PLANT SCIENCE TODAY
Vol 12(3): 1-7
https://doi.org/10.14719/pst.7942

eISSN 2348-1900

REVIEW ARTICLE

Exploring the use of wild species in vegetable grafting

Aishwarya M[1], G Ashok Kumar[1]*, Indurani C[1], Savitha B K[1], Boominathan P[2], Gurusamy K[3], Bini Sundar S T[4] & T Shanmugasundaram[1]

[1]Department of Vegetable Science, Tamil Nadu Agricultural University, Coimbatore 641 003, Tamil Nadu, India
[2]Department of Crop Physiology, Tamil Nadu Agricultural University, Coimbatore 641 003, Tamil Nadu, India
[3]Department of Food Process Engineering, Tamil Nadu Agricultural University, Coimbatore 641 003, Tamil Nadu, India
[4]Department of Floriculture and Landscape Architecture, Tamil Nadu Agricultural University, Coimbatore 641 003, Tamil Nadu, India

*Correspondence email - ashokkumar.g@tnau.ac.in

Received: 26 February 2025; Accepted: 03 July 2025; Available online: Version 1.0: 19 July 2025; Version 2.0: 29 July 2025

Cite this article: Aishwarya M, Ashok KG, Indurani C, Savitha BK, Boominathan P, Gurusamy K, Bini SST, Shanmugasundaram T. Exploring the use of wild species in vegetable grafting. Plant Science Today. 2025; 12(3): 1-7. https://doi.org/10.14719/pst.7942

Abstract

Grafting is a horticultural technique that combines a scion and rootstock to produce a grafted seedling with improved quality. It will be another way to reduce the yield loss caused by soil-borne pathogens. It is a very useful technique for decreasing plant disease and improving the quality and yield of produce. In that case, rootstocks are used to establish a strong root system, enhance disease resistance and determine the phenotype of the grafted plants. The scion is used to provide the vegetative character in the grafted plant. Nowadays, disease and pest incidence in plants is high due to the resistance or tolerance of pests and soil-borne pathogens against chemical use. Instead of using chemicals to control pests and pathogens, the grafting technique is a very useful method. Some of the wild species have a resistance trait to pests, pathogens and abiotic stresses. It serves as a genetic resource for vegetable crop improvement by grafting. Grafting using wild species is not only a new technology to improve yield, but also to enhance disease resistance and resilience. This paper examines the latest advancements in vegetable grafting using wild species. It provides in-depth information on the advantages, disadvantages and potential applications of grafting. A sustainable approach to addressing the issues of soil degradation, climate change and the rising demand for premium vegetables in agriculture is the incorporation of grafting with wild species. Grafting does not directly reverse soil degradation, but it provides a biological tool to manage the consequences of degraded soils. It enables continued productivity, reduces chemical dependence and supports soil-friendly agricultural practices. This review provides an overview of grafting techniques, suitable species, rootstocks and scions.

Keywords: grafting; rootstock; scion; vegetables; wild species

Introduction

Grafting is a valuable technique for propagating vegetables. It is considered a quick alternative for temporarily combining desirable traits, although it does not replace breeding in the development of new cultivars or the introduction of heritable genetic improvements (1, 2). Grafting techniques are useful for improving fruit quality, managing soil-borne diseases and nematodes and enhancing tolerance to abiotic stresses, including water-related conditions (such as drought and flooding) and temperature-related conditions (such as heat and cold) (3-9). Grafting techniques are useful in orchards for propagation in certain orchard crops (10). Grafting can be included as a tool in integrated nematode management practices (5). By using cleft grafting in tomatoes, the symptoms of tomato yellow leaf curl virus (TYLCV) can be delayed (11). Abiotic factors significantly limit plant growth and reduce yield. Salinity is one of the major abiotic stresses that reduces yield and affects plant growth and yield. This yield loss caused by salinity stress (an abiotic stress) can be mitigated by grafting with resistant rootstocks (7). In *Solanaceae* and *Cucurbitaceae* crops, grafting is mainly used for decreasing the yield loss caused by abiotic stress (7). Grafting tomato cultivars with resistant rootstocks can enhance resistance, yield and fruit quality (11).Grafting has been used to increase crop yield, fruit quality and resilience to abiotic stresses in the *Cucurbitaceae* family (3). Wild species can contribute valuable traits, such as stress resistance, which may help crops adapt to the impacts of global warming; however, they are not a sufficient solution to climate change (12).

Graft Compatibility and Incompatibility

There are two types of compatibility such as grafting compatibility and symbiotic compatibility. Grafting compatibility refers to the survival rate of the grafting combination. Symbiotic compatibility refers to the symbiotic capacity of the graft combination after establishment, encompassing both normal vegetative and reproductive growth (13). Epigenetic factors (such as DNA methylation) determine the success of graft union (5). Interaction and physiological signalling between scion and rootstock after grafting determines graft compatibility (14). Graft compatibility was determined by assessing the survival rate of the grafted plants after regeneration of vascular bundles across the graft interface and vegetative growth of the scion (15). Rootstock and scion incompatibility is the major problem in grafting (16). Graft incompatibility refers to the inability of a rootstock and scion to form a successful graft union when all the necessary environmental conditions are met (17). Graft compatibility is generally higher among closely related species; however, successful grafts between genera, such as those between tomato and eggplant, have also been reported. A subclade of β-1,4-glucanases facilitates cell wall repair around the graft interface, releasing into the extracellular region, according to comparative transcriptome analysis of graft combinations. Overexpression of β-1,4-glucanase facilitates grafting (1).

