

DAFTAR PUSTAKA

- Adriantama, S., Suriyanti, Nontji, M. 2021. Isolasi dan Identifikasi Morfologi serta Uji Pelarutan Fosfat terhadap Bakteri Rhizosfer Tanaman Kedelai (*Glycine max* L.). *Jurnal Agrotekman*.
- Agbodjato, N.A., Babalola O.O. 2024. Promoting Sustainable Agriculture by Exploiting Plant Growth-Promoting Rhizobacteria (PGPR) to Improve Maize and Cowpea Crops. *PeerJ*.
- Akköse, S., Gündüz, U., Yücel, M., & Eroglu, I. 2009. Effects of ammonium ion, acetate and aerobic conditions on hydrogen production and expression levels of nitrogenase genes in *Rhodobacter sphaeroides* OU 001. *international journal of hydrogen energy*, 34(21), 8818-8827.
- Ali, B. 2015. Bacterial Auxin Signaling: Comparative Study of Growth Induction in *Arabidopsis thaliana* and *Triticum aestivum*. *Turk J Botany*. 39(1):1–9
- Alikhani, H. A., Etesami, H., & Mohammadi, L. 2010. Effect of superior indole-3-acetic acid producing Rhizobia and the combination with Ag and L-tryptophan on wheat growth indices under in vitro conditions. *Journal of food, Agriculture and Environment*, 8(3-4 Part 2), 949-954.
- Alkurtany, A.E.S., Altai, S.H.M., & Alsamarrai, N.S.H. 2022. Phenotypic and molecular diagnosis of *Rhizobium* bacteria isolated from *Vigna unguiculata* plants grown in gypsiferous soils and testing their efficiency in producing indole acetic acid, chelating compounds and dissolving phosphates. *Biochemical & Cellular Archives*. 22(1).
- Allen, P., Phillips, C., Wilkes, S., Wright, G., & Newland, A. 1997. Principles of the polymerase chain reaction in Haematology. *Hematology*, 2(3), 249-256.
- Amin, S.S., Ghozali, T.Z., Efendi, M.R.S. 2023. Identifikasi Bakteri dari Telapak Tangan dengan Pewarnaan Gram Identification of Bacteria from Palms with Gram Stain. *CHEMVIRO*. 1(1).
- Amri, M., Rjeibi, M.R., Gatrouni, M., Mateus, D.M.R., Asses, N., Pinho, H.J.O., Abbes, C. 2023. Isolation, Identification, and Characterization of Phosphate-Solubilizing Bacteria from Tunisian Soils. *Microorganisms*.
- Andrade, L.A.D., Santos, C.H.B., Frezarin, E.T., Sales, L.R., Rigobelo, E.C. 2023. Plant Growth-Promoting Rhizobacteria for Sustainable Agricultural Production. *Microorganisms*. 11(4).
- Angel, R., Panhölzl, C., Gabriel, R., Herbold, C., Wanek, W., Richter, A., & Woebken, D. 2018. Application of stable-isotope labelling techniques for the detection of active diazotrophs. *Environmental microbiology*. 20(1). 44-61.

- Angelini, J., Ibáñez, F., Taurian, T., Tonelli, M. L., Valetti, L., & Fabra, A. 2011. A study on the prevalence of bacteria that occupy nodules within single peanut plants. *Current microbiology*, 62(6), 1752-1759.
- Ardiana, M., & Advinda, L. 2022. The Ability of Fluorescent Pseudomonad to Produce Indole Acetic Acid (IAA). *Jurnal Serambi Biologi*, 7(1), 59-64.
- Ariyani, M. D., Dewi, T. K., Pujiyanto, S., & Supriyadi, A. 2021. Isolasi dan karakterisasi plant growth promoting rhizobacteria dari perakaran kelapa sawit pada lahan gambut. *Bioma: Berkala Ilmiah Biologi*, 23(2), 159-171.
- Aryaldi, R., Saida, S., & Nontji, M. 2021. Identifikasi Morfologi Dan Uji Pelarut Fosfat Bakteri Rhizosfer Tanaman Kacang Tunggak (*Vigna unguiculata* L.). *AGrotekMAS Jurnal Indonesia*. 2(1).
- Astija, A., Yulisa, Y., Alibasyah, L., & Febriani, V. I. 2022. Plant Growth Promoting Rhizobacteria (PGPR) akar bambu, kacang hijau, dan putri malu untuk meningkatkan pertumbuhan bintil akar kacang hijau. *Bioscientist: Jurnal Ilmiah Biologi*. 10(2).
- Athfin, F., Handayani, K., Setiawan, W.A., Ekowati, C.N. 2023. Potensi Bacillus sp. dari Tanah Kebun Raya Liwa sebagai Penghasil Hormon Indole Acetic Acid (IAA). *Indonesian Journal of Chemical Analysis*. 6(1).
- Badan Pusat Statistik Jakarta Pusat. 2018. Tanaman Hortikultura. Statistik Indonesia Tahun 2018. Jakarta Pusat : Badan Pusat Statistik.
- Badan Pusat Statistik. 2022. Produksi Tanaman Sayuran Dalam Angka. BPS – Statistik Indonesia. Jakarta.
- Bait, M., Simarmata, R., Widyastuti, R. 2022. Identifikasi dan Kekerabatan Rhizobia Pohon Mangium dan Sengon Berdasarkan nodD1 dan nifH. *Jurnal Ilmu Pertanian Indonesia (JIPI)*. 27(4): 627-633.
- Barnett, M. J., Fisher, R. F. 2006. Global Gene Expression in the Rhizobial-legume Symbiosis. *Symbiosis*. 42: 1–24.
- Basu, A., Prasad, P., Das, S.N., Kalam, S., Sayyed, R., Reddy, M., El Enshasy, H. 2021. Plant Growth Promoting Rhizobacteria (PGPR) as Green Bioinoculants: Recent Developments, Constraints, and Prospects. *Sustainability*. 13(3): 1140.
- Beltran-Medina, I., Romero-Perdomo, F., Molano-Chavez, L., Gutiérrez, A. Y., Silva, A. M., & Estrada-Bonilla, G. 2023. Inoculation of phosphate-solubilizing bacteria improves soil phosphorus mobilization and maize productivity. *Nutrient Cycling in Agroecosystems*, 126(1), 21-34.
- Bianco, C., Imperlini, E., & Defez, R. 2009. Legumes like more IAA. *Plant Signaling & Behavior*. 4(8). 763-765.
- Biswas, B., Gresshoff, P.M. 2014. The role of symbiotic nitrogen fixation in sustainable production of biofuels. *Int. J. Mol. Sci*. 15, 7380–7397.

