



Evaluation of Local Rice Genotypes from Southwest Aceh for Resistance to Bacterial Leaf Blight (Xoo Strain VIII)

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Abstract: Local rice germplasm is a valuable genetic resource for developing bacterial leaf blight (BLB)-resistant and high-yielding rice cultivars. However, information on the resistance of Southwest Aceh local rice to *Xanthomonas oryzae* pv. *oryzae* (Xoo), particularly during the generative stage, remains limited. Previous studies have mainly focused on commercial cultivars or vegetative-stage screening, leaving the resistance potential of local germplasm at the reproductive stage largely unexplored. This study aimed to evaluate the resistance of local rice to BLB at the generative stage of plant growth. The research was conducted at Experimental Field, Teuku Umar University, West Aceh (4°08'33" N; 96°11'54" E). Fifteen local rice genotypes, together with resistant and susceptible control varieties, were evaluated following artificial inoculation with Xoo strain VIII. Disease resistance was assessed based on incubation period and lesion length, while agronomic performance was evaluated using key yield-related traits. Seven local genotypes Itam Tangke Lango, Jantong, Jempa Puteh, Manyam U, Pade Manggeng-1, Pade Manggeng-2, and Rangan Lango were classified as resistant based on lesion length. Among the evaluated genotypes, Sikleng exhibited superior agronomic performance, producing the highest number of productive tillers (27.50) and grains per panicle (317.73). The novelty of this study lies in evaluating Southwest Aceh local rice germplasm for bacterial leaf blight resistance at the generative stage using Xoo strain VIII while integrating disease resistance with yield-related agronomic traits. The identified resistant genotypes provide valuable donor parents for breeding BLB-resistant, high-yielding rice cultivars and contribute to sustainable rice production and regional food security.

Keywords: Bacterial inoculation; Bacterial leaf blight; Breeding; Genetic diversity

Introduction

Rice (*Oryza sativa* L.) is the staple food for more than half of the world's population and plays a crucial role in ensuring food security, particularly in Asian countries such as Indonesia. In 2023, Indonesia produced 31.10 million tons of rice, representing a decline of 1.39% compared with the previous year (BPS, 2023). This reduction has been associated with multiple factors, including climate change, which has altered temperature and rainfall patterns, thereby affecting rice growth, productivity, and disease dynamics (Singh et al., 2023). As global demand for rice continues to

increase, improving rice productivity while maintaining resilience to environmental stresses has become a major priority for sustainable agriculture.

Among the major biotic constraints affecting rice production, bacterial leaf blight (BLB), caused by *Xanthomonas oryzae* pv. *oryzae* (Xoo), is one of the most destructive diseases worldwide. Climate change is expected to increase the frequency and severity of BLB outbreaks because higher temperatures and prolonged periods of humidity favor pathogen survival, multiplication, and dissemination (Savary et al., 2019; Singh et al., 2023). The pathogen infects rice plants throughout their life cycle, but infections during the

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generative stage are particularly damaging because they reduce photosynthetic activity, disrupt grain filling, and may result in yield losses of up to 50–70% (Laraswati et al., 2021; Eryah et al., 2023). Therefore, identifying rice genotypes with stable resistance to BLB has become increasingly important under changing climatic conditions.

The deployment of resistant cultivars is widely recognized as the most economical, environmentally friendly, and sustainable strategy for managing BLB. Compared with chemical control, resistant varieties provide long-term protection while minimizing production costs and environmental impacts. Consequently, breeding programs have increasingly focused on incorporating BLB resistance genes into high-yielding cultivars (Mustikarini et al., 2024). The success of such programs depends largely on the availability of genetically diverse donor parents possessing durable resistance and desirable agronomic characteristics (Hadianto et al., 2015).

The West-South Aceh region possesses abundant local rice germplasm that has been maintained by farmers for generations under diverse agroecological conditions. Previous exploration identified approximately 20 local rice accessions distributed across Aceh Jaya, West Aceh, Nagan Raya, Southwest Aceh, South Aceh, and Simeulue (Hadianto et al., 2020). These local genotypes exhibit considerable variation in plant height, tillering ability, flowering time, panicle architecture, grain morphology, and adaptation to local environments, reflecting broad genetic diversity that is valuable for rice improvement (Sobrizal, 2016). Furthermore, local germplasm represents an important reservoir of alleles associated with resistance to biotic and abiotic stresses, yield potential, and adaptation, making it an indispensable genetic resource for modern rice breeding (Andarini et al., 2023).

