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Research Article

Studies on *Ralstonia solanacearum* Collected from Amalner Dist. Jalgaon.

Deshmukh A. M. and B. T. Pawar

Research Centre in Botany, Shri Muktanand College, Gangapur, Dist. Ch. Sambhajinagar (MS)
abhideshmukh331@gmail.com

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Abstract

Bacterial wilt, caused by *Ralstonia solanacearum*, poses a significant threat to banana cultivation globally. This study aims to explore how soil physicochemical parameters, particularly pH and water holding capacity (WHC), influence the susceptibility of banana plantations to this pathogen. A total of 21 composite soil samples were collected major banana-growing tehsils in the Jalgaon district of Maharashtra, India. The results demonstrated considerable variability in pH (ranging from 5.7 to 8.3) and WHC (from 35.45% to 52.40%) across the sampled sites. Soils exhibiting high WHC and near-neutral, were linked to more favorable conditions for plant growth and lower incidences of wilt. Conversely, sites characterized by high alkalinity or low WHC, appeared to create environments that promote pathogen persistence and increase host susceptibility. These findings highlight the crucial role of effective soil management in reducing R. solanacearum infections. By integrating region- specific soil assessments with targeted amendments, it may be possible to enhance the resilience of banana cropping systems. A combination of high WHC and near-neutral pH can help alleviate bacterial symptoms in banana plants, while high alkalinity or low WHC may foster conditions favorable to bacterial proliferation. Implementing soil monitoring and modifying soil properties could serve as effective preventive strategies against bacterial wilt in susceptible areas. Furthermore, the study reinforces emerging research on the interplay between soil health, microbial community complexity, and disease suppression. Overall, profiling soil physicochemical properties can be a valuable tool in integrated disease management strategies aimed at sustaining banana production in wilt-prone agro-ecological zones.

INTRODUCTION

The global banana industry faces a critical threat from Bacterial Wilt, a devastating systemic disease caused by the Ralstonia solanacearum species complex (Peeters et al., 2013). This soil-borne bacterium is notorious for its broad host range, affecting over 200 plant species worldwide (Meng, 2013). In the context of banana cultivation, the pathogen is the primary causal agent of Moko disease, which is identified by progressive chlorosis, vascular necrosis, and eventual plant collapse (Premabati & Mandal, 2020). While other bacterial pathogens like Xanthomonas and Erwinia also impact banana yields, R. solanacearum is particularly difficult to manage due to its ability to persist in the soil and water for extended periods, even in the absence of a host (Donoso & Valenzuela, 2018). The pathogen typically infiltrates the host via the root system, rapidly colonizing the xylem vessels and obstructing the flow of water and nutrients, which inevitably leads to host death. Current control strategies emphasize a combination of molecular diagnostics, the use of resistant germplasm, and strict phytosanitary protocols. However, the extreme resilience of the pathogen often renders infected fields unproductive for years (Peeters *et al*., 2013).

Environmental factors, particularly soil pH and moisture levels, are decisive in determining the survival and virulence of R. solanacearum. While acidic conditions often favor certain pathogens (Wetzel & McBride, 2020), the specific interaction between soil alkalinity and water retention in tropical climates requires further investigation. Jalgaon district, as a premier hub for Indian banana production, represents a significant ecological case study. If Jalgaon were an independent entity, its output would rank it as the seventh-largest banana producer globally (Chavan & Nile, 2012). This study seeks to provide localized insights into how soil health parameters influence disease dynamics in this vital agricultural region.

MATERIALS AND METHODS

Study Area:

The research was conducted in the Jalgaon district of Maharashtra, India, a region well known for its banana cultivation. Jalgaon is situated between latitudes 20°32′N and 21°18′N and longitudes 74°55′E and 76°28′E, featuring a diverse range of agroclimatic zones. The district experiences a tropical monsoon climate, characterized by average annual rainfall of 600-700 mm, primarily occurring from June to September. Temperatures in the region vary from 10 °C in winter to over 42 °C during the peak of

summer. The soil types are diverse, ranging from black cotton soils to mixed red loam varieties, each exhibiting different drainage and fertility characteristics. This study focused on banana plantations located in various tehsils, out of this Bhadgaon, where there have been frequent reports of bacterial wilt caused by *Ralstonia solanacearum*. Amalner is located at approximately 21.04°N latitude and 75.06°E longitude with an average elevation of 620fts. The region along the Bori River, the area experiences warm climate

Sample Description:

A total of 21 composite rhizosphere soil samples were collected from the Amalner tehsil. Samples were taken from a depth of 0–30 cm surrounding both symptomatic (diseased) and asymptomatic (healthy) banana plants. Each site was geo-tagged via GPS, and samples were stored at 4°C in sterile containers to maintain microbial and chemical integrity.

