The Use of Australian Native *Solanum* as Rootstock for Tomato (*Solanum lycopersicum* L.) and Eggplant (*Solanum melongena* L.) Production: A Case Study with *Solanum symonii* H.Eichler

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KEYWORDS. **crop wild relatives, native Australian plants, soil-borne pathogens, tomato rootstocks, vegetable grafting**

ABSTRACT. **Solanaceous species are crops of economic importance in Western Australia that also face challenges from poor soil quality, a warming and drying climate, and soil-borne pathogens. This study explored the potential of *Solanum symonii*, a native Western Australian species, as a rootstock for tomato (*Solanum lycopersicum*) and eggplant (*Solanum melongena*) to enhance their resilience to local growing conditions. There are no prior published reports of native Western Australian species as rootstock in commercial horticulture. Propagation trials using seeds and cuttings of *S. symonii* were conducted, followed by grafting trials to evaluate compatibility with tomato and eggplant scions. Grafted plants were grown in a greenhouse and subsequently transferred to a high tunnel for fruit yield assessment. Graft survival, leaf chlorophyll content, and fruit yield were measured. Results demonstrate long-term graft compatibility, despite 50% early graft failure, with no adverse effects on subsequent fruit production. These findings suggest *S. symonii* has potential as a novel rootstock for solanaceous crops in Western Australia if early graft survival can be improved. The results demonstrate the need for further research on *S. symonii* and other native Australian *Solanum* as rootstocks to address biotic and abiotic challenges in horticulture.**

Tomato (*Solanum lycopersicum* L.) is one of the most economically important and commonly grown vegetable crops globally and the second-most important vegetable crop in Australia in terms of economic value (Australian Bureau of Agriculture and Resource Economics and Sciences 2022; Global Food and Agriculture Statistics of FAO 2024). In 2020–21, ~15,000 t of tomatoes were grown in Western Australia, yielding a gross revenue of AU$43 million, making it an important species to the local horticultural sector (Australian Bureau of Agriculture and Resource Economics and Sciences 2022). Tomato production in Western Australia and other Australian regions is affected by several serious soil diseases that affect production negatively (Agriculture in Victoria, Government of Victoria 2022; Department of Primary Industries and Regional Development 2016; Stirling and Ashley 2003). Globally, tomato production, and the production of other *Solanum* species, is affected by a range of soil-borne pathogens, including bacteria (e.g., *Xanthomonas campestris*), fungi (e.g., *Alternaria alternata* f.sp. *lycopersici*), nematodes (e.g., *Meloidogyne* spp.), and oomycetes (e.g., *Phytophthora nicotianae* var. *nicotianae*) (Louws et al. 2010; Ma et al. 2023). Furthermore, tomato production in Western Australia commonly takes place on sandy soil types with very low-nutrient and water-holding capacity, and organic matter contents of <1%, necessitating extensive use of fertilizers and irrigation (Australian Bureau of Agriculture and Resource Economics and Sciences 2022; Department of Primary Industries and Regional Development 2024). Consequently, production of these crops is costly and can have negative economic and environmental impacts, such as nutrient runoff into water bodies and the overextraction of water supplies. Crop water stress and irrigation water supply constraints in the region are also predicted to worsen under climate change (Intergovernmental Panel on Climate Change 2021).

Grafting, whereby two different plant genotypes are joined, is commonly used in fruit and vegetable production to achieve a number of goals, including managing soil-borne pathogens and increasing tolerance to abiotic soil constraints (Bithell et al. 2013; Colla et al. 2017; Lee et al. 2010; Loupit et al. 2023; Louws et al. 2010; Singh et al. 2017). The technique is commonly used in the commercial production of tomato, and other *Solanum* species such as eggplant (*Solanum melongena* L.), to overcome biotic and abiotic production constraints (King et al. 2010; Louws et al. 2010; Singh et al. 2017).

Tomato is the focus of the most research and development related to grafting in horticultural species (Aydin 2024; Belmonte-Ureña et al. 2020; Latifah et al. 2023). *Solanum lycopersicum* hybrid cultivars, and interspecific hybrids, are used as rootstocks in commercial tomato production, but wild relatives have also been investigated and used, including *Cyphomandra betacea, Datura stramonium, Lyceum chinense, Nicotiana rustica, Nicotiana tabacum, Solanum intergrifolium, Solanum quitoense, Solanum sisymbriifolium, Solanum torvum,* and *Solanum toxicurium* (Colla et al. 2017; Singh et al. 2017; Tejada-Alvarado et al. 2023). The use of crop wild relatives as rootstock is still considered an underexplored area for overcoming local problems that limit crop yield and quality, and additional selection and breeding efforts are required to develop rootstocks for commercial production

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(Colla et al. 2017; King et al. 2010; Loupit et al. 2023).

There are 63 native *Solanum* species in Western Australia (FloraBase 2024; Symon and Purdie 2024). Now, none are used commercially as rootstock for solanaceous crop species, and there are no published research studies investigating them for this purpose. *Solanum symonii* H.Eichler, also called kangaroo apple or oondoroo, is a fast-growing, short-lived, erect perennial shrub, up to 2 m high, found commonly on sandy soils across 3000 km of near-coastal areas in southwestern and southern Australia (FloraBase 2024; The Australasian Virtual Herbarium 2024). The native range of *S. symonii* overlaps with regions where solanaceous crops are grown commercially. Given that *S. symonii* has preexisting adaptations to the impoverished sandy soils and hot Mediterranean climate of the region, it may have potential as a rootstock for commercial *Solanum* production.

Graft compatibility refers to the ability of a scion–rootstock combination to regenerate, fuse, and reconnect their nonvascular and vascular tissues, forming a union (Rasool et al. 2020). If morphophysiological compatibility between rootstock and scion is not present, grafting cannot take place successfully (Cardoso et al. 2019; Kawaguchi et al. 2008; Zeist et al. 2017). In general, taxonomically closer scion–rootstock combinations have greater graft compatibility, although this is not always the case (Singh et al. 2017). Intrageneric grafts in Solanaceae are usually compatible, whereas intergeneric grafts usually, although not always, fail as a result of incompatible immune systems (Thomas et al. 2023, 2024).

