

Unravelling Dynamics of *Solanum Nigrum* Grafted onto Wild Rootstocks

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Abstract

Solanum nigrum is an underutilized leafy vegetable of the Solanaceae family with considerable nutritional and medicinal significance, yet its cultivation is constrained by variable productivity and susceptibility to stress conditions. This study aimed to unravel the dynamics of rootstock–scion interactions in *S. nigrum* grafted onto the wild solanaceous rootstock *Solanum torvum*. The study was conducted at the Department of Vegetable Science, Tamil Nadu Agricultural University, Coimbatore, during December 2023 to May 2024, using CO 1 *S. nigrum* as the scion and *S. torvum* as the rootstock. Scions raised from seedlings and cuttings were cleft grafted onto *S. torvum* and evaluated for graft compatibility, growth and yield performance under field conditions. The emergence of new growth flushes characterized successful graft unions, while incompatible grafts exhibited desiccation or rotting at the graft junction. The results revealed successful compatibility between *S. nigrum* and *S. torvum*, with cutting-derived scions exhibiting earlier compatibility and superior berry production. The cutting treatment recorded the highest mean number of berries (242.30 plant⁻¹), whereas the seedling-derived scions recorded the highest herbage yield (230.98 g plant⁻¹). The enhanced performance of grafted plants could be associated with the vigorous root system of *S. torvum*, facilitating efficient water and nutrient acquisition and supporting sustained scion growth. The differential response of seedling- and cutting-derived scions highlights the importance of scion origin in determining graft performance and productivity. The findings establish *S. torvum* as a promising wild rootstock for *S. nigrum* and provide preliminary insights into rootstock–scion compatibility and performance dynamics in this underutilized vegetable. Further investigations on graft union anatomy, physiological responses and long-term field performance may help elucidate the mechanisms underlying this graft combination.

Keywords: *Solanum nigrum*, Grafting, Compatability, Rootstock, Scion

Introduction

In a rapidly changing world, where the emergence of new pests and the impact of climate change pose significant challenges, the future of food production is becoming increasingly daunting. Amidst these difficulties, plant grafting emerges as one of the most invaluable tools in vegetable production to combat soil-borne diseases and various stresses (Tsaballa *et al.*, 2021). The advantages offered by grafted plants extend far beyond disease resistance, encompassing benefits like enhanced yields even under adverse conditions, prolonged cultivation periods, reduced dependency on fertilizers and agrochemicals, utilization of a wide range of phylogenetic resources as rootstocks, and the elimination

of the need for crop rotation. Embracing plant grafting techniques not only addresses immediate challenges but also sets the stage for a more sustainable and resilient future in agriculture (Lee *et al.*, 2010)

The practice of grafting was initially introduced from East Asia to Europe during the 20th century, but it has experienced a surge in popularity over the last three decades. Nowadays, grafted plants have become a standard in the commercial cultivation of various crops, including tomato (*Solanum lycopersicum*), watermelon (*Citrullus lanatus*), melon (*Cucumis melo*), eggplant (*Solanum melongena*), cucumber (*Cucumis sativus*), pepper (*Capsicum annuum*), and numerous others. This widespread adoption of grafting demonstrates its effectiveness in improving crop productivity, disease resistance, and overall agricultural sustainability (Cao *et al.*, 2016)

Solanum nigrum (Makoi), locally called Mannathakali belonging to the family Solanaceae is a minor leafy vegetable with high medicinal value. The probable origin was Eurasia (Ogg *et al.*, 1981). Its berries are grown and consumed sporadically but not for commercial purposes in India. The leaves and berries are regularly eaten as food in Tamil Nadu after being cooked with tamarind, onion, and cumin seeds (Mukhopadhyay *et al.*, 2018)

Unlike all other vegetables. Makoi is not only primarily grown for its fruits, but also for the tender green leaves which are cooked and eaten directly to cure mouth ulcers, they fetch good prices in the local markets and for ayurvedic and medicinal uses. It is a pediatric plant used to treat a variety of disorders that cause infant death, including feverish convulsions, eye diseases, hydrophobia, and chronic skin ailments. In oriental medicine, *S. nigrum* is a commonly used plant that is thought to have antitumorigenic, antioxidant, anti-inflammatory, hepatoprotective, diuretic, and antipyretic properties (Jain *et al.*, 2011)

Due to the high palatability eminence of the leaves and fruits, there is high demand in the market. To meet this, the farmers of South Tamil Nadu are growing several local cultivars which exhibit a lot of variation in yield and other components. Despite this, *nigrum* plants are characterised by low resistance to various stress conditions. Grafting besides extending the harvesting periods, progresses the resistance to soil-borne diseases and advances the yield within a small area which indirectly raises the farmer's income (Melnik and Meyerowitz., 2015). The root-knot nematode, in particular, infects the roots of *S. nigrum*, causing changes in the plant's chemical properties which results in the poor herbage yield (Castillo *et al.*, 2008).

Therefore, the current study aimed to explore the compatibility of *Solanum nigrum* over *Solanum torvum*. The results of this investigation offered valuable insights in extending the harvesting period which aids in raising the farmers income. highlighting its potential value. This promising discovery paves the way for future research and opens up possibilities for harnessing the plant's beneficial attributes of nightshade (*Solanum nigrum*).

