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Screening of Eggplant Germplasm Against Bacterial Wilt Caused by *Ralstonia solanacearum* and its Chemical Evaluation

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ABSTRACT

Eggplant (*Solanum melongena* L.), an important vegetable crop widely grown across tropical and subtropical regions, is significantly threatened by bacterial wilt (BW), caused by *Ralstonia solanacearum*. This soil-borne pathogen affects over 200 plant species and is difficult to manage due to its persistence in the soil and the lack of effective chemical controls. In this study, twenty brinjal varieties were screened under controlled conditions to evaluate their resistance against BW. The varieties were inoculated with *R. solanacearum* and examined for disease symptoms based on mortality rates over a 70-day period. Results indicated that one variety, 'NEELUM-23, exhibited complete resistance (0% mortality). On the other hand, three varieties, LBH-001, DILNASHEEN, and DSC-BR-1351 were classified as highly susceptible. Six varieties including HUS-401, BE MISSAL, UX-401, AGHS-B2-92, BLACK LONG, and 'DIAMOND, were found to be susceptible. Meanwhile, ten varieties NIRALA, LBH-002, BLACK ROUND, URIB-2013, DIL, LAYYAH, BLACK DIAMOND, BRINJAL 2223, BLACK BRINJAL and SAHANA1010 exhibited a moderately resistant reaction to the disease. Additionally, chemical treatments were assessed over two consecutive years (2022 and 2023) using five different formulations: Kasomin (T1), Kocide (T2), X-spore (T3), Z-one (T4), and an untreated control (T5). Among them, Kasomin (T1) and Z-one (T4) showed the highest efficacy, reducing mortality by up to 75% compared to the control. Kocide (T2) and X-spore (T3) were moderately effective, while the untreated control exhibited the highest plant mortality (80%). These findings highlight 'NEELUM-23' as a promising resistant genotype for breeding programs and support the use of Kasomin and Z-one as effective chemical options for managing bacterial wilt in eggplant.

KEYWORDS: Eggplant, bacterial wilt, *Ralstonia solanacearum*, chemicals

INTRODUCTION

In Asia, eggplant is the third most significant vegetable, but its productivity faces constraints from pests, diseases, and environmental stresses, despite a global increase in production in recent years (Alam and Salimullah, 2021). Worldwide production of brinjal has reached 59.31 million tonnes (Food and Agriculture Organisation statistic, 2023). China and India are the leading producers, contributing about 63% and 21% of the global supply respectively, followed by Egypt and Turkey. This vegetable is rich in nutrients, providing dietary fiber, calcium, protein, phosphorus, iron, and vitamins A, B, and C. Due to its high levels of polyunsaturated fatty acids (around 65%), magnesium, and potassium, eggplant is known to help lower cholesterol and is traditionally used to treat high cholesterol levels and liver ailments (Daunay and Hazra, 2012). In some African regions, eggplant leaves are also used in cooking (Sunseri *et al.*, 2010). Additionally, extracts from the roots and leaves are believed to help with a range of health

issues, including skin conditions, coughs, toothaches, hemorrhoids, inflammation, sore throats, and digestive problems (Mak, 2015; Murray, 1995; Sekara *et al.*, 2007).

Bacterial wilt, caused by *Ralstonia solanacearum*, is one of the world's most destructive bacterial diseases of plants in tropical and sub-tropical zones of the world (Peeters *et al.*, 2013), poses a major threat to eggplant yields and quality (Patil *et al.*, 2012). Bacterial wilt is generally favored by temperature range between 25 and 37°C. *R. solanacearum* is a gram-negative, rod-shaped, aerobic bacterium (0.5-0.7x 1.5-2.0 mm in size). It is a soil-borne pathogen so it typically attacks plants through roots, enters the root system at the point of injury caused by farm equipment or soil pests and colonizes xylem vessels (García *et al.*, 2019). It may also spread by irrigation water and flood water, contaminated soil, nematodes, or seed dissemination. It is placed under β -subdivision of the Proteobacteria and classified in the family *Ralstoniaceae* (Meng F, 2013). Once

infection has occurred symptoms will be more severe in dry and hot conditions. Sudden leaf wilting is an early sign, initially reversible at night but eventually leading to permanent wilting and plant death. Leaves may become yellow or brown in a sectoral pattern, with vascular tissue in roots and stems showing yellow to brown discoloration. Bacterial wilt is a serious disease of eggplant that can cause losses 100% (Pest and Disease Information Service, 2023). *R. solanacearum* has a wide range of host plants worldwide causing bacterial wilt on more than 200 plant species, including commercially significant crops such as eggplant, potato, tomato, banana and ginger (Hayward, 1991), including more than fifty plant families (Aslam et al., 2017; Uwamahoro et al., 2020).

