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DAFTAR PUSTAKA

Ababa, G. 2024. Pathogenic diversity, ecology, epidemiology, and management practices of the potato bacterial wilt (*Ralstonia solanacearum*) disease. Cogent Food & Agriculture. 10(1): 1-18.

Alika, R. 2020. Redam Lonjakan Harga, Produksi Cabai Ditarget Naik 7% per Tahun. <https://katadata.co.id/berita/pertanian/5e9a495cec0f9/redam-lonjakan-harga-produksi-cabai-ditarget-naik-7-per-tahun>. Diakses tanggal 16 Januari 2025.

Álvarez, B., and E.G. Biosca. 2017. Bacteriophage-based bacterial wilt biocontrol for an environmentally sustainable agriculture. Frontiers in Plant Science. 8: 1218.

Álvarez, B., E.G. Biosca, and M.M. Lopez. 2010. On the life of *Ralstonia solanacearum*, a destructive bacterial plant pathogen. Current Research, Technology, and Education Topics in Applied Microbiology and Microbial Biotechnology. 12: 267-279.

Anonim. 2023. Survei Sosial Ekonomi Nasional : Pengeluaran untuk Konsumsi Penduduk Indonesia 2023. Badan Pusat Statistik, Jakarta.

Antoniou, A., M.D. Tsolakidou, I.A. Stringlis, and I.S. Pantelides. 2017. Rhizosphere microbiome recruited from a suppressive compost improves plant fitness and increases protection against vascular wilt pathogens of tomato. Frontiers in Plant Sciences. 8: 1-16.

Apriyadi, Z., E. Liestiany, dan Rodinah. 2019. Pengendalian biologi penyakit layu bakteri (*Ralstonia solanacearum*) pada tanaman tomat (*Lycopersicum esculentum*). Proteksi Tanaman Tropika. 2(2): 108-114.

Arwiyanto, T., A. Astusi, dan Y.M.S. Maryudani. 2007. Karakterisasi parsial *Streptomyces* spp., agens pengendali hayati penyakit lincat tembakau. Jurnal Perlindungan Tanaman Indonesia 13: 95-105.

Bailey, K.L., and G. Lazarovits. 2003. Suppressing soil-borne diseases with residue management and organic amendments. Soil and Tillage Research. 72(2): 169–180.

Baker, K.F., and R.J. Cook. 1974. Biological Control of Plant Pathogens. Freeman, San Francisco, California.

Barka, E.A., P. Vatsa, L. Sanchez, N.G. Vaillant, C. Jacquard, H.P. Klenk, C. Clément, Y. Ouhdouch, and G.P. van Wezel. 2016. Taxonomy, physiology, and natural products of *Actinobacteria*. Microbiology and Molecular Biology Reviews. 80(1): 1-43.

Basuki, R.S., I.W. Arshanti, L. Zamzani, N. Khaririyatun, Y. Kusandriani, dan Luthfy. 2014. Studi adopsi cabai merah varietas Tanjung-2 hasil penelitian balai penelitian tanaman sayuran di Kabupaten Ciamis Provinsi Jawa Barat. Jurnal Hortikultura. 24(4): 355-362.

UNIVERSITAS GADJAH MADA
Efektivitas Kompos Diperkaya Mikroba Antagonis dalam Menekan Patogenisitas Ralstonia solanacearum pada Pertanaman Cabai Merah (Capsicum annuum L.)
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Universitas Gadjah Mada, 2025 | Diunduh dari http://etd.repository.ugm.ac.id/

Bentham, A.R., J.C. de la Concepcion, N. Mukhi, R. Zdrzałek, M. Draeger, D. Gorenkin, R.K. Hughes, and M.J. Banfield. 2020. A molecular roadmap to the plant immune system. Journal of Biological Chemistry. 295(44): 14916-14935.

Bhuyan, S., L. Dutta, S. Begum, S.J. Giri, M. Jain, M. Mandal, and S.K. Ray. 2024. A study on twitching motility dynamics in *Ralstonia solanacearum* microcolonies by live imaging. Journal of Basic Microbiology. 6(1): 42–49.

Bonanomi, G., V. Antignani, C. Pane, and F. Scala. 2007. Suppression of soilborne fungal diseases with organic amendments. Journal of Plant Pathology. 8(3): 311-324.

Bonanomi, G., V. Antignani, M. Capodilupo, and F. Scala. 2010. Identifying the characteristics of organic soil amendments that suppress soilborne plant diseases. Soil Biology and Biochemistry. 42(2): 136-144.

Bonaterra, A., E. Badosa, N. Daranas, J. Francés, G. Roselló, and E. Montesinos. 2022. Bacteria as biological control agents of plant diseases. Microorganism. 10(9): 1759.

Borrero, C., M.I. Trillas, J. Ordovás, J.C. Tello, and M. Avilés. 2004. Predictive factors for the suppression of *Fusarium* wilt of tomato in plant growth media. Phytopathology. 94(10): 1094-1101.

Boshou, L. 2005. A broad review and perspective on breeding for resistance to bacterial wilt. In: C. Allen, P. Prior, and A.C. Hayward (Eds.). Bacterial Wilt Disease and the *Ralstonia solanacearum* Species Complex. APS Press, St. Paul, Minnesota, p: 225-238.

Bosland, P.W., and E.J. Votava. 2012. Peppers: Vegetable and Spice *Capsicums*. 2nd Ed. Crop Production Science in Horticulture. CABI, Oxfordshire.

Buddenhagen, I., and A. Kelman. 1964. Biological and physiological aspects of bacterial wilt caused by *Pseudomonas solanacearum*. Annual Review of Phytopathology. 2: 203-230.

Cao, Y., L.S. Thomashow, Y. Luo, H. Hu, X. Deng, H. Liu, Z. Shen, R. Li, and Q. Shen. 2022. Resistance to bacterial wilt caused by *Ralstonia solanacearum* depends on the nutrient condition in soil and applied fertilizers: A meta-analysis. Agriculture Ecosystem Environment. 329: 107874.

