

## DAFTAR PUSTAKA

- Acheampong, K., Hadley, P., & Daymond, A. J. (2013). Photosynthetic activity and early growth of four cacao genotypes as influenced by different shade regimes under west african dry and wet season conditions. *Experimental Agriculture*, 49(1), 31–42. <https://doi.org/10.1017/S0014479712001007>
- Ahmad, P., Ashraf, M., Hakeem, K. R., Azooz, M. M., Rasool, S., Chandna, R., & Akram, N. A. (2014). Potassium starvation-induced oxidative stress and antioxidant defense responses in *Brassica juncea*. *Journal of Plant Interactions*, 9(1), 1–9. <https://doi.org/10.1080/17429145.2012.747629>
- Ahmad, Z., Anjum, S., Waraich, E. A., Ayub, M. A., Ahmad, T., Tariq, R. M. S., Ahmad, R., & Iqbal, M. A. (2018). Growth, physiology, and biochemical activities of plant responses with foliar potassium application under drought stress—a review. *Journal of Plant Nutrition*, 41(13), 1734–1743. <https://doi.org/10.1080/01904167.2018.1459688>
- AID, F. (2020). Plant Lipid Metabolism. *Advances in Lipid Metabolism*. <https://doi.org/10.5772/intechopen.81355>
- Alexieva, V., Sergiev, I., Mapelli, S., & Karanov, E. (2001). The effect of drought and ultraviolet radiation on growth and stress markers in pea and wheat. *Plant, Cell and Environment*, 24(12), 1337–1344. <https://doi.org/10.1046/j.1365-3040.2001.00778.x>
- Alfaro, M. A., Alfaro, M. A., Jarvis, S. C., & Gregory, P. J. (2004). Factors affecting potassium leaching in different soils. *Soil Use and Management*, 20(2), 182–189. <https://doi.org/10.1079/sum2004249>
- Anda, M., Suryani, E., Widaningrum, W., & Nursyamsi, D. (2018). Soil Potassium Nutrient, Temperature and Rainfall Required To Generate ‘Honey Taste’ of Cilembu Sweet Potato. *Indonesian Journal of Agricultural Science*, 19(1), 33. <https://doi.org/10.21082/ijas.v19n1.2018.p33-47>
- Araujo, Q. R. de, Loureiro, G. A. H. de A., Baligar, V. C., Ahnert, D., Faria, J. C., & Valle, R. R. (2019). Cacao quality index for cacao agroecosystems in Bahia, Brazil. *International Journal of Food Properties*, 22(1), 1799–1814. <https://doi.org/10.1080/10942912.2019.1675691>
- Armengaud, P., Sulpice, R., Miller, A. J., Stitt, M., Amtmann, A., & Gibon, Y. (2009). Multilevel analysis of primary metabolism provides new insights into the role of potassium nutrition for glycolysis and nitrogen assimilation in arabidopsis roots1[W][OA]. *Plant Physiology*, 150(2), 772–785. <https://doi.org/10.1104/pp.108.133629>
- Arora, N. K. (2019). Impact of climate change on agriculture production and its sustainable solutions. *Environmental Sustainability*, 2(2), 95–96. <https://doi.org/10.1007/s42398-019-00078-w>
- Ashraf, U., Kanu, A. S., Deng, Q., Mo, Z., Pan, S., Tian, H., & Tang, X. (2017). Lead (Pb) toxicity; physio-biochemical mechanisms, grain yield, quality, and Pb distribution proportions in scented rice. *Frontiers in Plant Science*, 8(February). <https://doi.org/10.3389/fpls.2017.00259>