R. solanacearum species complex' (RSSC) consists of four phylotypes, each of them predominantly originating from different regions. Each phylotype is sectioned into different sequences which are clusters of isolates with highly conserved DNA sequences (Fegan and Prior, 2005). Phylotype I largely originates from Asia, phylotype II from America, phylotype III from Africa and the Indian Ocean, and phylotype IV from Indonesia. Recent studies have redefined these phylotypes into separate species, including *R. solanacearum* (phylotype II), *R. Pseudo solanacearum* (phylotypes I and III), and an array of *R. Syzygii* (phylotype IV) [Prior et al., 2016]. In each phylotype, further classification based on the endoglucanase (EGL) gene sequence (intraspecific marker in the structure gene of *R. Solanacearum*). The bacterium that causes wilt is classified into five races according to the host range variation, and five biovars according to the capability of races to oxidize three disaccharides and three hexose sugar alcohols (Hayward, 1964). Serological methods like immunofluorescent antibody stain and Tag-Man (PCR) were used by Janse et al., (2004). (del this lines , irrelevant and reference also missing in reference sec)

MATERIALS AND METHODS

Germplasm acquisition: Twenty different varieties (NIRALA, LBH-002, HUS-401, BLACK ROUND, LBH-001, URIB-2013, DIL, BE MISSAL, LAYYAH, UX-401, BLACK DIAMOND, DIAMOND, BRINJAL-2223, DILNASHEEN, BLACK BRINJAL, AGHS-B2-92, NEELUM-23, SAHANA-1010, DSC-BR-1351 and BLACK LONG) of eggplant were procured from Vegetable Research Institute, AARI. The seeds were put into plastic bags, labeled, and carried to the laboratory carefully where they placed at room temperature.

Soil treatment : Sand, silt, and farm yard manure (FYM) were combined with soil in a 1:1:1 ratio. Then soil was sterilized to remove any contamination, by

adding 50ml formalin in 10-liter water. The soil mound was treated with 5% formalin and covered with polythene sheet for 72 hours. To offset the effects of formalin, the polythene bag was removed after 72 hours and the soil was kept uncovered for 48 hours and then filled the pots with sterilized soil.

Pot preparation by filling sterilized soil: The Pots were cleaned and filled with sterilized soil. A piece of crockery was placed in the bottom of the pot, aids drainage. It allows water to run off more quickly than soil would and prevents compost from clogging up the holes at the bottom of the pot.

Sowing of varieties: Twenty eggplant (*Solanum melongena*) varieties were evaluated under controlled conditions using a completely randomized design (CRD) with five replicate of each variety. Seeds were surface-sterilized, and five seeds of each variety were sown per pot containing sterilized soil. One week after emergence, seedlings were thinned. Two seedlings /pot allowed to further grow.

Inoculation of pots with *Ralstonia Solanacearum* culture: After one week Soil infestation was carried out. Pots were inoculated with *Ralstonia solanacearum* by applying 20 mL of a homogenized bacterial suspension 106 CFU/ml per pot. In order to assess the disease severity in each variety, a second time bacterial culture was inoculated into each pot after 14 days of sowing. Eggplant growth was regularly monitored and irrigation was done as per need.

Data collection: Data was recorded according to disease rating scale after 70 days of inoculum application based on Plant mortality.