Solanum symonii belongs to the *Archaesolanum* subgenus, which also includes the species *Solanum aviculare, Solanum laciniatum, Solanum linearifolium, Solanum vescum, Solanum capsiciforme,* and *Solanum simile* (Poczai et al. 2011). These taxa are found across southern and eastern Australia (The Australasian Virtual Herbarium 2024). The *Archaesolanum* subgenus is thought to be related more closely to tomato than other solanaceous species commonly used as tomato rootstocks (Poczai et al. 2011). Given the relatively close taxonomic relationship of *S. symonii* to *S. lycopersicum* and *S. melongena*, graft unions between these species could be compatible.

There are informal reports and news stories of successful grafting of tomato and eggplant onto *S. aviculare*, including a commercial grower using this technique for tomato production in the 1950s (Deep Green Permaculture 2010; Moloney 2024; Portland Gaurdian 1950; Sheather et al. 2020; Vikstrom 2019). There are also industry reports of unsuccessful attempts to graft *Capsicum* (*Capsicum annum*) to *S. aviculare* (Carey 2016). However, there are no published reports addressing whether taxa in *Archaesolanum* are compatible with domestic *Solanum*.

We report the results of a series of experiments investigating the feasibility of using *S. symonii* as a rootstock for tomato and eggplant. The objective of our work was to evaluate the potential of *S. symonii* as a locally adapted rootstock for commercial tomato and eggplant production in Western Australia. The compatibility of *S. symonii* with tomato and eggplant was examined, and a high-tunnel study was conducted to assess the impact of grafting on the productivity of tomato and eggplant. Scant information has been published regarding the biology of *S. symonii*; therefore, we also aimed to make general observations of the biology of the species relevant to its use as a rootstock for commercial *Solanum* production.

Materials and methods

Plant materials and simple propagation trial. Seeds of *S. symonii* were obtained from germplasm originally sourced from coastal sand dunes in the town of Yanchep, Western Australia (lat. –31.54S, long. 115.62E). Experiments were initially conducted to explore the propagation of *S. symonii* from seed and cuttings. Seeds were separated from mature fruit, washed with water to remove extraneous material, and air-dried. Twenty-five seeds were placed in 90-mm petri dishes on seed germination papers (Advantec 424, 84-mm filter paper) with three different treatments: 1 μM KAR1 (3-methyl-2H-furo[2,3-c]pyran-2-one; Bioaustralis, Smithfield, New South Wales, Australia), 1 mM gibberellic acid (ProGibb® LV PLUS; Valent Biosciences, Ptd Ltd., Epping, New South Wales, Australia), and distilled water as control, adapting the approaches described in Merritt et al. (2006). Cuttings were also taken from actively growing plants and divided into softwood tip cuttings and semihardwood cuttings, each ~10 cm long. The cutting materials were disinfected with Milton antibacterial solution (1 tablet/1 L; Milton Australia Pty Ltd., Rozelle, New South Wales, Australia) for 1 min. Approximately 100 cuttings of each type were prepared in total, with half treated with a commercial rooting hormone (Richgro Garden Products Striking Hormone; 8 $g \cdot kg^{-1}$ indol-butyric acid; Richgro Garden Products, Jandakot, Western Australia) and half untreated, and then cuttings were inserted in potting soil. All potting soil in this work consisted of 50% fine composted pine bark, 30% river sand, and 20% coco peat (Table 1). Cuttings were placed in a greenhouse at Curtin University, Bentley, Western Australia (lat. –32.00S, long. 115.89E), maintained at 25 °C, and irrigated twice per day for ~5 min using overhead sprinklers.

Grafting trial. A grafting experiment was conducted in the greenhouse at Curtin University, starting the last week of Feb 2024, to assess the compatibility of tomato (cv. Sweet Million, an F1 indeterminate cultivar, resistant to Fusarium wilt and Tobacco mosaic virus) and eggplant (cv.

Table 1. Compositional analysis of the potting soil used throughout this work.

Soil component	Units	Content
Electrical conductivity	$dS \cdot m^{-1}$	4.9
pH	–	5.2
Soluble ammonia	$mg \cdot kg^{-1}$	117
Soluble nitrate	$mg \cdot kg^{-1}$	5531
Soluble inorganic phosphate	$mg \cdot kg^{-1}$	37
Aluminum	$mg \cdot kg^{-1}$	0.9
Boron	$mg \cdot kg^{-1}$	1
Calcium	$mg \cdot kg^{-1}$	1599.3
Copper	$mg \cdot kg^{-1}$	0.1
Electrical conductivity	$dS \cdot m^{-1}$	7.95
Iron	$mg \cdot kg^{-1}$	0.5
Potassium	$mg \cdot kg^{-1}$	1639.8
Magnesium	$mg \cdot kg^{-1}$	2050.7
Manganese	$mg \cdot kg^{-1}$	10.9
Sodium	$mg \cdot kg^{-1}$	369.8
Phosphorus	$mg \cdot kg^{-1}$	46
Sulfur	$mg \cdot kg^{-1}$	1853.5
Zinc	$mg \cdot kg^{-1}$	0.1

