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Hitar's Tree Eggplant, A Dual Plant Complex Grafted Between Common Eggplant (*Solanum melongena* L.) and Water Nightshade (*Solanum torvum* Sw.)

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Abstract Hitar's tree eggplant is a perennial shrub eggplant developed by Hainan Institute of Tropical Agricultural Resources (HITAR) by using grafting technique. By using common eggplant (*Solanum melongena* L.) as scion grafted onto rootstock of water nightshade (*Solanum torvum* Sw.) with the help of common grafting methods, a dual plant system was formed and the perennial shrub eggplant was developed. This kind of eggplant, called "Hitar's tree eggplant", can bloom and bear fruit all year round, and can grow for many years under natural conditions in tropical regions. Hitar's tree eggplant is especially suitable for farmers to plant in the courtyards, because it can not only provide daily vegetables for families, but also can be an ornamental plant in the courtyards.
Keywords Hitar's tree eggplant; Common eggplant (*Solanum melongena* L.); Water nightshade (*Solanum torvum* Sw.); Grafting; Dual plant complex

Eggplant (*Solanum melongena* L.) originated in tropical regions of Southeast Asia, and ancient India was the earliest domesticated place. Up to now, there are still wild and related species of eggplant in India. It is generally believed that China is the second origin of eggplant. China has a long history of cultivating eggplant. In the Chinese botanical work "Nan Fang Cao Mu Zhuang" written by Ji Han in the Jin Dynasty in 304 AD, it is said that there are eggplant trees in South China, which is the earliest record of eggplant in China.

Eggplant is one of the common vegetables on the Chinese table in summer, and it is cultivated all over China. It is not only one of the vegetables widely cultivated in the vegetable gardens by Chinese farmers, but also a common vegetable sporadically planted in the farmer's courtyards. Common eggplant (*Solanum melongena* L.) is usually considered to be an annual herb, but in fact, it can also grow for many years in tropical regions like Hainan. However, it often dies of bacterial wilt or verticillium wilt due to waterlogging in the rainy season.

Hitar's technician formed a dual plant system and developed a perennial shrub eggplant by using common eggplant (*Solanum melongena* L.) as scion grafted onto rootstock of water nightshade (*Solanum torvum* Sw.) with the help of common grafting methods, which overcame the problem that common eggplant often dies of bacterial wilt or verticillium wilt. This kind of eggplant, called "Hitar's tree eggplant", is a dual plant complex, which can bloom and bear fruit all year round, and can grow for many years under natural conditions in tropical regions. Hitar's tree eggplant is especially suitable for farmers to plant in the courtyards, because it can not only provide daily vegetables for families, but also can be an ornamental plant in the courtyards.

1 Water Nightshade as Rootstock

Water nightshade (*Solanum torvum* Sw.) is a common wild shrub of *Solanum* genus in tropical regions, which widely grows in roadsides, gullies, wastelands and among shrubs (Figure 1A). Water nightshade is a valuable wild germplasm resource of *Solanum* genus with the characteristics of tolerance to barren soil and high humidity as well as resistance to pests and diseases. The 2~3-year-old water nightshade with the tree height of about 1.5 m was selected as the rootstock and the grafting was carried out on new branches (1-year-old branches) (Figure 1A).