- Budiharjo, A., Wulandari, D., Shabrina, J., Mawarni, R.S., Maulana, A.R., Nurhayati, N., Wijanarka, W., Hartajanie, L., Lindayani, L. 2024. Bioprospecting and Molecular Identification of Amylase and Cellulase Producing Thermophilic Bacteria from Sediment of Nglimut Hot Springs, Kendal. *Journal of Tropical Biodiversity and Biotechnology*. 9(3).
- Bueno Batista, M., Richardson, J., Webster, M. W., Ghilarov, D., Peters, J. W., Lawson, D. M., & Dixon, R. 2025. Structural analysis of the NifL-NifA complex reveals the molecular basis of anti-activation of nitrogen fixation gene expression in *Azotobacter vinelandii*. *The FEBS Journal*.
- Candraningtyas, C. F., & Indrawan, M. 2023. Analisis efektivitas penggunaan Plant Growth Promoting Rhizobacteria (PGPR) untuk peningkatan pertanian berkelanjutan. *RISALAH KEBIJAKAN PERTANIAN DAN LINGKUNGAN Rumusan Kajian Strategis Bidang Pertanian dan Lingkungan*. 10(2).
- Chaiharn, M., Lumyong, S. 2011. Screening and Optimization of Indole-3-Acetic Acid Production and Phosphate Solubilization from Rhizobacteria Aimed at Improving Plant Growth. *Curr Microbiol*. 62(1):173–181.
- Chambon, R., Pradeau, S., Fort, S., Cottaz, S., & Armand, S. 2017. High yield production of *Rhizobium NodB* chitin deacetylase and its use for in vitro synthesis of lipo-chitinoligosaccharide precursors. *Carbohydrate Research*, 442, 25-30.
- Chang, M. C., Chiang, Y. C., Ho, C. M., Chen, Y. L., Chen, C. A., Cheng, W. F., & Chou, C. Y. 2012. New primers for methylation-specific polymerase chain reaction enhance specificity of detecting STAT1 methylation. *Taiwanese Journal of Obstetrics and Gynecology*, 51(1), 43-49.
- Checucci, A., Azzarello, E., Bazzicalupo, M., Galardini, M., Lagomarsino, A., Mancuso, S., & Mengoni, A. 2016. Mixed nodule infection in *Sinorhizobium meliloti*–*Medicago sativa* symbiosis suggest the presence of cheating behavior. *Frontiers in Plant Science*, 7, 835.
- Chen, W.F., Wang, E.T., Ji, Z.J., Zhang, J.J. 2021. Recent Development and New Insight of Diversification and Symbiosis Specificity of Legume Rhizobia: Mechanism and Application. *J. Appl. Microbiol*. 131: 553–563.
- Chowdhury F.T. 2021. Anti-fungal Secondary Metabolites and Hydrolytic Enzymes from Rhizospheric Bacteria in Crop Protection: a Review. *J. Bangladesh Acad. Sci*. 44:69–84.
- Cordova-Rodriguez, A., Rentería-Martínez, M.E., López-Miranda, C.A., Guzmán-Ortíz, J.M. and Moreno-Salazar, S.F., 2022. Simple and sensitive spectrophotometric method for estimating the nitrogen-fixing capacity of bacterial cultures. *MethodsX*, 9, p.101917.

- da Silva, V. B., da Silva, A. F., da Silva, T. R., dos Santos, J. W. M., da Silva, J. F., de Souza, A. P., ... & Fernandes-Júnior, P. I. 2019. Fast and efficient symbiotic gene-based duplex PCR approach for the preliminary selection of legume root nodule bacteria. *Rhizosphere*, 10, 100144.
- Dasgupta, D., Panda, A. K., Mishra, R., Mahanty, A., De Mandal, S., & Bisht, S. S. 2021. Nif genes: tools for sustainable agriculture. In *Recent advancement in microbial biotechnology*. Academic Press: New York.
- Del Cerro, P., Ayala-García, P., Jiménez-Guerrero, I., López-Baena, F.J., Vinardell, J.M., Megías, M., Hungria, M., Gil-Serrano, A.M., Pérez-Montaño, F., Ollero, F.J. 2019. The Non-Flavonoid Inducible nodA3 and the Flavonoid Regulated nodA1 Genes of *Rhizobium Tropici* CIAT 899 Guarantee Nod Factor Production and Nodulation of Different Host Legumes. *Plant Soil*. 440, 185–200.
- Del Cerro, P., Megías, M., López-Baena, F. J., Gil-Serrano, A., Pérez-Montaño, F., & Ollero, F. J. 2019. Osmotic stress activates nif and fix genes and induces the *Rhizobium tropici* CIAT 899 Nod factor production via NodD2 by up-regulation of the nodA2 operon and the nodA3 gene. *Plos one*. 14(3).
- Deshwal, V.K., & Chaubey, A. 2014 Isolation and Characterization of *Rhizobium leguminosarum* from Root nodule of *Pisum sativum* L. *Journal of Academia and Industrial Research*. 2(8).
- Dewi, P.F., & Guntur, T. 2024. Isolasi dan Karakterisasi Bakteri Penambat Nitrogen dari Rizosfer Tanaman Nanas di Lereng Gunung Kelud Kediri. *LenteraBio*. 13(1).
- Dhole, A. M., Shelat, H. N., Patel, H. K., & Jhala, Y. K. 2023. Evaluation of the Co-inoculation Effect of *Rhizobium* and Plant Growth Promoting Non-rhizobial Endophytes on *Vigna radiata*. *Current Microbiology*, 80(5).
- Dhull, S., Gera, R., Sheoran, H.S., Kakar, R. 2018. Phosphate Solubilization Activity of Rhizobial Strains Isolated From Root Nodule of Cluster Bean Plant Native to Indian Soils. *International Journal of Current Microbiology and Applied Sciences*. 7(4).
- Dini, I. R., Wawan, W. W., Hapsoh, H. H., & Devi, R. (2020). eksplorasi dan karakterisasi bakteri rhizobium asal tanaman *Mucuna bracteata* di tanah gambut. *Jurnal Agroekoteknologi*, 12(1), 1-12.
- Dini, I.S., Wawan, W., Hapsoh, H., Devi, R. 2020. Eksplorasi dan Karakterisasi Bakteri Rhizobium Asal Tanaman *Mucuna bracteata* di Tanah Gambut. *Jurnal Agroekoteknologi*. 12(1).
- Dixon, R.O.D., Wheeler, C.T. 1986. *Nitrogen Fixation in Plants*. Glasgow, United Kingdom: Blackie.
- Dorfmüller, H. C., Ferenbach, A. T., Borodkin, V. S., & van Aalten, D. M. (2014). A structural and biochemical model of processive chitin synthesis. *Journal of Biological Chemistry*, 289(33), 23020-23028.