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Black Beauty, a determinate heirloom cultivar) scions with *S. symonii* rootstock. The rootstock plants, grown from seeds using the methods described earlier, were established in 3-L black plastic pots, with two plants per pot. The pots contained potting soil (described earlier). Scion and rootstock material were established in a greenhouse at Curtin University, maintained at 25 °C, and irrigated twice per day for ~5 min using overhead sprinklers. Plants were fertilized weekly with 5 g·L^{-1} Aquasol Soluble Plant Fertilizer (N23–P4–K14 plus S, Mg, Mn, Cu, Fe, Zn, and B; Yates DuluxGroup Pty. Ltd., Clayton South, Victoria, Australia) at a rate of ~50 mL per pot. On 23 Feb 2024, two-month-old scions (with approximately five adult leaves) and 2- to 3-month-old rootstocks (with ~5–10 adult leaves), with stem diameters between ~3 and 5 mm, and still in their juvenile growth stage, were cut with a sterilized razor blade, joined using a cleft graft, and bound with parafilm. The size of the scion and rootstock plants was inconsistent, so cleft grafting was chosen because it is more accommodating of differences in stem size in scion and rootstock (Colla et al. 2017). Two graft combinations were used—tomato/eggplant scion and *S. symonii* rootstock (heterograft)—and tomato or eggplant cut and regrafted to itself (autograft or self-graft). There were 30 plants in each treatment, with two plants per pot. All grafting was done under 50% shadecloth. Plastic bags, closed around the stems, were used to cover the newly grafted plants and to maintain humidity postgrafting. The mean temperature in the greenhouse during the grafting was 25 ± 5 °C. Newly grafted plants were initially covered with 90% shadecloth for ~1 week, followed by 50% shadecloth for an additional week. The plastic bags were then removed and the plants were exposed to full light inside a polypropylene high tunnel (details provided in the next section). The peak photon flux density in the greenhouse was ~1000 μmol·m^{-2}·s^{-1}, measured with a LI-COR LI-185B Quantum/Radiometer/Photometer (LI-COR Environmental, Lincoln, NE, USA). Pots were arranged in a randomized complete block design, with two plants per replicate and 15 replicates. Survival of grafted plants was then assessed ~1, 2, and 3 weeks after grafting.

High-tunnel study. The typical growing season for the field production of tomatoes on the Swan Coastal Plain of southwestern Australia is August to July (Department of Agriculture Western Australia 2009), and high-tunnel production is used to extend the season. Our study therefore occurred about within this production season. In the first week of Apr 2024, ~4 weeks after grafting, plants from the grafting trial, and ungrafted tomato and eggplant of the same cultivar and age, were transferred to 8-L black plastic pots containing potting mix (described earlier). One plant was established in each pot, and eight replicates of each grafting and control treatment were used. The pots were placed in a high tunnel at Curtin University in a randomized complete block design. The high tunnel was covered with polyethylene film ~3 m high, 10 m wide, and 20 m long. The pots were spaced 50 cm apart and fertilized weekly with 5 g·L^{-1} Aquasol Soluble Plant Fertilizer at a rate of ~50 mL per pot. The high tunnel had a mean temperature of 20 ± 5 °C and the plants were watered via drip irrigation twice daily to maintain the substrate at close to field capacity. Plants were not pruned during the experiment. Bamboo stakes were used for support as needed. The greenhouse was open, allowing for insects to enter for natural pollination.

During the growing period, the leaf chlorophyll content of the plants was measured approximately every 2 weeks using a SPAD-502Plus chlorophyll meter (Konica-Minolta, Tokyo, Japan). Four separate readings were taken from each plant from the youngest, fully expanded leaves in the plant canopy. Beginning the last week of May 2024, fruit were harvested approximately once per week. Fruit were harvested when they reached a uniform red color. At each harvest, the number and total weight of the harvested fruit were recorded for each pot. There were 11 separate tomato harvests and eight separate eggplant harvests. The final harvests took place ~8 months after plant establishment, in the second week of Sep 2024, by which time all plants were showing extensive leaf senescence.

Pest control. In the grafting and high-tunnel studies, Success Ultra (Spinetoram 5 g·L^{-1}; Yates, Padstow, New South Wales, Australia) and Baythroid Advanced (beta-cyfluthrin 25 g·L^{-1}; Yates) were used as labeled for insect control (*Spodoptera litura* and *Leucinodes orbonalis*) at 6 mL·L^{-1} and 5 mL·L^{-1}, respectively. Lime sulfur (polysulfide 200 g·L^{-1}; Yates) was used as labeled for mite control (*Tetranychus evansi*) at 10 mL·L^{-1}.

Microscopy of graft union. After completion of the high-tunnel study, the graft unions for self- and hetero-grafted plants were observed via electron microscopy. Four replicates of each graft type were observed in each species. Samples were cut with a clean, sharp razor blade and placed on a specimen holder using double-sided C tape (Ted Pella Inc., Redding, CA, USA). Imaging was performed using a Jeol NeoScope JCM-6000Plus benchtop scanning electron microscope (JEOL Australasia Pty Ltd., Akishima, Tokyo). Preliminary testing found that no fixation or coating was required. Images were taken in variable pressure mode with a beam energy of 15 keV.

Statistical analysis. R statistical software was used for all data analyses and manipulations (version 4.4.1; R Foundation for Statistical Computing, Vienna, Austria). For the data from the grafting trial, a generalized linear model with a binomial distribution and logit link function were fitted to the data to assess the effects of species and grafting treatment, as well as their interaction, on plant survival (alive or dead). Post hoc pairwise comparisons were conducted via the *emmeans* package to determine significant differences between species and grafting combinations at the final observation time using estimated marginal means (Lenth 2024). An analysis of variance was conducted for the data from the high-tunnel study to evaluate the effects of grafting treatment on fruit yield, fruit size, and leaf chlorophyll content. Post hoc Tukey's honestly significant difference tests were performed to identify pairwise differences between grafting treatments via the *multcompView* package (Graves et al. 2024).

Results

Plant materials and propagation. Seeds of *S. symonii* treated with 1 μM karrikinolide had the greatest germination (97%) after

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6 weeks. By comparison, seeds treated with distilled water, which served as the control, achieved just > 50% germination. The lowest germination (37%) was observed for seeds incubated on 100 mM gibberellic acid. Seedlings initially formed a rosette, with little node separation until ~8 weeks of growth, after which stem elongation—as needed for grafting—began. Seedlings thereafter displayed rapid stem elongation. After ~10 d, the softwood tip cuts were observed to be producing roots and, after about 5 weeks, 100% of the tip cuttings, both those treated with rooting hormone and untreated controls, had produced extensive root growth. In contrast, no semihardwood cuttings produced roots. Cuttings showed more early stem elongation compared with seedlings.

Grafting survival. There was no significant difference in survival between the self-grafts of tomato and eggplant or between the heterografts of tomato and eggplant (Fig. 1). However, graft survival was reduced significantly by heterografting relative to self-grafting in the same species. After the initial death of grafted plants in the first week after grafting, graft survival did not decrease significantly.