Despite the high diversity of local rice germplasm in West-South Aceh, information regarding its resistance to BLB remains limited. Previous studies have primarily focused on germplasm exploration, morphological characterization, or resistance evaluation during the vegetative stage, whereas information on disease responses during the generative stage, when BLB has the greatest impact on grain yield, is still lacking. Moreover, the resistance of these local genotypes against Xoo strain VIII, one of the important virulent strains in Indonesia, has not been comprehensively evaluated. The novelty of this study lies in the first comprehensive evaluation of Southwest Aceh local rice germplasm for BLB resistance during the generative stage using Xoo strain VIII while integrating disease resistance with yield-related agronomic traits. This integrated approach provides more reliable information for identifying local donor parents with

both disease resistance and favorable agronomic performance.

Therefore, this study aimed to evaluate the resistance of local rice genotypes from West-South Aceh to bacterial leaf blight during the generative stage using Xoo strain VIII and to assess their agronomic performance under disease pressure. The findings are expected to identify promising donor parents for BLB resistance breeding and provide valuable genetic resources for developing high-yielding, BLB-resistant rice cultivars adapted to local agroecosystems, thereby supporting sustainable rice production and regional food security.

Method

The research was conducted at Experimental Field, Teuku Umar University. West Aceh (4°08'33" N; 96°11'54" E).

The research materials used were 15 types of local West-South Aceh rice, IR-64 varieties (susceptible control), Rangan Lango, Jantong, Sigupai, Tinggong, Jempa Puteh, Siputeh, Rasi Kuneng, Sirende, Pade Manggeng-2, Manyam U, Itam Tangke Lango, Pade Manggeng-1, Sikleng and resistant control varieties (IR-BB27), alluvial soil, manure, Urea, SP-36 and KCl, 70% ethanol, agar, pots per bucket and Nutrient Agar (NA) media. The equipment used in this study included Petri dishes, freezers, analytical scales, cameras, meters, and other equipment.

Research Procedure

The research was conducted by soaking the rice seeds overnight, followed by germination for two days in a container covered with a sack to prevent direct sunlight. After germination, the seeds were sown in nursery trays.

The planting medium used was alluvial soil placed in pots containing 8 kg of soil per pot. A total of 90 pots were prepared, filled with water, and the soil was thoroughly mixed until it became muddy. Rice seedlings were transplanted at one week after sowing (WAS) by planting one seedling per pot.

The experiment was arranged in a completely randomized design (CRD) consisting of 13 local rice genotypes and two control varieties (IR64 as the susceptible control and IRBB27 as the resistant control), with three replicates. Each replication consisted of two plants, resulting in a total of 90 experimental plants for the study.

Initial fertilization consisted of urea at 300 kg ha⁻¹ (1.2 g per pot), SP-36 fertilizer (0.8 g per pot), and KCl fertilizer (0.6 g per pot). SP-36 and KCl were applied once at planting, whereas urea was applied in three stages: the first application at 2 weeks after transplanting

(WAT) at 40% (0.48 g per pot), the second at 6 WAT at 40% (0.48 g per pot), and the third at the flower primordial stage at 20% (0.24 g per pot).

Rice plant maintenance included replanting missing seedlings and weed control. Harvesting was performed when the grains reached physiological maturity or full ripeness.

The experiment was conducted under open field conditions. During the study period, the average air temperature ranged from 28–32°C with relative humidity between 75 and 90%, environmental conditions that are favorable for bacterial leaf blight development.

Inoculum Preparation (Strain VIII)

The bacterial inoculum of Strain VIII was obtained from the Protection Laboratory, Faculty of Agriculture, Syiah Kuala University, and prepared in the Protection Laboratory of the Faculty of Agriculture at the same university. The bacterial culture was maintained on slant agar medium at a temperature of 20–25 °C to prevent contamination.

Strain VIII was selected because it is one of the most virulent and widely distributed pathotypes of *Xanthomonas oryzae* pv. *oryzae* (Xoo) in Indonesia. Its high virulence enables reliable differentiation between resistant and susceptible rice genotypes, making it an appropriate strain for screening germplasm and identifying potential donor parents in rice-breeding programs.

Bacterial inoculation (Strain VIII) was performed in the afternoon using the leaf-clipping method, in which the tips of rice leaves were clipped with scissors previously dipped into a bacterial isolate suspension contained in an Erlenmeyer flask. Inoculation with *Xanthomonas oryzae* pv. *oryzae* (Xoo) isolate was applied to rice plants at the vegetative stage, specifically at 6 weeks after transplanting (WAT).

