

References

- Abu Hammad, A., & Tumeizi, A. (2012). Land degradation: socioeconomic and environmental causes and consequences in the eastern Mediterranean. *Land Degradation & Development*, 23(3), 216–226. <https://doi.org/10.1002/ldr.1069>
- Akiyama, K., Matsuzaki, K., & Hayashi, H. (2005). Plant sesquiterpenes induce hyphal branching in arbuscular mycorrhizal fungi. *Nature*, 435(7043), 824–827. <https://doi.org/10.1038/nature03608>
- Allison, S. D., Nielsen, C., & Hughes, R. F. (2006). Elevated enzyme activities in soils under the invasive nitrogen-fixing tree *Falcataria moluccana*. *Soil Biology and Biochemistry*, 38(7), 1537–1544. <https://doi.org/10.1016/j.soilbio.2005.11.008>
- Anderson, D. W. (1988). The effect of parent material and soil development on nutrient cycling in temperate ecosystems. *Biogeochemistry*, 5(1), 71–97. <https://doi.org/10.1007/BF02180318>
- Andrino, A., Guggenberger, G., Kernchen, S., Mikutta, R., Sauheitl, L., & Boy, J. (2021). Production of Organic Acids by Arbuscular Mycorrhizal Fungi and Their Contribution in the Mobilization of Phosphorus Bound to Iron Oxides. *Frontiers in Plant Science*, 12. <https://doi.org/10.3389/fpls.2021.661842>
- Anwesha Banerjee, Sanghamitra Sanyal, & Sribir Sen. (2012). Soil phosphatase activity of agricultural land: A possible index of soil fertility. *Agricultural Science Research Journals*, 2(7), 412–419.
- Arnold, P. K., & Finley, L. W. S. (2023). Regulation and function of the mammalian tricarboxylic acid cycle. *Journal of Biological Chemistry*, 299(2), 102838. <https://doi.org/10.1016/j.jbc.2022.102838>
- Barroso, C. B., & Nahas, E. (2005). The status of soil phosphate fractions and the ability of fungi to dissolve hardly soluble phosphates. *Applied Soil Ecology*, 29(1), 73–83. <https://doi.org/10.1016/j.apsoil.2004.09.005>
- Bolan, N. S. (1991). A critical review on the role of mycorrhizal fungi in the uptake of phosphorus by plants. *Plant and Soil*, 134(2), 189–207. <https://doi.org/10.1007/BF00012037>
- Bonfante, P., & Requena, N. (2011). Dating in the dark: how roots respond to fungal signals to establish arbuscular mycorrhizal symbiosis. *Current Opinion in Plant Biology*, 14(4), 451–457. <https://doi.org/10.1016/j.pbi.2011.03.014>
- Brady NC. (1990). *Phosphorus and Potassium. The Nature and Properties of Soils 9th edition Macmillan Publishing Company*.
- Brady NC, & Weil RR. (2002). *The nature and properties of soils* (13th ed.). Pearson Education Inc.
- Brundrett, M. C., & Tedersoo, L. (2018). Evolutionary history of mycorrhizal symbioses and global host plant diversity. *New Phytologist*, 220(4), 1108–1115. <https://doi.org/10.1111/nph.14976>
- Chang, S. C., & Jackson, M. L. (1958). Soil Phosphorus Fractions In Some