- Badrie, N., Bekele, F., Sikora, E., & Sikora, M. (2015). Cocoa Agronomy, Quality, Nutritional, and Health Aspects. *Critical Reviews in Food Science and Nutrition*, 55(5), 620–659. <https://doi.org/10.1080/10408398.2012.669428>
- Bailey-Serres, J., & Colmer, T. D. (2014). Plant tolerance of flooding stress - recent advances. *Plant Cell and Environment*, 37(10), 2211–2215. <https://doi.org/10.1111/pce.12420>
- Bailey, B. A., & Meinhardt, L. W. (2016). Cacao diseases: A history of old enemies and new encounters. *Cacao Diseases: A History of Old Enemies and New Encounters*, 1–633. <https://doi.org/10.1007/978-3-319-24789-2>
- Baligar, V. C., Elson, M. K., Almeida, A.-A. F., de Araujo, Q. R., Ahnert, D., & He, Z. (2021). Carbon Dioxide Concentrations and Light Levels on Growth and Mineral Nutrition of Juvenile Cacao Genotypes. *American Journal of Plant Sciences*, 12(05), 818–839. <https://doi.org/10.4236/ajps.2021.125056>
- Ballottari, M., Mozzo, M., Girardon, J., Hienerwadel, R., & Bassi, R. (2013). Chlorophyll triplet quenching and photoprotection in the higher plant monomeric antenna protein Lhcb5. *Journal of Physical Chemistry B*, 117(38), 11337–11348. <https://doi.org/10.1021/jp402977y>
- Baskoro, D. P. T., & Tarigan, S. D. (2007). Soil Moisture Characteristics on Several Soil Types. *Jurnal Ilmu Tanah Dan Lingkungan*, 9(2), 77–81. <https://doi.org/10.29244/jitl.9.2.77-81>
- Bertazzo, A., Comai, S., Brunato, I., Zancato, M., & Costa, C. V. L. (2011). The content of protein and non-protein (free and protein-bound) tryptophan in *Theobroma cacao* beans. *Food Chemistry*, 124(1), 93–96. <https://doi.org/10.1016/j.foodchem.2010.05.110>
- Bertolde, F. Z., Almeida, A. A. F., Pirovani, C. P., Gomes, F. P., Ahnert, D., Baligar, V. C., & Valle, R. R. (2012). Physiological and biochemical responses of *Theobroma cacao* L. genotypes to flooding. *Photosynthetica*, 50(3), 447–457. <https://doi.org/10.1007/s11099-012-0052-4>
- Butarbutar, T. (2012). Agroforestri Untuk Adaptasi Dan Mitigasi Perubahan Iklim (Agroforestry For Mitigating And Adapting Climate Change). *Jurnal Analisis Kebijakan Kehutanan*, 9(1), 1–10.
- Cakmak, I. (2005). The role of potassium in alleviating detrimental effects of abiotic stresses in plants. *Journal of Plant Nutrition and Soil Science*, 168(4), 521–530. <https://doi.org/10.1002/jpln.200420485>
- Carvalho, J. M. G., Bonfim-Silva, E. M., Da Silva, T. J. A., Sousa, H. H. F., Guimarães, S. L., & Pacheco, A. B. (2016). Nitrógeno y potasio en la producción, nutrición y eficiencia del uso de agua en plantas de trigo. *Ciencia e Investigacion Agraria*, 43(3), 442–451. <https://doi.org/10.4067/S0718-16202016000300010>
- Chen, G., Chen, H., Shi, K., Raza, M. A., Bawa, G., Sun, X., Pu, T., Yong, T., Liu, W., Liu, J., Du, J., Yang, F., Yang, W., & Wang, X. (2020). Heterogeneous light conditions reduce the assimilate translocation towards maize ears. *Plants*, 9(8), 1–15. <https://doi.org/10.3390/plants9080987>
- Chen, H., Bullock, D. A., Alonso, J. M., & Stepanova, A. N. (2022). *To Fight or to Grow: The Balancing Role of Ethylene in Plant Abiotic Stress Responses*.

- Chen, K., Li, G. J., Bressan, R. A., Song, C. P., Zhu, J. K., & Zhao, Y. (2020). Absciscic acid dynamics, signaling, and functions in plants. *Journal of Integrative Plant Biology*, 62(1), 25–54. <https://doi.org/10.1111/jipb.12899>
- Chen, Y., Yu, M., Zhu, Z., Zhang, L., & Guo, Q. (2013). Optimisation of Potassium Chloride Nutrition for Proper Growth, Physiological Development and Bioactive Component Production in *Prunella vulgaris* L. *PLoS ONE*, 8(7), 1–7. <https://doi.org/10.1371/journal.pone.0066259>
- Christiana, B., Gafur, A., Syahrir, M., & Callebaut, B. (n.d.). *Modul Dasar Praktik Budidaya Tanaman Kakao*. 57.
- Croce, R., & Van Amerongen, H. (2014). Natural strategies for photosynthetic light harvesting. *Nature Chemical Biology*, 10(7), 492–501. <https://doi.org/10.1038/nchembio.1555>
- Croft, H., & Chen, J. M. (2017). Leaf pigment content. In *Comprehensive Remote Sensing* (Vols. 1–9). Elsevier. <https://doi.org/10.1016/B978-0-12-409548-9.10547-0>
- da Silva Branco, M. C., de Almeida, A. A. F., Dalmolin, Â. C., Ahnert, D., & Baligar, V. C. (2017). Influence of low light intensity and soil flooding on cacao physiology. *Scientia Horticulturae*, 217, 243–257. <https://doi.org/10.1016/j.scienta.2017.01.038>
- Daymond, A. J., & Hadley, P. (2008). Differential effects of temperature on fruit development and bean quality of contrasting genotypes of cacao (*Theobroma cacao*). *Annals of Applied Biology*, 153(2), 175–185. <https://doi.org/10.1111/j.1744-7348.2008.00246.x>
- De Almeida, A. A. F., & Valle, R. R. (2007). Ecophysiology of the cacao tree. *Brazilian Journal of Plant Physiology*, 19(4), 425–448. <https://doi.org/10.1590/S1677-04202007000400011>
- de MELO, C. W. B., Bandeira, M. de J., Maciel, L. F., Bispo, E. da S., de SOUZA, C. O., & Soares, S. E. (2020). Chemical composition and fatty acids profile of chocolates produced with different cocoa (*Theobroma cacao* L.) cultivars. *Food Science and Technology*, 40(2), 326–333. <https://doi.org/10.1590/fst.43018>
- de Souza, P. A., Moreira, L. F., Sarmento, D. H. A., & da Costa, F. B. (2018). Cacao—*Theobroma cacao*. *Exotic Fruits*, 3(2001), 69–76. <https://doi.org/10.1016/b978-0-12-803138-4.00010-1>
- Dewi Hs, E. S., Yudono, P., Putra, E. T. S., & Purwanto, B. H. (2020). Physiological and biochemical activities of cherelle wilt on three cocoa clones (*Theobroma cacao*) under two levels of soil fertilities. *Biodiversitas*, 21(1), 187–194. <https://doi.org/10.13057/biodiv/d210124>
- Dreyer, I., Gomez-Porras, J. L., & Riedelsberger, J. (2017). The potassium battery: a mobile energy source for transport processes in plant vascular tissues. *New Phytologist*, 216(4), 1049–1053. <https://doi.org/10.1111/nph.14667>
- Erwiyono, R., & Sucahyo, A. A. (2006). *Keefektifan Pemupukan Kalium Lewat Daun Terhadap Pembungan dan Pembuahan Tanaman Kakao*. 22(1), 13–24.
- Estrada-Melo, A. C., Ma, C., Reid, M. S., & Jiang, C. Z. (2015). Overexpression of an ABA biosynthesis gene using a stress-inducible promoter enhances drought