Five fully expanded leaves were inoculated per plant using the leaf-clipping method, with approximately 2–3 cm of each leaf tip clipped to ensure uniform pathogen infection in all experimental units.

Observed Agronomic Parameters During the Generative Phase

The observation parameters during the generative phase included plant height at harvest (cm), number of productive tillers (tillers), harvesting age (days), panicle length (cm), number of grains per panicle (grains), percentage of filled and unfilled grains (%), and 1,000-grain weight (g).

Incubation Period (Strain VIII)

The incubation period (Strain VIII) was observed from the time of inoculation until disease symptoms

appeared on the rice leaves. Observations were conducted daily for 14 days after inoculation (DAI).

Lesion Length

Lesion length was observed 14 days after inoculation (DAI) by measuring the length of leaves showing lesions on five rice leaf samples from three replicates. The severity of *Xanthomonas oryzae* pv. *oryzae* (Xoo) infection was classified based on the resistance scoring standard of the Standard Evaluation System (SES) developed by International Rice Research Institute. Plants were categorized as resistant when lesion length was < 3 cm, moderately resistant at 3–6 cm, and susceptible when lesion length was > 6 cm (Chen et al., 2001). The following research flow diagram is presented in Figure 1.

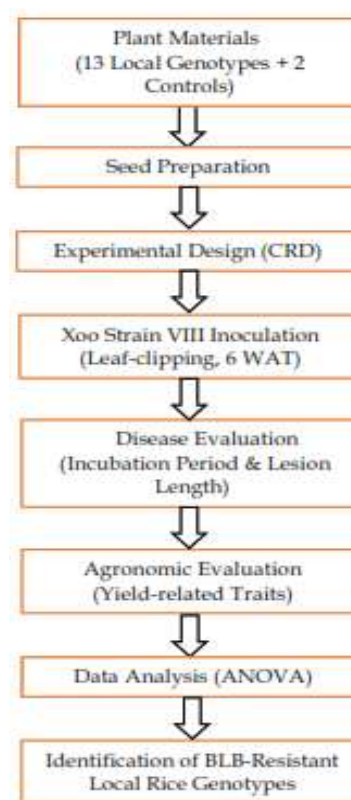


Figure 1. Research flow diagram

Result and Discussion

Generative Phase Agronomic Characters

The F-test results from the analysis of variance of 15 local rice genotypes from West South Aceh showed a highly significant effect on plant height at harvest, number of productive tillers, harvest age, panicle length, number of grains per panicle, percentage of filled rice grains, percentage of unfilled rice grains, and weight of 1000 grains.

Aceh local rice genotypes generally exhibited taller plant stature than the commercial cultivar IR-64,

indicating their potential as valuable genetic resources for breeding programs (Table 1). This indicates that Aceh local rice genotypes exhibit greater plant height than national high-yielding varieties, reflecting their broad genetic diversity. Taller plant stature is an important agronomic trait that can be exploited in rice breeding, and these genotypes may serve as valuable genetic resources for developing cultivars with improved adaptation and yield potential. The average number of productive tillers was highest in the IR-64 variety (28,00 tillers) as the control; however, there was

no significant difference compared to the Sikleng genotype (27,50 tillers) and the Itam Tangke Lango genotype (24,67 tillers). This demonstrates that local Aceh rice genotypes have a high yield potential, as indicated by the number of productive tillers. Furthermore, most of the Aceh local rice genotypes tested exhibited a number of productive tillers comparable to the comparator varieties, falling within the medium (10–19 tillers) and high (20–25 tillers) categories (Hadianto et al., 2023).

Table 1. Average Plant Height at Harvest, Number of Productive Tillers, Harvest Age, and Panicle Length in 15 Local Rice Genotypes from West-South Aceh

Genotypes	Observation Variables			
	PHH	NPT	HA	PL
IR-64	90.50 a	28.00 d	104	25.67 a
IRBB-27	95.18 a	11.83 a	106	30.42 d
Rangan Lango	142.50 b	14.67 ab	149	31.16 e
Siputeh	144.78 b	23.67 c	174	24.94 a
Sirinde	153.50 b	23.33 c	147	26.07 bc
Sikleng	166.33 b	27.50 d	174	26.42 b
Pade Manggeng (2)	167.00 b	19.83 bc	175	25.80 a
Tinggong	168.00 bc	24.00 c	171	26.14 bc
Itam Tangke Lango	176.67 c	24.67 d	152	28.11 c
Rasi Kuneng	180.17 c	23.17 c	148	25.84 ab
Jantong	180.50 c	21.00 c	174	28.89 cd
Sigupai	185.20 c	19.33 b	146	24.50 a
Manyam u	188.77 c	19.17 b	135	26.76 bc
Pade Manggeng (1)	193.17 c	22.17 c	173	23.68 a
Jempa Puteh	197.33 c	24.50 c	149	29.55 d
LSD 5%	29.92	6.03	-	2.19