High-tunnel study. There was a reduction in mean total fruit yield of ~15% in the heterograft treatment of tomato relative to the control (Fig. 2); however, the reduction was not significant ($P = 0.190$). There was also no significant difference in mean total fruit yield between either grafting treatments or the control for eggplant ($P = 0.999$) (Fig. 2). The median fruit size was slightly larger in the heterograft treatment for both species, relative to the self-graft and control; however, the difference was also not statistically significant (tomato, $P = 0.336$; eggplant, $P = 0.472$) (Fig. 3). Leaf chlorophyll content varied throughout the study, with no clear relationship to fruit production or graft type. During the middle period of the study, the heterografted tomato plants exhibited a significantly elevated leaf chlorophyll content relative to controls and self-grafted plants (Fig. 4), whereas the heterografted eggplants exhibited a significantly reduced leaf chlorophyll content relative to controls and self-grafted plants (Fig. 5).

Electron microscope visualization found that the stem tissues of tomato, eggplant, and *S. symonii* were similar morphologically, and the graft union was usually not discernible in the cortex or phloem, but could be seen in the xylem and pith in some samples. In self-grafted plants, the graft union was often difficult to distinguish from surrounding tissues, notably in eggplant (Fig. 6). In heterografted plants, the tissues at the graft union were usually visually distinct from the tissues of the scion and rootstock, and appeared "disorganized" (Fig. 7). In some, but not all, heterograft samples, there was no visible connection between the scion and rootstock in some regions of the sample (Fig. 7).

Other observations. *Solanum symonii* plants commenced flowering within 3 to 4 months of germination, and then flowered continuously in the greenhouse. Flowers produced fruit even in a greenhouse with an apparent absence of pollinators. Individual fruit provided large quantities of seed that germinated readily. Relative to tomato and eggplant, *S. symonii* was observed to develop an extensive root system quickly.

Discussion

The aim of our work was to explore the potential of *S. symonii* as a locally adapted rootstock for tomato and eggplant in Western Australia. This species was found to be easy to propagate via seed and cuttings, and seed germination could be improved with the use of kar_1 or smoke water, as found for other species of native *Solanum* (Commander et al. 2008). Although unexpected, gibberellic acid was observed to lower germination, as observed in *Ipomopsis aggregata* and *Stanleya pinnata* (Kildisheva et al. 2019), and this response may be the result of a supraoptimal gibberellic acid concentration that suppressed, rather than promoted, germination. Plants from both seed and cuttings grew rapidly and established a strong root system quickly. Generating plant material for grafting is straightforward. Significant graft failure was observed initially when using *S. symonii* rootstock for scions of tomato and eggplant, resulting in the loss of

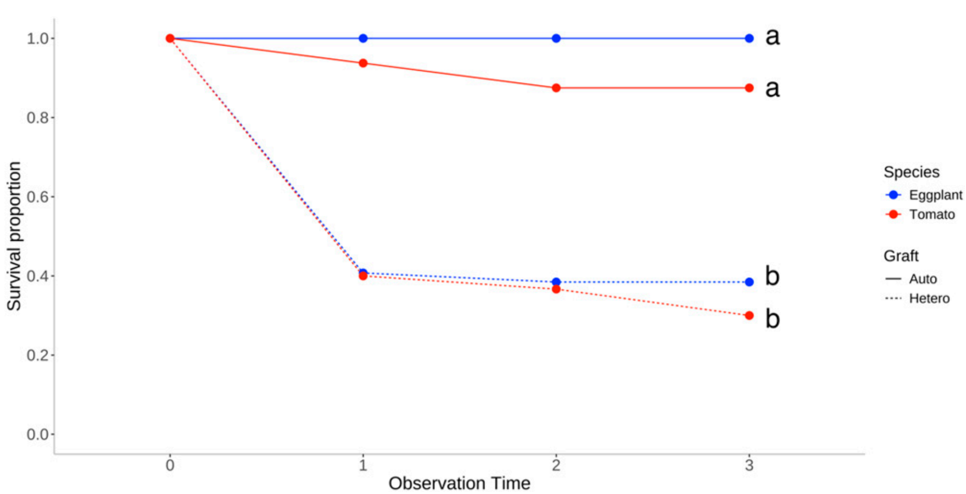

Fig. 1. The survival of plants 1, 2, and 3 weeks after grafting. The same lowercase letter indicates nonsignificance at $P = 0.05$. Auto = self-grafted treatment, which is tomato (*Solanum lycopersicum* L.) scion grafted to tomato rootstock or eggplant (*Solanum melongena* L.) scion grafted to eggplant rootstock; Hetero = heterografting treatment, which is tomato scion grafted to *Solanum symonii* rootstock or eggplant scion grafted to *S. symonii* rootstock.