- resistance in petunia. *Horticulture Research*, 2(February), 1–9.  
<https://doi.org/10.1038/hortres.2015.13>
- Fatmawati, Ariffin, Tyasmoro, S., & Sulistyono, R. (2018). Sun light intensity identification in cocoa plant on variation of shading plant type in soppeng regency. *International Journal of Scientific and Technology Research*, 7(12), 205–210.
- Feng, L., Raza, M. A., Li, Z., Chen, Y., Khalid, M. H. Bin, Du, J., Liu, W., Wu, X., Song, C., Yu, L., Zhang, Z., Yuan, S., Yang, W., & Yang, F. (2019). The influence of light intensity and leaf movement on photosynthesis characteristics and carbon balance of Soybean. *Frontiers in Plant Science*, 9(January), 1–16.  
<https://doi.org/10.3389/fpls.2018.01952>
- Fraire-Velazquez, S., & Emmanuel, V. (2013). Abiotic Stress in Plants and Metabolic Responses. *Abiotic Stress - Plant Responses and Applications in Agriculture*.  
<https://doi.org/10.5772/54859>
- Fuglsang, A. T., & Gaxiola, R. A. (2011). P-Type H<sup>+</sup>-ATPases. In *Transporters and Pumps in Plant Signaling, Signaling and Communication in Plants* (Vol. 7, Issue May). <https://doi.org/10.1007/978-3-642-14369-4>
- Ghaffari, H., Tadayon, M. R., Nadeem, M., Cheema, M., & Razmjoo, J. (2019). Proline-mediated changes in antioxidant enzymatic activities and the physiology of sugar beet under drought stress. *Acta Physiologiae Plantarum*, 41(2), 0.  
<https://doi.org/10.1007/s11738-019-2815-z>
- Giannakoula, A., Therios, I., & Chatzissavvidis, C. (2021). Effect of lead and copper on photosynthetic apparatus in citrus (*Citrus aurantium* L.) plants. the role of antioxidants in oxidative damage as a response to heavy metal stress. *Plants*, 10(1), 1–14. <https://doi.org/10.3390/plants10010155>
- Gill, S. S., & Tuteja, N. (2010). Reactive oxygen species and antioxidant machinery in abiotic stress tolerance in crop plants. *Plant Physiology and Biochemistry*, 48(12), 909–930. <https://doi.org/10.1016/j.plaphy.2010.08.016>
- Gohara, D. W., & Cera, E. Di. (2016). Molecular Mechanisms of Enzyme Activation by Monovalent Cations \*. *Journal of Biological Chemistry*, 291(40), 20840–20848. <https://doi.org/10.1074/jbc.R116.737833>
- Guo, J., Jia, Y., Chen, H., Zhang, L., Yang, J., Zhang, J., Hu, X., Ye, X., Li, Y., & Zhou, Y. (2019). Growth, photosynthesis, and nutrient uptake in wheat are affected by differences in nitrogen levels and forms and potassium supply. *Scientific Reports*, 9(1), 1–12. <https://doi.org/10.1038/s41598-018-37838-3>
- Haddad, M., Bani-Hani, N. M., Al-Tabbal, J. A., & Al-Fraihat, A. H. (2016). Effect of different potassium nitrate levels on yield and quality of potato tubers. *Journal of Food, Agriculture and Environment*, 14(1), 101–107.
- Hafsi, C., Debez, A., & Abdelly, C. (2014). Potassium deficiency in plants: Effects and signaling cascades. *Acta Physiologiae Plantarum*, 36(5), 1055–1070.  
<https://doi.org/10.1007/s11738-014-1491-2>
- Hao, D., Sun, X., Ma, B., Zhang, J. S., & Guo, H. (2017). Ethylene. In *Hormone Metabolism and Signaling in Plants*. <https://doi.org/10.1016/B978-0-12-811562-6.00006-2>