Soil Physicochemical Analysis:

Soil pH was determined using a digital pH meter in a 1:2.5 soil-to-water suspension following Jackson's (1973) method. Water Holding Capacity (WHC): WHC was calculated gravimetrically using the Keen-Raczkowski box method. Soil Texture: Texture was classified using the hydrometer method (Bouyoucos, 1962) and cross-referenced with USDA taxonomy. All tests were performed in triplicate to ensure statistical reliability.

RESULTS AND DISCUSSION

The analysis revealed a direct link between soil characteristics and the health status of banana plantations in the Amalner region. The soil profiles primarily consisted of Regur (Black Soil), known for its high clay content and inherent fertility. However, the varying levels of pH and WHC created distinct "micro-environments" for the pathogen: pH Dynamics: Samples ranged from slightly acidic (6.2) to moderately alkaline (8.4). While the optimal range for banana growth is 6.0 to 7.5, several sites (e.g., AM07 and AM03) showed high alkalinity, which

likely disrupts nutrient uptake and weakens the plant's natural defenses against R. solanacearum. Moisture Retention (WHC): A significant disparity in WHC was observed. Lower values (e.g., 36.45% in AM19) suggest sandy textures with poor water retention, leading to drought stress that predisposes plants to infection. Conversely, samples with higher WHC (e.g., 53.43% in AM18) supported more robust plant growth, though excessively saturated conditions can also facilitate bacterial motility. Our findings align with emerging research suggesting that disease-suppressive soils are often characterized by balanced pH and high microbial complexity (Qi et al., 2019). Sites with near-neutral pH and adequate WHC likely foster a diverse community of antagonistic rhizobacteria, which naturally compete with

R. solanacearum for resources (Hayward, 1991). In contrast, the less complex microbial networks found in alkaline or nutrient-poor soils may allow the pathogen to proliferate unchecked (Zhang et al., 2020).

This study concludes that soil pH and WHC are fundamental predictors of bacterial wilt prevalence in Jalgaon's banana plantations. Near-neutral soils with high moisture-holding capabilities appear to provide a degree of natural suppression against R. solanacearum.

Moving forward, sustainable banana cultivation in wilt-prone zones should move beyond simple pathogen detection and incorporate soil health profiling. By implementing site- specific amendments to correct alkalinity and improve organic matter content, farmers can enhance the resilience of their crops against this persistent bacterial threat.

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Table1. Physicochemical Soil Properties (pH and WHC) of Diseased Banana Plantations across Amalner Tehsil, Jalgaon District, India

Sr. No.	Sample Code	Location	Site	Variety of Banana	Physical Properties of soil		
					Soil Type	pH	WHC
1	AM01	Ambare	Bori river south side	Plantics	Regur	6.8	51.40
2	AM02	Ambare	Village north side	Plantics	Deep Black	7.4	48.54
3	AM03	Amalner	Near galwade road	Jain Tissue	Loamy	8.2	45.32
4	AM04	Amalner	East side of Amalner	Grand naine	Iedium Black	7.9	42.65
5	AM05	Karankhede	Bori river East side	Jain Tissue	Regur	6.7	52.45
6	AM06	Karankhede	Village south side	Agrostar	Regur	8.2	51.25
7	AM07	Khadke	e gadivan baba temple	Plantics	Regur	8.4	49.85
8	AM08	Khadke	Village north side	Plantics	Iedium Black	6.8	46.35
9	AM09	Dhanore	ı side of sitai temple	Agrostar	Regur	8.2	50.25
10	AM10	Dhanore	Village East side	Safed vel	Loamy	6.5	45.35
11	AM11	Jalod	Tapi river north side	Shrimantti	Deep Black	7.8	47.45
12	AM12	Jalod	Village East side	Jain Tissue	Deep Black	6.8	46.59
13	AM13	Talvade	Village north side	Jain Tissue	Regur	6.4	49.95
14	AM14	Talvade	Village west side	Mahalakshmi	Iedium Black	8.1	45.32
15	AM15	Sonkhedi	athamik vidya mandir	Jain Tissue	Regur	6.3	50.23
16	AM16	Sonkhedi	Village East side	Safed vel	Loamy	8.0	45.65
17	AM17	Satri	Village south side	Mahalakshmi	Deep Black	6.5	47.71
18	AM18	Satri	Village east side	Madhukar	Regur	8.1	53.43
19	AM19	Janvi	Village north side	Shrimantti	sandy	6.8	36.45
20	AM20	Janvi	Village west side	Mahalakshmi	Regur	6.2	49.25
21	AM21	Eklehare	Village south side	Madhukar	sandy	7.6	37.65
Range						6.2 to 8.4	36.45 to
							53.43
Average						7.3	47.29

REFERENCES

Anbarasu M, Gurusamy A, Saravanan S. 2024, Properties of different graded coir pith by Keen. Raczkowski box and Brunauer-Emmett-Teller analysis, *J Environ Biol.*;45(3):257-262. https://doi.org/10.22438/jeb/45/3/mrn-5233

Bruehl GW, Lai P. 1968, Influence of soil pH and humidity on survival of Cephalosporium gramineum in infested wheat straw, *Can J Plant Sci.*;48(3):245-252. https://doi.org/10.4141/cjps68-045

Bouyoucos G.J. 1962, The hydrometer method improved for making particle size analyses of soils, *Agron J,* 54(5):464-465.