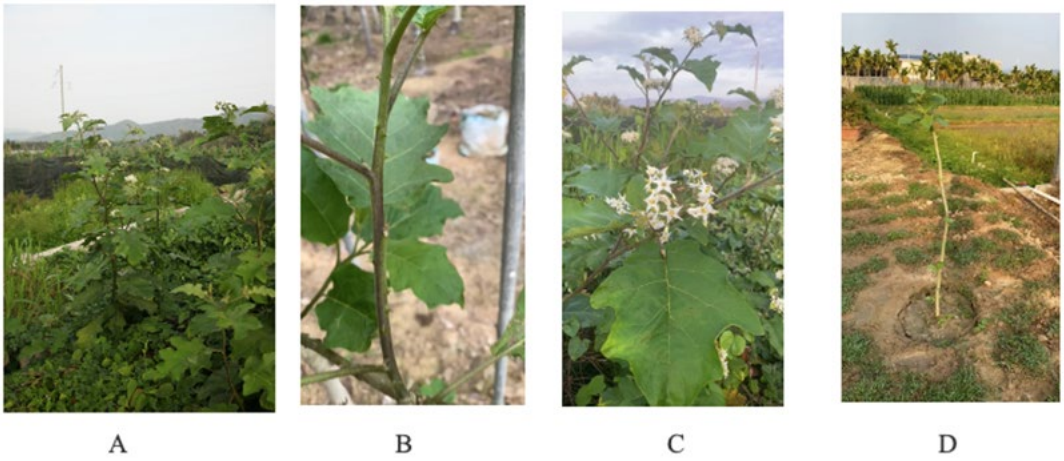

Figure 1 Water nightshade

Note: A. water nightshade growing in roadsides; B. leaves and stem spines of water nightshade; C. flowers and fruit of water nightshade; D. a transplanting plant of two-year-old water nightshade

2 Common Eggplant as Scion

Common eggplant (*Solanum melongena* L.) belongs to *Solanum* genus in the family of Solanaceae. In this study, the eggplant used as scion was a long variety with a curved base (*Solanum melongena* L. var. *serpentinum* Bailey) (Figure 2), which is widely cultivated in southern China, with the skin color of purple or dark purple, green or light green. In this study, two types with medium growth and about 20 cm slender rod-shaped fruit were selected, one was a variety with green skin (Figure 2A) and the other was a variety with purple skin (Figure 2B).

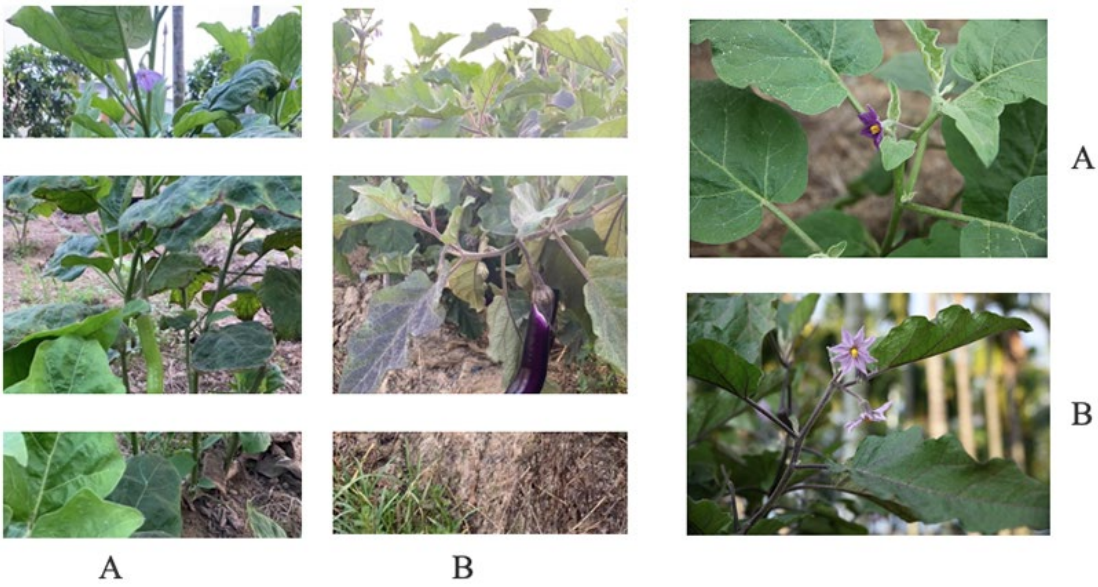

Figure 2 Common eggplant

Note: A. eggplant with green skin; B. eggplant with purple skin

3 Hitar's Tree Eggplant

We formed a dual plant system (Figure 3) and developed a perennial shrub eggplant by using common eggplant (*Solanum melongena* L.) as scion grafted onto rootstock of water nightshade (*Solanum torvum* Sw.) with the help of common grafting methods. This kind of eggplant, called "Hitar's tree eggplant", can bloom and bear fruit all year round, and can grow for many years under natural conditions in tropical regions. In terms of the traits such as tolerance to barren soil, resistance to pests and diseases and high productivity, it is significantly superior to common eggplant.