- Hartati, S., Suryono, ., & Purnama, L. S. (2019). The Potential of Potassium Fertilizers in Improving the Availability and Uptake of Potassium in Rice Grown on Entisol. *Journal of Tropical Soils*, 24(2), 83. <https://doi.org/10.5400/jts.2019.v24i2.83-91>
- Hasanuzzaman, M., Bhuyan, M. H. M. B., Nahar, K., Hossain, M. S., Al Mahmud, J., Hossen, M. S., Masud, A. A. C., Moumita, & Fujita, M. (2018). Potassium: A vital regulator of plant responses and tolerance to abiotic stresses. *Agronomy*, 8(3). <https://doi.org/10.3390/agronomy8030031>
- Hasanuzzaman, M., Bhuyan, M. H. M. B., Zulfiqar, F., Raza, A., Mohsin, S. M., Al Mahmud, J., Fujita, M., & Fotopoulos, V. (2020). Reactive oxygen species and antioxidant defense in plants under abiotic stress: Revisiting the crucial role of a universal defense regulator. *Antioxidants*, 9(8), 1–52. <https://doi.org/10.3390/antiox9080681>
- Hashimoto, H., Sugai, Y., Uragami, C., Gardiner, A. T., & Cogdell, R. J. (2015). Natural and artificial light-harvesting systems utilizing the functions of carotenoids. *Journal of Photochemistry and Photobiology C: Photochemistry Reviews*, 25, 46–70. <https://doi.org/10.1016/j.jphotochemrev.2015.07.004>
- Hatmi, R. U., Ainuri, M., & Sukartiko, A. C. (2021). Fatty Acid Composition of Cocoa Beans from Yogyakarta Special Region for the Establishment of Geographical Origin Discriminations. *AgriTECH*, 41(1), 25. <https://doi.org/10.22146/agritech.55172>
- Hayat, S., Hayat, Q., Alyemeni, M. N., Wani, A. S., Pichtel, J., & Ahmad, A. (2012). Role of proline under changing environments: A review. *Plant Signaling and Behavior*, 7(11), 1456–1466. <https://doi.org/10.4161/psb.21949>
- He, M., Qin, C. X., Wang, X., & Ding, N. Z. (2020). Plant Unsaturated Fatty Acids: Biosynthesis and Regulation. *Frontiers in Plant Science*, 11(April), 1–13. <https://doi.org/10.3389/fpls.2020.00390>
- Hegazi, A. M., & El-Shraiy, A. M. (2017). Stimulation of Photosynthetic Pigments, Anthocyanin, Antioxidant Enzymes in Salt Stressed Red Cabbage Plants by Ascorbic Acid and Potassium Silicate. *Middle East Journal of Agriculture Research*, 553–568.
- Hill, K. E., Guerin, G. R., Hill, R. S., & Watling, J. R. (2014). Temperature influences stomatal density and maximum potential water loss through stomata of *Dodonaea viscosa* subsp. *angustissima* along a latitude gradient in southern Australia. *Australian Journal of Botany*, 62(8), 657–665. <https://doi.org/10.1071/BT14204>
- Hu, B., Cao, J., Ge, K., & Li, L. (2016). The site of water stress governs the pattern of ABA synthesis and transport in peanut. *Scientific Reports*, 6(October), 1–11. <https://doi.org/10.1038/srep32143>
- Huang, G. T., Ma, S. L., Bai, L. P., Zhang, L., Ma, H., Jia, P., Liu, J., Zhong, M., & Guo, Z. F. (2012). Signal transduction during cold, salt, and drought stresses in plants. *Molecular Biology Reports*, 39(2), 969–987. <https://doi.org/10.1007/s11033-011-0823-1>
- Ivanova, N., Gugleva, V., Dobрева, M., Pehlivanov, I., Stefanov, S., & Andonova, V. (2016). We are IntechOpen , the world ' s leading publisher of Open Access books Built by scientists , for scientists TOP 1 %. *Intech, i(tourism)*, 13.