RESULTS

Among twenty varieties, each variety had five replicates. In NIRALA one plant showed dead behavior and four plants were found alive. The mortality in NIRALA was 20% showing moderately resistant behavior. Similarly, in LBH-002, one plant died and four remained alive, also showing a 20% mortality rate and moderately resistance. In HUS-401, two plants died and three survived, giving a 40% mortality rate, which is categorized as susceptible. For the BLACK ROUND variety, one plant died and four survived, having 20% mortality and moderate resistance. In the LBH-001 variety, three out of five plants died, resulting in a 60% mortality rate and indicating a highly susceptible response. URIB-2013 showed one dead plant and four alive, reflecting 20% mortality and moderately resistant behavior. The DIL variety also had one plant die and four survive, indicating 20% mortality and moderate resistance. BE MISSAL recorded two dead plants and three alive plants, with a mortality rate of 40%, marking it as susceptible. LAYYAH had one plant die and four alive, showing 20% mortality and moderate resistance. In UX-401, two plants died and three

survived, with a 40% mortality rate, indicating susceptibility. For BLACK DIAMOND, one plant died and four remained alive, giving a 20% mortality rate and moderate resistance. DIAMOND recorded two dead plants and three alive, resulting in 40% mortality, which is considered as susceptible. BRINJAL-2223 had one dead and four living plants, showing 20% mortality and moderate resistance. In AGHS-B2-92, two plants died while three survived, reflecting 40% mortality and a susceptible response. NEELUM-23 showed no mortality, with all five plants surviving, indicating 0% mortality and a highly

resistant nature. In SAHANA-1010, one plant died and four survived, indicating 20% mortality and moderate resistance. DSC-BR-1351 had the highest mortality, with four plants dead and one alive, resulting in an 80% mortality rate and highly susceptible behavior. Finally, in the BLACK LONG variety, two plants died and three survived, producing a 40% mortality rate, which also indicates susceptibility (Table. 1)

Table. 1. Screening of eggplant germplasm against *Ralstonia solanacearum* bacterium

Sr. No.	Variety/line	Average	Reaction
1	NIRALA	20 ± 4.00	MR
2	LBH-002	20 ± 4.00	MR
3	HUS-401	40 ± 4.80	S
4	BLACK ROUND	20 ± 4.00	MR
5	LBH-001	60 ± 4.89	HS
6	URIB-2013	20 ± 4.00	MR
7	DIL	20 ± 4.00	MR
8	BE MISSAL	40 ± 4.80	S
9	LAYYAH	20 ± 4.80	MR
10	UX-401	40 ± 4.80	S
11	BLACK DIAMOND	20 ± 4.00	MR
12	DIAMOND	40 ± 4.80	S
13	BRINJAL-2223	20 ± 4.00	MR
14	DILNASHEEN	60 ± 4.89	HS
15	BLACK BRINJAL	20 ± 4.00	MR
16	AGHS-B2-92	40 ± 4.80	S
17	NEELUM-23	0 ± 0.00	HR
18	SAHANA-1010	20 ± 4.00	MR
19	DSC-BR-1351	80 ± 4.00	HS
20	BLACK LONG	40 ± 4.80	S

Table no 2 Reaction of eggplant germplasm against bacterial wilt

SR. NO.	Reaction	Varieties/line	Total
1	HR (0%)	NEELUM 23	1
2	R (1-10%)	-	0
3	MR (11-20%)	NIRALA, LBH-002, BLACK ROUND, URIB-2013, DIL, LAYYAH, BLACK DIAMOND, BRINJAL-2223, BLACK BRINJAL, SAHANA-1010	10
4	MS (21-30%)	-	0
5	S (31-40%)	HUS-401, BE MISSAL, UX-401, AGHS-B2-92, BLACK LONG, DIAMOND	6
6	HS (>40%)	LBH-001, DILNASHEEN, DSC-BR-1351	3
			20

Caption: Among twenty varieties none of them was found resistant and moderately susceptible to bacterial wilt. One variety NEELUM 23 was highly resistant and three varieties LBH-001, DILNASHEEN, DSC-BR-1351 were highly susceptible. Six varieties HUS-401, BE MISSAL, UX-401, AGHS-B2-92, BLACK LONG, DIAMOND was found susceptible. Ten

varieties NIRALA, LBH-002, BLACK ROUND, URIB-2013, DIL, LAYYAH, BLACK DIAMOND, BRINJAL-2223, BLACK BRINJAL, SAHANA-1010 showed moderately resistant response against bacterial wilt (Table. 2)