- Representative Soils ¹. *Journal of Soil Science*, 9(1), 109–119. <https://doi.org/10.1111/j.1365-2389.1958.tb01903.x>
- Chhabra, S., Brazil, D., Morrissey, J., Burke, J. I., O’Gara, F., & N. Dowling, D. (2013). Characterization of mineral phosphate solubilization traits from a barley rhizosphere soil functional metagenome. *MicrobiologyOpen*, 2(5), 717–724. <https://doi.org/10.1002/mbo3.110>
- Courty, P.-E., Buée, M., Diedhiou, A. G., Frey-Klett, P., Le Tacon, F., Rineau, F., Turpault, M.-P., Uroz, S., & Garbaye, J. (2010). The role of ectomycorrhizal communities in forest ecosystem processes: New perspectives and emerging concepts. *Soil Biology and Biochemistry*, 42(5), 679–698. <https://doi.org/10.1016/j.soilbio.2009.12.006>
- Darch, T., Blackwell, M. S. A., Hawkins, J. M. B., Haygarth, P. M., & Chadwick, D. (2014). A Meta-Analysis of Organic and Inorganic Phosphorus in Organic Fertilizers, Soils, and Water: Implications for Water Quality. *Critical Reviews in Environmental Science and Technology*, 44(19), 2172–2202. <https://doi.org/10.1080/10643389.2013.790752>
- Demenois, J., Carriconde, F., Bonaventure, P., Maeght, J.-L., Stokes, A., & Rey, F. (2018). Impact of plant root functional traits and associated mycorrhizas on the aggregate stability of a tropical Ferralsol. *Geoderma*, 312, 6–16. <https://doi.org/10.1016/j.geoderma.2017.09.033>
- Duan, S., Declerck, S., Feng, G., & Zhang, L. (2023). Hyphosphere interactions between *Rhizophagus irregularis* and *Rahnella aquatilis* promote carbon–phosphorus exchange at the peri-arbuscular space in *Medicago truncatula*. *Environmental Microbiology*, 25(4), 867–879. <https://doi.org/10.1111/1462-2920.16333>
- Dubois, O. (2011). *The State of the World’s Land and Water Resources for Food and Agriculture: Managing Systems at Risk*. Earthscan.
- Fernandez CW, & Kennedy PG. (2015). Moving Beyond The Black-Box: Fungal Traits, Community Structure, and Carbon Sequestration in Forest Soils. *New Phytol*, 205, 1378–1380.
- Hodge, A. (2004). The plastic plant: root responses to heterogeneous supplies of nutrients. *New Phytologist*, 162(1), 9–24. <https://doi.org/10.1111/j.1469-8137.2004.01015.x>
- Indonesian Law No.37/2014 Concerning Soil and Water Conservation, Pub. L. No. No.37/2014 (2014).
- Jiang, Y., Wang, W., Xie, Q., Liu, N., Liu, L., Wang, D., Zhang, X., Yang, C., Chen, X., Tang, D., & Wang, E. (2017). Plants transfer lipids to sustain colonization by mutualistic mycorrhizal and parasitic fungi. *Science*, 356(6343), 1172–1175. <https://doi.org/10.1126/science.aam9970>
- Jiang, Y., Xie, Q., Wang, W., Yang, J., Zhang, X., Yu, N., Zhou, Y., & Wang, E. (2018). Medicago AP2-Domain Transcription Factor WRI5a Is a Master Regulator of Lipid Biosynthesis and Transfer during Mycorrhizal Symbiosis. *Molecular Plant*, 11(11), 1344–1359.

<https://doi.org/10.1016/j.molp.2018.09.006>

Karandashov, V., & Bucher, M. (2005). Symbiotic phosphate transport in arbuscular mycorrhizas. *Trends in Plant Science*, 10(1), 22–29.

<https://doi.org/10.1016/j.tplants.2004.12.003>

Kaur, S., & Suseela, V. (2020). Unraveling Arbuscular Mycorrhiza-Induced Changes in Plant Primary and Secondary Metabolome. *Metabolites*, 10(8), 335. <https://doi.org/10.3390/metabo10080335>

Keymer, A., Pimprikar, P., Wewer, V., Huber, C., Brands, M., Bucerius, S. L., Delaux, P.-M., Klingl, V., Röpenack-Lahaye, E. von, Wang, T. L., Eisenreich, W., Dörmann, P., Parniske, M., & Gutjahr, C. (2017). Lipid transfer from plants to arbuscular mycorrhiza fungi. *ELife*, 6. <https://doi.org/10.7554/eLife.29107>

