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Screening Traditional Eggplant for Potential Resistance Rootstock in Management of Bacterial Wilt Disease on Tomato

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Abstract: Tomato plants (*Solanum lycopersicum* L.) suffer major yield losses due to bacterial wilt, a highly destructive disease resulting from infection by the soil-borne bacterium *Ralstonia solanacearum*. One effective strategy to manage this pathogen is grafting susceptible tomato varieties onto resistant rootstocks. In this study, nine traditional eggplant (Solanum melongena) accessions from MARDI MyGenebank were screened under glasshouse conditions for resistance to R. solanacearum using artificial inoculation via soil drenching. Disease symptoms were monitored for 21 days post-inoculation to assess disease severity and wilting percentage. Results revealed that terung pipit, terung rapuh 77, and terung rapuh 22 exhibited strong resistance, with wilting percentages ranging from 0.0% to 10.0% and disease index values below 1. Terung assam and terung telunjuk exhibited moderate resistance, with 33–50% wilting and disease index values ranging from 2 to 3. The remaining accessions were highly susceptible, exhibiting 55–100% wilting and disease indices of 3–4. These findings are consistent with international studies on traditional and wild Solanaceae species, highlighting the genetic diversity and resistance potential within local germplasm. The identification of resistant accessions provides promising candidates for rootstock development in grafting systems to control bacterial wilt in tomato. Future work should focus on field validation and molecular characterisation to support the integration of these accessions into sustainable tomato production systems.

Keywords: Bacterial wilt, *Ralstonia solanacearum,* terung rapuh, terung telunjuk, disease resistant

1. Introduction

One of the most significant and extensively grown horticultural crops in the world is the tomato (Solanum lycopersicum). Due to its extensive use in various food products, including sauces, tomato paste, and juice, as well as its role as a necessary component in many recipes, it has a high nutritional value and contributes significantly to the global agricultural economy. In Malaysia, tomatoes are widely grown, especially in regions with a tropical climate that is conducive to their growth. This cultivation is heavily practiced in highland regions, such as Kundasang in Sabah and the Cameron Highlands in Pahang. Tomatoes are becoming a high-value commodity in Malaysia's agricultural sector, driven by rising local demand and exports (Islam, 2012). But the escalation of farming operations in these vulnerable highland ecosystems has contributed to environmental issues like soil erosion and landslides. Consequently, there is an increasing need to diversify and adapt tomato production to lowland areas to ensure a more sustainable supply chain while alleviating pressure and reducing environmental degradation in highland regions.

The production of tomatoes in lowland regions was significantly hampered by bacterial wilt diseases brought on by Ralstonia solanacearum. According to Yadessa et al. (2010), the pathogen is soil-borne, thrives at temperatures between 28 and 32 °C, and has a lengthy survival period. Globally, solanaceous plant cultivation has been found to be impacted by this soil-borne disease (Barik et al., 2020), and the disease is made worse by exceptionally high temperatures in lowlands. This pathogen causes wilting, chlorosis, and eventually plant death by infecting tomato plants' vascular systems.

Grafting with disease-resistant rootstocks is a widely recognized strategy for managing soil-borne diseases such as bacterial wilt in tomato cultivation. Rootstocks play a crucial role as the primary interface between the host plant and

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soil pathogens, influencing both resistance mechanisms and overall plant performance (Romano & Paratore, 2001). Among potential rootstocks, traditional eggplant (*Solanum melongena*) genotypes have shown considerable promise due to their inherent genetic resistance to *Ralstonia solanacearum*, the causal agent of bacterial wilt (Manickam et al., 2021). In addition to cultivated genotypes, wild relatives within the *Solanum* genus particularly *Solanum torvum* have demonstrated strong resistance to bacterial wilt. According to Oladosu et al. (2021), these wild species provide resistance traits and genetic diversity that are frequently lacking in domesticated varieties.

Malaysia has a vast diversity of traditional eggplant species (Mohd Zulkhairi et al., 2020). Investigating the diverse array of wild relatives of eggplant for resistance or tolerance to bacterial wilt allows for the discovery of new sources of resistance that can be successfully used as rootstocks in tomato farming. A sustainable and eco-friendly method of managing bacterial wilt is the use of resistant rootstocks, especially from wild and traditional species, which represents a sustainable and environmentally friendly approach to bacterial wilt management. Incorporating such rootstocks into integrated disease management strategies may enhance tomato production, particularly in lowland areas severely affected by the disease, while also contributing to the long-term improvement of local tomato cultivars. This study aims to evaluate the potential of traditional eggplant (*Solanum* spp.) accessions as resistant rootstocks for managing bacterial wilt disease in tomato cultivation.