Use of rootstock and scion in grafting

Tomato rootstock (maxifort) is resistant to Fusarium wilt race 1. Rootstock performance can vary depending on the scion variety used (18). Selection of rootstock and grafting method influences the fruit taste in tomato breeding (19). Screening is essential for finding rootstock/scion compatibility to improve yield and resistance to abiotic stresses (4). Rootstocks can enhance resistance to abiotic stressors, such as salinity, drought and soil impedance. However, genetic diversity in rootstocks increases the likelihood of selecting for traits that confer resistance (20). Table 1 represents the suitable rootstocks for different vegetables (15, 3, 21). Fig. 1 shows the steps in grafting (22). Fig. 2 shows steps in graft healing (23-25).

Biochemical changes after grafting

The enzymes SOD (Superoxide Dismutase) and POD (Peroxidase) are key antioxidant enzymes that mitigate oxidative stress and facilitate graft union formation. Their enhanced activity supports successful healing, vascular differentiation and long-term graft compatibility, especially under environmental stress conditions. SOD (superoxide dismutase) activity depends on graft compatibility, scion-rootstock interaction and environmental stressors (26). Plants grafted onto salt-tolerant rootstocks may exhibit improved growth and development under saline conditions, including higher leaf water content, enhanced photosynthesis and increased accumulation of compatible osmolytes, polyamines and abscisic acid in the leaves, compared to ungrafted plants; however, these benefits depend on the compatibility and effectiveness of the specific rootstock-scion combination (7). The degree of compatibility was positively correlated with graft success rate, while negatively correlated with total phenol content and peroxidase activity. Phenolic compound levels and peroxidase activity may be used as supportive indicators to pre-screen for incompatibility in particular species. Still, they are not universally reliable markers across all graft combinations (16). A study was conducted on the molecular mechanisms of grafting in *Arabidopsis thaliana* hypocotyls, with a particular emphasis on alterations in gene expression. An asymmetry in tissue expression arises from the activation of genes associated with cambium, phloem and xylem formation in grafted tissues. This asymmetry leads to the accumulation of starch. The starch buildup correlates with genes that respond to sugar. However, in grafted tissues, genes associated with vascular formation were activated, indicating a wound-healing recognition mechanism. Inter-tissue communication, tissue fusion events and tissue regeneration may all be impacted by gene expression asymmetry (27). The study examined the effect of the rootstock on shoot growth and whether grafting could improve watermelon plants' ability to withstand alkalinity. Significant decreases in shoot, root biomass and leaf components were observed in two greenhouse tests when the pH was increased. Grafted plants had lower leaf concentrations of macronutrients and greater leaf concentrations of iron (7). Rootstock-grafted plants show a significant reduction in lipid peroxidation due to increased catalase activities and antioxidant enzymes (28).

Utilization of Wild Relatives in Grafting

Crop wild relatives are species closely related to cultivated crops that exhibit broad environmental adaptations. Examples of tomato and brinjal wild relatives are S. sisymbriifolium and S. macrocarpon, respectively. Since these two wild species (*S. sisymbriifolium* and *S. macrocarpon*) are reported to be more drought-tolerant than the cultivated species, this consideration should be taken into account when selecting rootstocks for crop improvement (12). Some of the potential wild and related species of vegetables that could be utilized for grafting are discussed below:

Solanum habrochaites

Wild species of *Solanum* are used as a source for incorporating various biotic and abiotic stress resistance traits into the cultivated brinjal (29). The wild species *Solanum habrochaites* is useful in tomato grafting to improve suboptimal temperature tolerance. At 25 ºC, *S. habrochaites* may not significantly affect shoot and leaf expansion rates; however, as a rootstock, it can still influence scion physiology under suboptimal nutrient or normal conditions. *S. habrochaites* has a greater capacity to adjust the root-to-shoot ratio (R:S ratio) at suboptimal temperatures compared to *S. lycopersicum* rootstock (30).