Kiers, E. T., Duhamel, M., Beesetty, Y., Mensah, J. A., Franken, O., Verbruggen, E., Fellbaum, C. R., Kowalchuk, G. A., Hart, M. M., Bago, A., Palmer, T. M., West, S. A., Vandenkoornhuyse, P., Jansa, J., & Bücking, H. (2011). Reciprocal Rewards Stabilize Cooperation in the Mycorrhizal Symbiosis. *Science*, 333(6044), 880–882. <https://doi.org/10.1126/science.1208473>

Kraut, J. (1988). How Do Enzymes Work? *Science*, 242(4878), 533–540. <https://doi.org/10.1126/science.3051385>

Krisnawati H, Varis E, Kallio M, & Kanninen M. (2011). *Paraserianthes falcataria* (L.) Nielsen Ekologi, Silvikultur, Produktivitas. CIFOR.

Kumoro, B. (2022). *Acquisition of Unavailable Phosphorus by Extraradical Hyphae of Arbuscular Mycorrhizal Fungi* [Graduate Thesis]. Yamagata University.

Lan, Z. M., Lin, X. J., Wang, F., Zhang, H., & Chen, C. R. (2012). Phosphorus availability and rice grain yield in a paddy soil in response to long-term fertilization. *Biology and Fertility of Soils*, 48(5), 579–588. <https://doi.org/10.1007/s00374-011-0650-5>

Larsen, S. (1967). *Soil Phosphorus* (pp. 151–210). [https://doi.org/10.1016/S0065-2113\(08\)60735-X](https://doi.org/10.1016/S0065-2113(08)60735-X)

Lewis, G. P., & Owen, P. E. (1989). *Legumes of the Ilha de Maraca*. Royal Botanical Gardens.

Lidbury, I. D. E. A., Scanlan, D. J., Murphy, A. R. J., Christie-Oleza, J. A., Aguilo-Ferretjans, M. M., Hitchcock, A., & Daniell, T. J. (2022). A widely distributed phosphate-insensitive phosphatase presents a route for rapid organophosphorus remineralization in the biosphere. *Proceedings of the National Academy of Sciences*, 119(5). <https://doi.org/10.1073/pnas.2118122119>

Luginbuehl, L. H., Menard, G. N., Kurup, S., Van Erp, H., Radhakrishnan, G. V., Breakspear, A., Oldroyd, G. E. D., & Eastmond, P. J. (2017). Fatty acids in arbuscular mycorrhizal fungi are synthesized by the host plant. *Science*, 356(6343), 1175–1178. <https://doi.org/10.1126/science.aan0081>

Luthfiana, N. (2017). *Acid Phosphatase Production of Arbuscular Mycorrhizal*

Fungi and Its Effect On Phosphorus Content and Growth of Test Plant Allium fistulosum [Undergraduate Thesis]. Universitas Gadjah Mada.