- Egamberdieva, D., Lugtenberg, B. 2014. Use of Plant Growth-Promoting Rhizobacteria to Alleviate Salinity Stress in Plants. *Springer*. 1: 73–96.
- Eggerding, F. A., Peters, J., Lee, R. K., & Inderlied, C. B. 1991. Detection of rubella virus gene sequences by enzymatic amplification and direct sequencing of amplified DNA. *Journal of clinical microbiology*, 29(5), 945-952.
- Ehrhardt, D. W., Wais, R., and Long, S. R. 1996. Calcium Spiking in Plant Root Hairs Responding to Rhizobium Nodulation Signals. *Cell*. 85: 673–681.
- Ekowati, C. N., Mirani, M., Handayani, K., & Agustrina, R. (2021). Detection of nitrogenase producing bacteria from the soil of Liwa botanical garden. *Jurnal Ilmiah Biologi Eksperimen dan Keanekaragaman Hayati (J-BEKH)*, 8(2), 53-58.
- Fahde, S., Boughribil, S., Sijilmassi, B., Amri, A. 2023. Rhizobia: A Promising Source of Plant Growth-Promoting Molecules and Their Non-Legume Interactions: Examining Applications and Mechanisms. *Agriculture*. 13(7).
- Fallo, G., Banusu, M.S., Pardosi, L., Tefa, A. 2023. Isolasi dan Identifikasi Bakteri Rhizosfer dari Tanaman Kacang Gude (*Cajanus cajan* L) sebagai Penghasil Hormon IAA (Indole Acetic Acid) dan Aplikasinya pada Benih Padi (*Oryza sativa* L.). *Jurnal Ilmu Hayati*. 22(1).
- Faskhutdinova, E.R., Fotina, N.V., Neverova, O.A., Golubtsova, Y.V., Mudgal, G., Asyakina, L.K. and Aksenova, L.M., 2024. Extremophilic bacteria as biofertilizer for agricultural wheat. *Foods and Raw materials*, 12(2), pp.348-360.
- Fatimah, Millah AI, Fadilah RLA, Salsabila S, Ramly ZA, Sugiarti T, Nurhariyati T, Ni'matuzahroh, dan Affandi M, 2022. Isolation and Potency Test of Endophytic Bacteria as Nitrogen Fixer from Mangrove Plant in Lamongan. *Jurnal Riset dan Aplikasinya*. 4(1): 26-33.
- Ferguson, S., Major, A. S., Sullivan, J. T., Bourke, S. D., Kelly, S. J., Perry, B. J., & Ronson, C. W. 2020. *Rhizobium leguminosarum* bv. *trifolii* NodD2 enhances competitive nodule colonization in the clover-rhizobium symbiosis. *Applied and environmental microbiology*, 86(18), e01268-20.
- Fournier, J., Timmers, A. C. J., Sieberer, B. J., Jauneau, A., Chabaud, M., and Barker, D. G. 2008. Mechanism of Infection Thread Elongation in Root Hairs of *Medicago truncatula* and Dynamic Interplay with Associated Rhizobial Colonization. *Plant Physiol*. 148: 1985–1995.
- Frache, C., Lindström, K., Elmerich, C. 2009. Nitrogen-fixing Bacteria Associated with Leguminous and Non-leguminous Plants. *Plant Soil*. 321: 35–59.
- Frank, I. E., Turk-Kubo, K. A., & Zehr, J. P. 2016. Rapid annotation of *nif H* gene sequences using classification and regression trees facilitates environmental functional gene analysis. *Environmental microbiology reports*, 8(5), 905-916.

- Freiberg, C., Fellay, R., Bairoch, A., Broughton, W.J., Rosenthal, A., Perret, X. 1997. Molecular Basis of Symbiosis Between Rhizobium and Legumes. *Nature*. 387:394–401.
- Fujishige, N. A., Lum, M. R., De Hoff, P. L., Whitelegge, J. P., Faull, K. F., & Hirsch, A. M. 2008. Rhizobium common nod genes are required for biofilm formation. *Molecular microbiology*, 67(3), 504-515.
- Gaby, J.C., Buckley, D.H. 2014. A Comprehensive Aligned NifH Gene Database: a Multipurpose Tool for Studies of Nitrogen-fixing bacteria. *Database Oxford*.
- Galloway, J.N., Aber, J.D., Erisman, J.W., Seitzinger, S.P., Howarth, R.W., Cowling, E.B. 2003. The Nitrogen Cascade. *Bio. Sci.* 53: 341–356.
- Garrity, G., Bell, J., and Lilburn, T. 2005. *Bergey's Manual® of Systematic Bacteriology*. New York: Springer US, pp. 1–574.
- Gera, R., Kumar, V., Shekhawat, K., & Goyal, S. 2014. Genotypic diversity in native rhizobial population nodulating *Vicia faba* in arid and semi-arid regions of Haryana state (India). *Annals of Microbiology*, 64(2), 619-626.
- Glick, B.R. 2014. Bacteria with ACC Deaminase Can Promote Plant Growth and Help to Feed the World. *Microbiological Research*. 169(1): 30-39.
- Goyal, R.K., Mattoo, A.K., Schmidt, M.A. 2021. Rhizobial–Host Interactions and Symbiotic Nitrogen Fixation in Legume Crops Toward Agriculture Sustainability. *Frontiers in Microbiology*.
- Graham, P.H.; Vance, C.P. 2003. Legumes: Importance and constraints to greater use. *Plant Physiol.* 131, 872–877.
- Granada, C.E., Strochein, M., Vargas, L.K., Bruxel, M., Sá, E.L.S.D., Passaglia, L.M. 2014. Genetic Diversity and Symbiotic Compatibility Among Rhizobial Strains and *Desmodium incanum* and *Lotus* spp. *Plants. Genet Mol Bio.l* 37(2): 396–405
- Gray, E.J., Smith, D.L. 2005. Intracellular and Extracellular PGPR: Commonalities and Distinctions in the Plant-bacterium Signaling Processes. *Soil Biol Biochem.* 37:395–412.
- Gupta, R.S., Rekha, S., Aparna, A., Kuhad, R.C. 1994. A Modified Plate Assay for Screening Phosphate Solubilizing Microorganisms. *J Gen Appl Microbiol.*
- Hadianta, R., Rusmana, I., & Mubarik, N. R. 2014. Diversity of nitrogen fixing bacteria based on nifH gene in rice fields. *AENSI Journals*. 8(14).
- Hakim, S., Imran, A., & Mirza, M. S. 2021. Phylogenetic diversity analysis reveals Bradyrhizobium yuanmingense and Ensifer aridi as major symbionts of mung bean (*Vigna radiata* L.) in Pakistan. *Brazilian Journal of Microbiology*, 52(1), 311-324.