Cappuccino, J.G., and N. Sherman. 2014. Microbiology: a Laboratory Manual 10th Edition. Pearson, London.

Chachar, Z., X. Xue, J. Fang, M. Chen, J. Chen, W. Chen, N. Ahmed, S. Chachar, M.U.N. Narejo, N. Ahmed, L. Fan, R. Lai, and Y. Qi. 2025. Key mechanisms of plant-*Ralstonia solanacearum* interaction in bacterial wilt pathogenesis. 16: 1521422.

Champoiseau, P.G., and T.M. Momol. 2009. Bacterial Wilt of Tomato. <https://plantpath.ifas.ufl.edu/rsol/trainingmodules/bwtomato_module.html>. Diakses tanggal 15 Januari 2025.

Choiriyah, A., dan S.D. Nurcahyanti. 2019. Pengendalian penyakit layu bakteri (*Ralstonia solanacearum*) pada tanaman tomat dengan penyambungan batang bawah tahan. Jurnal Bioindustri. 2(1): 295-306.

UNIVERSITAS
GADJAH MADA
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Universitas Gadjah Mada, 2025 | Diunduh dari http://etd.repository.ugm.ac.id/

Collinge, D.B., D.F. Jensen, M. Rabiey, S. Sarrocco, M.W. Shaw, and R.H. Shaw. 2022. Biological control of plant diseases – What has been achieved and what is the direction?. Plant Pathology. 71(5): 1024-1047.

Compant, S., B. Duffy, J. Nowak, C. Clément, and E.A. Barka. 2005. Use of plant growth-promoting bacteria for biocontrol of plant diseases: principles, mechanisms of action, and future prospects. Applied and Environmental Microbiology. 71(9): 4951 - 4959.

Cook, R.J. 2014. Plant Health Management: Pathogen Suppressive Soils. In: N.K. van Alfen. Encyclopedia of Agriculture and Food Systems. Elsevier, Amsterdam, Netherlands, p: 441-455.

Cook, R.J., and A.D. Rovira. 1976. The role of bacteria in the biological control of *Gaeumannomyces graminis* by suppressive soils. Soil Biology and Biochemistry. 8(4): 269-273.

Cook, R.J., and K.F. Baker. 1983. The Nature and Practice of Biological Control of Plant Pathogens. American Phytopathological Society, St. Paul, Minnesota.

Cotxarrera, L., M.I. Trillas-Gay, C. Steinberg, and C. Alabouvette. 2002. Use of sewage sludge compost and *Trichoderma asperellum* isolates to suppress *Fusarium* wilt of tomato. Soil Biology and Biochemistry. 34(4): 467-476.

Denny, T.P. 2006. Plant Pathogenic *Ralstonia* Species. In: S.S. Gnanamanickam (Eds.). Plant-Associated Bacteria. Springer, Dodrecht, p: 573-644.

Denny, T.P., and A.C. Hayward. 2001. Gram-negative bacteria: *Ralstonia*. Laboratory Guide for Identification of Plant Pathogenic Bacteria 3rd Edition. APS Press, St. Paul.

Denny, T.P., and S.R. Baek. 1991. Genetic evidence that extracellular polysaccharide is a virulence factor of *Pseudomonas solanacearum*. Molecular Plant-Microbe Interactions. 4: 198-206.

Faisal, A.F., and Y.F. Mustofa. 2025. Chili pepper: A delve into its nutritional values and roles in food-based therapy. Food Chemistry Advances. 6: 100928.

Fatichah, N.L. 2022. Isolasi dan Identifikasi Aktinomisetes Kompos yang Berkemampuan Antagonis terhadap *Rhodococcus fascians* dan *Streptomyces puniciscabiei*. Fakultas Pertanian. Universitas Gadjah Mada. Skripsi.

Fierer, N., M.A. Bradford, and R.B. Jackson. 2007. Toward an ecological classification of soil bacteria. Ecology. 86(6): 1354-1364.

Fontaine, S., A. Mariotti, and L. Abbadie. 2003. The priming effect of organic matter: a question of microbial competition?. Soil Biology and Biochemistry. 35(6): 837–843.

Frąc, M., S.E. Hannula, M. Bełka, and M. Jędryczka. 2018. Fungal biodiversity and their role in soil health. Frontiers in Microbiology. 9: 707.

UNIVERSITAS
GADJAH MADA
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Universitas Gadjah Mada, 2025 | Diunduh dari http://etd.repository.ugm.ac.id/

Friedel, J.K., K. Molter, and W.R. Fischer. 1994. Comparison and improvement of methods for determining soil dehydrogenase activity by using triphenyltetrazolium chloride and iodonitrotetrazolium chloride. Biology and Fertility of Soils. 18: 291-296.

Garcia, R.O., J.P. Kerns, and L. Thiessen. 2019. *Ralstonia solanacearum* species complex: a quick diagnostic guide. Plant Health Progress. 20(1): 7-13.

Ge, C., B. Liu, Y. Zhu, Y. Lin, R. Xiao. 2004. Study on the methods on identifying the virulence of *Ralstonia solanacearum* using tissue cultured tomatoes. Wuyi Science Journal. 20: 13–16.

Genin, S. 2010. Molecular traits controlling host range and adaptation to plants in *Ralstonia solanacearum*. New Phytologist. 187(4): 920–928.

Genin, S., and T.P. Denny. 2012. Pathogenomics of the *Ralstonia solanacearum* species complex. Annual Review of Phytopathology. 50(1): 67–89.

Gomez, J.D., K. Denef, C.E. Stewart, J. Zheng, and M.F. Cotrufo. 2014. Biochar addition rate influences soil microbial abundance and activity in temperate soils. European Journal of Soil Science. 65(1): 28–39.

González, E.T., and C. Allen. 2003. Characterization of a *Ralstonia solanacearum* operon required for polygalacturonate degradation and uptake of galacturonic acid. Molecular Plant-Microbe Interactions. 16(6): 536-544.