Cao Y, Thomashow LS, Luo Y, Hu H, Deng X, Liu H, et al. 2022, Resistance to bacterial wilt caused by Ralstonia solanacearum depends on nutrient condition in soil and applied fertilizers: A meta-analysis, *Agric Ecosyst Environ*, 329:107874. https://doi.org/10.1016/j.agee.2022.107874

Chavan M.B., Nile S. K. S. 2012, Comparative study of quantitative and cartographic techniques of

banana crop concentration in Raver Tehsil of Jalgaon District (M.S., India), *J Geogr Geol*.;4(2). https://doi.org/10.5539/jgg.v4n2p108

Donoso A, Valenzuela 2018, S. In-field molecular diagnosis of plant pathogens: Recent trends and future perspectives, *Plant Pathol*, 67(7):1451-61.

Hayward AC. 1991, Biology and epidemiology of bacterial wilt caused by Pseudomonas solanacearum, *Annu Rev Phytopathol*, 29(1):65-87.

Jadhav R, Shaikh N, Pawar K, Mendhe A, Chaure J. 2020, Assessment of post-harvest losses in banana under Jalgaon conditions, Maharashtra, *Int J Chem Stud,* 8(3):889-92.

Jayaraman S, Naorem A, Lal R, Dalal RC, Sinha N, Patra A,. 2021, Disease-suppressive soils beyond food production: a critical review, *J Soil Sci Plant Nutr*, 21(2):1437-1465. https://doi.org/

Jackson M. L. 1973, Soil chemical analysis. *New Delhi: Prentice Hall of India*, 10.1007/s42729-021-00451-x 10;, p. 151-154.

Jiang G, Wang N, Zhang Y, Wang Z, Zhang Y, Yu J, 2021, Relative importance of soil moisture in predicting bacterial wilt disease occurrence, *Soil Ecol Lett*, (4):356-366. https://doi.org/10.1007/s42832-021-0086-2

Meng F. 2013, Ralstonia solanacearum species complex and bacterial wilt disease. *J Bacteriol Parasitol*, 4 (2). https://doi.org/10.4172/2155-9597.1000e119

Morris CE, Moury B. 2019, Revisiting the concept of the host range of plant pathogens, *Annu Rev Phytopathol.* 57(1):63-90. https://doi.org/10.1146/annurev-phyto-082718-100034

Peeters N, Guidot A, Vailleau F, Valls M. 2013, Ralstonia solanacearum, a widespread bacterial plant pathogen in the post-genomic era, *Mol Plant Pathol,* 14(7):651-62. https://doi.org/10.1111/mpp.12038

Premabati T, De Mandal S. 2020, Bacterial diseases of banana: detection, characterization, and control management. *In: Elsevier E-Books*, p. 71-85. https://doi.org/10.1016/b978-0- 12-821265-3.00004-9

Qi G, Ma G, Chen S, Lin C, Zhao X. 2019, Microbial network and soil properties are changed in bacterial wiltsusceptible soil. *Appl Environ Microbiol*, 85(13). https://doi.org/10.1128/aem.00162-19

Rasheed MW, Tang J, Sarwar A, Shah S, Saddique N, Khan MU. 2022, Soil moisture measuring techniques and factors affecting moisture dynamics: *A comprehensive review. Sustainability,* 14(18): 11538. https://doi.org/10.3390/su141811538

Specht LP. 1989, Sporulation and survival of conidia of Cephalosporium gramineum influenced by soil pH, soil matric potential, and soil fumigation, *Phytopathology*, 79(7):787. https://doi.org/10.1094/phyto-79-787

Wetzel D, McBride SM. 2020, Impact of pH on Clostridioides difficile sporulation and physiology. *Appl Environ Microbiol*, 86(4):e02706-19.

Zhang Y, Hu A, Zhou J, Zhang W, Li P. 2020, Comparison of bacterial communities in soil samples with and without tomato bacterial wilt caused by Ralstonia solanacearum species complex. *BMC Microbiol*, **20**(1). https://doi.org/10.1186/s12866-020-01774

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