Note: Numbers in the same column bearing the same letter are not statistically significantly different ($P = 0.05$). Plant Height at Harvest (PHH), Number of Productive Tillers (NPT), Harvest Age (HA), Panicle Length (PL).

The fastest average harvest age was observed in the IR-64 variety (104 days), while the longest harvest age was recorded in the Pade Manggeng (2) genotype (175 days) (Table 1). The longest average panicle length was found in the Rangan Lango genotype (31,16 cm), and the shortest in the Pade Manggeng (1) genotype (23,68 cm). Panicle length has a direct influence on the number and shape of grains per panicle, which significantly impacts rice yield (Huang et al., 2019).

The highest average number of grains per panicle was observed in the resistant control variety IRBB27 (457.56 grains), which was not significantly different from that of the Sikleng genotype (317.73 grains) but was significantly higher than that of the lowest-performing genotype (107.31 grains) (Table 2). The highest percentage of filled grains was recorded in the Siputeh (83.38%) and Rangan Lango (80.82%) genotypes, whereas the Manyam U genotype exhibited the lowest percentage of filled grains (4.89%) and the highest percentage of unfilled grains (95.11%). The higher percentage of filled grains observed in resistant

genotypes, particularly Rangan Lango, suggests that resistance to bacterial leaf blight contributes to maintaining grain filling by reducing disease severity during the reproductive stages. Conversely, the high proportion of unfilled grains in the susceptible genotype Manyam U indicates that severe BLB infection likely impairs photosynthesis and assimilate translocation, resulting in poor grain development. These findings indicate a positive relationship between BLB resistance and grain filling, highlighting the importance of disease resistance in maintaining rice yield under pathogen pressure (Shaw et al., 2022; Li et al., 2025).

The highest average 1000-grain weight was observed in the Itam Tangke Lango genotype (35,10 g) and the Rangan Lango genotype (31,36 g), which were significantly different from the Jantong genotype (14,70 g). The Aceh local rice genotypes Itam Tangke Lango and Rangan Lango exhibited a heavier 1000-grain weight compared to the control variety (IR-64). This indicates that Aceh local rice genotypes have high yield potential based on the 1000-grain weight and grain size

characteristics. These results are consistent with the findings of Hadianito et al. (2023), who reported that the tested haploid lines had a heavier 1000-grain weight and

larger grain size compared to the comparator variety (Inpari 42).

Table 2. Average Number of Grains per Panicle, Percentage of Filled Grains, Percentage of Unfilled Grains, and 1000-Grain Weight in 15 Local Rice Genotypes from West-South Aceh

Genotypes	Observation Variables			
	NGP	PFG	PUG	GW
IR-64	305.06 c	48.42 d	51.58 d	23.16 c
IRBB-27	457.56 d	46.81 d	53.19 d	17.02 ab
Rangan Lango	251.00 b	80.82 g	19.18 a	31.36 ef
Siputeh	107.31 a	83.38 g	16.62 a	22.45 c
Sirinde	274.27 c	71.13 f	28.87 b	20.03 bc
Sikleng	317.73 cd	58.78 e	41.22 c	23.86 cd
Pade Manggeng(2)	231.50 b	66.54 f	33.46 b	30.67 e
Tinggong	278.70 c	63.09 ef	36.91 bc	28.03 de
Itam Tangke Lango	230.30 b	71.51 f	28.49 ab	35.10 f
Rasi Kuneng	187.13 b	52.84 de	47.16 cd	21.61 c
Jantong	240.87 b	24.10 b	75.90 ef	14.70 a
Sigupai	309.43 c	43.39 cd	56.61 de	22.57 c
Manyam u	270.90 c	4.89 a	95.11 f	19.69 b
Pade Manggeng (1)	222.90 b	73.44 fg	26.56 a	23.24 c
Jempa Puteh	185.47 a	56.45 e	43.55 c	24.53 d
LSD 5%	79.99	11.91	11.91	4.42

Note: Numbers in the same column that share the same letter are not statistically significantly different ($P = 0.05$). Number of Grains per Panicle (NGP), Percentage of Filled Grains (PFG), Percentage of Unfilled Grains (PUG), 1000-Grain Weight (GW).