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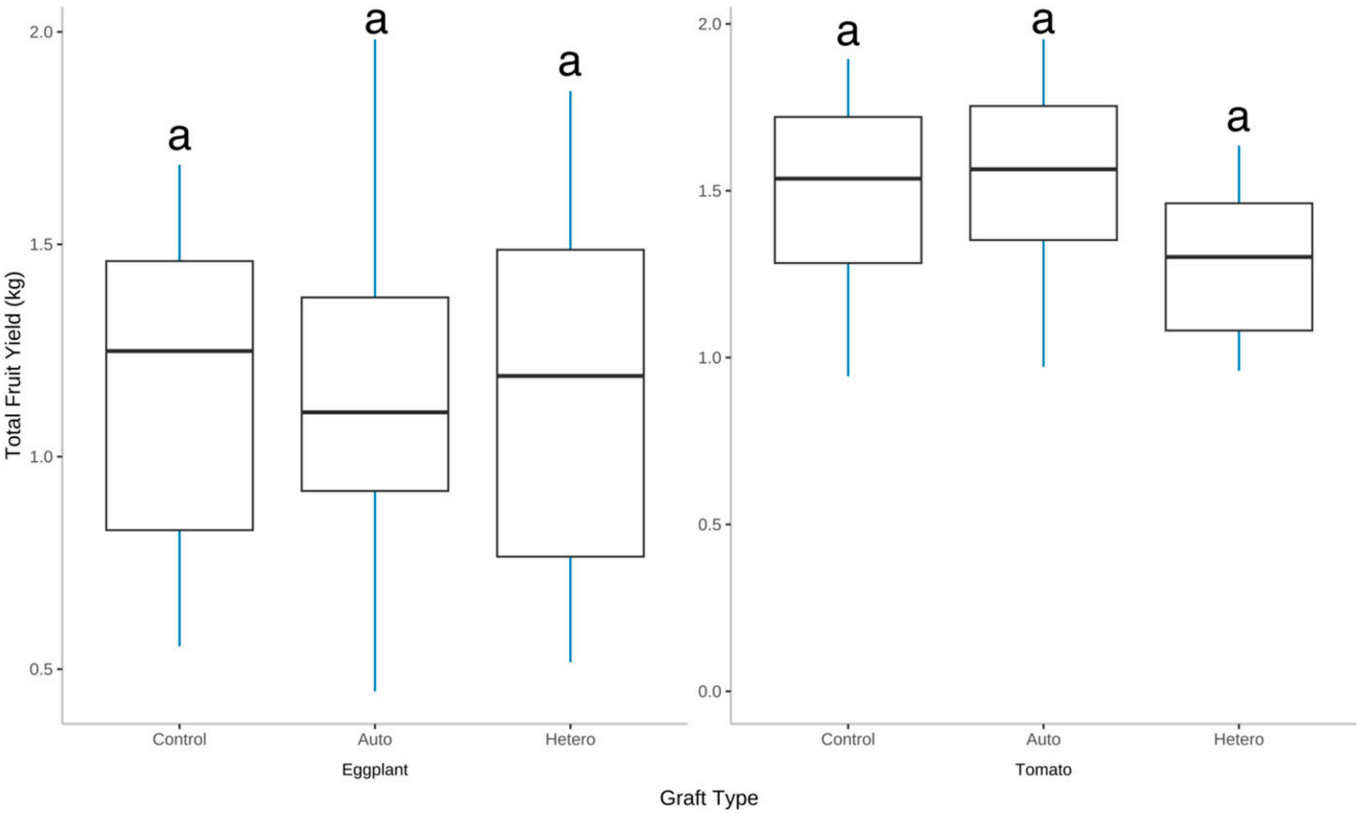

Fig. 2. Total fruit yield from tomato and eggplant under different grafting treatments. The same lowercase letter indicates nonsignificance at $P > 0.05$. Auto = self-grafted treatment, which is tomato (*Solanum lycopersicum* L.) scion grafted to tomato rootstock or eggplant (*Solanum melongena* L.) scion grafted to eggplant rootstock; Hetero = heterografting treatment, which is tomato scion grafted to *Solanum symonii* rootstock or eggplant scion grafted to *S. symonii* rootstock.

approximately half of the newly grafted plants after a week, relative to self-grafted plants. Surviving grafted plants then grew and produced fruit normally.

Some level of graft failure is common, and levels of failure comparable to those in this study can be experienced even from intraspecific grafts of different genotypes in Solanaceae (Thomas et al. 2023). Even with high rates of early graft survival, delayed graft incompatibility can still occur months or years after grafting (Rasool et al. 2020). Relative to self-grafted plants, tomato and eggplant with *S. symonii* rootstock displayed poorer connection of tissues at the graft site, potentially indicating some level of incompatibility. However, no significant death of heterografted plants relative to ungrafted or self-grafted plants was observed throughout the remainder of the study—a period of >9 months. In addition, preliminary experimentation by our research group found grafted tomato plants produced fruit 18 months after grafting whereas nongrafted plants established at the same time had mostly senesced. These findings suggest *S. symonii* can be tentatively considered a compatible rootstock for both tomato and eggplant if early graft survival can be improved.

To achieve a high grafting success rate, it is necessary to optimize factors such as humidity, temperature, light intensity, and duration of conditions postgrafting (Colla et al. 2017; Singh et al. 2017). In addition, the specific genotype of scion and rootstock can affect grafting outcomes significantly (Gong et al. 2022; Singh et al. 2017). It may be possible to increase postgraft survival of tomato and eggplant on *S. symonii* rootstock with appropriate postgraft management and genotype selection.

Solanum symonii was found to be very easy to propagate from vegetative cuttings. Vegetative propagation of rootstock is used to reduce the time and costs associated with the production of rootstock from seed as well as the supply of genetically uniform root stock material (Garner 2013; Miceli et al. 2014). The grafting of unrooted cuttings is also used to increase further the efficiency and cost-effectiveness of grafting operations (Miceli et al. 2014). The rapid and high strike rates of green tip cuttings, which can be produced in abundance from suitably maintained parent plants, giving *S. symonii* advantages as a rootstock, which could be advantageous if higher quality cultivars are identified.

Using *S. symonii* as a rootstock did not result in any significant change in fruit yield or size relative to controls for either tomato or eggplant. Given these results, there is no production advantage to using *S. symonii* as rootstock that can justify the additional cost and complexity of grafting. However, the benefits from grafting in *Solanum* are often only observed when the rootstock is resistant to biotic or abiotic stresses present in production (Gong et al. 2022). Such stresses were not present in the high tunnel.

Tomato production in Western Australia and other Australian regions is affected by several serious soil