Gorodecki, B., and Y. Hadar. 1990. Suppression of *Rhizoctonia solani* and *Sclerotium rolfsii* diseases in container media containing composted separated cattle manure and composted grape marc. Crop Protection. 9(4): 271-274.

Grimault, V., and P. Prior. 1994. Grafting tomato cultivars resistant or susceptible to bacterial wilt: analysis of resistance mechanisms. Journal of Phytopathology. 141(3): 330-334.

Gunawan, O.S. 2006. Virulensi dan ras *Ralstonia solanacearum* pada pertanaman kentang di Kecamatan Pangalengan, Kabupaten Bandung, Jawa Barat. Jurnal Hortikultura. 16(3): 211-218.

Hadiwiyono. 2008. Tanah supresif: terminologi, sejarah, karakteristik, dan mekanisme. Jurnal Perlindungan Tanaman Indonesia. 14(2): 47-54.

Hamidson, H., R. Adrian, A. Umayah, & B. Gunawan. 2022. Insidensi Dan Identifikasi Penyakit Layu Pada Terong (*Solanum melongena* L.) Di Desa Tanjung Pering, Kabupaten Ogan Ilir, Provinsi Sumatera Selatan. Prosiding pada Seminar Nasional "Revitalisasi Sumber Pangan Nabati dan Hewani Pascapandemi dalam Mendukung Pertanian Lahan Suboptimal secara Berkelanjutan", Palembang, 27 Oktober 2022.

Hartman, G.L., and J.G. Elphinstone. 1994. Advances in The Control Of *Pseudomonas solanacearum* Race 1 in Major Food Crops. In: A.C. Hayward and G.L. Hartman (Eds.). Bacterial Wilt: The Disease and Its Causative Agent, *Pseudomonas solanacearum*. CAB International, Wallingford, UK, p: 157-177.

UNIVERSITAS
GADJAH MADA
**Efektivitas Kompos Diperkaya Mikroba Antagonis dalam Menekan Patogenisitas Ralstonia solanacearum
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Universitas Gadjah Mada, 2025 | Diunduh dari http://etd.repository.ugm.ac.id/

Hayward, A.C. 1991. Biology and epidemiology of bacterial wilt caused by *Pseudomonas solanacearum*. Annual review of phytopathology. 29: 65-87.

He, D., C. Gao, S. Zhao, H. Chen, P. Li, X. Yang, D. Li, T. Zhao, H. Jiang, and C. Liu. 2024. Antibacterial, herbicidal, and plant growth-promoting properties of *Streptomyces sp.* Std57 from the rhizosphere of *Adenophora stricta*. Microorganism. 12(11): 2245.

He, X., Q.W. Huang, X.M. Yang, W. Ran, Y.C. Xu, B. Shen, and Q.R. Shen. 2010. Screening and identification of pathogen causing banana *Fusarium* wilt and the relationship between spore suspension concentration and the incidence rate. Scientia Agricultura Sinica. 43(18): 3809–3816.

Heriyanto. 2019. Kajian pengendalian penyakit layu *Fusarium oxysporum* dengan *Trichoderma* sp. pada tanaman cabai. Jurnal Ilmu-Ilmu Pertanian. 26(2): 26-35.

Hida, A., T. Tajima, and J. Kato. 2019. Two citrate chemoreceptors involved in chemotaxis to citrate and/or citrate-metal complexes in *Ralstonia pseudosolanacearum*. Journal of Bioscience and Bioengineering. 127(2): 169-175.

HiMedia Laboratories. 2024. Nutrient Agar (M001). Technical Data Sheet. <https://www.himedialabs.com/media/TD/M001.pdf>. Diakses tanggal 5 Januari 2025.

HiMedia Laboratories. 2024. Nutrient Broth (M002). Technical Data Sheet. <https://www.himedialabs.com/media/TD/M002.pdf>. Diakses tanggal 5 Januari 2025.

Hoffman, M.D., L.I. Zucker, P.J.B. Brown, D.T. Kysela, Y.V. Brun, and S.C. Jacobson. 2015. Timescales and frequencies of reversible and irreversible adhesion events of single bacterial cells. Analytical Chemistry. 87(24): 12032-12039.

Hoitink, H.A.J. 1980. Composted bark, a light weight growth medium with fungicidal properties. Plant Disease. 64(2): 142–147.

Hoitink, H.A.J., A. Stone, and D.Y. Han. 1997. Suppression of plant diseases by composts. Hortscience. 32(2):184–187.

Hoitink, H.A.J., and M.J. Boehm. 1999. Biocontrol within the context of soil microbial communities: A strategy for sustainable agriculture. Annual Review of Phytopathology. 37(1): 427–446.

Hoitink, H.A.J., M.S. Krause, and D.Y. Han. 2001. Spectrum And Mechanisms Of Plant Disease Control With Composts. In: P.J. Stoffella and B.A. Kahn, (Eds.). Compost Utilization in Horticultural Cropping Systems. CRC Press, Boca Raton, p: 263–274.

Huang, J., T.P. Denny, and M.A. Schell. 1993. vsrB, a regulator of virulence genes of *Pseudomonas solanacearum*, is homologous to sensors of the two-component regulator family. Journal of Bacteriology. 175(19): 6169-6178.

UNIVERSITAS
GADJAH MADA
**Efektivitas Kompos Diperkaya Mikroba Antagonis dalam Menekan Patogenisitas Ralstonia solanacearum
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Universitas Gadjah Mada, 2025 | Diunduh dari http://etd.repository.ugm.ac.id/

Huang, Q., and C. Allen. 2000. Polygalacturonases are required for rapid colonization and full virulence of *Ralstonia solanacearum* on tomato plants. Physiological and Molecular Plant Pathology. 57(2): 77-83.

Ikrarwati, S. Sutardi, K. Mayasari, dan E. Sugiartini. 2018. Budidaya Cabe di Perkotaan. Balai Pengkajian Teknologi Pertanian, Jakarta.