2.0 Material and Methods

2.1 Planting materials and growth conditions

The experiment was conducted at the plant pathology greenhouse of the Agrobiodiversity and Environment Research Centre using a randomized complete block design (RCBD). Seeds of nine (9) accessions of traditional eggplants (Table 1) were obtained from the MyGenebank, MARDI Serdang. They were sown into 72-cell flats germination trays containing peat moss. The trays were placed in a greenhouse maintained at a temperature range of 25-30°C, ensuring optimal conditions for seed germination and early seedling growth. They were adequately watered as needed. Seeds of tomato var. baccarate from commercially available sources were included as a susceptible check or positive control and grown under the same conditions. Seedlings at the 3-5 leaf cotyledon stage were transplanted into individual polybags, filled with potting media, and grown until all seedlings developed four to six true leaves. Pots were arranged on raised benches in a greenhouse, exposed to natural light and a temperature range of 25 °C to 30 °C. Plants were irrigated twice daily using a sprinkler system and spaced to exclude pathogen splash dispersal. Three replications with eight plants each were used for inoculation, including negative control

Table 1: Traditional eggplants used for evaluation for resistance to bacterial wilt

No	Eggplant accession
1.	Terung putih asal
2.	Terung Bulu
3.	Terung TE Sabah
4.	Terung pipit
5.	Terung rapuh 77
6.	Terung Asam
7.	Terung susu
8.	Terung rapuh 22
9.	Terung telunjuk

2.2 Preparation for bacterial suspension

Ralstonia solanacearum was isolated from infected tomato plants by serial dilution on a casamino acid-peptone glucose (CPG) medium. Cultures were incubated at room temperature for 24 hours and pure cultured by repeatedly streaking a single colony on CPG agar medium before use (Figure 1). The virulent bacteria, typically characterized by a fluid white or cream-colored appearance, were used to prepare an inoculum suspension. The pure culture colonies were transferred and grown in nutrient broth (Difco, USA) with shaking at 1200 rpm on an orbital shaker (Orbitek, India) for 48 hours. The bacterial suspensions were prepared and adjusted to approximately 10^8 CFU/ml (OD600 = 0.8) and used for artificial inoculation of seedlings in the glasshouse (Namisy et al., 2019).

Fig. 1: Culture of *Ralstonia solanacearum*

2.3 Bacterial inoculation

A soil drenching technique (Aslam et al., 2017) was used to inoculate plants with *R. solanacearum*. Each plant received 10 mL of bacterial suspension inoculum containing approximately 10^8 CFU/mL, poured around the base near the root zone (Prior et al., 2013). watered the plants regularly to maintain adequate soil moisture for plant growth, and monitored wilting symptoms daily for 21 days. Approximately 10% of symptomatic plants were sampled for pathogen reisolation. The presence of milky bacterial ooze in wilted plants, a crucial criterion, was considered evidence of R. solanacearum infection.

2.4 Disease evaluation

Disease development was evaluated using the method of Kim et al. (2016), employing a bacterial wilt disease rating scale of 0-4 as shown in Table 2. Symptom grading was based on visual assessment: 0 = no wilted leaves or no symptoms, 1 = up to 25% wilted leaves, 2 = 26–50% wilted leaves, 3 = 51–75% wilted leaves, and 4 = 76–100% wilted leaves. Symptom progression and disease severity were monitored at 21 days post-inoculation. Disease incidence was calculated using the formula:

Disease incidence (%)=(Total number of inoculated plants / Number of infected plants) × 100

Meanwhile, the disease index (DI) for bacterial wilt was determined using the following formula:

Disease Index (%)=
(Total number of plants×Maximum disease rating∑(Disease rating×Number of plants at that rating))×100

Based on Disease Index (DI) values, a measure of the overall disease severity, plant resistance to bacterial wilt was classified into five categories (Table 3): Resistant (R) seedlings had a mean DI of less than 2, indicating a low level of disease severity. Those with a DI between 2 and 3 were categorized as moderately resistant (MR), showing a moderate level of disease severity. Seedlings with a mean DI greater than three were classified as susceptible (S), indicating a high level of disease severity.

Table 2: Bacterial wilt disease rating scale (Kim et al. 2016)

Rating	Symptom
0	No wilting
1	1-25 % wilted leaves
2	26-50% wilted leaves
3	51-75% wilted leaves
4	76-100% wilted leaves

Table 3: Disease index of bacterial wilt

Scale	Disease severity	Resistant category
0	0.00	Resistant (R)
1	0.01- 0.25	Resistant (R)
2	0.26- 0.50	moderate resistant (MR)
3	0.51- 0.75	moderate resistant (MR)
4	0.76 – 1.0	Susceptible (S)