- Jakubowicz, M., & Nowak, W. (2010). *an Enzyme of Ethylene Biosynthesis*.
- Jiska A. van Vliet, M. S. and K. E. G. (2017). Mineral Nutrition of Cocoa. In *Advances in Agronomy* (Issue July). <https://doi.org/10.1016/bs.agron.2016.10.017>
- Jung, J. Y., Shin, R., & Schachtman, D. P. (2009). Ethylene mediates response and tolerance to potassium deprivation in arabidopsis. *Plant Cell*, 21(2), 607–621. <https://doi.org/10.1105/tpc.108.063099>
- Kalavati Prajapati, & Modi, H. A. (2016). The Importance of Potassium in Plant Growth—a Review. *Indian Journal of Plant Sciences*, 1(July 2012), 177–186.
- Kant, S., Kant, P., & Kafkafi, U. (2005). Potassium uptake by higher plants: From field application to membrane transport. *Acta Agronomica Hungarica*, 53(4), 443–459. <https://doi.org/10.1556/AAgr.53.2005.4.11>
- Kavalcová, P., Bystrická, J., Tóth, T., Volnová, B., Kopernická, M., & Harangozo, L. (2015). Potassium and its effect on the content of polyphenols in onion (*Allium cepa* L.). *Journal of Microbiology, Biotechnology and Food Sciences*, 4(Special issue 3), 74–77. <https://doi.org/10.15414/jmbfs.2015.4.special3.74-77>
- Khanna-Chopra, R., Kumar Semwal, V., Lakra, N., & Pareek, A. (2019). Proline – A Key Regulator Conferring Plant Tolerance to Salinity and Drought. *Plant Tolerance to Environmental Stress*, January, 59–80. <https://doi.org/10.1201/9780203705315-5>
- Khorobrykh, S., Havurinne, V., Mattila, H., & Tyystjärvi, E. (2020). Oxygen and ROS in photosynthesis. *Plants*, 9(1), 1–61. <https://doi.org/10.3390/plants9010091>
- Kondo, T., Kajita, R., Miyazaki, A., Hokoyama, M., Nakamura-Miura, T., Mizuno, S., Masuda, Y., Irie, K., Tanaka, Y., Takada, S., Kakimoto, T., & Sakagami, Y. (2010). Stomatal density is controlled by a mesophyll-derived signaling molecule. *Plant and Cell Physiology*, 51(1), 1–8. <https://doi.org/10.1093/pcp/pcp180>
- Kone, K., Akueson, K., & Norval, G. (2020). On the production of potassium carbonate from cocoa pod husks. *Recycling*, 5(3), 1–6. <https://doi.org/10.3390/recycling5030023>
- La Habi, M., Nendissa, J. I., Marasabessy, D., & Kalay, A. M. (2018). Ketersediaan Fosfat, Serapan Fosfat, Dan Hasil Tanaman Jagung (*Zea mays* L.) Akibat Pemberian Kompos Granul Ela Sagu Dengan Pupuk Fosfat Pada Inceptisols. *Agrologia*, 7(1). <https://doi.org/10.30598/a.v7i1.356>
- Lacombe, B., & Achard, P. (2016). Long-distance transport of phytohormones through the plant vascular system. *Current Opinion in Plant Biology*, 34, 1–8. <https://doi.org/10.1016/j.pbi.2016.06.007>
- Lahive, F., Hadley, P., & Daymond, A. J. (2019). The physiological responses of cacao to the environment and the implications for climate change resilience. A review. *Agronomy for Sustainable Development*, 39(1). <https://doi.org/10.1007/s13593-018-0552-0>
- Latifa, I. C., & Anggarwulan, E. (2009). *Nitrogen content , nitrate reductase activity , and biomass of kimpul ( Xanthosoma sagittifolium ) on shade and nitrogen fertilizer variation*. 1(2), 65–71.
- Lawal, J. O., & Omonona, B. T. (2014). The effects of rainfall and other weather parameters on cocoa production in Nigeria. *Comunicata Scientiae*, 5(4), 518–