Table. 3. Evaluation of Chemicals against bacterial wilt of eggplant in 2022

Data 2022			
Treatments	Total Mortality	% Mortality	% Decrease over control
T1(Kasomin)	1	20	75
T2(Kocide)	2	40	50
T3(Xspore)	3	60	25
T4(Z-one)	2	40	50
T5(Control)	4	80	0

One month old Brinjal variety (BE MISSAL) was transplanted singly in earthen pots (20cm diameter) with 5 replicates. After one week of transplantation chemicals were added in pots. Bacterial inoculum was applied after one week of chemical application. The harvesting was done after eight weeks of inoculum application. Five different treatments (T1 to T5) were given in controlling *R. solanacearum*, measured across five replicates (R1 to R5). Each treatment showed varying levels of mortality, with T5 serving as the untreated control. T1 (Ka) resulted in the lowest mortality, with only 1 dead plant and a corresponding

20% mortality rate, achieving the highest percentage decrease over control at 75%. T4 (Z-one) and T2(Kocide) followed with 2 dead plants (40% mortality) each, showing a 50% reduction in disease compared to the control. T3 (Xspore) had 3 dead plants (60% mortality), yielding a 25% decrease over the control. The control group (T5) had the highest mortality, with 4 dead plants and an 80% mortality rate, serving as the baseline for comparison. Overall, the results indicate that T1 was the most effective treatment in reducing mortality **Table. 3.**

Table. 4. Evaluation of Chemicals against bacterial wilt of eggplant in 2023

Data 2023			
Treatments	Total mortality	% mortality	% decrease over control
T1(Kasomin)	1	20	75
T2(Z-one)	1	20	75
T3(Kocide)	3	60	25
T4(X-spore)	2	40	50
T5(Control)	4	80	0

One month old Brinjal variety (DILNASHEEN) was transplanted singly in earthen pots (20cm diameter) with 5 replicates. After two weeks of transplantation chemical treatments were given to the pots. Bacterial inoculum was applied after one week of chemical application. The harvesting was done after six weeks of inoculum application. Five different treatments (T1 to T5) were given in controlling *R. solanacearum*, measured across five replicates (R1 to R5). Each treatment showed varying levels of mortality, with T5 serving as the untreated control. T1 (Ka) and T2 (Z-one) both resulted in the lowest mortality, with only 1 dead plant each and a corresponding 20% mortality rate, achieving the highest percentage decrease over control at 75%. T4 (X-spore) followed with 2 dead plants (40% mortality), showing a 50% reduction in disease compared to the control. T3 (Kocide) had 3 dead plants (60% mortality), yielding a 25% decrease over the control. The control group (T5) had the highest mortality, with 4 dead plants and an 80% mortality rate, serving as the baseline for comparison. Overall, the results indicate that T1 and T2 were the most effective treatments in reducing mortality **Table. 4.**

DISCUSSION

The pot-screening of twenty eggplant (*Solanum melongena* L.) varieties revealed clear and

agriculturally meaningful variation in response to *Ralstonia solanacearum*. One accession, NEELUM-23, showed complete resistance under our experimental conditions (0% mortality), while three varieties (LBH-001, DILNASHEEN, DSC-BR-1351) were highly susceptible (>60% mortality). A substantial portion of the tested germplasm (10/20) exhibited moderate resistance (≈20% mortality), and six entries were susceptible (≈40% mortality). These findings demonstrate both useful genetic variation for breeding and the presence of partial resistance/tolerance phenotypes that could be exploited in integrated management.

The observed spectrum of responses is consistent with the known biology of *R. solanacearum* as a genetically diverse, xylem-colonizing pathogen whose virulence often depends on host genotype, strain identity, and environmental conditions (Genin & Denny, 2012; Salgon *et al.*, 2017). Resistance in eggplant is often quantitative (polygenic) in nature, including both broad-spectrum resistance and strain-specific loci (Salgon *et al.*, 2017). Thus, the identification of NEELUM-23 as fully resistant makes it especially promising both as a donor in breeding programs and as a rootstock candidate.

The chemical trials provided consistent evidence that certain formulations, especially Kasomin (T1) and Z-one (T2 in 2023), greatly reduced mortality (75% decrease over control) when applied before inoculation. Kocide and Xspore had intermediate effectiveness. These results reflect findings in previous investigations where chemical treatments (e.g., copper-based formulations, biofungicides) have shown efficacy in pot or greenhouse conditions but often less so under field environments due to issues of pathogen persistence and environmental variability (Nion & Toyota, 2015; Genin & Denny, 2012). Chemical suppression tends to delay or reduce symptom expression rather than fully eradicate *Ralstonia*, especially due to the pathogen's deep soil survival and xylem colonization.