Solanum pimpinellifolium

In tomatoes**,** the negative effect of the salinity stress on the scion can be reduced by grafting. *Solanum pimpinellifolium* is a wild species of tomato that can be used as a rootstock to reduce the effect of salt stress (19). In salt stress conditions, the graft combination (*S. lycopersicum* × *S. pimpinellifolium* hybrid as a rootstock and variety Galaxy as scion) exhibits high fresh

Table 1. Suitable rootstocks for different vegetables

S. No	Crop	Compatible rootstocks	Usage	References
1.	Bitter gourd	Pumpkin (*Cucurbita moschata*)	-	(15)
2.	Mini Watermelon	Pumpkin (RS 841)	Maintaining yield and quality parameters	(3)
3.	Watermelon	Wild watermelon	Improving lycopene content	(21)

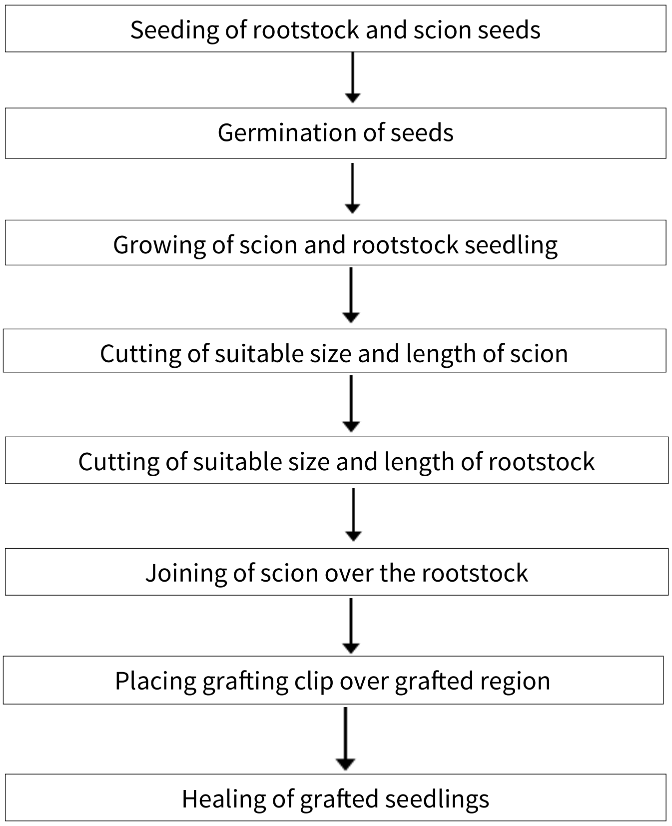

Fig. 1. Steps in grafting (22).

root and shoot weights, as well as a higher number of leaves. Compared to ungrafted plants, grafted plants using *Solanum pimpinellifolium* species have more antioxidant enzyme activity and amino acid content in leaf tissues. This graft combination contains high levels of amino acids, including isoleucine, proline, lysine, methionine, hydroxyproline, glutamate, histidine, alanine, arginine and leucine. Tomato plants under salt stress experience oxidative damage and reduced growth. However, increased amino acid accumulation in grafted combinations protects them by maintaining osmotic balance, supporting antioxidant defence and stabilizing proteins and membranes. This leads to improved plant growth and physiological performance, proving the effectiveness of grafting in saline environments. These contents help to reduce the effects of salt stress on plants (31). *L. pimpinellifolium* parent fruits have higher invertase activities, greater hexose contents and lower sucrose accumulation (32).

Solanum auriculatum **and** ***Nicotiana glauca***

Steroidal glycoalkaloids (solanine and chaconine) produced by Solanaceae crops are toxic to animals and humans. Solanine levels in rootstock do not directly determine compatibility or toxicity in scions. Plants produce these steroidal glycoalkaloids for their protection (33). *S. auriculatum* and *N. glauca* species have low concentrations of chaconine and solanine. Therefore, this can be used as a better rootstock for tree tomato (34).

Lycopersicon hirsutum

Lycopersicon hirsutum Humb. and Bonpl. Green-fruited cultivars accumulate sucrose to 118 micromoles per gram fresh weight during the final stages of development, while *Lycopersicon esculentum* Mill. Cultivars have less than 15 μmol/g of fresh weight of sucrose at the ripe stage. In *Lycopersicon hirsutum*, sucrose accumulates to approximately 118 μmol/g FW during the final stage of fruit development, which is significantly

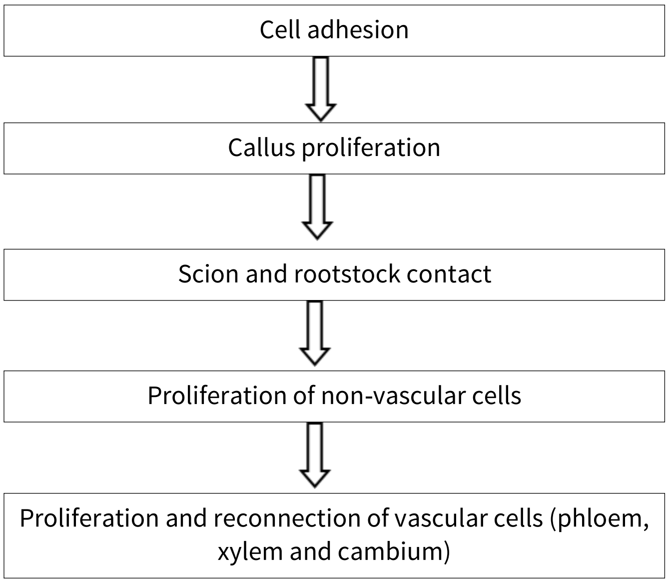

Fig. 2. Steps in graft healing (23-25).

higher than in cultivated *L. Esculentum.* Glucose and fructose levels remain relatively constant (22-50 μmol/g FW), while starch content is low from early stages and decreases further as development progresses.a decline in soluble acid invertase activity coincides with increasing sucrose levels, whereas cell wall-bound acid invertase activity remains stable (~3 μmol/g FW/h). Sucrose phosphate synthase (SPS) activity, initially moderate (~5 μmol/g FW/h), increases sharply (~40 μmol/g FW/h) during later developmental stages. This increase in SPS activity appears to be closely associated with enhanced sucrose accumulation in *L. Hirsutum* fruit (35).