523. <https://doi.org/10.14295/cs.v5i4.365>

- Li, J., Wu, Y., Xie, Q., & Gong, Z. (2017). Absciscic acid. In *Hormone Metabolism and Signaling in Plants*. Jiayang Li, Chuanyou Li and Steven Smith. <https://doi.org/10.1016/B978-0-12-811562-6.00005-0>
- Li, Y.-M., Elson, M., Zhang, D., Sicher, R. C., Liang, H., Meinhardt, L. W., & Baligar, V. (2013). Physiological Traits and Metabolites of Cacao Seedlings Influenced by Potassium in Growth Medium. *American Journal of Plant Sciences*, 04(05), 1074–1080. <https://doi.org/10.4236/ajps.2013.45133>
- Li, Y., He, N., Hou, J., Xu, L., Liu, C., Zhang, J., Wang, Q., Zhang, X., & Wu, X. (2018). Factors influencing leaf chlorophyll content in natural forests at the biome scale. *Frontiers in Ecology and Evolution*, 6(JUN), 1–10. <https://doi.org/10.3389/fevo.2018.00064>
- Liu, C. H., Chao, Y. Y., & Kao, C. H. (2012). Absciscic acid is an inducer of hydrogen peroxide production in leaves of rice seedlings grown under potassium deficiency. *Botanical Studies*, 53(2), 229–237.
- Luan, M., Tang, R. J., Tang, Y., Tian, W., Hou, C., Zhao, F., Lan, W., & Luan, S. (2017). Transport and homeostasis of potassium and phosphate: Limiting factors for sustainable crop production. *Journal of Experimental Botany*, 68(12), 3091–3105. <https://doi.org/10.1093/jxb/erw444>
- Mall, R. K., Gupta, A., & Sonkar, G. (2017). Effect of Climate Change on Agricultural Crops. In *Current Developments in Biotechnology and Bioengineering: Crop Modification, Nutrition, and Food Production*. Elsevier B.V. <https://doi.org/10.1016/B978-0-444-63661-4.00002-5>
- Maoka, T. (2020). Carotenoids as natural functional pigments. *Journal of Natural Medicines*, 74(1), 1–16. <https://doi.org/10.1007/s11418-019-01364-x>
- Marimon-Junior, B. H., Hay, J. D. V., Oliveras, I., Jancoski, H., Umetsu, R. K., Feldpausch, T. R., Galbraith, D. R., Gloor, E. U., Phillips, O. L., & Marimon, B. S. (2020). Soil water-holding capacity and monodominance in Southern Amazon tropical forests. *Plant and Soil*, 450(1–2), 65–79. <https://doi.org/10.1007/s11104-019-04257-w>
- Miftahuddin. (2016). Analisis Unsur-unsur Cuaca dan Iklim Melalui Uji Mann-Kendall Multivariat. *Matematika, Statistika, Dan Komputasi*, 13(1), 26–38.
- Miransari, M. (2014). Plant Signaling under Environmental Stress. In *Oxidative Damage to Plants: Antioxidant Networks and Signaling*. Elsevier Inc. <https://doi.org/10.1016/B978-0-12-799963-0.00018-6>
- Mohammad, F., & Naseem, U. (2006). Effect of K application on leaf carbonic anhydrase and nitrate reductase activities, photosynthetic characteristics, NPK and NO<sub>3</sub> contents, growth, and yield of mustard. *Photosynthetica*, 44(3), 471–473. <https://doi.org/10.1007/s11099-006-0053-2>
- Moinuddin, & Imas, P. (2014). Potassium Uptake in Relation to Drought Tolerance of Chickpea Under Rain-Fed Conditions. *Journal of Plant Nutrition*, 37(7), 1120–1138. <https://doi.org/10.1080/01904167.2014.881863>
- Morales, M., & Munné-Bosch, S. (2019). Malondialdehyde: Facts and artifacts. *Plant Physiology*, 180(3), 1246–1250. <https://doi.org/10.1104/pp.19.00405>

- Mukhtar, M. K., & Nurwadjedi, N. (2020). Study of physical environment based on land system map of Kabupaten Bandung. *Jurnal Geografi Lingkungan Tropik*, 3(2), 1–11. <https://doi.org/10.7454/jglitrop.v3i2.53>
- Müller, M. (2021). Foes or friends: ABA and ethylene interaction under abiotic stress. *Plants*, 10(3), 1–7. <https://doi.org/10.3390/plants10030448>
- Nair, K. P. P. (2010). Cocoa (*Theobroma cacao* L.). In *The Agronomy and Economy of Important Tree Crops of the Developing World*. <https://doi.org/10.1016/b978-0-12-384677-8.00005-9>
- Of, E., Tension, M., Faba, O. N., & Vicia, B. (2016). *Using of Potassium and Abscissic Acid in Reductase the Negative*. 4(4), 32–46.
- Oladipupo, A. J., Eyitamilayo Victoria, A., Toyin Blessing, O., & Tahjudeen, A. (2019). Agronomic Evaluation of Manure Ashes: Changes in Soil Phosphorus Fractions, Maize (*Zea mays*) Yield, and Phosphorus Uptake. *Communications in Soil Science and Plant Analysis*, 50(14), 1683–1699. <https://doi.org/10.1080/00103624.2019.1631335>
- Patade, V. Y., Lokhande, V. H., & Suprasanna, P. (2014). Exogenous Application of Proline Alleviates Salt Induced Oxidative Stress More Efficiently than Glycine Betaine in Sugarcane Cultured Cells. *Sugar Tech*, 16(1), 22–29. <https://doi.org/10.1007/s12355-013-0261-6>
- Peláez, P., Bardón, I., & Camasca, P. (2016). Methylxanthine and catechin content of fresh and fermented cocoa beans, dried cocoa beans, and cocoa liquor. *Scientia Agropecuaria*, 7(4), 355–365. <https://doi.org/10.17268/sci.agropecu.2016.04.01>
- Pendahuluan, B. A. B. I. (2020). *Bab i. pendahuluan 1.1*.
- Pereira, D. M., Valentão, P., Pereira, J. A., & Andrade, P. B. (2009). Phenolics: From chemistry to biology. *Molecules*, 14(6), 2202–2211. <https://doi.org/10.3390/molecules14062202>
- Pohlan, H. A. J. (n.d.). *M SC PL O E – C EO M SC PL O E –*.
- Prasad, R., & Chakraborty, D. (2019). Phosphorus Basics: Understanding Phosphorus Forms and Their Cycling in the Soil. *Alabama Cooperative Extension System*, 1–4. [https://www.aces.edu/wp-content/uploads/2019/04/ANR-2535-Phosphorus-Basics\\_041719L.pdf](https://www.aces.edu/wp-content/uploads/2019/04/ANR-2535-Phosphorus-Basics_041719L.pdf)
- Raddatz, N., Morales de los Ríos, L., Lindahl, M., Quintero, F. J., & Pardo, J. M. (2020). Coordinated Transport of Nitrate, Potassium, and Sodium. *Frontiers in Plant Science*, 11(March), 1–18. <https://doi.org/10.3389/fpls.2020.00247>
- Ragel, P., Raddatz, N., Leidi, E. O., Quintero, F. J., & Pardo, J. M. (2019). Regulation of K + nutrition in plants. *Frontiers in Plant Science*, 10(March). <https://doi.org/10.3389/fpls.2019.00281>
- Raghad Mouhamad, A. A. and M. I. (2016). Behavior of Potassium in Soil: A mini review. *Chemistry International*, 2(1), 47–58. <https://doi.org/10.13140/RG.2.1.4830.7041>
- Rawel, H. M., Huschek, G., Sagu, S. T., & Homann, T. (2019). Cocoa bean proteins-Characterization, changes and modifications due to ripening and post-harvest processing. *Nutrients*, 11(2). <https://doi.org/10.3390/nu11020428>