Isah, A.S., E.B. Amans, E.C. Odion, and A.A. Yusuf. 2014. Growth rate and yield of two tomato varieties (*Lycopersicon esculentum* Mill) under green manure and NPK fertilizer rate Samaru Northern Guinea savanna. International Journal of Agronomy. 2014(ID 932759): 1-8.

Janse, J.D., F.A.X. Araluppan, J. Schans, M. Wenneker, and W. Westerhuis. 1998. Experiences with bacterial brown rot, *Ralstonia solanacearum* biovar 2 race 3, in the Netherlands. In: Ph. Prior, C. Allen, and J. Elphinstone (Eds.). Bacterial Wilt Disease: Molecular and Ecological Aspects. Springer-Verlag, Berlin, p: 146-154.

Jayaraman, S., A.K. Naorem, R. Lal, R.C. Dalal, N.K. Sinha, A.K. Patra, and S.K. Chaudhari. 2021. Disease-suppressive soils—beyond food production: a critical review. Journal of Soil science and Plant Nutrition. 21: 1437-1465.

Jiang, G.F., N.Q. Wang, Y.Y. Zhang, Z. Wang, Y.L. Zhang, J.B. Yu, Y. Zhang, Z. Wei, Y.C. Xu, S. Geisen, and V.P. Firman. 2021. The relative importance of soil moisture in predicting bacterial wilt disease occurrence. Soil Ecology Letters. 3(4): 356–366.

Johnson, K.B., V.O. Stockwell, T.L. Sawyer, and D. Sugar. 2000. Assessment of environmental factors influencing growth and spread of *Pantoea agglomerans* on and among blossoms of pear and apple. Phytopathology. 90(11): 1285–1294.

Jubaedah, N.S. 2025. Penanganan instabilitas pasokan aneka cabai dan bawang merah untuk menekan inflasi. Jurnal Perencanaan Pembangunan Pertanian. 2(2): 1-11.

Juhnke, M.E., and E. des Jardin. 1989. Selective medium for isolation of *Xanthomonas maltophilia* from soil and rhizosphere environments. Applied and Environmental Microbiology. 55(3): 747 – 750.

Jumas, J.R. 2022. Efektivitas Kompos dalam Mengendalikan Patogenisitas *Ralstonia solanacearum* pada Pertanaman Tomat (*Solanum lycopersicum*). Fakultas Pertanian. Universitas Gadjah Mada. Skripsi.

Kaari, M., J. Joseph, R. Manikkam, A. Sreenivasan, G. Venugopal, B. Alexander, and S. Krishnan. 2021a. Anti-biofilm activity and biocontrol potential of *Streptomyces* cultures against *Ralstonia solanacearum* on tomato plants. Indian Journal of Microbiology. 62(1): 32-39.

Kaari, M., J. Joseph, R. Manikkam, G. Venugopal, and K. Soytong. 2021b. *Streptomyces* mediated stimulation of defense related enzymes to increase the biocontrol resistance in *Capsicum annuum* L. against *Ralstonia solanacearum*. International Journal of Agricultural Technology. 17(%): 1779-1792.

UNIVERSITAS
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Kaari, M., R. Manikkam, J. Joseph, S. Krishnan, K.K. Annamalai, A. Khan, V. Rajput, S.G. Dastager, M.S. Dharne, M. Umar, G. Venugupal, and B. Alexander. 2024. Integrated genomic and functional analysis of *Streptomyces sp.* UP1A-1 for bacterial wilt control and *Solanaceae* yield increase. Gene Reports. 37: 102012.

Kaminsky, L.M., R.V. Trexler, R.J. Malik, K.L. Hockett, and T.H. Bell. 2019. The inherent conflicts in developing soil microbial inoculants. Trends in Biotechnology, 37(2): 140-151.

Kang, Y., H. Liu, R.W. Carlson, and T.P. Denny. 2004. Lipopolysaccharide O-antigen of *Ralstonia solanacearum* contributes to virulence on tomato plants. Phytopathology. 94: S49.

Kao, C.C., and L. Sequeira. 1991. A gene cluster required for coordinated biosynthesis of lipopolysaccharide and extracellular polysaccharide also affects virulence of *Pseudomonas solanacearum*. Journal of Bacteriology. 173(24):7841-7847.

Kelman, A. 1953. The Bacterial Wilt Caused by *Pseudomonas solanacearum*. A Literary Review and Bibliography. Technical Bulletin of North Carolina Agricultural Experiment Station No. 99, Raleigh, North Carolina.

Kelman, A. 1954. The relationship of pathogenicity of *Pseudomonas solanacearum* to colony appearance in a tetrazolium medium. Phytopathology. 44(12): 693-695.

Kementerian Pertanian. 2011. Peraturan Menteri Pertanian Nomor 70/Permentan/SR.140/10/2011.

Khokhani, D., T.M. Tran, T.M. Lowe-Power, and C. Allen. 2018. Plant assays for quantifying *Ralstonia solanacearum* virulence. Bio Protocol. 8(18): e3028.

Kim, S.G., O.S. Hur, N.Y. Ro, H.C. Ko, J.H. Rhee, J.S. Sung, K.Y. Ryu, S.Y. Lee, and H.J. Baek. 2016. Evaluation of resistence to *Ralstonia solanacearum* in tomato genetic resources at seedling stage. The Plant Pathology Journal. 32(1): 58-64.

Kusuma, B.K.U.D. 2023. Isolasi dan Identifikasi Bakteri Kompos Berdaya Antagonistik terhadap Patogen Tular Tanah. Fakultas Pertanian. Universitas Gadjah Mada. Skripsi.

Li, S., Y. Yu, J. Chen, B. Guo, L. Yang, and W. Ding. 2016. Evaluation of the antibacterial effects and mechanism of action of protocatechualdehyde against *Ralstonia solanacearum*. Molecules. 21(6): 754.