- Hakim, S., Mirza, B. S., Imran, A., Zaheer, A., Yasmin, S., Mubeen, F., & Mirza, M. S. 2020. Illumina sequencing of 16S rRNA tag shows disparity in rhizobial and non-rhizobial diversity associated with root nodules of mung bean (*Vigna radiata* L.) growing in different habitats in Pakistan. *Microbiological research*, 231, 126356.
- Hamdi, Y. A. 2002. Application of nitrogen fixing systems in soil improvement and management. *FAO Soil Bulletin*. FAO and Agriculture Organization of The United Nations.
- Hamels, S., Glouden, T., Gillard, K., Mazzara, M., Debode, F., Foti, N., & Remacle, J. 2009. A PCR-microarray method for the screening of genetically modified organisms. *European Food Research and Technology*, 228(4), 531-541.
- Han, T. X., Tian, C. F., Wang, E. T., & Chen, W. X. (2010). Associations among rhizobial chromosomal background, nod genes, and host plants based on the analysis of symbiosis of indigenous rhizobia and wild legumes native to Xinjiang. *Microbial ecology*, 59(2), 311-323.
- Haskett, T. L., Cooke, L., Green, P., & Poole, P. S. 2025. Regulation of Rhizobial Nodulation Genes by Flavonoid-Independent NodD Supports Nitrogen-Fixing Symbioses With Legumes. *Environmental Microbiology*, 27(1).
- Hasruddin dan Husna, R. 2014. *Mini Riset Mikrobiologi Terapan*. Yogyakarta: GRAHA ILMU.
- Haukka K., Lindström K., Young J.P. 1998. Three Phylogenetic Groups of NodA and NifH Genes in *Sinorhizobium* and *Mesorhizobium* Isolates from Leguminous Trees Growing in Africa and Latin America. *Appl Environ Microbiol.* 64(2):419-26.
- Haukka, K., Lindström, K., Young, J.P.W. 1998. Three Phylogenetic Groups of nodD and nifH Genes in *Sinorhizobium* and *Mesorhizobium* Isolates from Leguminous Trees Growing in Africa and Latin America. *Applied and Environmental Microbiology*. 64(2).
- Hawkins, J.P., Oresnik, I.J. 2022. The Rhizobium-Legume Symbiosis: Co-opting Successful Stress Management. *Frontiers*.
- Hernández, G., Ríos, Y., García, T. H., Louis, Y., Spengler, I., & Ortiz, Y. (2025). Rhizobium sp. as a Growth Inducer of Phaseolus vulgaris L., Determining the Qualitative Chemical Composition of Its Ethyl Acetate Extract Using High-Resolution Liquid Chromatography Coupled with Mass Spectrometry. *International Journal of Plant Biology*. 16(1), 37.
- Hikmatyar, M.F., Royani, J.I., Dasumiati. 2015. Isolasi dan Amplifikasi DNA Keladi Tikus (*Thyponium flagelliform*) Untuk identifikasi Keragaman Genetik. *Jurnal Bioteknologi dan Biosains Indonesia*. 2(2), 42-48.
- Hussain, A., Adnan, M., Iqbal, S., Fahad, S., Saeed, M., Mian, I.A., Andaleeb, S. 2019. Combining Phosphorus (P) with Phosphate Solubilizing Bacteria

- (PSB) Improved Wheat Yield and P Uptake in Alkaline Soil. *Pure Appl. Biol.* 8:1809–1817.
- Imada, E. L., de Oliveira, A. L. M., Hungria, M., & Rodrigues, E. P. 2017. Indole-3-acetic acid production via the indole-3-pyruvate pathway by plant growth promoter *Rhizobium tropici* CIAT 899 is strongly inhibited by ammonium. *Research in Microbiology*, 168(3), 283-292.
- Indriyani, Y. A., Tornando, H., & Utami, A. D. 2024. Isolasi dan Karakterisasi *Rhizobium* dari Rhizosfer Kacang Tanah (*Arachis hypogaea*) serta Aplikasinya sebagai Pupuk Hayati pada Pertumbuhan Akar Kedelai (*Glycine max*). In *Prosiding Seminar Nasional Fakultas Pertanian UNS*. 8(1).
- Jaya, F. 2019. *Ilmu, Teknologi, dan Manfaat Kefir*. Malang: UB Press.
- Kawulusan, M.M. 2014. Populasi *Lamprosema indicata* (LEPIDOPTERA: PYRALIDAE) pada Tanaman Kacang Merah di Kecamatan Tompaso dan Kawangkoan Kabupaten Minahasa. *Ejournal Unsrat*.
- Kaziūnienė, J., Pini, F., Shamshitov, A., Razbadauskienė, K., Frercks, B., Gegeckas, A., & Supronienė, S. 2024. Genetic Characterization of *Rhizobium* spp. Strains in an Organic Field Pea (*Pisum sativum* L.) Field in Lithuania. *Plants*, 13(14), 1888.
- Khan, M.S., Zaidi, A., Ahmad, E. 2014. Mechanism of Phosphate Solubilization and Physiological Functions of Phosphate-solubilizing Microorganisms. *Springer*. 31-62.
- King, C.A., Purcell, L.C. 2005. Inhibition of N₂ fixation in soybean is associated with elevated ureides and amino acids. *Plant Physiol.* 137: 1389–1396.
- Kloepper, J.W., Schroth, M.N. 1978. Plant Growth-promoting Rhizobacteria on Radishes. In: *Végétale et Phyto-Bactériologie Station de Pathologie. Proceedings of the 4th International Conference on Plant Pathogenic Bacteria*. 879–882.
- Kumalasari, I.D., Astuti, E.D., Prihastanti, E. 2013. Pembentukan Bintil Akar Tanaman Kedelai (*Glycine max* (L) Merrill) dengan Perlakuan Jerami pada Masa Inkubasi yang Berbeda. *Jurnal Sains dan Matematika*. 21(4).
- Kumar, S., Singh, R.K., Kumar, S.C., Banjare, U., Partel, A.K., Pandey, A., Akansha, Singh, P. 2021. Evaluation of Phosphate Solubilizing Ability of the Bacterial Strains Isolated from Root Nodules of Pigeon Pea (*Cajanus cajan*). *Plant Archives*. 21(1).
- Kuznetsova, I. G., Karlov, D. S., Sazanova, A. L., Guro, P. V., Alekhina, I. A., Tikhomirova, N. Y., & Safronova, V. I. 2023. Genetic diversity of microsymbionts of legumes *Lathyrus pratensis* L., *Vicia cracca* L., *Trifolium repens* L., and *Astragalus schelichowii* Turcz. growing near Norilsk in Arctic Russia. *Russian Journal of Plant Physiology*, 70(8), 187..