Solanum sisymbriifolium

Solanum macrocarpon and *Solanum sisymbriifolium* are the wild species of brinjal and tomato, respectively, that are subjected to different water stress conditions, such as 25 %, 50 % and 70 %. These wild species exhibit greater tolerance to drought compared to cultivated species (12).

Shintoza (Cucurbita Maxima × Cucurbita Moschata)

Watermelon is one of the top cucurbitaceae crops that has been propagated by grafting (8). Fusarium wilt in solanaceous and cucurbits can be controlled by grafting (36). *Cucurbita lanatus var. citroides* is used in grafting to reduce the infection of root-knot nematode. *C. maxima* × *C. moschata* is mainly used as a rootstock for melon grafting (37). *C. maxima* × *C. moschata* is used as rootstock in watermelon grafting for high resistance to *Fusarium* and to control the *Verticillium* wilt (38, 39). *C. maxima* × *C. moschata* hybrid rootstock can be used in watermelon production to control the *Fusarium* wilt. The survival ratio and yield of crops are increasing when using shintoza (*C. maxima* × *C. moschata*) as a rootstock in watermelon (40).

Solanum torvum

Bacterial wilt is a severe, yield-decreasing disease in brinjal caused by *Ralstonia solanacearum* (41, 42). *Solanum torvum* rootstock can be suitable to reduce the bacterial wilt disease in tomato and brinjal plants (43, 44). The study found that iodine application and grafting on *S. torvum* rootstock significantly improved eggplant yield, with grafting having a more substantial effect. Plants grafted onto *S. torvum* and self-grafted plants increased their marketable yield by 53.0 % and

45.8 %, respectively, compared to ungrafted plants. Thus, both iodine application and grafting improved eggplant yield, with grafting having a more substantial effect. Iodine stress tolerance in brinjal can be increased by grafting onto *Solanum torvum*. Browning of brinjal flesh is decreased by grafting (4).

Pumpkin rootstock for cucumber grafting

Grafting cucumber onto pumpkin rootstocks enhances growth and yield and helps mitigate biotic and abiotic stresses (45, 46). Grafted cucumbers with pumpkin rootstock express the salinity tolerance (45). The study examined the physiological characteristics of cucumber plants and figleaf gourd plants, with cucumber grafted onto figleaf gourd as rootstock. Results showed that own-rooted figleaf gourd plants thrived at low root temperatures, while cucumber plants suffered at temperatures below 20°C. The study also discussed the differences between scion leaves and rootstock roots at low temperatures (47). A greenhouse experiment was conducted using *Cucumis sativus* L. cv. Jinchun No. 2 as scion and Chaofeng Kangshenwang and figleaf gourd as salt-tolerant commercial rootstocks. It was found that salinity reduced cucumber fruit yield; however, grafted plants produced a higher number of fruits and a greater yield. Salinity improved fruit quality by increasing dry matter, soluble sugar and titratable acidity, but not vitamin C content (48).

Wild watermelon

Watermelon can be grafted onto bottle gourd or wild watermelon (*Citrullus lanatus* var. *citroides*) rootstocks. Grafting onto wild watermelon improves lycopene content in watermelon fruits (21). Rootstocks have been found to enhance post-harvest fruit quality and shelf life, suggesting potential for improving melon fruit storage (37). Grafting improves yield in watermelon. *Cucurbita* hybrids are commonly used as rootstocks in watermelon grafting. But these rootstocks cause quality reduction. Grafting using citron melon (*Citrullus lanatus* var. *citroides*) as a rootstock is an alternative method to prevent quality loss in watermelon in certain instances. Citron melon is a suitable rootstock for enhancing nematode resistance and improving fruit quality, which is a key limitation in traditional watermelon grafting (49). Rootstocks influence lycopene accumulation in grafted watermelon fruits. Bottle gourd and wild watermelon promote lycopene accumulation by upregulating biosynthetic genes and downregulating catabolic genes. Pumpkin does not affect lycopene accumulation by upregulating both genes. This rootstock-dependent characteristic offers an alternative model for investigating lycopene metabolic regulation in grafted watermelon fruits (21). Table 2. Represents the rootstocks of wild species for disease tolerance/resistance.