Given these data, the best current strategy is an integrated disease management (IDM) approach. Use of a strongly resistant genotype like NEELUM-23, deployment in field trials, combined with strategic application of effective chemical agents (Kasomin, Z-one), could substantially reduce losses. In addition, grafting resistant lines has been reported as a useful method to protect susceptible scions (Salgon et al., 2017).

CONCLUSION

This study showed clear differences among the tested eggplant varieties in their response to bacterial wilt. NEELUM-23 stood out as completely resistant (0% mortality), making it a highly valuable variety for future breeding programs. In contrast, three varieties—LBH-001, DILNASHEEN, and DSC-BR-1351—were highly susceptible, while six varieties (HUS-401, BE MISSAL, UX-401, AGHS-B2-92, BLACK LONG, and DIAMOND) were classified as susceptible. Ten varieties, including NIRALA, LBH-002, BLACK ROUND, URIB-2013, DIL, LAYYAH, BLACK DIAMOND, BRINJAL-2223, BLACK BRINJAL, and SAHANA-1010, showed a moderately resistant response.

The chemical treatments also produced promising results. Kasomin (T1) and Z-one (T4) achieved the highest effectiveness, reducing plant mortality by 75%, while Kocide and X-spore showed moderate effectiveness.

Overall, NEELUM-23 emerges as an excellent source of resistance for breeding programs, and Kasomin and Z-one appear to be effective chemical options for helping manage bacterial wilt in eggplant when used as part of an integrated disease management strategy.

AUTHOR CONTRIBUTIONS

All authors contributed equally in the manuscript.

COMPETING OF INTEREST

There is no conflict of interest amongst the authors.

REFERENCES

- Alam, I. and Salimullah, M. 2021. Genetic engineering of eggplant (*Solanum melongena* L.): Progress, controversy and Potential. *Horticulture*, 7(78): 1-3.
- Aslam, M. N., Mukhtar, T., Hussain, M. A., & Raheel, M. (2017). Assessment of resistance to bacterial wilt incited by *Ralstonia solanacearum* in tomato germplasm. *Journal of Plant Diseases and Protection*, **124**, 585–590.
- Bainsla, N. K., Singh, S., Singh, P. K., Kumar, K., Singh, A. K., & Gautam, R. K. (2016). Genetic behaviour of bacterial wilt resistance in brinjal (*Solanum melongena* L.) in tropics of Andaman and Nicobar Islands of India. *American Journal of Plant Sciences*, 7(2), 333–338.
- Boshou, L. (2005). A broad review and perspective on breeding for resistance to bacterial wilt. In C. Allen, P. Prior, & A. C. Hayward (Eds.), *Bacterial wilt disease and the Ralstonia solanacearum species complex* (pp. 225–238). American Phytopathological Society.
- Cao, B. H., Lei, J. J., Wang, Y., & Chen, G. J. (2009). Inheritance and identification of SCAR marker linked to bacterial wilt-resistance in eggplant. *African Journal of Biotechnology*, **8**(20), 5201–5207.
- Daunay, M. C., & Hazra, P. (2012). Eggplant. In P. Hazra & K. V. Peter (Eds.), *Handbook of vegetables* (pp. 257–322). Studium Press.
- Fegan, M., & Prior, P. (2005). How complex is the '*Ralstonia solanacearum*' species complex? In C. Allen, P. Prior, & A. C. Hayward (Eds.), *Bacterial wilt: The disease and the Ralstonia solanacearum species complex* (pp. 449–461). American Phytopathological Society Press.
- García, R. O., Kerns, J. P., & Thiessen, L. (2019). *Ralstonia solanacearum* species complex: A quick diagnostic guide. *Plant Health Progress*, **20**(1), 7–13.
- Genin, S., & Denny, T. P. (2012). Pathogenomics of the *Ralstonia solanacearum* species complex. *Annual review of phytopathology*, 50(1), 67-89.
- Grimault, V., Anaïs, G., & Prior, P. (1994). Distribution of *Pseudomonas solanacearum* in the stem tissues of tomato plants with different levels of resistance to bacterial wilt. *Plant Pathology*, **43**, 663.