- Reichle, D. E. (2020). Energy relationships between organisms and their environment. *The Global Carbon Cycle and Climate Change*, 15–41. <https://doi.org/10.1016/b978-0-12-820244-9.00003-2>
- Richardson, L. G. L., & Torii, K. U. (2013). Take a deep breath: Peptide signalling in stomatal patterning and differentiation. *Journal of Experimental Botany*, 64(17), 5243–5251. <https://doi.org/10.1093/jxb/ert246>
- Rosolem, C. A., Sgariboldi, T., Garcia, R. A., & Calonego, J. C. (2010). Potassium leaching as affected by soil texture and residual fertilization in tropical soils. *Communications in Soil Science and Plant Analysis*, 41(16), 1934–1943. <https://doi.org/10.1080/00103624.2010.495804>
- Rossatto, T., do Amaral, M. N., Benitez, L. C., Vighi, I. L., Braga, E. J. B., de Magalhães Júnior, A. M., Maia, M. A. C., & da Silva Pinto, L. (2017). Gene expression and activity of antioxidant enzymes in rice plants, cv. BRS AG, under saline stress. *Physiology and Molecular Biology of Plants*, 23(4), 865–875. <https://doi.org/10.1007/s12298-017-0467-2>
- Sadeghipour, O. (2018). *Enhancing Cadmium Tolerance in Common Bean Plants by Potassium Application*. July.
- Sakiroh, Sobari, I., & Herman, M. (2015). Teknologi mengurangi dampak perubahan iklim pada kakao di lahan kering. *Balai Penelitian Tanaman Industri Dan Penyegar*, 55–66.
- Salazar, J. C. S., Melgarejo, L. M., Casanoves, F., Di Rienzo, J. A., DaMatta, F. M., & Armas, C. (2018). Photosynthesis limitations in cacao leaves under different agroforestry systems in the Colombian Amazon. *PLoS ONE*, 13(11), 1–13. <https://doi.org/10.1371/journal.pone.0206149>
- Santander Muñoz, M., Rodríguez Cortina, J., Vaillant, F. E., & Escobar Parra, S. (2020). An overview of the physical and biochemical transformation of cocoa seeds to beans and to chocolate: Flavor formation. *Critical Reviews in Food Science and Nutrition*, 60(10), 1593–1613. <https://doi.org/10.1080/10408398.2019.1581726>
- Santosa, E., Sakti, G. P., Fattah, M. Z., Zaman, S., & Wahjar, A. (2018). Cocoa Production Stability in Relation to Changing Rainfall and Temperature in East Java, Indonesia. *Journal of Tropical Crop Science*, 5(1), 6–17. <https://doi.org/10.29244/jtcs.5.1.6-17>
- Sardans, J., & Peñuelas, J. (2021). Potassium Control of Plant Functions : Ecological and. In *Plants*.
- Schachtman, D. P. (2015). The role of ethylene in plant responses to K<sup>+</sup> deficiency. *Frontiers in Plant Science*, 6(DEC), 1–4. <https://doi.org/10.3389/fpls.2015.01153>
- Setiawati, T., Ayalla, A., Nurzaman, M., & Mutaqin, A. Z. (2018). Influence of Light Intensity on Leaf Photosynthetic Traits and Alkaloid Content of Kiasahan (*Tetracera scandens* L.). *IOP Conference Series: Earth and Environmental Science*, 166(1), 0–7. <https://doi.org/10.1088/1755-1315/166/1/012025>
- Shahid, M., Saleem, M. F., Saleem, A., Sarwar, M., Khan, H. Z., & Shakoore, A. (2020). Foliar Potassium-Induced Regulations in Glycine Betaine and Malondialdehyde Were Associated with Grain Yield of Heat-Stressed Bread Wheat (*Triticum aestivum* L.). *Journal of Soil Science and Plant Nutrition*, 20(4), 1785–1798.