Incubation Period (strain VIII)

The results regarding the incubation period of Xoo bacteria in 15 local rice genotypes from West-South Aceh (strain VIII) are presented in Table 3. In several of the tested local genotypes, the incubation period was marked by the appearance of greyish-green symptoms on rice leaves near the cut tip.

Table 3. Average Incubation Period of Strain VIII from the Time of Inoculation until 14 Days after Inoculation

Genotypes	Incubation Period (Days)
Rasi Kuneng	3.25
Pade Manggeng-2	3.92
Sikleng	4.67
Jantong	4.94
Sirinde	5.42
IR-64	5.58
Manyam u	5.83
Jempa Puteh	5.86
Pade Manggeng-1	5.87
Itam Tangke Lango	5.92
Tinggong	7.17
Siputeh	9.00
Rangan Lango	9.17
IRBB-27	11.22
Sigupai	12.42

The incubation period of the bacterial pathogen causing bacterial leaf blight (strain VIII) in 15 local rice genotypes from West Aceh, observed over a period of 1–14 days after inoculation (DAI) (Table 3), showed varied

results. Disease symptoms appeared earliest in the Rasi Kuneng genotype (3.25 DAI) and Pade Manggeng-2 genotype (3.92 DAI). In contrast, the susceptible control IR-64 variety began showing symptoms at 5.58 DAI. The latest onset of disease symptoms was detected in the Sigupai genotype (12.42 DAI); however, its incubation period was statistically similar to that of the resistant control IRBB-27 (11.22 DAI). Based on these results, a longer incubation period indicated a higher level of resistance to *Xanthomonas oryzae* pv. *oryzae* (Xoo) (Niones et al., 2022). The incubation period reflects the time required for pathogens to colonize host tissues and produce visible disease symptoms. In resistant genotypes, Xoo invasion is delayed because plants rapidly activate defense mechanisms following pathogen recognition (Tauqeer et al., 2025). These defenses include the accumulation of phytoalexins, phenolic compounds, pathogenesis-related (PR) proteins, and reactive oxygen species, which restrict bacterial multiplication and limit its spread through xylem vessels. In addition, resistant plants may possess resistance (Xa) genes that recognize pathogen effectors and trigger defense responses, thereby delaying the development of symptoms (Valletta et al., 2023). Consequently, disease symptoms appear later in resistant genotypes than in susceptible ones, resulting in a longer incubation period. Similar findings have been reported by Suryaningsih et al. (2023), who demonstrated that host-induced defense responses inhibit the progression of bacterial infection and delay

symptom expression in rice infected with *X. oryzae* pv. *oryzae*.

The incubation period of *Xoo* strain VIII varied among the evaluated rice genotypes, indicating differences in their resistance responses (Table 4). As no standard classification is available for the incubation period of bacterial leaf blight, the categories used in this study were established based on the distribution of the observed data. Genotypes with longer incubation periods generally exhibited shorter lesion lengths than those with shorter incubation periods, indicating that delayed symptom development was associated with greater resistance to *Xoo*. This response is biologically reasonable because, in resistant genotypes, pathogen recognition activates pattern-triggered immunity (PTI) and effector-triggered immunity (ETI), which induce the accumulation of salicylic acid, jasmonic acid, phytoalexins, reactive oxygen species, and

pathogenesis-related proteins. These defense responses suppress bacterial multiplication and restrict pathogen movement within the xylem, thereby delaying the appearance of symptoms and reducing lesion expansion (Jiang et al., 2020; Zhong et al., 2024). Furthermore, the ability of resistant plants to limit *Xoo* colonization in the vascular tissues slows disease progression, resulting in a prolonged incubation period and lower disease severity (Qi et al., 2025). In the present study, the susceptible control IR64 exhibited the shortest incubation period and longest lesion length, whereas the resistant control IRBB27 showed the longest incubation period and shortest lesion length. Similarly, the Sigupai genotype exhibited one of the longest incubation periods, along with a relatively short lesion length, suggesting that this genotype possesses an effective defense mechanism against *Xoo* and has potential as a donor parent for bacterial leaf blight resistance breeding.