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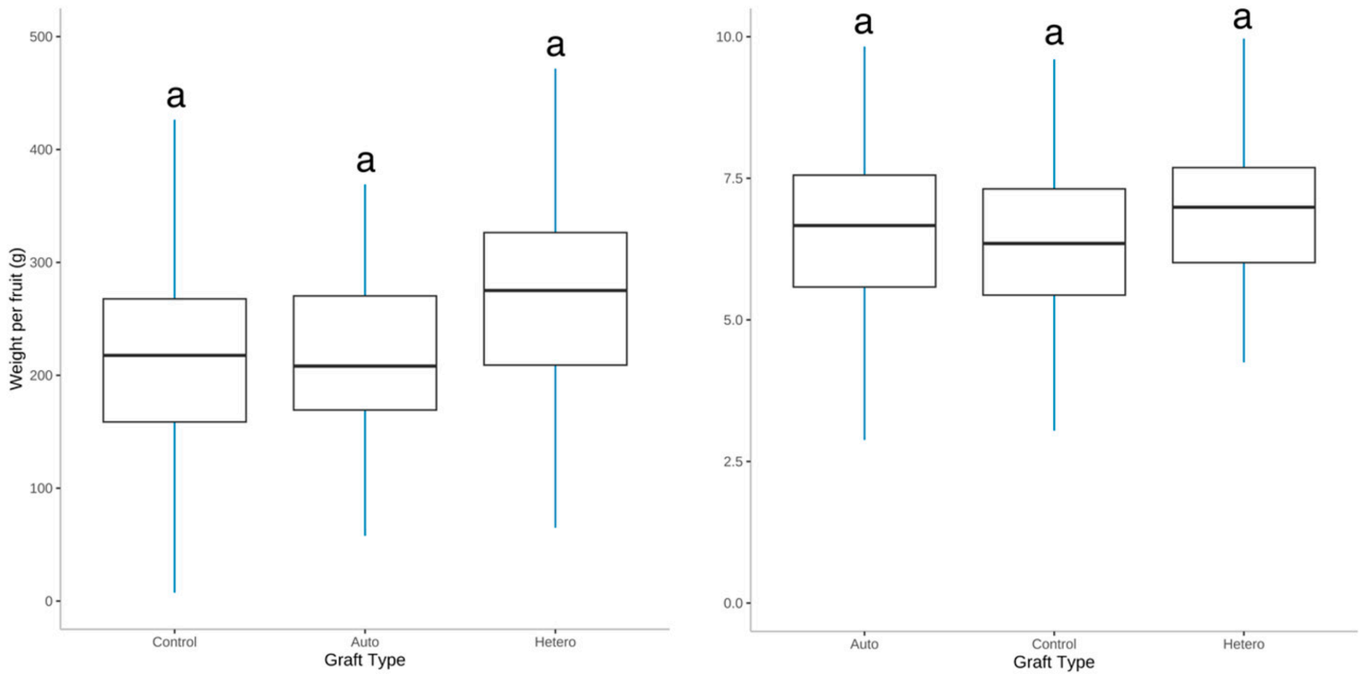

Fig. 3. Fruit size for tomato and eggplant under different grafting treatments. The same lowercase letter indicates nonsignificance at $P > 0.05$. Auto = self-grafted treatment, which is tomato (*Solanum lycopersicum* L.) scion grafted to tomato rootstock or eggplant (*Solanum melongena* L.) scion grafted to eggplant rootstock; Hetero = heterografting treatment, which is tomato scion grafted to *Solanum symonii* rootstock or eggplant scion grafted to *S. symonii* rootstock.

diseases. For example, root-knot nematode (*Meloidogyne* spp.) are a ubiquitous and problematic pest in horticulture throughout Western Australia, requiring costly chemical management (Department of Primary Industries and Regional Development 2016; Singh et al. 2017). In a preliminary study, our team grew both tomato (cv. Sweet Million) plants, and tomato (cv. Sweet Million) with *S. symonii* rootstock in soil with a root-knot nematode (*Meloidogyne javanica*, *Meloidogyne incognita*, *Meloidogyne arenaria*) population of 997 pg DNA/g, confirmed via a PREDICTA® B test (Ophel-Keller et al. 2008; Simpfendorfer et al. 2021). Root-knot nematodes at these levels could reduce crop productivity significantly for susceptible species. Both tomato and *S. symonii* showed root knots from nematodes, but the number and size of root knots were greater on the tomato plants, suggesting *S. symonii*

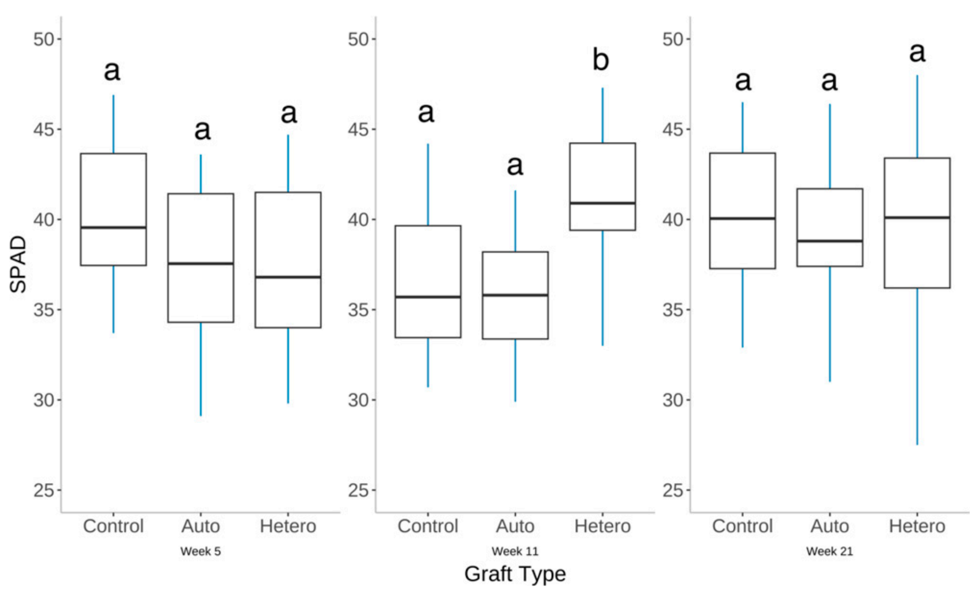

Fig. 4. Leaf chlorophyll [soil plant analysis development (SPAD)] content of tomato plants under different grafting treatments. The same lowercase letter indicates nonsignificance at $P > 0.05$. Auto = self-grafted treatment, which is tomato (*Solanum lycopersicum* L.) scion grafted to tomato rootstock; Hetero = heterografting treatment, which is tomato scion grafted to *Solanum symonii* rootstock.