- Laguerre, G., Nour, S.M., Macheret, V., Sanjuan, J., Drouin, P., Amarger, N. 2001. Classification of Rhizobia Based on *nodC* and *nifH* Gene Analysis Reveals a Close Phylogenetic Relationship Among *Phaseolus vulgaris* Symbionts. *Microbiology*. 147: 981–993.
- Lebrazi, S., Fadil, M., Chraibi, M. 2020. Screening and Optimization of Indole-3-acetic Acid Production by *Rhizobium* sp. Strain Using Response Surface Methodology. *J Genet Eng Biotechnol*. 18: 21.
- Ledermann, R., Schulte, C.C.M., Poole, P.S. 2021. How Rhizobia Adapt to the Nodule Environment. *J. Bacteriol*.
- Lewar, Y. dan A. Hasan. 2019. Potential Seed Production of Red Bean Varieties Inerie ngada in the Lowlands Dry Land : Studies Application Type Bio Char and Volume Giving Water Against Viability and Viogur of Seeds. *Ecology, Environment and Conservation*. 25: 52 – 57.
- Limanskiĭ, A., Minukhin, V., Limanskaia, O., Pavlenko, N., Mishina, M., & Tsygenenko, A. 2005. Species-specific detection of *Proteus vulgaris* and *Proteus mirabilis* by the polymerase chain reaction. *Zhurnal Mikrobiologii, Epidemiologii i Immunobiologii*, (3), 33-39.
- Lindstrom, K., & Mousavi, S.A. 2019. Effectiveness of Nitrogen Fixation in Rhizobia. *Microbial Biotechnology*. 13(5).
- Lirio-Paredes, J., Ogata-Gutiérrez, K., & Zúñiga-Dávila, D. 2022. Effects of Rhizobia Isolated from Coffee Fields in the High Jungle Peruvian Region, Tested on *Phaseolus vulgaris* L. var. Red Kidney. *Microorganisms*. 10(4).
- Liu, J., Liu, X., Zhang, Q., Li, S., Sun, Y., Lu, W., Ma, C. 2020. Response of Alfalfa Growth to Arbuscular Mycorrhizal Fungi and Phosphate-solubilizing Bacteria Under Different Phosphorus Application Levels. *AMB Express*. 10:200.
- Löhis, F., and Hansen, R. 1921. Nodulating Bacteria of Leguminous Plant. *J. Agric. Res.* 20, 543-556.
- Mahmud, K., Makaju, S., Ibrahim, R., & Missaoui, A. 2020. Current progress in nitrogen fixing plants and microbiome research. *Plants*. 9(1), 1–17.
- Mathews A., Carroll B. J., Gresshoff P. M. 1989. Development of Bradyrhizobium infections in supernodulating and non-nodulating mutants of soybean (*Glycine max* [L.] Merrill). *Protoplasma*. 150: 40–47.
- Matsumura, A., & Daimon, H. 2018. An evaluation of phosphorus uptake in *Sesbania cannabina* when ferric phosphate is applied in the presence of phosphate-solubilizing rhizobia. *Legume research*. 41(2).
- Mehboob, I., Naveed, M., Zahir, Z.A. 2009. Rhizobial Association with Non-Legumes: Mechanisms and Applications. *Crit. Rev. Plant Sci*.

- Mekonnen, M., Kebede, A., Egigu, M.C., Muthuswany, M. 2024. Efficiency of Indigenous Soil Rhizobia on Growth Performance of the Common Bean (*Phaseolus vulgaris* L.). *Malaysian Journal of Soil Science*.
- Meli, A., & Murtiyaningsih, H. 2018. Pengukuran Indole-3-Acetic Acid (IAA) pada *Bacillus* sp. dengan Penambahan L-Tryptofan. *Bioeduscience*. 2(2).
- Melino, V. J., Drew, E. A., Ballard, R. A., Reeve, W. G., Thomson, G., White, R. G., & O'hara, G. W. (2012). Identifying abnormalities in symbiotic development between *Trifolium* spp. and *Rhizobium leguminosarum* bv. *trifolii* leading to sub-optimal and ineffective nodule phenotypes. *Annals of Botany*, 110(8), 1559-1572.
- Mousavi, S.A. 2016. Revised Taxonomy of the Family Rhizobiaceae, and Phylogeny of Mesorhizobia Nodulating *Glycyrrhiza* spp. *Disertasi*. Schola Doctoralis Scientiae Circumiectalis, Alimentariae, Biologicae.
- Mulyadi, A. 2012. Pengaruh Pemberian Legin, Pupuk NPK (15-15-15), dan Urea pada Tanah Gambut terhadap Kandungan N, P Total Pucuk dan Bintil Akar Kedelai (*Glycine max* (L) Merr.). *Kaunia*. 8(1) : 21-29.
- Musapa, M., Taida, K., Mtawa, M., Sandra, C., Douglas, E.N., Philip, E.T., Sungano, M. 2013. A Simple Chelex Protocol for DNA Extraction from *Anopheles* spp. *Journal of Visualized Experiments*. (71), e3281, doi:10.3791/3281.
- Ngginak, J., Manalu, T.S.J., Isu, D.A., Hae, M.L., Polin, S.D., Hendrik, A.C., Mbay, Y. 2024. *Sebaran Tanaman Golongan Kacang-kacangan (Leguminosae) di NTT*. Pekalongan: Penerbit NEM.
- Nkot, L.N., Timb, S.A.L., Nyouma, A., Rapsia, D. 2025. Screening and Optimization of Indole-3-Acetic Acid Production by Cowpea (*Vigna unguiculata* L. Walp.) Rhizobia Isolates. *American Journal of Plant Sciences*. 16(6).
- Noisangiam, R., Teamtisong, K., Tittabutr, P., Boonkerd, N., Toshiki, U., Minamisawa, K., & Teaumroong, N. 2012. Genetic Diversity, Symbiotic Evolution, and Proposed Infection Process of *Bradyrhizobium* Strains Isolated from Root Nodules of *Aeschynomene americana* L. in Thailand. *Applied and environmental microbiology*, 78(17), 6236-6250.
- Nural Yaman, B.E.L.M.A. 2025. Species-specific primer design for environmental microorganisms and extremophiles. *Methods in Microbiology*, 57.
- Ojija, F., & Aloo, B. N. 2023. The Role of Rhizobia Toward Food Production, Food and Soil Security through Microbial Agro-input Utilization in Developing Countries. *Elsevier*. 8.
- Oksana, M. I., Fianiray, A. R., & Zam, S. I. (2020). Isolasi dan identifikasi bakteri pelarut fosfat pada tanah ultisol di Kecamatan Rumbai, Pekanbaru. *Agrotechnology Research Journal*, 4(1), 22-25.

