespread in the Western continents too. In India, grafting work was started in IIHR Bangalore by Dr. R.M. Bhatt and his associates. IIHR Bangalore also organised first ever short course on "vegetable grafting" during year 2013. Now, constant and progressive

Article History

Received in 10th September 2020

Received in revised form 16th September 2020

Accepted in final form 17th September 2020

E-mail: *bioticapublications@gmail.com*

research and field trials have been conducted by both private and public sectors. An increase in yield upto 80% in Solanaceae and upto 60-90 % in cucurbits has been witnessed with the deployment of vegetable grafting. To attain success in vegetable grafting a potential rootstock that is compatible and appropriate to impart tolerance should be selected which is most often varietal/ species specific.

Need for Vegetable Grafting in Present Scenario

Though the ultimate goal is enhanced yield, it is often accompanied with imparting resistance to pest and diseases (soil borne), to decrease the level of toxicity, to impart resistance to cold, heat, drought *etc*., improving quality, improve scion vigour, effective use of applied inputs to the soil through deployment of efficient rootstock and to manipulate the harvest period. However, it has emerged as a successful technique to withstand nematode infestation which is otherwise not easily controlled.

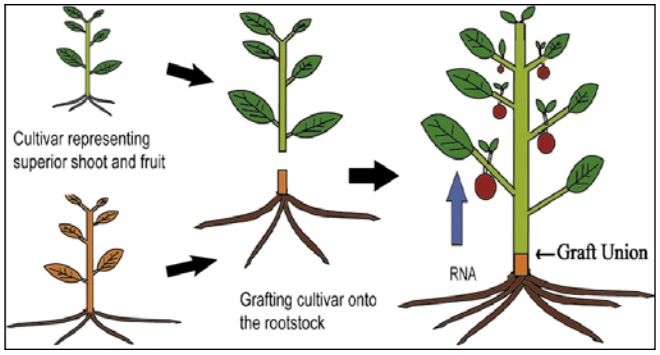

Figure 1: Long distance transport of RNA from the rootstock to the scion

How to Produce A Grafted Vegetable?

- Selection of scions and rootstocks with desired quality.
- Preparation of seedling.
- Grafting the scion over rootstock using specific type of grafting for a particular species.
- Placing in healing chamber for the faster union of scion and rootstock through vascular connection between them and to reduce water loss from scion.
- Acclimatization (hardening) to the outdoor environment.
- Eventual transplantation in the field or greenhouse.

Common Methods of Grafting

1. Hole Insertion Grafting

It is widely adopted in cucurbits, usually when scion and rootstock have hollow hypocotyls. First a hole is made in the rootstock and an appropriate size scion is inserted into the hole and clipped together. A temperature of 21-36 °C and RH 95% should be maintained for obtaining higher success rate.

2. Tongue Approach/ Approach Grafting

This method gives high rate of success and hence is widely adopted by farmers and nurserymen; uniformity of grafted seedlings makes it highly desirable. Equal size root stock & scion should be selected and scion and rootstock should be prepared by making cut in hypocotyl at 30-40° in relation to the perpendicular axis. The scion and rootstock are clipped together by securing the joint with a grafting clip.

3. Cleft Grafting

This is a common and easy method practiced in all vegetables. The rootstock is prepared by cutting the cotyledonous leaves from the rootstock and make 10-15 cm deep cut with blade on rootstock while, a wedge cut on scion is made and is inserted into the cut made on rootstock and clipped together.

4. Slant/ Splice Grafting

This is mostly developed for robotic grafting and practiced in most vegetables. The cotyledonous leaves are removed and a slant cut is given on rootstock and similar cut is made on scion and both are joined and clipped together. The grafted plants are to be maintained at 25 °C and 100% humidity for three days.

5. Pin Grafting

It is similar to slice grafting. The only difference being that specially designed pins are used instead of clips to fix the grafted position of the scion and rootstock.

6. Tube Grafting

It is similar to slant grafting except that in this method root stock & scion union are held with an elastic tube instead of clips.

Other highly sophisticated methods like robotic grafting and micro grafting are being developed for efficient and rapid multiplication of grafted seedlings.

Table 1: Benefits of Vegetable grafting

Benefit	Crop
Disease resistance to soil borne pathogens and foliar pathogens	Tomato, watermelon, Aubergine, Artichoke, Cucumber , Pepper, Melon
Nematode resistance	Tomato
Salt tolerance	Cucumber, Pepper, watermelon, tomato
High and Low temperature tolerance	Tomato, Pepper, Cucumber
Drought tolerance	Pepper, Tomato

Source: CAB International 2019. Vegetable grafting: Principles and Practices (G. Colla, F. Perez-Alfocea and D. Schwarz)

Note: Presence of male plants in dieocious species is uneconomical. The female plants are grafted on to the male plants to increase its production. In *Momordica cochinchinensis* (a dioecious species) 98% of graft success was observed at NBPGR regional station, Thrissur, Kerala, ICAR News, 2011.

The Major Drawbacks Associated with Grafting of Vegetables

In the current scenario labour is the major concern for all the operations like grafting and post graft care, constant management, incompatibility of scion and rootstock, excessive vegetative growth and disorders, expensive seeds of rootstock, infrastructure for rooting and graft union, the quality and attributes of fruits may be affected in the undesirable direction.

Table 2: Grafting methods for different rootstocks

SCION PLANT	ROOTSTOCK	METHOD
Eggplant	*S. torvum* *S. sissymbrifolium* *S. khassianum*	Tongue grafting Cleft method Both tongue and cleft
Tomato	*L. pimpinelifolium* *S.nigrum*	Cleft method Both tongue and cleft
Cucumber	*C.moschata* *Cucurbita maxima*	Hole insertion and Tongue grafting Tongue grafting
Water melon	*Benincasahispida* *C.moschata* *C.moschata x C. maxima*	Hole insertion and Cleft method Hole insertion and Cleft method Hole insertion
Bitter gourd Bottle gourd	*C.Moschata* *C.moschata, Luf-fasps.*	Hole insertion and Tongue grafting Hole insertion and Tongue grafting

Precautions for Successful Grafting

- Specific grafting technique for a particular species should be used to attain maximum success.
- The seedlings should be placed under suitable temperature (25-30 °C) and high RH 80-95 %.
- The cut surfaces should not be dried and grafting process should be carried under shade.
- The scion and rootstock should match in size and girth.
- Appropriate stage of rootstock should be considered (first true leaf stage).
- The media and tools should be sterilized.
- The labours should be well acquainted with the process.

Conclusion

Vegetable grafting is a novel technique to combat the site specific issues. It has emerged as a reliable tool to overcome the problems of nematodes too. Identification of appropriate rootstock and scion that are compatible and also the deployment of species specific methods is highly rewarding in attaining greater rate of graft success. However, it is still in the budding stage of research in India hence, breeding of appropriate rootstocks is still a matter of trial and error. Also, the use of specific physiological parameters to select plants in the breeding process will be rewarding for future rootstock breeding. Hence, vegetable grafting is being highly encouraged as a way of reducing the cost of management of various biotic and abiotic stresses and enhancing the quality of the produce.

References

Food and Agriculture Organization, 2012.

Colla, G., Perez-Alfocea, F., Schwarz, D., 2019. Vegetable grafting: principles and practices. CAB International.