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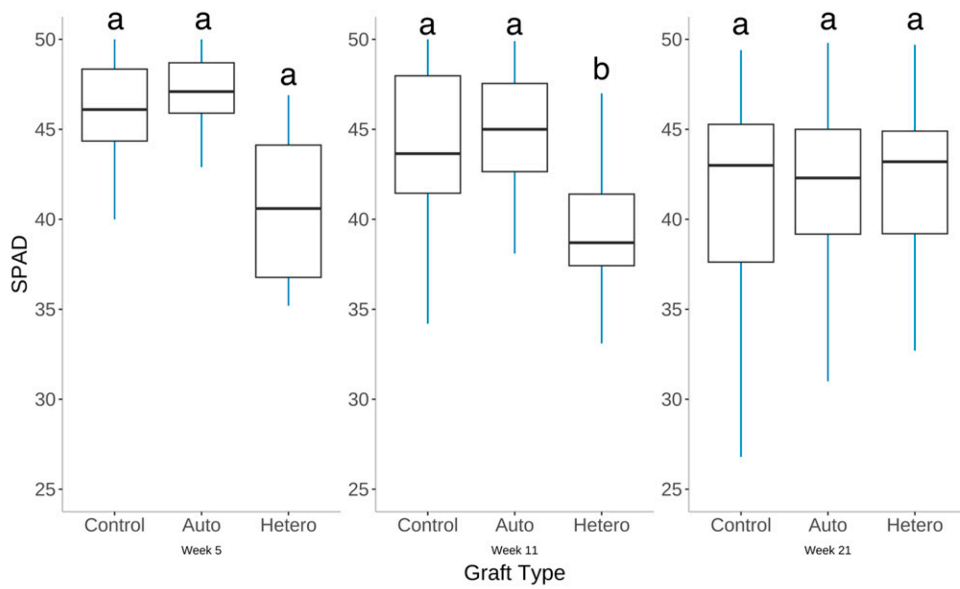

Fig. 5. Leaf chlorophyll content of eggplant under different grafting treatments. The same lowercase letter indicates nonsignificance at $P > 0.05$. Auto = self-grafted treatment, which is eggplant (*Solanum melongena* L.) scion grafted to eggplant rootstock; Hetero = heterografting treatment, which is eggplant scion grafted to *Solanum symonii* rootstock; SPAD = soil plant analysis development.

has some tolerance to root-knot nematode. Further work is needed to explore the resistance of *S. symonii* to soil-borne diseases.

The soils of the Swan Coastal Plain have extremely poor water- and nutrient-holding capacity, which poses production challenges to vegetable growers (Phillips et al. 2014). The majority of vegetable production is on yellow-brown Spearwood and Karrakatta sands (Phillips et al. 2014), which are the soil types on which *S. symonii* is generally found growing naturally (The Australasian Virtual Herbarium 2024). Vegetable production is also increasingly moving to older Bassendean sands farther inland, which have lower water- and nutrient-holding capacity (Phillips et al. 2014). Furthermore, Western Australian tomato production regions experience high summer temperatures with little to no rainfall during this time, which can affect production adversely (Singh et al. 2017). *Solanum symonii* appears to have the potential to develop a more extensive root system rapidly than tomato or eggplant, and similar observations have been made for the

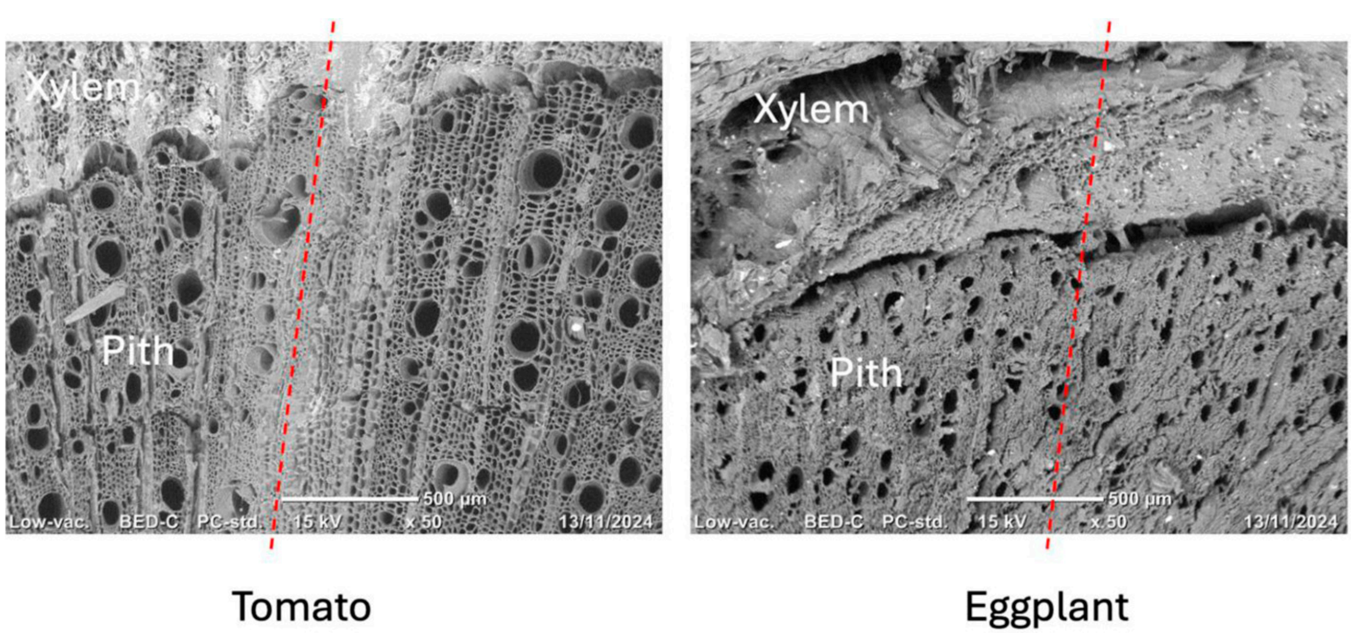

Fig. 6. Scanning electron microscope images of the graft union of self-grafted tomato and eggplant from transverse stem cross sections. The approximate location of the graft union is indicated by the red dashed line, with the scion on the left of the image and the rootstock on the right. The cortex is at the top of the image and the interior of the stem is at the bottom.