- Oldroyd, G.E.D., Murray, J.D., Poole, P.S., and Downie, J.A. 2011. The Rules of Engagement in the Legume-rhizobial Symbiosis. *Annu. Rev. Genet.* 45: 119–144.
- Oleńska E., Małek W., Wójcik M., Swiecicka I., Thijs S., Vangronsveld J. 2020. Beneficial Features of Plant Growth-promoting Rhizobacteria for Improving Plant Growth and Health in Challenging Conditions: A Methodical Review. *Sci. Total Environ.*
- OO, A., Dianda, M., & Adelowo, F. O. 2021. Evaluation of some Nodulation Genes found in Bambara Symbiotic Rhizobia Strains. *Journal of Microbiology and Pathology.* 5(2).
- Ormeño-Orrillo, E., Gomes, D. F., Del Cerro, P., Vasconcelos, A. T. R., Canchaya, C., Almeida, L. G. P., & Hungria, M. 2016. Genome of *Rhizobium leucaenae* strains CFN 299T and CPAO 29.8: searching for genes related to a successful symbiotic performance under stressful conditions. *BMC genomics*, 17(1), 534.
- Ott, T., Van Dongen, J.T., Günther, C. 2005. Symbiotic Leghemoglobins are Crucial for Nitrogen Fixation in Legume Root Nodules but Not for General Plant Growth and Development. *Curr Biol.* 15:531–535.
- Paço, A., Da-Silva, J. R., Eliziário, F., Brígido, C., Oliveira, S., & Alexandre, A. 2019. traG Gene is Conserved Across *Mesorhizobium* spp. able to Nodulate the Same Host Plant and Expressed in Response to Root Exudates. *BioMed Research International*, 2019(1), 3715271.
- Pattern, C.L., & Glick, B.R. 2002. Role of *Pseudomonas putida* Indole Acetic Acid in Development of the Host Plant Root System. *Appl Environ Microbiol.* 68 (8).
- Paul, D., Sinha, S.N. 2013. Phosphate Solubilization Potential and Phosphatase Activity of Some Bacterial Strains Isolated from Thermal Power Plant Effluent Exposed Water of River Ganga. *CIBTech J. Microbiol.* 2:1–7.
- Peix, A., Ramírez-Bahena, M.H., Velázquez, E., Bedmar, E.J. 2015. Bacterial Associations with Legumes. *CRC Crit. Rev. Plant Sci.* 34: 17–42.
- Peix, A., Velázquez, E., Silva Luis, R. 2010. Key Molecules Involved in Beneficial Infection Process in Rhizobia-legume Symbiosis. *Springer.* 55–79
- Peoples, M.B., Ladha, J.K., Herridge, D.F. 1995. Enhancing Legume N₂ Fixation through Plant and Soil Management. *Plant Soil.* 174:83–101
- Pindi, P.V., Satyanarayana, S.D.V., Kumar, K.S. 2020. Rhizobium-Legume Symbiosis: Molecular Determinants and Geospecificity. *J Pure Appl Microbiol.* 14(2): 1107-1114.
- Pirog, T., Piatetska, D., Klymenko, N., & Iutynska, G. 2022. Ways of auxin biosynthesis in microorganisms. *Microbiological Journal.*
- Pohan, S.C., Manalu, K., Nasution, R.A. 2024. Isolasi dan Identifikasi Bakteri Endofit Penghasil Hormon IAA (Indole Acetic Acid) dari Akar

- Tanaman Mangrove *Avicennia marina*. *BIOEDUSAINS: Jurnal Pendidikan Biologi dan Sains*. 7(1).
- Pomuato, E.R., Musa, N., Zakaria, F. 2022. Kajian Tentang Interval Waktu Pemberian Air Dan Jarak Tanam Terhadap Pertumbuhan Dan Hasil Tanaman Kacang Merah (*Phaseolus vulgaris* L.). *JATT*. 11(2): 1-11.
- Prabhu, N., Borkar, S., Garg, S. 2019. In *Advances in Biological Science Research: Phosphate Solubilization by Microorganisms*. Amsterdam: Elsevier.
- Pravin, V., Rosazlin, A., Tumirah K., Ismail, S., Boyce, A. N. 2016. Role of Plant Growth Promoting Rhizobacteria in Agricultural Sustainability a Review. *Molecules*. 21:573
- Puspawati C. dan Haryono P. 2018. *Bahan Ajar Kesehatan Lingkungan Penyehatan Tanah*. Jakarta: Pusat Pendidikan Sumber Daya Manusia Kesehatan Edisi Tahun 2018, Kementerian Kesehatan Republik Indonesia.
- Qin, Y., Huang, Y.Y., Khan, Q., Zhang, K.K., Guo, D.J., Yang, L.T., Li, Y.R., Xing, Y.X. 2023. Cloning, Prokaryotic Expression and Functional Characterization of *NifH* Gene from the Associative Nitrogen-Fixing Bacteria *Klebsiella Variicola* DX120E. *Iran J Biotechnol*. 21(3).
- Raheem, A., Shaposhnikov, A., Belimov, A.A., Dodd, I.C., Ali, B. 2018. Auxin Production by Rhizobacteria was Associated with Improved Yield of Wheat (*Triticum aestivum* L.) Under Drought Stress. *Arch Agron Soil Sci*. 64(4): 574–587.
- Rahi, P., Girama, P., Chaudhari, D., diCenzo, G.C., Kiran, S., Khullar, A., Chandel, M., Gawari, S., Mohana, A., Chavana, S., Mahajana, B. 2020. *Rhizobium indicum* sp. nov., Isolated from Root Nodules of Pea (*Pisum sativum*) Cultivated in the Indian trans-Himalayas. *Systematic and Applied Microbiology*. 43.
- Rahma, H., Zainal, A., Surahman, M., Sinaga, M.S., Giyanto. 2014. Potensi Bakteri Endofit dalam Menekan Penyakit Layu Stewart (*Pantoea Stewartii* subsp. *Stewartii*) pada Tanaman Jagung. *Jurnal HPT Tropika*. 14(2).
- Rahmayuni, E., Ismiani, S., Muslimah, D.H., Wilujeng, E.D.I., & Rizqulloh, M.N. 2018. Karakterisasi dan Viabilitas Isolat Bakteri Pelarut Fosfat dalam Bahan Pembawa Kompos dan Zeolit. *Jurnal Agrosains dan Teknologi*. 3(1), 31-38.
- Ramos Solano, B., Barriuso Maicas, J., Pereyra de la Iglesia, M.T., Domenech, J., Gutiérrez Mañero, F.J. 2008. Systemic Disease Protection Elicited by Plant Growth Promoting Rhizobacteria Strains: Relationship Between Metabolic Responses, Systemic Disease Protection, and Biotic Elicitors. *Phytopathology*. 98(4): 451–457.
- Rania, M.A., Nassar, Yasser, M., Ahmed and Mohamed S., Boghdady. 2010. Botanical Studies on *Phaseolus vulgaris* L. I-Morphology of Vegetative and Reproductive Growth. *International Journal of Botany*.