- M. Giovannetti, & B. Mosse. (1980). An Evaluation of Techniques for Measuring Vesicular Arbuscular Mycorrhizal Infection in Roots. *The New Phytologist*, Vol. 84, No. 3, 489–500.
- Ma, B., Zhou, Z.-Y., Zhang, C.-P., Zhang, G., & Hu, Y.-J. (2009). Inorganic phosphorus fractions in the rhizosphere of xerophytic shrubs in the Alxa Desert. *Journal of Arid Environments*, 73(1), 55–61. <https://doi.org/10.1016/j.jaridenv.2008.08.006>
- Maillet, F., Poinot, V., André, O., Puech-Pagès, V., Haouy, A., Gueunier, M., Cromer, L., Giraudet, D., Formey, D., Niebel, A., Martinez, E. A., Driguez, H., Bécard, G., & Dénarié, J. (2011). Fungal lipochitooligosaccharide symbiotic signals in arbuscular mycorrhiza. *Nature*, 469(7328), 58–63. <https://doi.org/10.1038/nature09622>
- Mallmann, G. C., Sousa, J. P., Sundh, I., Pieper, S., Arena, M., da Cruz, S. P., & Klauber-Filho, O. (2018). Placing arbuscular mycorrhizal fungi on the risk assessment test battery of plant protection products (PPPs). *Ecotoxicology*, 27(7), 809–818. <https://doi.org/10.1007/s10646-018-1946-0>
- Marschner H. (2002). *Mineral Nutrition of Higher Plants* (second edition). Academic Press.
- Martawidjaya, A., Kartasujana, I., & Kadir, K. (1989). *Atlas Kayu Indonesia: Vol. 2*. Departemen Kehutanan, Badan Penelitian dan Pengembangan Hutan.
- Nadal, M., & Paszkowski, U. (2013). Polyphony in the rhizosphere: presymbiotic communication in arbuscular mycorrhizal symbiosis. *Current Opinion in Plant Biology*, 16(4), 473–479. <https://doi.org/10.1016/j.pbi.2013.06.005>
- Newman, E. I. (1966). A Method of Estimating the Total Length of Root in a Sample. *The Journal of Applied Ecology*, 3(1), 139. <https://doi.org/10.2307/2401670>
- Olsen, S. R. , & Sommers, L. E. (1965). Phosphorus Methods of Soil Analysis. Part 2. Chemical and Microbiological Properties. *Chemical and Microbiological Properties*. ASA, Inc. SSSA, Inc, 403–430.
- Paul E A, & Clark F E. (1988). *Soil Microbiology and Biochemistry*. Academic Press.
- Peña Venegas, R. A., Lee, S.-J., Thuita, M., Mlay, D. P., Masso, C., Vanlauwe, B., Rodriguez, A., & Sanders, I. R. (2021). The Phosphate Inhibition Paradigm: Host and Fungal Genotypes Determine Arbuscular Mycorrhizal Fungal Colonization and Responsiveness to Inoculation in Cassava With Increasing Phosphorus Supply. *Frontiers in Plant Science*, 12. <https://doi.org/10.3389/fpls.2021.693037>
- Rajan, S. S. S., Watkinson, J. H., & Sinclair, A. G. (1996). *Phosphate Rocks for Direct Application to Soils* (pp. 77–159). [https://doi.org/10.1016/S0065-2113\(08\)60923-2](https://doi.org/10.1016/S0065-2113(08)60923-2)
- RARC, J. (2014). *Soil Analysis Manual*. Rokupr Agricultural Research Center and

Japan International Cooperation Agency.