Table 4. Grouping of the Incubation Period for Bacterial Leaf Blight (BLB) Disease (Strain VIII) Based on Incubation Period

Incubation Period (Days)	Criteria	Genotypes
> 10 days	Long	Sigupai and IRBB-27
8-10 days	Moderate	Rangan lango and Siputeh
< 8 days	Fast	Tinggong, IR-64, Jumpa Puteh, Rasi Kuneng, Pade Manggeng-2, Sirinde, Manyam U, Itam Tangke Lango, Manggeng-1, Jantong and Sikleng.

Lesion Length

Resistance classification based on lesion length of 15 local rice genotypes inoculated with *Xanthomonas oryzae* pv. *oryzae* (*Xoo*) strain VIII is presented in Table 5. Lesion length is a reliable indicator of bacterial leaf blight (BLB) severity, as it reflects the extent of bacterial colonization and movement within the xylem tissues. In susceptible genotypes, rapid bacterial multiplication promotes lesion expansion, whereas resistant genotypes restrict pathogen spread by activating host defense responses, resulting in shorter lesions (Yang et al., 2022; Qi et al., 2025). The resistant control IRBB27 exhibited the shortest lesion length because it carries the Xa27 resistance gene, an executor-type resistance gene that triggers effector-triggered immunity (ETI) after recognition of the corresponding *Xoo* effector, thereby suppressing bacterial multiplication and limiting

disease development (Jiang et al., 2020; Yang et al., 2022). Although the resistance genes present in the local rice genotypes have not yet been characterized, their short lesion lengths suggest that they may harbor known *Xa* genes or novel resistance alleles with similar defense functions. Similar observations have been reported in resistant rice germplasm, where effective defense responses involving pattern-triggered immunity (PTI), ETI, reactive oxygen species, phytoalexin accumulation, and pathogenesis-related proteins significantly reduce lesion expansion and disease severity (Zhong et al., 2024; Qi et al., 2025; Lore et al., 2025). Therefore, the resistant local genotypes identified in this study represent valuable genetic resources for future molecular characterization and the development of durable BLB-resistant rice cultivars.

Table 5. Grouping of Lesion Length Resistance in 15 Local Rice Genotypes from West-South Aceh (strain VIII) at 21 DAI with *Xoo* Bacteria

Lesion Length	Criteria	Genotypes
< 3 cm	Resistant	IR-64, IRBB-27, Itam Tangke Lango, Jantong, Jempa Puteh, Manyam U, Pade Manggeng -1, Pade Manggeng-2, dan Rangan Lango
3-6 cm	Moderate Resistant	Rasi Kuneng, Sigupai dan Sikleng
> 6 cm	Susceptible	Siputeh, Sirinde dan Tinggong

Based on the lesion length criterion for resistance (<3 cm), seven Aceh local rice genotypes – Itam Tangke

Lango, Jantong, Jempa Puteh, Manyam U, Pade Manggeng-1, Pade Manggeng-2, and Rangan Lango –

were classified as resistant to *Xanthomonas oryzae* pv. *oryzae*. These resistant genotypes represent valuable genetic resources for rice breeding, as local germplasm broadens the genetic base for identifying resistance genes and developing durable bacterial leaf blight-resistant cultivars. The effective utilization of local germplasm is essential for pyramiding resistance genes, enhancing resistance durability, and developing high-yielding rice varieties adapted to diverse pathogen populations and changing environmental conditions (Sanya et al., 2022; Xu et al., 2022).

Conclusion

This study identified Sikleng as a promising high-yielding genotype, while Itam Tangke Lango, Jantong, Jempa Puteh, Manyam U, Pade Manggeng-1, Pade Manggeng-2, and Rangan Lango were resistant to bacterial leaf blight (BLB) based on lesion length. These findings provide valuable local germplasm for developing superior rice varieties with BLB resistance and high-yield potential. The resistant local genotypes identified in this study may serve as promising donor parents in rice breeding programs for bacterial leaf blight resistance. However, further validation through multi-location trials and molecular characterization of resistance genes is required to support their effective use in rice breeding programs.

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Author Contributions

Conceptualization, W.H. and N.A.; methodology, S.F.L.; software, Y.; validation, W.H., J.I. and C.H.; formal analysis, W.H. and A.G.; investigation, W.H. and E.J.H.; resources, W.H.; data curation, W.H. and S.F.L.; writing—original draft preparation, N.A.; writing—review and editing, J.I.; visualization, A.G.; supervision, W.H.; project administration, Y.; funding acquisition, W.H. All authors have read and agreed to the published version of the manuscript.

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Conflicts of Interest

No Conflicts of interest.

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