- Rawat, P., Shankhdhar, D., Shankhdhar, S.C. 2020. Plant Growth-promoting Rhizobacteria: A Booster for Ameliorating Soil Health and Agriculture Production. *Springer*.
- Riah, W., Laval, K., Laroche-Ajzenberg, E., Mougin, C., Latour, X., Trinsoutrot-Gattin, I. 2014. Effects of Pesticides on Soil Enzymes: a Review. *Environmental Chemistry Letters*. 12(2):257–273.
- Rini, I, A., Oktaviani, I., Asril, M., Agustin, R., Frima, F.K. 2020. Isolasi dan Karakterisasi Bakteri Penghasil IAA (Indole Acetic Acid) dari Rhizosfer Tanaman Akasia (*Acacia mangium*). *Agro Bali*. 3(2).
- Rodriguez, H., Fraga, R. 1999. Phosphate Solubilizing Bacteria and Their Role in Plant Growth promotion. *Biotechnology Advances*. 17(4-5).
- Rogel, M. A., Bustos, P., Santamaría, R. I., González, V., Romero, D., Cevallos, M. Á., & Martínez-Romero, E. 2014. Genomic basis of symbiovar mimosae in *Rhizobium etli*. *BMC genomics*, 15(1), 575.
- Rosita, B. A., Wangiyana, W., & Nufus, N. H. 2025. Pengaruh Mikroba Bintil Akar Beberapa Jenis Gulma dan Musim Tanam terhadap Pertumbuhan dan Pembentukan Bintil Akar Kacang Hijau. *Jurnal Ilmiah Mahasiswa Agrokomplek*. 4(2).
- Saida, Puspitasari, Aminah. 2022. Uji Aktivitas Penambatan Nitrogen dan Penghasil IAA dari Rizosfer Tanaman Kedelai (*Glycine max* L.). *Jurnal Agrotek*. 6(1).
- Saksaganskaia, A.S., Vladimirova, M.E., Muntyan, V.S., Roumiantseva, M.L. 2021. Sinorhizobium meliloti Harboured Distinct Alleles of Nod Genes Showed Different Symbiotic Activity on Medicago Lupulina and Medicago Varia. *International Multidisciplinary Scientific Geoconference Surveying Geology and Mining Ecology Management, SGEM*.
- Sapalina, F., Ginting, E. N., & Hidayat, F. 2022. Bakteri penambat nitrogen sebagai agen biofertilizer. *War. Pus. Penelit. Kelapa Sawit*, 27(1), 41-50.
- Sari, E. N. 2019. Isolasi Dan Karakterisasi Rhizobium Dari Glycine max L. Dan Mimosa pudica Linn. *EKOTONIA: Jurnal Penelitian Biologi, Botani, Zoologi dan Mikrobiologi*.
- Sari, R., Prayudyarningsih, R. 2015. Rhizobium: Pemanfaatannya Sebagai Bakteri Penambat Nitrogen. *Info Teknis EBONI*. 12(1).
- Satyanarayana, S. D., Krishna, M. S. R., Kumar, P. P., & Jeeredy, S. 2018. In silico structural homology modeling of nif A protein of rhizobial strains in selective legume plants. *Journal of Genetic Engineering and Biotechnology*, 16(2), 731-737.
- Schmidt, T.M., DeLong, E.F., Pace, N.R. 1991. Analysis of a Marine Picoplankton Community by 16S rRNA Gene Cloning and Sequencing. *J Bacteriol*. 173:4371–8.

- Schultze, M., Kondorosi, A. 1998. Regulation of Symbiotic Root Nodule Development. *Annu. Rev. Genet.* 32, 33–57.
- Seidu, O. A., Githiri, S. M., Wesonga, J. M., & Ngumi, V. W. 2025. Isolation, screening and in-vitro characterization of plant growth-promoting Bradyrhizobium isolates from the nodules of Bambara groundnut (*Vigna subterranean*) for potential use as bioinoculants. *Frontiers in Sustainable Food Systems*.
- Serapide, F., Pallone, R., Quirino, A., Marascio, N., Barreca, G. S., Davoli, C., & Russo, A. 2025. Impact of Multiplex PCR on Diagnosis of Bacterial and Fungal Infections and Choice of Appropriate Antimicrobial Therapy. *Diagnostics*, 15(8), 1044.
- Shen J, Yuan L, Zhang J, Li H, Bai Z, Chen X, Zhang W, Zhang F. 2011. Phosphorus dynamics: from soil to plant. *Plant Physiol*.
- Sihaloho, A.N., Purba, R., dan Sihombing, N. 2019. Respon Pertumbuhan dan Produksi Tanaman Kacang Merah (*Vigna angularis*) dengan Pemberian Pupuk NPK dan Pupuk Kascing. Fakultas Pertanian. Universitas Simalungun. *Jurnal Ilmiah Rhizobia Vol.* 1(2).
- Sijilmassi, B., Filali-Maltouf, A., Fahde, S., Ennahli, Y., Boughribil, S., Kumar, S., & Amri, A. 2020. In-vitro plant growth promotion of Rhizobium strains isolated from lentil root nodules under abiotic stresses. *Agronomy*, 10(7), 1006.
- Silva, F. G. N., & Vidor C. 2000. Solubilização de Fosfato por Microrganismos na Presença de Fontes de Carbono. *Rev Bras Cienc Solo*. 24: 311-319.
- Singh, K., & Gera, R. 2018. Assessing phosphate solubilization ability of sesbania grandiflora rhizobia isolated from root nodules using diverse agroecological zones of Indian soils for biofertilizer production. *International Journal of Chemical Studies*, 6(4), 398-402.
- Smýkal, P., Coyne, C. J., Ambrose, M. J., Maxted, N., Schaefer, H., Blair, M. W. 2015. Legume Crops Phylogeny and Genetic Diversity for Science and Breeding. *Crit. Rev. Plant Sci.* 34: 43–104.
- Soniya, S., Swati, L., Priyanka, K., Vijaya, R. 2023. *Advanced Microbial Technology for Sustainable Agriculture and Environment*. United States: Academic Press.
- Sophian, A., Yustina. 2022. Analisis Nilai Kemurnian DNA Menggunakan Nano Fotometer pada Rasio 260/230 yang Diisolasi dari Produk Nugget. *Jurnal Umj.* 3(2).
- Spaepen, S., Das, F., Luyten, E., Michiels, J., & Vanderleyden, J. 2009. Indole-3-acetic acid-regulated genes in *Rhizobium etli* CNPAF512. *FEMS microbiology letters*. 291(2). 195-200.
- Spaepen, S., Vanderleyden, J., Okon, Y. 2009. Plant Growth-promoting Actions of Rhizobacteria. *Adv Bot Res.* 51:283–320.