Ling, L., X. Han, X. Li, X. Zhang, H. Wang, L. Zhang, P. Cao, Y. Wu, X. Wang, J. Zhao, and W. Xiang. 2020. A *Streptomyces sp.* NEAU-HV9: isolation, identification, and potential as a biocontrol agent against *Ralstonia solanacearum* of tomato plants. Microorganisms. 8(3): 351.

Liu, H., Y. Kang, S. Genin, M.A. Schell, and T.P. Denny. 2001. Twitching motility of *Ralstonia solanacearum* requires a type IV pilus system. Microbiology. 147(12): 3215-3229.

UNIVERSITAS
GADJAH MADA
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Universitas Gadjah Mada, 2025 | Diunduh dari http://etd.repository.ugm.ac.id/

Longwe, K., G. Akiniwale, O.J. Mwenye, D. van Vugt, M. Chiipanthenga, and A.T. Phiri. 2023. Effects of soil amendments on bacterial wilt incidences and potato tuber yield across different environments in Malawi. Resources, Environment, and Sustainability. 13: 100116.

Lowe-Power, T.M., D. Khokhani, and C. Allen. 2018. How *Ralstonia solanacearum* exploits and thrives in the flowing plant xylem environment. Trends in Microbiology. 26(11):929-942.

Lu, H., S.A. Lema, M.P. Marquès, A.A. Díaz, M. Valls, and N.S. Coll. 2018. Type III secretion-dependent and-independent phenotypes caused by *Ralstonia solanacearum* in Arabidopsis roots. Molecular Plant-Microbe Interaction. 31(1): 175–184.

Lugtenberg, B., and F. Kamilova. 2009. Plant-growth-promoting rhizobacteria. Annual Review of Microbiology. 63: 541-556.

Lugtenberg, B., and J. Leveau. 2007. Biocontrol Of Plant Pathogens: Principles, Promises, And Pitfalls. In: R. Pinton, Z. Varanini, and P. Nannipieri (Eds.). The Rhizosphere: Biochemistry and Organic Substances at The Soil–Plant Interface. CRC Press, Boca Raton, p: 267–296.

Malandraki, I., S.E. Tjamos, I.S. Pantelides, and E.J. Paplomatas. 2008. Thermal inactivation of compost suppressiveness implicates possible biological factors in disease management. Biological Control. 44(2): 180-187.

Mardalena, J., dan Edidas. 2021. Rancang bangun sistem penyiraman cabe merah menggunakan perangkat mobile berbasis Internet of Things. Journal Vocational Teknik Elektronika dan Informatika. 9(3): 1-5.

Mareza, E., K. Agustina, Yursida, dan M. Syukur. Keragaan agronomi cabai keriting (*Capsicum annuum* L.) IPB di lahan pasang surut Sumatera Selatan. Jurnal Agronomi Indonesia. 49(2): 169-176.

Mazzola, M. 2004. Assessment and management of soil microbial community structure for disease suppression. Annual Review of Phytopathology. 42: 243–259.

McGarvey, J.A., T.P. Denny, and M.A. Schell. 1999. Spatial-temporal and quantitative analysis of growth and EPS I production by *Ralstonia solanacearum* in resistant and susceptible tomato cultivars. Phytopathology. 89(12): 1233-1239.

Mendes, R., M. Kruijt, I. de Bruijn, E. Dekkers, M. van der Voort, J.H.M. Schneider, Y.M. Piceno, T.Z. DeSantis, G.L. Andersen, P.A.H.M. Bakker, and J.M. Raaijmakers. 2011. Deciphering the rhizosphere microbiome for disease-suppressive bacteria. Science. 332(6033): 1097-1100.

Morris, C.E., M. Bardin, L.L. Kinkel, B. Moury, P.C. Nicot, and D.C. Sands. 2009. Expanding the paradigms of plant pathogen life history and evolution of parasitic fitness beyond agricultural boundaries. PLoS Pathogens. 5(12): el000693.

Murniasih, T., J.T. Wibowo, M.Y. Putra, F. Untari, dan M. Maryani. 2018. Pengaruh nutrisi dan suhu terhadap selektivitas potensi antibakteri dari bakteri yang berasosiasi dengan spons. Jurnal Kelautan Tropis. 21(1): 65-70.

UNIVERSITAS
GADJAH MADA
**Efektivitas Kompos Diperkaya Mikroba Antagonis dalam Menekan Patogenisitas Ralstonia solanacearum
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Universitas Gadjah Mada, 2025 | Diunduh dari http://etd.repository.ugm.ac.id/

Nakaho, K., H. Hibino, and H. Miyagawa. 2000. Possible mechanisms limiting movement of *Ralstonia solanacearum* in resistant tomato tissues. Journal of Phytopathology. 148(3): 181-190.

Ntougias, S., K.K. Papadopoulou, G.I. Zervakis, N. Kavroulakis, and C. Ehaliotis. 2008. Suppression of soilborne pathogens of tomato by composts derived from agro-industrial wastes abundant in Mediterranean regions. Biology and Fertility of Soils. 44:1081–1090.

Ongena, M., and P. Jacques. 2008. *Bacillus* lipopeptides: versatile weapons for plant disease biocontrol. Trends in Microbiology. 16(3): 115-125.

Orgambide, G., H. Montrozier, P. Servin, J. Roussel, D. Trigalet-Demery, and A. Trigalet. 1991. High heterogeneity of the exopolysaccharides of *Pseudomonas solanacearum* strain GMI 1000 and the complete structure of the major polysaccharide. Journal of Biological Chemistry. 266(13): 8312-8321.

Papasotiriou, F.G., K.G. Varypatakis, N. Christofi, S.E. Tjamos, and E.J. Paplomatas. 2013. Olive mill wastes: a source of resistance for plants against *Verticillium dahliae* and a reservoir of biocontrol agents. Biological Control. 67(1): 51-60.

Pasmawati, P., A. Tjahjoleksono, and S. Suharsono. 2021. Obtaining of transgenic potato (*Solanum tuberosum* L.) cultivar IPB CP3 containing LYZ-C gene resistant to bacterial wilt disease. Indonesian Journal of Biotechnology. 26(1): 48–53.