3.0 Results and Discussion

Various levels of resistance to bacterial wilt caused by *Ralstonia solanacearum* were found in a screening of nine traditional eggplant accessions (Figure 2). Three of them, terung pipit, terung rapuh 77, and terung rapuh 22, demonstrated strong resistance, as evidenced by disease index scores below 2 and consistently low disease severity (ranging from 0.0% to 10.0%). These findings are in accordance with earlier research showing the potential of wild or traditional Solanaceae species as important genetic resources for resistance. In tropical areas like the Philippines and India, for instance, wild species like *Solanum torvum* and *Solanum sisymbriifolium* are frequently used as rootstocks due to their notable resistance to R. solanacearum, according to Daunay et al. (2010). Likewise, Pradhanang et al. (2000) found disease-resistant native eggplant varieties in Nepal. with disease severity under 20%. In comparison, the resistant accessions identified in this study exhibited similar performance, particularly under controlled glasshouse conditions. This suggests that certain Malaysian landraces may carry inherent resistance traits, presenting potential applications in breeding or grafting strategies.

Accessions such as *terung assam* and *terung telunjuk* exhibited moderate resistance, with disease severity between 33% and 50% and disease index values ranging from 2 to 3. These characteristics are comparable to those observed in traditional eggplant varieties from Thailand, as reported by Nion and Toyota (2008), further supporting the role of regional genetic diversity in offering various resistance levels suitable for different agroecosystems. In contrast, accessions like *terung susu*, *terung putih asal*, *terung TE Sabah*, and *terung bulu* were found to be susceptible, with severity levels reaching 55%–100% and disease index values between 3 and 4. This observation aligns with findings by Mochizuki et al. (2005), who noted high susceptibility in several cultivated Asian eggplants unless grafted onto resistant stocks.

In summary, the results underscore the significance of evaluating local germplasm for resistance attributes. Traditional Malaysian eggplant varieties may offer comparable, if not superior, resistance compared to foreign lines. Moving forward, extensive field evaluations across multiple environments and molecular studies are recommended to confirm the resistance potential and integrate these traits into sustainable cultivation practices.

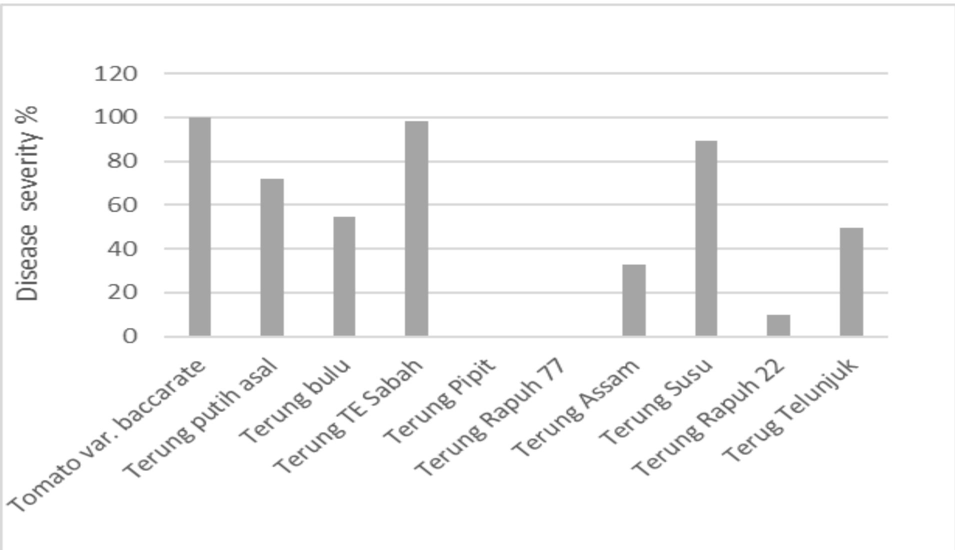

Fig. 2: Disease severity percentage in the traditional eggplant accessions

Table 4: Resistance of different traditional eggplant accessions to *R. solanacearum*

DI	Eggplant accession	Grading
0	Terung Rapuh 77, Terung Pipit	R
1	Terung Rapuh 22	R
2	Terung Telunjuk	MR
3	Terung Assam	MR
4	Terung Putih Asal, Terung Bulu, Terung Susu, Terung TE Sabah, Tomato var. baccarate	S

Notes: Susceptible (S), Moderate Resistant (MR), Resistant

4.0 Conclusion

The nine traditional eggplant accessions showed varying levels of resistance to *Ralstonia solanacearum*. Three accessions *terung pipit*, *terung rapuh 77*, and *terung rapuh 22* were identified as resistant, while others like *terung assam* and *terung telunjuk* showed moderate resistance, highlighting the genetic diversity among local varieties. In contrast, several accessions were highly susceptible. These findings underscore the value of screening local germplasm and suggest that traditional Malaysian eggplants hold promise as sources of resistance for breeding or grafting. Further field and molecular studies are recommended to support sustainable eggplant production.

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Conflict of Interest

The authors declare no conflicts of interest.

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