Materials and methods:

The experiment was conducted in the Orchard, Department of Vegetable Science at HC&RI, Tamil Nadu Agricultural University, Coimbatore from December 2023 to May 2024. CO 1 variety of *Solanum nigrum* was selected as a scion raised from seedlings and cuttings. Rootstock is chosen based on its historical resilience and ability to resist soil-borne diseases, particularly in comparison to *Solanum nigrum*. The wild species selected as rootstocks were *Solanum torvum* which was Cleft grafted with the *Solanum nigrum*.

Results and Discussion

Rootstock-scion compatibility: After grafting, the grafts are placed in a mist chamber at 90 percent humidity for approximately one week. This period allows the junction to heal. Subsequently, they are transferred to a net house for the following week to acclimatize before being transplanted into the field. The evaluation of compatibility between the rootstock and scion was conducted by observing the emergence of new growth flushes approximately one week after grafting. Combinations that lacked compatibility displayed signs of rot or desiccation at the graft junction, ultimately causing the plant to topple over. Among the scions examined, it was noted that *Solanum torvum* exhibited greater compatibility with the scion (*Solanum nigrum*) when derived from cuttings, showing an earlier compatibility compared to scions from seedlings. These rootstock-scion pairs exhibited excellent compatibility, resulting in enhanced plant performance (Afful *et al.*, 2018).

The success of grafting in higher plants relies on two crucial factors. Firstly, it involves the physiological compatibility between the two graft partners, the scion, and rootstock. Secondly, the proper alignment of tissues is essential. The formation of vascular tissue marks the final stage of a successful graft. The establishment of a robust union is contingent on the differentiation and quantity of new vascular elements formed after grafting.

Effect of different Treatments: For the Number of Leaves, the Control treatment has the highest mean number of leaves (106.64), indicating more leaves compared to the other treatments (Table 1). The increased leaf count in the seedling scion, as compared to the control group over an extended period, could potentially be accredited to the robust root system of the rootstocks. These root systems are typically efficient in absorbing water and plant nutrients, acting as excellent sources of endogenous hormones. In terms of the Number of Berries, the Cuttings treatment shows the highest mean (242.30), suggesting it has the highest number of berries with different sizes on average (Fig 1). Prior to graft transplantation into field conditions, scions obtained from cuttings exhibited earlier flowering and fruit initiation. This accelerated development occurred after spending one week in a mist chamber during the acclimatization process. This outcome could be attributed to the terminal portion of the plant chosen as the scion, which might have been at a transition stage from vegetative to reproductive phases. This transition period likely contributed to the higher berry production in the grafted plants using cuttings as scions.

For Herbage Yield, the Seedlings treatment has the highest mean yield (230.98), which is greater than both the Control (186.00) and Cuttings (128.15) treatments but on long term internal. This rise in yield could potentially be attributed to the consistent absorption of nutrients and water throughout the crop's growth period, facilitated by the robust root system of the wild rootstock. The vigorous root system might have produced higher amounts of cytokinin, thereby increasing growth via the ascending xylem sap. These findings align with the conclusions drawn by Ioannou *et al.* (2001). Therefore, the grafting process may have led to an expansion in leaf area, leaf number and berries. The potential mechanism behind the crop productivity could be ascribed to several factors, such as increased water and nutrient absorption by the vigorous rootstock, leading to an expanded stomatal conductance and subsequent crop growth (Leonardi and Giuffrida, 2006). This mechanism might also involve regulated uptake, synthesis, and translocation of water, minerals, and plant hormones (Lee and Oda, 2003), along with improved photosynthesis (Hu *et al.*, 2006). These processes collectively contribute to the observed enhancement in crop productivity. The results are in accordance with the findings of Bletsos (2005), who reported that grafted aubergine plants on *Solanum torvum* were significantly more vigorous, with more yield.

Conclusion

The study's results have highlighted the compatibility between the *Solanum nigrum* scion, derived from both seedlings and cuttings, when grafted onto the wild solanaceous rootstock *Solanum torvum*. If maximizing the number of berries is the primary goal, the Cuttings treatment might be preferred. Conversely, if achieving a higher herbage yield is more important, the Seedlings treatment would be recommended. These combinations displayed superior performance in field conditions, particularly showcasing significant differences in berry yield when using cuttings as scions. These findings underscore the previously unreported successful grafting of *Solanum nigrum*, signifying its potential for further exploration and investigation, especially in medical research. The revealed compatibility opens up new avenues for potential applications in increasing yield and discovering therapeutic benefits associated with *Solanum nigrum*. These outcomes suggest a need for continued research and exploration in various domains to harness its potential and facilitate its potential applications in different fields.

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Table1: Treatment details

Treatments	Number of leaves	Number of berries	Herbage yield (g)
Control	106.64	151.93	186.00
Seedlings	95.62	189.20	230.98
Cuttings	58.73	242.30	128.15
Mean	87.00	194.48	181.71
S.E(d)	2.01	3.51	3.59
C.D (0.05)	5.57	9.74	9.97

Figure 1: Graph representing the difference in the yield when *Solanum nigrum* scion (seedlings and Cuttings) is grafted over *Solanum torvum*