Phiri, T.M., G. Bhattarai, K.E. Chiwina, Q. Fan, H. Xiong, I. Alatawi, R. Dickson, N.K. Joshi, A. Rojas, K.S. Ling, and Shi A. 2024. An evaluation of bacterial wilt (*Ralstonia solanacearum*) resistance in a set of tomato germplasm from the United States Department of Agriculture. Agronomy 14: 350-364.

Piay, S.S., A. Tyasdjaja, Y. Ermawati, dan F.R.P. Hantoro. 2010. Budidaya dan Pascapanen Cabai Merah (*Capsicum annuum* L.). Badan Penelitian dan Pengembangan Pertanian, Jawa Tengah.

Pieterse, C.M.J., C. Zamioudis, R.L. Berendsen, D.M. Weller, S.C.M. van Wees, and P.A.H.M. Bakker. 2014. Induced systemic resistance by beneficial microbes. Annual Review of Phytopathology. 52: 347–375.

Poorter, H., K.J. Niklas, P.B. Reich, J. Oleksyn, P. Poot, and L. Mommer. Biomass allocation to leaves, stems and roots: meta-analyses of interspecific variation and environmental control. New Phytologist. 193(1): 30-50.

Prior, P., and C. Allen. 1995. Characteristics of *Pseudomonas solanacearum* colony variants. Applied and Environmental Microbiology. 61(6): 2242-2247.

Prior, P., F. Ailloud, B.L. Dalsing, B. Remenant, B. Sanchez, and C. Allen. 2016. Genomic and proteomic evidence supporting the division of the plant pathogen *Ralstonia solanacearum* into three species. BMC Genomics. 17(90):1-11.

Pusat Data dan Sistem Informasi Pertanian. 2024. Outlook Cabai 2024. Sekretariat Jenderal Kementerian Pertanian, Jakarta.

UNIVERSITAS
GADJAH MADA
**Efektivitas Kompos Diperkaya Mikroba Antagonis dalam Menekan Patogenisitas Ralstonia solanacearum
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Universitas Gadjah Mada, 2025 | Diunduh dari http://etd.repository.ugm.ac.id/

Raaijmakers, J.M., T.C. Paulitz, C. Steinberg, C. Alabouvette, and Y.M. Loccoz. 2009. The rhizosphere: a playground and battlefield for soilborne pathogens and beneficial microorganisms. Plant Soil. 321: 341-361.

Rahayu, D.R., dan S. Mangkoedihardjo. 2022. Kajian bioaugmentasi untuk menurunkan konsentrasi logam berat di wilayah perairan menggunakan bakteri (studi kasus: pencemaran merkuri di sungai Krueng Sabee, Aceh Jaya). Jurnal Teknik ITS. 11(1): 15-22.

Rante, H., G. Alam, Usmar, dan SNA Wahid. 2020. Isolasi actinomycetes dari sponge Pulau Barrangcaddi sebagai penghasil antimikroba. Majalah Farmasi dan Farmakologi. 24(1): 25-28.

Remenant, B., J.C. de Cambiaire, G. Cellier, J.M. Jacobs, S. Mangenot, V. Barbe, A. Lajus, D. Vallenet, C. Medigue, M. Fegan, C. Allen, and P. Prior. 2011. *Ralstonia syzygii*, the blood disease bacterium and some Asian *R. solanacearum* strains form a single genomic species despite divergent life-styles. PLOS ONE. 6(9): e24356.

Reuveni, R., M. Raviv, A. Krasnovsky, L. Freiman, S. Medina, A. Bar, and D. Orion. 2002. Compost induces protection against *Fusarium oxysporum* in sweet basil. Crop Protection. 21(7): 583-587.

Saddler, G.S. 2005. Management of Bacterial Wilt Disease. In: C. Allen, P. Prior, and A.C. Hayward (Eds.). Bacterial Wilt Disease and the *Ralstonia solanacearum* Species Complex . APS Press, St. Paul, Minnesota, p: 121-132.

Safni, I., I. Cleenwerck, P. de Vos, M. Fegan, L. Sly, and U. Kappler. 2014. Polyphasic taxonomic revision of the *Ralstonia solanacearum* species complex: Proposal to emend the descriptions of *Ralstonia solanacearum* and *Ralstonia syzygii* and reclassify current *R. syzygii* strains as *Ralstonia syzygii* subsp. *syzygii* subsp. nov., *R. solanacearum* phylotype IV strains as *Ralstonia syzygii* subsp. *indonesiensis* subsp. nov., banana blood disease bacterium strains as *Ralstonia syzygii* subsp. *celebesensis* subsp. nov. and *R. sol-anacearum* phylotype I and III strains as *Ralstonia pseudosolanacearum* sp. nov. International Journal of Systematic and Evolutionary Microbiology. 64(9): 3087-3103.

Sahu, P.K., A. Gupta, P. Kumari, G. Lavanya, and A.K. Yadav. 2017. Attempts for Biological Control of *Ralstonia solanacearum* by Using Beneficial Microorganisms. In: V.S. Mena, P.K. Mishra, J.K. Bisht, and A. Pattanayak (Eds.). Agriculturally Important Microbes For Sustainable Agriculture. Springer, Singapore, p: 315–342.

Saile, E., M.A. Schell, and T.P. Denny. 1997. Role of extracellular polysaccharide and endoglucanase in root invasion and colonization of tomato plants by *Ralstonia solanacearum*. Phytopathology 87(12): 1264-1271.

Scheuerell, S.J., D.M. Sullivan, and W.F. Mahaffee. 2005. Suppression of seedling damping-off caused by *Pythium ultimum*, *P. irregulare*, and *Rhizoctonia solani* in container media amended with a diverse range of Pacific Northwest compost sources. Phytopathology. 95(3): 306-15.