- Hartman, G. L., Hong, W. F., & Hayward, A. C. (1993). Potential of biological and chemical control of bacterial wilt. *ACIAR Proceedings*, **45**, 322–326.
- Hayward, A. C. (1964). Characteristics of *Pseudomonas solanacearum*. *Journal of Applied Bacteriology*, **27**, 265–277.
- Hayward, A. C. (1991). Biology and epidemiology of bacterial wilt caused by *Pseudomonas solanacearum*. *Annual Review of Phytopathology*, **29**, 65–87.
- Huet, G. (2014). Breeding for resistances to *Ralstonia solanacearum*. *Frontiers in Plant Science*, **5**, 715.
- Lemessa, F., & Zeller, W. (2007). Screening rhizobacteria for biological control of *Ralstonia solanacearum* in Ethiopia. *Biological Control*, **42**, 336–344.
- Mak, G. (2015). Health benefits of Aubergine. Retrieved from www.healthbenefitstimes.com. Accessed, 22.
- Mansfield, J., Genin, S., Magori, S., Citovsky, V., Sriariyanum, M., Ronald, P., Dow, M. A. X., Verdier, V., Beer, S. V., Machado, M. A., et al.. (2012). Top 10 plant pathogenic bacteria in molecular plant pathology. *Molecular Plant Pathology*, **13**, 614–629.
- Meng, F. (2013). *Ralstonia solanacearum* species complex and bacterial wilt disease. *Bacteriology and Parasitology*, **4**(2), 1–3.
- Murray, M. T. (1995). *The healing power of herbs: the enlightened person's guide to the wonders of medicinal plants*. Rev.
- Murakoshi, S., & Takahashi, M. (1984). Trials of some control of tomato bacterial wilt caused by *Pseudomonas solanacearum*. *Bulletin of Kanagawa Horticultural Experimental Station*, **31**, 50–56.
- Namisy, A., Chen, J. R., Prohens, J., Metwally, E., Elmahrouk, M., & Rakha, M. (2019). Screening cultivated eggplant and wild relatives for resistance to bacterial wilt (*Ralstonia solanacearum*). *Agriculture*, **9**(7), 157.
- Nion, Y. A., & Toyota, K. (2015). Recent trends in control methods for bacterial wilt diseases caused by *Ralstonia solanacearum*. *Microbes and environments*, **30**(1), 1–11.
- Patil, V. U., Gopal, J., & Singh, B. P. (2012). Improvement for bacterial wilt resistance in potato by conventional and biotechnological approaches. *Agricultural Research*, **1**, 299–316.
- Peeters, N., Guidot, A., Vailleau, F., & Valls, M. (2013). *Ralstonia solanacearum*, a widespread bacterial plant pathogen in the post-genomic era. *Molecular Plant Pathology*, **14**, 651–662.
- Salgon, S., Jourda, C., Sauvage, C., Daunay, M. C., Reynaud, B., Wicker, E., & Dintinger, J. (2017). Eggplant resistance to the *Ralstonia solanacearum* species complex involves both broad-spectrum and strain-specific quantitative trait loci. *Frontiers in plant science*, **8**, 828.
- Sekara, A., Cebula, S., & Kunicki, E. (2007). Cultivated eggplants – origin, breeding objectives and genetic resources: A review. *Folia Horticulturae*, **19**(1), 97–114.
- Sunseri, F., Polignano, G. B., Alba, V., Lotti, C., Bisignano, V., & Mennella, G. (2010). Genetic diversity and characterization of African eggplant germplasm collection. *African Journal of Plant Science*, **4**(7), 231–241.
- Uwamahoro, F., Berlin, A., Bucagu, C., Bylund, H., & Yuen, J. (2020). *Ralstonia solanacearum* causing potato bacterial wilt: Host range and cultivars' susceptibility in Rwanda. *Plant Pathology*, **69**(3), 559–568.
- Weller, D. M. (1988). Biological control of soilborne plant pathogens in the rhizosphere with bacteria. *Annual Review of Phytopathology*, **26**, 379–407.

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