Advantages of utilizing wild species in grafting

Soluble sugar content in ripe fruits of wild species is higher than that of cultivated species. Salinity also increases sugar content, with wild species experiencing a 1.3-fold increase and hybrids experiencing a 1.7-fold increase. Higher fruit quality of wild species may depend more on sucrose import during ripening (51). Grafting is a method used to improve tomato plant quality, which has been found to increase the soluble solids content and titratable acidity, making it a quick and efficient solution (52). Grafted plants show improved growth under heat stress (53).

Disadvantages of utilizing wild species in grafting

Uneven emergence and seedling growth are the major limiting factors when wild species are used for grafting. These issues can lead to non-uniform plant development, reduced grafting success and increased variability in field performance. Wild species often exhibit dormancy, slow germination rates, or weaker initial vigour compared to cultivated varieties, making them more challenging to manage during nursery stages. Pre-treatment methods are essential for effectively utilizing wild species in grafting programs (11). Graft incompatibilities can affect yield and plant longevity. Graft incompatibilities can lead to poor vascular connection, reducing nutrient flow and overall plant vigour. This often results in lower yields, early plant decline and shorter plant lifespan. Ensuring rootstock-scion compatibility is crucial for sustained productivity and graft success (54). Temperature is a critical factor influencing graft formation, as it affects callus development, vascular connection and healing at the graft union. Optimal temperatures promote faster and more successful graft union, while extreme heat or cold can delay healing or cause graft failure. Maintaining suitable temperature conditions during and after grafting is essential for ensuring compatibility and plant survival (55).

Inability to manage some systemic diseases

Wild species grafting is not suitable for all vegetable crops. Some vegetables either do not respond well to grafting or have no compatible wild relatives that can be used as rootstocks without introducing physiological or genetic incompatibilities.

Conclusion

Wild species grafting in vegetable production has shown promise in enhancing plant resilience, disease resistance and

Table 2. Rootstock of wild species for disease tolerant/resistance

S. No	Crop	Wild species	Resistance/tolerance traits	References
1	Tomato	*Solanum. pimpinellifolium*	Tolerant to TYLCV	(11)
2	Tomato	*Lycopersicon peruvianum*	Control of tobacco mosaic virus	(50)
3.	Tomato	*L. peruvianum*	Resistance to Tomato spotted wilt virus	(50)
4.	Tomato	*L. peruvianum*	Partial resistance to *Clavibacter michiganensis*	(50)
5.	Tomato	*L. peruvianum*	Low temperature tolerance	(30)
6.	Tomato	*L. cheesmanii*, *L. peruvianum*, *L. pennellii*	Salt tolerance	(50)
7.	Brinjal	*S. torvum*	Resistance to bacterial wilt	(41)

yield potential. Integrating wild species grafting into climate-smart agriculture and precision farming could offer targeted solutions for adapting to climate variability, optimizing resource use and improving crop performance under stress conditions such as drought, salinity and extreme temperatures. However, further research is needed to understand long-term impacts and effective techniques. Long-term impacts depend on rootstock-scion compatibility, soil health, climate adaptation. This could lead to the adoption of sustainable agricultural practices, thereby contributing to global food security and environmental sustainability.

Acknowledgements

The authors are grateful to the Department of Vegetable Science, HC & RI, Tamil Nadu Agricultural University (TNAU), Coimbatore, 641003, for providing long-term support, which is fully acknowledged.

Authors' contributions

AM wrote the first draft of the manuscript. GA provided overall guidance for correction and improvement. IC, SK, BP, GK, BT and TS assisted with literature collection and formatting. All authors contributed equally to revising the manuscript and approved the final draft.

Compliance with ethical standards

Conflict of interest: The Authors do not have any conflicts of interest to declare.