UNIVERSITAS
GADJAH MADA
**Efektivitas Kompos Diperkaya Mikroba Antagonis dalam Menekan Patogenisitas Ralstonia solanacearum
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Universitas Gadjah Mada, 2025 | Diunduh dari http://etd.repository.ugm.ac.id/

Semangun, H. 2006. Pengantar Ilmu Penyakit Tumbuhan. Gadjah Mada University Press, Yogyakarta.

Setiawan, A.W. 2019. Epidemiologi penyakit layu bakteri dan perkembangan kompleks spesies *Ralstonia solanacearum*. Jurnal Galung Tropika. 8(3): 243-270.

Shafi, J., H. Tian, and M. Ji. 2017. *Bacillus cereus* as versatile weapons for plant pathogens: a review. Biotechnology & Biotechnological Equipment. 31(3): 446-459.

Sharma, S.K., K. Rajesh, N.P. Dohroo, and K. Rajesh. 2004. Effect of soil solarization on *Ralstonia solanacearum* population and bacterial wilt of tomato in Himachal Pradesh. Indian Phytopathology. 57(2): 200-204.

Shi, H., Y. Liu, A. Ding, W. Wang, and Y. Sun. 2023. Induced defense strategies of plants against *Ralstonia solanacearum*. Frontiers in Microbiology. 14: 1059799.

Sholeh, A., I. Yulianah, dan S.L. Purnamaningsih. 2017. Penampilan sifat ketahanan penyakit layu bakteri (*Ralstonia solanacearum*) dan produktivitas tinggi tanaman cabai merah (*Capsicum annuum* L.) pada 24 famili F5. Jurnal Produksi Tanaman. 5(6): 957-964.

Sholihah, S.M., L.S. Banu, A. Nuraini, dan P.A. Piguno. 2020. Kajian perbandingan analisa usaha tani serta produktivitas tanaman cabai rawit di dalam polybag dan di lahan pekarangan. Jurnal Ilmiah Respati. 11(1): 13-23.

Skerman, V.B.D., V. McGowan, and P.H.A. Sneath. 1980. Approved lists of bacterial names. International Journal of Systematic Bacteriology. 30:255-420

Smith, E.F. 1896. A Bacterial Disease of the Tomato, Eggplant, and Irish potato (*Bacillus solanacearum* nov. sp.). U.S. Department of Agriculture, Washington, DC.

Smith, E.F. 1914. Bacteria in Relation to Plant Diseases. Carnegie Institute, Washington D.C.

Sneath, P.H., R.S. Bread, E.G. Murray, and R.N. Smith. 1986. Bergeys Manual of Determination Bacteriology. William and Wilkins, London.

Soetiarso, T.A., W. Setiawati, dan D. Musaddad. 2011. Keragaan pertumbuhan, kualitas buah, dan kelayakan finansial dua varietas cabai merah. Jurnal Hortikultura. 21(1): 77-88.

Strom, M.S., and S. Lory. 1993. Structure-function and biogenesis of the type IV pili. Annual Review of Microbiology. 47: 565-596.

Subramanyan, J., L. Thokchom, M. Mizo, P. Patidar, and I. Moin. 2025. A comparative study on dehydrogenase activity using the TTC test. 10 (5): 32-36.

Sumarni, N., dan A. Muharam. 2005. Budidaya Tanaman Cabai Merah. Balai Penelitian Tanaman Sayuran, Bandung.

Sundin, G.W., N.A. Werner, K.S. Yoder, and H.S. Aldwinckle. 2009. Field evaluation of biological control of fire blight in the eastern United States. Plant Disease. 93(4):386–394.

UNIVERSITAS GADJAH MADA
Efektivitas Kompos Diperkaya Mikroba Antagonis dalam Menekan Patogenisitas Ralstonia solanacearum pada Pertanaman Cabai Merah (Capsicum annuum L.)
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Universitas Gadjah Mada, 2025 | Diunduh dari http://etd.repository.ugm.ac.id/

Suprapto, H. 1998. Bertanam Kedelai. Penebar Swadaya, Jakarta.

Suryaminarsih, P., F.L. Saadah, E.T. Prasetyawati, and N. Farida. 2024. Effectiveness of *Streptomyces* spp. as biological control agents of bacterial wilt (*Ralstonia* sp.) in chili pepper. Proceeding of The 3rd Southeast Asia Plant Protection Conference, Bogor, Indonesia, 1-2 November 2024.

Swanson, J.K., J. Yao, J. Tans-Kersten, and C. Allen. 2005. Behavior of *Ralstonia solanacearum* race 3 biovar 2 during latent and active infection of geranium. Phytopathology. 95(2): 136–43.

Tafesse, S., C. Braam, B. van Mierlo, B. Lemaga, and P.C. Struik. 2021. Association between soil acidity and bacterial wilt occurrence in potato production in Ethiopia. Agronomy. 11(8): 1541.

Taiz, L., E. Zeiger, I.M. Møller, and A. Murphy. 2015. Plant Physiology and Development. 6th ed. Sinauer Associates, Massachusetts.

Tanaka, S., X. Han, and R. Kahmann. 2015. Microbial effectors target multiple steps in the salicylic acid production and signaling pathway. Frontiers in Plant Science. 6: 349.

Tans-Kersten, H., Y. Huang, and C. Allen. 2001. *Ralstonia solanacearum* needs motility for invasive virulence on tomato. Journal of Bacteriology 183, 3597-3605.

Tans-Kersten, J., Y.F. Guan, and C. Allen. 1998. *Ralstonia solanacearum* pectin methylesterase is required for growth on methylated pectin but not for bacterial wilt virulence. Applied and Environmental Microbiology. 64(12): 4918-4923.

Thakur, H., A. Sharma, P. Sharma, and R.S. Rana. 2021. An insight into the problem of bacterial wilt in *Capsicum* spp. with special reference to India. Crop Protection. 140, 105420.

Tilston, E.L., D. Pitt, and A.C. Groenhof. 2002. Composted recycled organic matter suppresses soil-borne diseases of field crops. New Phytologist. 154(3): 731-740.