- Spaink, H.P. 2000. Root nodulation and infection factors produced by rhizobial bacteria. *Annu. Rev. Microbiol.* 54: 257–288.
- Sprent, J.I. 2008. 60Ma of Legume Nodulation What's new? What's changing?. *J Exp Bot.* 59: 1081–1084.
- Sprent, J.I. 2009. *Legume Nodulation. A Global Perspective.* Chichester, UK: Wiley-Blackwell..
- Suranoto, J., Antuli, Z., Une, S. 2020. Analisa Karakteristik Kimia dan Sensori Tempe dengan Substitusi Kacang Merah (*Phaseolus vulgaris* L.). *Ejurnal Ung.*
- Suryanti, E., Nabilla, A.Y., Prastya M.E., Sari, D.A. 2024. Isolasi dan Karakterisasi Bakteri *Rhizobium* asal Bintil Akar Tanaman Kacang Tanah (*Arachis hypogaea*) dan Koro Rawe (*Mucuna bracteata*). *Jurnal Sumberdaya HAYATI.* 10(4).
- Susilowati D.N., Sudiana, I.M., Mubarik, N.R., Suwanto, A. 2015. Keragaman Spesies dan Fungsional Rhizobakteri pada Tanaman Padi di Tanah Sawah Daerah Pesisir di Indonesia. *Indonesian Journal of Agricultural Science.* 16(1).
- Szczyglowski, K., Shaw, R.S.; Wopereis, J., Copeland, S., Hamburger, D., Kasiborski, B., Dazzo, F.B., De Bruijn, F.J. 1998. Nodule Organogenesis and Symbiotic Mutants of the Model Legume *Lotus japonicus*. *Mol. Plant-Microbe Interact.* 11: 684–697.
- Talbi, C., Delgado, M. J., Girard, L., Ramírez-Trujillo, A., Caballero-Mellado, J., & Bedmar, E. J. 2010. Burkholderia phymatum strains capable of nodulating *Phaseolus vulgaris* are present in Moroccan soils. *Applied and Environmental Microbiology,* 76(13), 4587-4591.
- Theunis, M., Prinsen, E., Kobayashi, H., Broughton, W.J. 2004. Flavonoids, NodD1, NodD2, and Nod-box NB15 Modulate Expression of the y4wEFG Locus that is Required for Indole-3-acetic Acid Synthesis in *Rhizobium* sp. strain NGR234. *Mol Plant-Microbe Interact.* 17(10):1153–1161.
- Timmers, A., Auriac, M.C., Truchet, G.J.D. 1999. Analisis yang disempurnakan mengenai langkah-langkah simbiosis awal interaksi *Rhizobium-Medicago* dalam hubungannya dengan penataan ulang kerangka sel mikrotubular. *Development.* 126: 3617–3628.
- Timofeeva, A., Galyamova, M., Sedykh, S. 2022. Prospects for Using Phosphate-Solubilizing Microorganisms as Natural Fertilizers in Agriculture. *Plants.*
- Utami, N.W.A.D., Zulkifli, L., Rasmi, D.A.C., Sedjiani, P. 2024. Exploration of P-Solubilizing and IAA-producing Rhizobacteria from Saline Environments: Their Effects on *Vigna radiata* Growth-promotion. *Jurnal Biologi Tropis.* 24(4).

- Vejan, P., Abdullah, R., Khadiran, T., Ismail, S., Nasrullohaq, Boyce, A. 2016. Role of Plant Growth Promoting Rhizobacteria in Agricultural Sustainability-A Review. *Molecules*. 21(5):573.
- Verma, R., Annapragada, H., Katiyar, N., Shrutika, N., Das, K., & Murugesan, S. (2020). Rhizobium. In *Beneficial microbes in agro-ecology* (pp. 37-54). Academic Press.
- Widawati, S., Suliasih, S., & Saefudin, S. 2015. Isolasi dan uji efektivitas Plant Growth Promoting Rhizobacteria di lahan marginal pada pertumbuhan tanaman kedelai (*Glycine max* L. Merr.) var. Wilis. In *Prosiding Seminar Nasional Masyarakat Biodiversitas Indonesia*. 1(1).
- Widodo, R. W., Taryana, Y., dan Niawati, E. 2019. Pengaruh Takaran Pupuk Kandang Ayam terhadap Pertumbuhan dan Hasil Tanaman Kacang Merah Besar (*Phaseolus vulgaris* L.). *Jurnal Pertanian*. 10(2): 71.
- Wiguna, I.K.C., & Pharmawati, M. 2021. Seleksi Primer RAPD Untuk Analisis Keragaman Genetik Tanaman Pisang (*Musa* spp.). *Jurnal Biologi Universitas Andalas*. 9(2).
- Winarsih, L., Aprira, Susanto, D., Edwar. 2020. Mencari Media Pemanas Autoclave yang Murah dan Bersih. *Indonesian Journal of Laboratory*. 3(1).
- Wulandari, D., Songwattana, P., Gressent, F., Piromyou, P., Teamtisong, K., Boonkerd, N., & Teaumroong, N. 2022. Nod-Factor structure and functional redundancy of nod genes contribute the broad host range *Bradyrhizobium* sp. DOA9. *Rhizosphere*, 22, 100503.
- Yadav, A., Singh, A. L., Kumar, A., Singh, A. K., Pandey, K. D., & Singh, M. 2015. Rhizobium-legume symbiosis and effects of environmental stresses on the symbiosis. In *Microbes in soil and their agricultural prospects* (pp. 35-48). New York: Nova Science Publishers Inc.
- Yanto, Arnoldus Herdi., dan Sunaryo, Y. S. W. 2019. Pengaruh Konsentrasi Dan Interval Pemberian Pupuk Organik Cair Terhadap Pertumbuhan Dan Hasil Tanaman Kacang Merah (*Phaseolus vulgaris* L.) Dalam Polybag. *Journal of Chemical Information and Modeling*. 53(9), 1689–1699.
- Yelti, S.N., Zul, D., Fibriarti, B.L. 2014. Formulasi Biofertilizer Cair Menggunakan Bakteri Pelarut Fosfat Indigenus Asal Tanah Gambut Riau. *JOM FMIPA*. 1(2).
- Young, J.P.W., Haukka, K.E. 1996. Diversity and Phylogeny of Rhizobia. *New Phytol*. 133:87–94.
- Yuniliani, D., Wilson, W., Isworo, J.T. 2018. Pemanfaatan Kacang Merah (*Phaseolus vulgaris* L.) sebagai Media Alternatif Pertumbuhan *Trichophyton* sp. *Prosiding Seminar Nasional Mahasiswa Unimus*. 1(1).

- Zahran, H.H. 1999. Rhizobium-Legume Symbiosis and Nitrogen Fixation under Severe Conditions and in an Arid Climate. *Microbiology and Molecular Biology Reviews*. 63(4).
- Zega, I. C., & Lase, N. K. 2025. Potensi Rhizobium dalam Meningkatkan Efisiensi Fiksasi Nitrogen untuk Kesuburan Tanah: Kajian Literatur. *Hidroponik: Jurnal Ilmu Pertanian Dan Teknologi Dalam Ilmu Tanaman*, 2(1), 86-94.
- Zerrouk, I.Z., Rahmoune, B., Khelifi, L., Mounir, K., Baluska, F., Ludwig-Müller, J. 2019. Algerian Sahara PGPR Confers Maize Root Tolerance to Salt and Aluminum Toxicity via ACC Deaminase and IAA. *Acta Physiol Plant*. 41(6): 91.
- Zézé, A., Mutch, L. A., & Young, J. P. W. (2001). Direct Amplification of nodD from Community DNA Reveals the Genetic Diversity of *Rhizobium leguminosarum* in soil. *Environmental Microbiology*, 3(6), 363-370.
- Zhang, J., Feng, Y., Wang, J., Wang, E., & Andrews, M. 2023. Diverse Bradyrhizobium spp. with similar symbiosis genes nodulate peanut in different regions of China: characterization of symbiovar sv. *Arachis*. *Plants*, 12(21), 3776.