Ethical issues: None

References

1. Notaguchi M, Kurotani KI, Sato Y, Tabata R, Kawakatsu Y, Okayasu K, et al. Cell-cell adhesion in plant grafting is facilitated by β-1,4-glucanases. Science. 2020;369(6504):698–702. https://doi.org/10.1126/science.abc3710
2. Pugalendhi L, Bharathi S, Selvi NA, Nandhini Devi HU. Anatomical and histological studies of grafted tomato with interspecific solanaceous rootstocks. Int J Plant Soil Sci. 2021;33(20):132–40. https://doi.org/10.9734/ijpss/2021/v33i2030639
3. Tripodi G, Condurso C, Cincotta F, Merlino M, Verzera A. Aroma compounds in mini-watermelon fruits from different grafting combinations. J Sci Food Agric. 2020;100(3):1328–35. https://doi.org/10.1002/jsfa.10149
4. Consentino BB, Rouphael Y, Ntatsi G, De Pasquale C, Iapichino G, D'Anna F, et al. Agronomic performance and fruit quality in greenhouse grown eggplant are interactively modulated by iodine dosage and grafting. Sci Hortic. 2022;295:110891. https://doi.org/10.1016/j.scienta.2022.110891
5. Phani V, Gowda MT, Dutta TK. Grafting vegetable crops to manage plant-parasitic nematodes: a review. J Pest Sci. 2024;97(2):539–60. https://doi.org/10.1007/s10340-023-01658-w
6. Davis AR, Perkins-Veazie P, Sakata Y, Lopez-Galarza S, Maroto JV, Lee SG, et al. Cucurbit grafting. CRC Crit Rev Plant Sci. 2008;27(1):50–74. https://doi.org/10.1080/07352680802053940
7. Colla G, Rouphael Y, Cardarelli M, Salerno A, Rea E. The effectiveness of grafting to improve alkalinity tolerance in watermelon. Environ Exp Bot. 2010;68(3):283–91. https://doi.org/10.1016/j.envexpbot.2009.12.005
8. Fallik E, Ziv C. How rootstock/scion combinations affect watermelon fruit quality after harvest? J Sci Food Agric. 2020;100(8):3275–82. https://doi.org/10.1002/jsfa.10325
9. Seymen M, Yavuz D, Ercan M, Akbulut M, Çoklar H, Kurtar ES, et al. Effect of wild watermelon rootstocks and water stress on chemical properties of watermelon fruit. Hortic Environ Biotechnol. 2021;62(3):411–22. https://doi.org/10.1007/s13580-020-00329-4
10. Warschefsky EJ, Klein LL, Frank MH, Chitwood DH, Londo JP, von Wettberg EJ, et al. Rootstocks: diversity, domestication and impacts on shoot phenotypes. Trends Plant Sci. 2016;21(5):418–37. https://doi.org/10.1016/j.tplants.2015.11.008
11. Mahmoud A. Grafting as a tool to improve TYLCV-tolerance in tomato. J Hortic Sci Ornamental Plants. 2014;6(3):109–15.
12. Kégbé AM, Salako KV, Lokonon B, Mensah S, Noba K, Assogbadjo AE. A comparative study of morpho-physiological responses of wild and cultivated *Solanum* species to water stress: the case of *S. sisymbriifolium* and *S. macrocarpon*. Genet Resour Crop Evol. 2024:1–5. https://doi.org/10.1007/s10722-024-02095-z
13. Xu W, Cui K, Xu A, Nie L, Huang J, Peng S. Drought stress condition increases root to shoot ratio via alteration of carbohydrate partitioning and enzymatic activity in rice seedlings. Acta Physiol Plant. 2015;37:1–1. https://doi.org/10.1007/s11738-014-1760-0
14. Pina A, Errea P, Schulz A, Martens HJ. Cell-to-cell transport through plasmodesmata in tree callus cultures. Tree Physiol. 2009;29(6):809–18. https://doi.org/10.1093/treephys/tpp025
15. Tamilselvi NA, Pugalendhi L. Studies on effect of grafting technique on growth and yield of bitter gourd (*Momordica charantia* L.). 2017.
16. Jalali A, Moghaddam EG, Marjani A. Early detection of graft incompatibility in sweet cherry by internode association and callus fusion techniques. Plant Cell Tissue Organ Cult. 2024;156(2):47. https://doi.org/10.1007/s11240-023-02663-8
17. Assunção M, Santos C, Brazão J, Eiras-Dias JE, Fevereiro P. Understanding the molecular mechanisms underlying graft success in grapevine. BMC Plant Biol. 2019;19:1–7K. https://doi.org/10.1186/s12870-019-1967-8
18. Grieneisen ML, Aegerter BJ, Stoddard CS, Zhang M. Yield and fruit quality of grafted tomatoes and their potential for soil fumigant use reduction. A meta-analysis. Agron Sustain Dev. 2018;38:1–6. https://doi.org/10.1007/s13593-018-0507-5
19. Zhou Z, Yuan Y, Wang K, Wang H, Huang J, Yu H, et al. Rootstock-scion interactions affect fruit flavor in grafted tomato. Hortic Plant J. 2022;8(4):499–510. https://doi.org/10.1016/j.hpj.2022.01.001
20. Albacete A andújar C, Dodd I, Giuffrida F, Hichri I, Lutts S, et al. Rootstock-mediated variation in tomato vegetative growth under drought, salinity and soil impedance stresses. Acta Hortic 2014;1086:141–6. https://doi.org/10.17660/ActaHortic.2015.1086.17
21. Kong Q, Yuan J, Gao L, Liu P, Cao L, Huang Y, et al. Transcriptional regulation of lycopene metabolism mediated by rootstock during the ripening of grafted watermelons. Food Chem. 2017;214:406–11. https://doi.org/10.1016/j.foodchem.2016.07.103
22. Masoud S, Chowdhury BD, Son YJ, Kubota C, Tronstad R. Simulation based optimization of resource allocation and facility layout for vegetable grafting operations. Comput Electron Agric. 2019;163:104845. https://doi.org/10.1016/j.compag.2019.05.054
23. Thomas H, Van den Broeck L, Spurney R, Sozzani R, Frank M. Gene regulatory networks for compatible versus incompatible grafts identify a role for SlWOX4 during junction formation. Plant Cell. 2022;34(1):535–56. https://doi.org/10.1093/plcell/koab246
24. Loupit G, Cookson SJ. Identifying molecular markers of successful graft union formation and compatibility. Front Plant Sci. 2020;11:610352. https://doi.org/10.3389/fpls.2020.610352