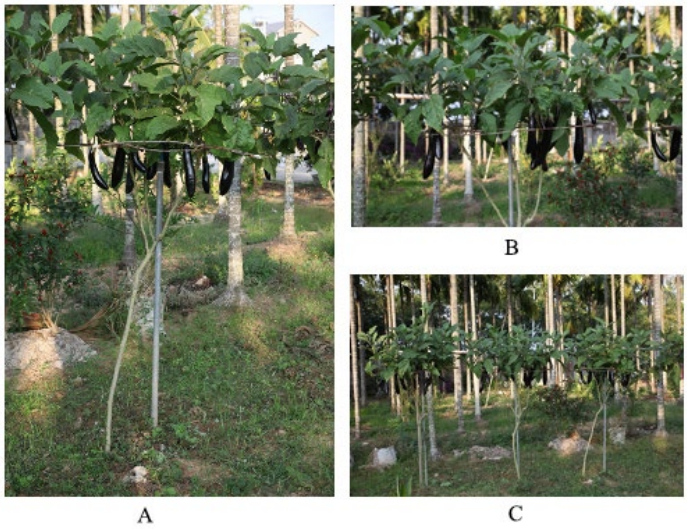

Figure 3 Hitar's tree eggplant

Note: A. the plant of tree eggplant; B. the fruit of tree eggplant; C. tree eggplant planted in the courtyard

Developing a dual plant system relies on the self-healing ability of plants, and connecting the independent root system with the vascular bundle of the branch system, we formed a perfect grafting interface (Figure 4). The grafting of common eggplant and water nightshade had high compatibility, and the ability of vascular bundle connection was very strong, which made Hitar's tree eggplant combine the advantages of both and show superior traits.

Figure 4 Grafting position and healing state of Hitar's tree eggplant

4 Discussion

Grafting relies on the self-healing ability of plants, and connecting the independent root system with the branch system to form a dual plant system can combine the advantages of both and show superior traits. Successful grafting depends on the formation of the grafting interface, and the compatibility of scion and rootstock is the key to successful grafting.

Our research and practice have proved that the grafting of common eggplant and water nightshade has high compatibility, and that the ability of vascular bundle connection was very strong. The grafting of pepper and water nightshade was “seriously” incompatible (Figure 5). The grafting of tomato and water nightshade can survive for several months and even blossom and bear fruit (Figure 6), but the successful vascular bundle connection was not formed eventually, resulting in the slow growth of scion branches, the formation of adventitious roots and the uplift of the grafting interface, and eventually leading to the fracture at the grafting site. The ability to fail to form successful vascular bundle connection is called delayed incompatibility, and the grafting with delayed incompatibility will eventually fracture at the grafting site and lead to the failure of the grafting.

Figure 5 The “seriously” incompatible grafting of pepper and water nightshade

Figure 6 The delayed incompatible grafting of tomato and water nightshade

So far, modern molecular biology studies have found that only eight genes are directly involved in the formation of grafting, which are involved in cell proliferation and the formation of vascular bundles. In view of the important role of vascular bundle reconnection in the process of the formation of grafting, the genes involved in the process of maintaining relatively good characteristics of cambium-xylem can be used as a promising regulator of the formation and development of grafting (Thomas et. al., 2022).

Authors' Contributions

LZG was the executor of this research; HYP, ZCY and ZJY jointly participated in the writing of the first draft of the manuscript, data analysis, manuscript revision and translation. All authors read and approved the final manuscript.

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