Titarenko, E., E.L. Solanilla, F.G. Olmedo, and P.R. Palenzuela. 1997. Mutants of *Ralstonia* (*Pseudomonas*) *solanacearum* sensitive to antimicrobial peptides are altered in their lipopolysaccharide structure and are avirulent in tobacco. Journal of Bacteriology. 179(21): 6699–6704.

U.S. Department of Agriculture (USDA). 2019. Peppers, hot chili, red, raw (FDC ID: 170106). FoodData Central. <https://fdc.nal.usda.gov/food-details/170106/nutrients>. Diakses tanggal 5 Juni 2025.

van Elsas, J.D., L.S. van Overbeek, M.J. Bailey, J. Schönfeld, and K. Smalla. 2005. Fate of *Ralstonia solanacearum* Biovar 2 as Affected By Conditions and Soil Treatments in Temperate Climate Zones. In: C. Allen, P. Prior, and A.C. Hayward (Eds.). Bacterial Wilt Disease and the *Ralstonia solanacearum* Species Complex. APS Press, St. Paul, Minnesota, p: 39-49.

UNIVERSITAS
GADJAH MADA
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Universitas Gadjah Mada, 2025 | Diunduh dari http://etd.repository.ugm.ac.id/

Waithaka, P.N., E.M. Gathuru, B.M. Githaiga, & C.O. Ouma. 2018. Microbial degradation of maize waste materials using actinomycetes isolated from Egerton University soils, Njoro in Kenya. International Research Journal of Biological Sciences. 1(1): 31 – 36.

Wang, K., W. Yu, G. Yu, L. Zhang, L. Xian, Y. Wei, J.P. Sancho, H. Xue, J.S. Rufian, H. Zhuang, C. Kwon, and A.P. Macho. 2023. A bacterial type III effector targets plant vesicle-associated membrane proteins. Molecular Plant Pathology. 24(9): 1154–1167.

Wang, N., L. Wang, K. Zhu, S. Hou, L. Chen, D. Mi, Y. Gui, Y. Qi, C. Jiang, and J.H. Guo. 2019. Plant root exudates are involved in *Bacillus cereus* AR 156 mediated biocontrol against *Ralstonia solanacearum*. Frontiers in Microbiology. 10: 98.

Wang, Z., W. Luo, S. Cheng, H. Zhang, J. Zong, and Z. Zhang. 2023. *Ralstonia solanacearum* - A soil borne hidden enemy of plants: Research development in management strategies, their action mechanism and challenges. Frontiers In Plant Science. 14: 1141902.

Weller, D.M., J.M. Raaijmakers, B.B.M. Gardener, and L.S. Thomashow. 2002. Microbial populations responsible for specific suppressiveness to plant pathogens. Annual Review of Phytopathology. 40(1): 309–348.

Wicker, E., L. Grassart, R.C. Beaudu, D. Mian, C. Guilbaud, M. Fegan, and P. Prior. 2007. *Ralstonia solanacearum* strains from Martinique (French West Indies) exhibiting a new pathogenic potential. Applied and Environmental Microbiology. 73(21): 6790-6801.

Wiratno. 2017. Pengendalian Organisme Pengganggu Tanaman Obat Berkelanjutan. Prosiding pada Seminar Nasional "Pertanian dan Tanaman Herbal Berkelanjutan di Indonesia", Fakultas Pertanian UMJ, 8 November 2017.

Xue, H., R. Lozano-Durán, and A.P. Macho. 2020. Insights into the root invasion by the plant pathogenic bacterium *Ralstonia solanacearum*. Plants. 9(4): 516.

Yabuuchi, E., I. Yano, H. Hotta, Y. Nishiuchi, and Y. Kosako. 1995. Transfer of two *Burkholderia* and an *Alcaligenes* species to *Ralstonia* gen. nov.: Proposal of *Ralstonia pickettii* (Ralston, Palleroni, and Doudoroff, 1973) comb. nov., *Ralstonia solanacearum* (Smith, 1896) comb. nov. and *Ralstonia eutropha* (Davis, 1969) comb. nov. Microbiology and Immunology. 39(11):897-904.

Yabuuchi, E., Y. Kosako, H. Oyaizu, I. Yano, H. Hotta, Y. Hashimoto, T. Ezaki, and M. Arakawa. 1992. Proposal of *Burkholderia* gen. nov. and transfer of seven species of the genus *Pseudomonas* homology group II to the new genus, with the type species *Burkholderia cepacia* (Palleroni and Holmes 1981) comb. nov. Microbiology and Immunology. 36(12): 1251-1275.

Yao, J., and C. Allen. 2006. Chemotaxis is required for virulence and competitive fitness of the bacterial wilt pathogen *Ralstonia solanacearum*. Journal of Bacteriology. 88(10): 3697–3708.

UNIVERSITAS
GADJAH MADA
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Universitas Gadjah Mada, 2025 | Diunduh dari http://etd.repository.ugm.ac.id/

Yuliar, Y.A. Nion, and K. Toyota. 2015. Recent trends in control methods for bacterial wilt diseases caused by *Ralstonia solanacearum*. Microbes and Environments. 30(1): 1-11.

Yuniarti, S., dan S.T. Rukmini. 2021. Deskripsi VUB Cabai Badan Litbang Pertanian (Leaflet). Balai Penerapan Teknologi Pertanian, Banten.

Zhang, C., Y. Lin, X. Tian, Q. Xu, Z. Chen, and W. Lin. 2017. Tobacco bacterial wilt suppression with biochar soil addition associates to improved soil physiochemical properties and increased rhizosphere bacteria abundance. Applied Soil Ecology. 112: 90–96.

Zhang, Z., A. Lu, and W.G. D'Arcy. 1994. *Solanaceae*. Flora of China. 17: 300-332.

Zheng, X., Y. Zhu, J. Wang, Z. Wang, and B. Liu. 2019. Combined use of a microbial restoration substrate and avirulent *Ralstonia solanacearum* for the control of tomato bacterial wilt. Scientific Reports. 9(1): 20091.