25. Duan Y, Zhang F, Meng X, Shang Q. Spatio-temporal dynamics of phytohormones in the tomato graft healing process. Hortic Plant J. 2024;10(6):1362–70. https://doi.org/10.1016/j.hpj.2022.11.014

26. Huang Q, Zhang B, Wang D, Zhao M, Chen L, Yang X, et al. Physiological, anatomical and transcriptome analyses reveal 'Huaizhi' as widely compatible rootstock in *Litchi chinensis* Sonn. grafting. Sci Hortic. 2024;331:113161. https://doi.org/10.1016/j.scienta.2024.113161

27. Melnyk CW, Gabel A, Hardcastle TJ, Robinson S, Miyashima S, Grosse I, et al. Transcriptome dynamics at Arabidopsis graft junctions reveal an intertissue recognition mechanism that activates vascular regeneration. PNAS Nexus. 2018;115(10):E2447–56. https://doi.org/10.1073/pnas.1718263115

28. He Y, Zhu Z, Yang J, Ni X, Zhu B. Grafting increases the salt tolerance of tomato by improvement of photosynthesis and enhancement of antioxidant enzymes activity. Environ Exp Bot. 2009;66(2):270–8. https://doi.org/10.1016/j.envexpbot.2009.02.007

29. Anushma PL, Rajasekharan PE, Singh TH. Pollen cryobanking in wild solanums for conservation and utilization of nuclear genetic diversity. Genet Resour Crop Evol. 2024;71(6):2687–97. https://doi.org/10.1007/s10722-023-01805-3

30. Venema JH, Dijk BE, Bax JM, van Hasselt PR, Elzenga JT. Grafting tomato (*Solanum lycopersicum*) onto the rootstock of a high-altitude accession of *Solanum habrochaites* improves suboptimal-temperature tolerance. Environ Exp Bot. 2008;63(1-3):359–67. https://doi.org/10.1016/j.envexpbot.2007.12.015

31. Aydın A. The growth, leaf antioxidant enzymes and amino acid content of tomato as affected by grafting on wild tomato rootstocks 1 (*S. pimpinellifolium* and *S. habrochaites*) under salt stress. Sci Hortic. 2024;325:112679. https://doi.org/10.1016/j.scienta.2023.112679

32. Husain SE, James C, Shields R, Foyer CH. Manipulation of fruit sugar composition but not content in *Lycopersicon esculentum* fruit by introgression of an acid invertase gene from *Lycopersicon pimpinellifolium*. New Phytol. 2001:65–72. https://doi.org/10.1046/j.1469-8137.2001.00070.x

33. Sucha L, Tomsik P. The steroidal glycoalkaloids from Solanaceae: toxic effect, antitumour activity and mechanism of action. Planta Med. 2016;82(5):379–87. https://doi.org/10.1055/s-0042-100810

34. Viteri-Díaz P, Vásquez-Castillo W, Racines-Oliva M, Viera-Arroyo W. Andean Solanaceae species with resistance to biotic factors, such as tree tomato (*Solanum betaceum* Cav.) rootstocks. Manglar. 2020;17(4):347–52. https://doi.org/10.17268/manglar.2020.052

35. Miron D, Schaffer AA. Sucrose phosphate synthase, sucrose synthase and invertase activities in developing fruit of *Lycopersicon esculentum* Mill. and the sucrose accumulating *Lycopersicon hirsutum* Humb. and Bonpl. Plant Physiol. 1991;95(2):623–7. https://doi.org/10.1104/pp.95.2.623

36. King SR, Davis AR, Liu W, Levi A. Grafting for disease resistance. HortScience. 2008;43(6):1673–6. https://doi.org/10.21273/hortsci.43.6.1673

37. Kaleem MM, Nawaz MA, Alam SM, Ding X, Cheng J, Bie Z. Rootstock-scion interaction mediated impact on fruit quality attributes of thick-skinned melon during storage under different temperature regimes. Sci Hortic. 2023;312:111823. https://doi.org/10.1016/j.scienta.2022.111823

38. Devi P, Tymon L, Keinath A, Miles C. Progress in grafting watermelon to manage *Verticillium* wilt. Plant Pathol. 2021;70(4):767–77. https://doi.org/10.1111/ppa.13344

39. Mashilo J, Shimelis H, Contreras-Soto RI, Ngwepe RM. A meta-analysis on rootstock-induced effects in grafted watermelon (*Citrullus lanatus* var. *lanatus*). Sci Hortic. 2023;319:112158. https://doi.org/10.1016/j.scienta.2023.112158

40. Miguel A, Maroto JV, San Bautista A, Baixauli C, Cebolla V, Pascual B, et al. The grafting of triploid watermelon is an advantageous alternative to soil fumigation by methyl bromide for control of *Fusarium* wilt. Sci Hortic. 2004;103(1):9–17. https://doi.org/10.1016/j.scienta.2004.04.007