- Richardson, A. E., & Simpson, R. J. (2011). Soil Microorganisms Mediating Phosphorus Availability Update on Microbial Phosphorus. *Plant Physiology*, 156(3), 989–996. <https://doi.org/10.1104/pp.111.175448>
- Sahoo, H. R., & Gupta, N. (2014). Phosphate-Solubilizing Fungi: Impact on Growth and Development of Economically Important Plants. In *Phosphate Solubilizing Microorganisms* (pp. 87–111). Springer International Publishing. https://doi.org/10.1007/978-3-319-08216-5_4
- Sato, T., Ezawa, T., Cheng, W., & Tawaraya, K. (2015). Release of acid phosphatase from extraradical hyphae of arbuscular mycorrhizal fungus *Rhizophagus clarus*. *Soil Science and Plant Nutrition*, 61(2), 269–274. <https://doi.org/10.1080/00380768.2014.993298>
- Sato, T., Hachiya, S., Inamura, N., Ezawa, T., Cheng, W., & Tawaraya, K. (2019). Secretion of acid phosphatase from extraradical hyphae of the arbuscular mycorrhizal fungus *Rhizophagus clarus* is regulated in response to phosphate availability. *Mycorrhiza*, 29(6), 599–605. <https://doi.org/10.1007/s00572-019-00923-0>
- Sharma, S. B., Sayyed, R. Z., Trivedi, M. H., & Gobi, T. A. (2013). Phosphate solubilizing microbes: sustainable approach for managing phosphorus deficiency in agricultural soils. *SpringerPlus*, 2(1), 587. <https://doi.org/10.1186/2193-1801-2-587>
- Shrivastava, M., Srivastava, P. C., & D'Souza, S. F. (2018). Phosphate-Solubilizing Microbes: Diversity and Phosphates Solubilization Mechanism. In *Role of Rhizospheric Microbes in Soil* (pp. 137–165). Springer Singapore. https://doi.org/10.1007/978-981-13-0044-8_5
- Siregar, U. J., Rachmi, A., Massijaya, M. Y., Ishibashi, N., & Ando, K. (2007). Economic analysis of sengon (*Paraserianthes falcataria*) community forest plantation, a fast growing species in East Java, Indonesia. *Forest Policy and Economics*, 9(7), 822–829. <https://doi.org/10.1016/j.forpol.2006.03.014>
- Smith, S. E., & Read, D. J. (2010). *Mycorrhizal symbiosis*. Academic press.
- Soerianegara, I., & Lemmens, R. H. M. J. (1993). *Plant Resources of South-East Asia 5 (1): Timber Trees: Major Commercial Timbers*. Pudoc Scientific Publishers.
- Sri Wilarso, B., CAHYO WIBOWO, ANDI SUKENDRO, & HABIB SATRIO BEKTI. (2020). The Growth improvement of *Falcataria moluccana* inoculated with MycoSilvi grown in post-mining silica sand soil medium amended with soil ameliorants. *Biodiversitas Journal of Biological Diversity*, 21(1). <https://doi.org/10.13057/biodiv/d210149>
- Sullivan, B. W., Alvarez-Clare, S., Castle, S. C., Porder, S., Reed, S. C., Schreeg, L., Townsend, A. R., & Cleveland, C. C. (2014). Assessing nutrient limitation in complex forested ecosystems: alternatives to large-scale fertilization experiments. *Ecology*, 95(3), 668–681. <https://doi.org/10.1890/13-0825.1>
- Sun, X., Bonfante, P., & Tang, M. (2015). Effect of volatiles versus exudates