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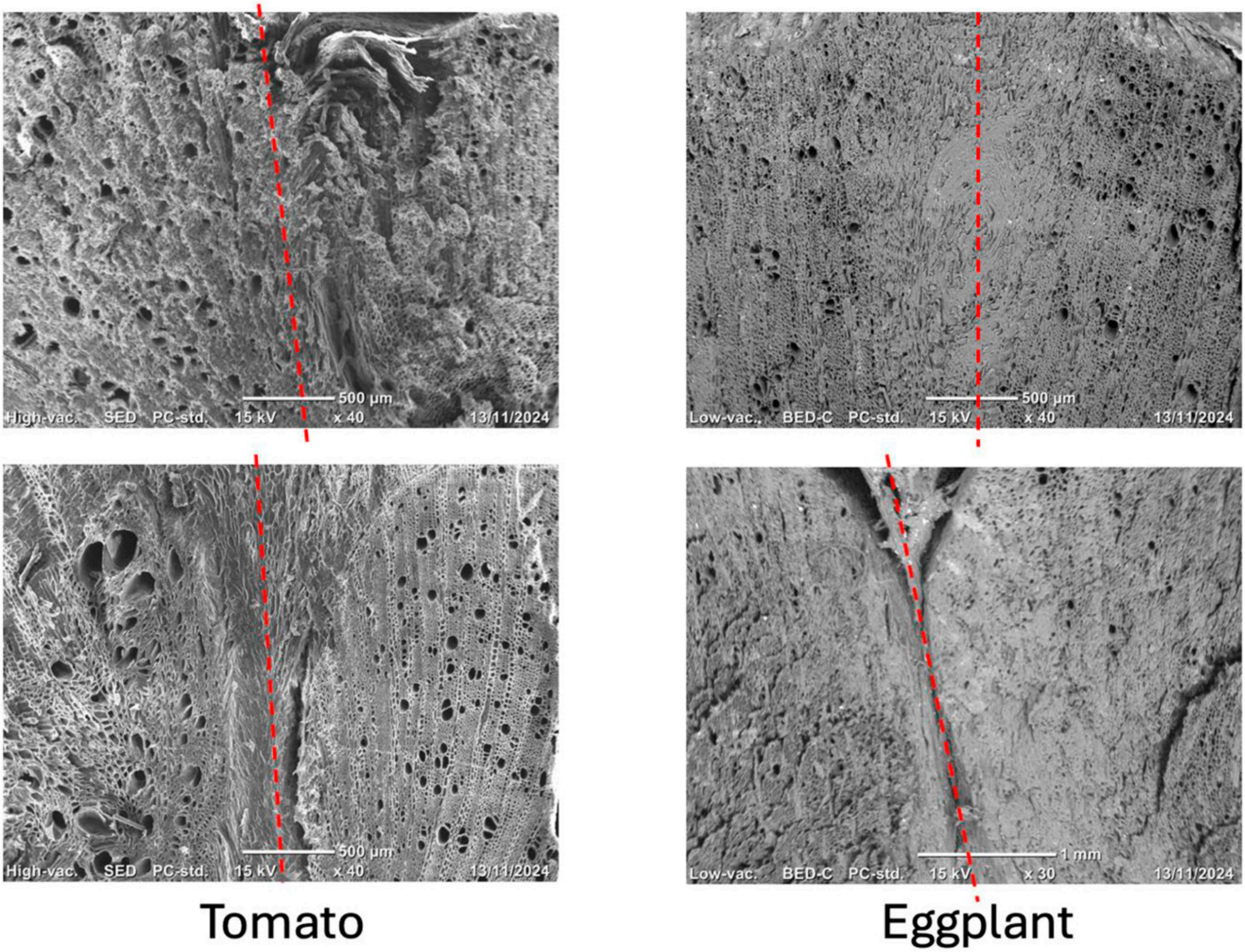

Fig. 7. Scanning electron microscope images of the graft union of heterografted tomato and eggplant from transverse stem cross sections. The approximate location of the graft union is indicated by the red dashed line, with the scion on the left of the image and the rootstock on the right. The cortex is at the top of the image and the interior of the stem is at the bottom. The upper images show sections where the scion and rootstock have fused, whereas the lower images are examples where fusion failed to take place completely.

related *S. aviculare* (Carey 2016). A larger root system suggests a greater capacity to scavenge water and nutrients than tomato or eggplant. Field trials of tomato and eggplant with *S. symonii* rootstock should therefore be conducted to test whether *S. symonii* has morphological and physiological root adaptations to low-nutrient and water-deficit conditions that can offer advantages for *Solanum* production on Swan Coastal Plain soils.

Grafting can affect commercially relevant fruit quality and composition traits of tomato significantly (Gong et al. 2022; Moreno et al. 2019; Singh et al. 2017), and there is also evidence for the translocation of potentially toxic alkaloids from rootstock to scion fruit when tomatoes are grafted to species of *Datura* and *Nicotiana* (Belmonte-Ureña et al. 2020). The impact of *S. symonii* rootstock on fruit quality and composition must therefore be investigated, particularly given that species of *Solanum* in the *Archaesolanum* subgenus can have high levels of potentially toxic alkaloids (Bradley et al. 1978).

At least 130 Australian taxa are crop wild relatives, and there is considerable potential for the use of native Australian plants as new food crops and as a source of germplasm for breeding (George et al. 2023). Our work illustrates that native Australian wild relatives can be explored for other potential agricultural applications aside from food. We suggest that other Australian *Solanum* be investigated for their potential as rootstock for solanaceous crops. For example, the species *Solanum hoplopetalum*, *Solanum lasiophyllum*, *Solanum orbiculatum*, *Solanum oldfieldii*, and *S. simile* are widely distributed in southwestern Western Australia, across a diversity of soil types, with some occurring in arid conditions (The Australasian Virtual Herbarium 2024). *Solanum hoplopetalum*, *S. lasiophyllum*, and *S. orbiculatum* also have the potential to be weedy in grain and livestock production systems [e.g., Michael et al. (2012)], suggesting they have characteristics that lend them for use as rootstock for tomato production in a range of

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potentially challenging environments, and thus have the potential to broaden significantly the environmental envelope for the commercial cultivation of tomato.

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