41. Barik S, Ponnam N, Acharya GC, Kumari M, Adamala AK, Petikam S, et al. Assessment of bacterial wilt-resistant *Solanum* genetic resources as rootstocks for yield and fruit quality traits in eggplant. Australas Plant Pathol. 2023;52(4):253–69. https://doi.org/10.1007/s13313-023-00916-w

42. Smith J, Saravanakumar D. Development of resistance in tomato plants grafted onto *Solanum torvum* against bacterial wilt disease. J Plant Dis Prot. 2022;129(6):1389–99. https://doi.org/10.1007/s41348-022-00650-3

43. Ramesh R, Achari G, Asolkar T, Dsouza M, Singh NP. Management of bacterial wilt of brinjal using wild brinjal (*Solanum torvum*) as rootstock. Indian Phytopathol. 2016;69(3):260–5.

44. Ramesh R, D'Souza M, Asolkar T, Achari G, Gupta MJ. Rootstocks for the management of bacterial wilt in eggplant (*Solanum melongena* L.) and tomato (*Solanum lycopersicum* L.) in the coastal regions of India. Adv Agric. 2022;2022(1):8594080. https://doi.org/10.1155/2022/8594080

45. Amerian M, Palangi A, Gohar G, Ntatsi G. Enhancing salinity tolerance in cucumber through selenium biofortification and grafting. BMC Plant Biol. 2024;24(1):24. https://doi.org/10.1186/s12870-023-04711-z

46. Pu D, Wen ZY, Sun JB, Zhang MX, Zhang F, Dong CJ. Unveiling the mechanism of source-sink rebalancing in cucumber-pumpkin heterografts: the buffering roles of rootstock cotyledon. Physiol Plant. 2024;176(2):e14232. https://doi.org/10.1111/ppl.14232

47. Ahn SJ, Im YJ, Chung GC, Cho BH, Suh SR. Physiological responses of grafted-cucumber leaves and rootstock roots affected by low root temperature. Sci Hortic. 1999;81(4):397–408. https://doi.org/10.1016/S0304-4238(99)00042-4

48. Huang Y, Tang R, Cao Q, Bie Z. Improving the fruit yield and quality of cucumber by grafting onto the salt tolerant rootstock under NaCl stress. Sci Hortic. 2009;122(1):26–31. https://doi.org/10.1016/j.scienta.2009.04.004

49. Fredes A, Roselló S, Beltrán J, Cebolla-Cornejo J, Pérez-de-Castro A, Gisbert C, et al. Fruit quality assessment of watermelons grafted onto citron melon rootstock. J Sci Food Agric. 2017;97(5):1646–55. https://doi.org/10.1002/jsfa.7915

50. Lindhout P. Genetics and breeding. In: Atherton JG, Rudich J, editors. Tomatoes. Wallingford (UK): CABI Publishing; 2005. p. 21–52. https://doi.org/10.1079/9780851993966.0021

51. Balibrea ME, Martínez-Andújar C, Cuartero J, Bolarín MC, Pérez-Alfocea F. The high fruit soluble sugar content in wild *Lycopersicon* species and their hybrids with cultivars depends on sucrose import during ripening rather than on sucrose metabolism. Funct Plant Biol. 2006;33(3):279–88. https://doi.org/10.1071/FP05134

52. Flores FB, Sanchez-Bel P, Estañ MT, Martinez-Rodriguez MM, Moyano E, Morales B, et al. The effectiveness of grafting to improve tomato fruit quality. Sci Hortic. 2010;125(3):211–7. https://doi.org/10.1016/j.scienta.2010.03.026

53. Abdelmageed AHA, Gruda N. Influence of grafting on growth, development and some physiological parameters of tomatoes under controlled heat stress conditions. Eur J Hortic Sci. 2009;74(1):16–20.

54. Tedesco S, Irisarri P, Santos MT, Fevereiro P, Pina A, Kragler F. Early detection of grapevine graft incompatibility: insights into translocated and virus-induced incompatibility. Sci Hortic. 2023;318:112087. https://doi.org/10.1016/j.scienta.2023.112087

55. Meng X, Zhang F, Yang W, Shang Q. A PHYB-PIF4-auxin module promotes tomato graft formation in response to elevated ambient temperature. Hortic Plant J. 2025;11(1):227–38.

Additional information

Peer review: Publisher thanks Sectional Editor and the other anonymous reviewers for their contribution to the peer review of this work.

Reprints & permissions information is available at https://horizonepublishing.com/journals/index.php/PST/open_access_policy

Publisher's Note: Horizon e-Publishing Group remains neutral with regard to jurisdictional claims in published maps and institutional affiliations.

Indexing: Plant Science Today, published by Horizon e-Publishing Group, is covered by Scopus, Web of Science, BIOSIS Previews, Clarivate Analytics, NAAS, UGC Care, etc

See https://horizonepublishing.com/journals/index.php/PST/indexing_abstracting

Publisher information: Plant Science Today is published by HORIZON e-Publishing Group with support from Empirion Publishers Private Limited, Thiruvananthapuram, India.