- released by germinating spores of *Gigaspora margarita* on lateral root formation. *Plant Physiology and Biochemistry*, 97, 1–10. <https://doi.org/10.1016/j.plaphy.2015.09.010>
- Syers JK, Johnston AE, & Curtin D. (2008). *Efficiency of Soil and Fertilizer Phosphorus Use: Reconciling Changing Concepts of Soil Phosphorus Behavior with Agronomic Information*. FAO Fertilizer and Plant Nutrition Bulletin 18.
- Takahashi, S. (2007). Residual Effect of Phosphorus Fertilizer in a Low-Humic Andosol with Low Extractable Phosphorus. *Communications in Soil Science and Plant Analysis*, 38(11–12), 1479–1485. <https://doi.org/10.1080/00103620701378433>
- Tarafdar, J. C., Yadav, R. S., & Meena, S. C. (2001). Comparative efficiency of acid phosphatase originated from plant and fungal sources. *Journal of Plant Nutrition and Soil Science*, 164(3), 279–282. [https://doi.org/10.1002/1522-2624\(200106\)164:3<279::AID-JPLN279>3.0.CO;2-L](https://doi.org/10.1002/1522-2624(200106)164:3<279::AID-JPLN279>3.0.CO;2-L)
- Tawaraya, K. (2022). Response of mycorrhizal symbiosis to phosphorus and its application for sustainable crop production and remediation of environment. *Soil Science and Plant Nutrition*, 68(2), 241–245. <https://doi.org/10.1080/00380768.2022.2032335>
- Tawaraya, K., Hashimoto, K., & Wagatsuma, T. (1998). Effect of root exudate fractions from P-deficient and P-sufficient onion plants on root colonisation by the arbuscular mycorrhizal fungus *Gigaspora margarita*. *Mycorrhiza*, 8(2), 67–70. <https://doi.org/10.1007/s005720050214>
- The Ministry of Environment and Forestry. (2018). *Statistics of Ministry of Environment and Forestry*. The Ministry of Environment and Forestry.
- Truog E. (1930). The determination of readily available phosphorus in soils. *Journal of the American Society of Agronomy*, 22, 874–882.
- Van Der Heijden, M. G. A., Bardgett, R. D., & Van Straalen, N. M. (2008). The unseen majority: soil microbes as drivers of plant diversity and productivity in terrestrial ecosystems. *Ecology Letters*, 11(3), 296–310. <https://doi.org/10.1111/j.1461-0248.2007.01139.x>
- van der Heijden, M. G. A., Martin, F. M., Selosse, M., & Sanders, I. R. (2015). Mycorrhizal ecology and evolution: the past, the present, and the future. *New Phytologist*, 205(4), 1406–1423. <https://doi.org/10.1111/nph.13288>
- van der Heijden, M. G. A., & Walder, F. (2016). Reply to ‘Misconceptions on the application of biological market theory to the mycorrhizal symbiosis.’ *Nature Plants*, 2(5), 16062. <https://doi.org/10.1038/nplants.2016.62>
- Vitousek, P. M., & Sanford, R. L. (1986). Nutrient Cycling In Moist Tropical Forest. *Annual Review of Ecology and Systematics*, 17(1), 137–167. <https://doi.org/10.1146/annurev.es.17.110186.001033>
- Wagatsuma, T., Kawashima, T., & Tawaraya, K. (1988). Comparative stainability of plant root cells with basic dye (methylene blue) in association with aluminum tolerance. *Communications in Soil Science and Plant Analysis*,

19(7–12), 1207–1215. <https://doi.org/10.1080/00103628809368006>

- Wang, J., Wang, G. G., Zhang, B., Yuan, Z., Fu, Z., Yuan, Y., Zhu, L., Ma, S., & Zhang, J. (2019). Arbuscular Mycorrhizal Fungi Associated with Tree Species in a Planted Forest of Eastern China. *Forests*, 10(5), 424. <https://doi.org/10.3390/f10050424>
- Wang, W., Li, Y., Wang, H., & Zu, Y. (2014). Differences in the Activities of Eight Enzymes from Ten Soil Fungi and Their Possible Influences on the Surface Structure, Functional Groups, and Element Composition of Soil Colloids. *PLoS ONE*, 9(11), e111740. <https://doi.org/10.1371/journal.pone.0111740>
- Wissuwa, M., Gamat, G., & Ismail, A. M. (2005). Is root growth under phosphorus deficiency affected by source or sink limitations? *Journal of Experimental Botany*, 56(417), 1943–1950. <https://doi.org/10.1093/jxb/eri189>
- Wulandari, D., Saridi, Cheng, W., & Tawaraya, K. (2016). Arbuscular mycorrhizal fungal inoculation improves Albizia saman and Paraserianthes falcataria growth in post-opencast coal mine field in East Kalimantan, Indonesia. *Forest Ecology and Management*, 376, 67–73. <https://doi.org/10.1016/j.foreco.2016.06.008>
- Xie, X., Lai, W., Che, X., Wang, S., Ren, Y., Hu, W., Chen, H., & Tang, M. (2022). A SPX domain-containing phosphate transporter from *Rhizophagus irregularis* handles phosphate homeostasis at symbiotic interface of arbuscular mycorrhizas. *New Phytologist*, 234(2), 650–671. <https://doi.org/10.1111/nph.17973>
- Zengler, K., & Zaramela, L. S. (2018). The social network of microorganisms — how auxotrophies shape complex communities. *Nature Reviews Microbiology*, 16(6), 383–390. <https://doi.org/10.1038/s41579-018-0004-5>