<https://doi.org/10.1007/s42729-020-00250-w>

- Shi, L., & Tu, B. P. (2015). Acetyl-CoA and the regulation of metabolism: Mechanisms and consequences. *Current Opinion in Cell Biology*, 33, 125–131. <https://doi.org/10.1016/j.ceb.2015.02.003>
- Shiddieq, F. a R. (2013). PENGARUH CEKAMAN KURANG AIR TERHADAP BEBERAPA KARAKTER FISILOGIS TANAMAN NILAM ( *Pogostemon cablin* Benth ) The Effect of Water Deficit on Physiological Characteristics of Patchouli ( *Pogostemon cablin* Benth ) air. *Journal Littri*, 19(3), 121–129.
- Shimada, T., Sugano, S. S., & Hara-Nishimura, I. (2011). Positive and negative peptide signals control stomatal density. *Cellular and Molecular Life Sciences*, 68(12), 2081–2088. <https://doi.org/10.1007/s00018-011-0685-7>
- Shin, R., Berg, R. H., & Schachtman, D. P. (2005). Reactive oxygen species and root hairs in arabidopsis root response to nitrogen, phosphorus and potassium deficiency. *Plant and Cell Physiology*, 46(8), 1350–1357. <https://doi.org/10.1093/pcp/pci145>
- Shin, R., & Schachtman, D. P. (2004). Hydrogen peroxide mediates plant root cell response to nutrient deprivation. *Proceedings of the National Academy of Sciences of the United States of America*, 101(23), 8827–8832. <https://doi.org/10.1073/pnas.0401707101>
- Smirnoff, N., & Arnaud, D. (2019). Hydrogen peroxide metabolism and functions in plants. *New Phytologist*, 221(3), 1197–1214. <https://doi.org/10.1111/nph.15488>
- Stahl, W., & Sies, H. (2003). Antioxidant activity of carotenoids. *Molecular Aspects of Medicine*, 24(6), 345–351. [https://doi.org/10.1016/S0098-2997\(03\)00030-X](https://doi.org/10.1016/S0098-2997(03)00030-X)
- SUBARDJA, D. (2007). Karakteristik dan Pengelolaan Tanah Masam dari Batuan Vulkanik untuk Pengembangan Jagung di Sukabumi, Jawa Barat. *Jurnal Tanah Dan Iklim*, 25, 59–69.
- Sui, X. L., Mao, S. L., Wang, L. H., Zhang, B. X., & Zhang, Z. X. (2012). Effect of Low Light on the Characteristics of Photosynthesis and Chlorophyll a Fluorescence During Leaf Development of Sweet Pepper. *Journal of Integrative Agriculture*, 11(10), 1633–1643. [https://doi.org/10.1016/S2095-3119\(12\)60166-X](https://doi.org/10.1016/S2095-3119(12)60166-X)
- Thummanatsakun, V., & Yampracha, S. (2018). Effects of interaction between nitrogen and potassium on the growth and yield of cassava. *International Journal of Agricultural Technology*, 14(7), 2137–2150.
- Tränkner, M., Tavakol, E., & Jákli, B. (2018). Functioning of potassium and magnesium in photosynthesis, photosynthate translocation and photoprotection. *Physiologia Plantarum*, 163(3), 414–431. <https://doi.org/10.1111/ppl.12747>
- Trivedi, D. K., Gill, S. S., & Tuteja, N. (2016). Absciscic Acid (ABA): Biosynthesis, Regulation, and Role in Abiotic Stress Tolerance. *Abiotic Stress Response in Plants*, 315–326. <https://doi.org/10.1002/9783527694570.ch15>
- Virtanen, O., Constantinidou, E., & Tyystjärvi, E. (2020). Chlorophyll does not reflect green light—how to correct a misconception. *Journal of Biological Education*, 00(00), 1–8. <https://doi.org/10.1080/00219266.2020.1858930>
- Wang, M., Zheng, Q., Shen, Q., & Guo, S. (2013). The critical role of potassium in plant stress response. *International Journal of Molecular Sciences*, 14(4), 7370–

7390. <https://doi.org/10.3390/ijms14047370>

- Wang, X. G., Zhao, X. H., Jiang, C. J., Li, C. H., Cong, S., Wu, D., Chen, Y. Q., Yu, H. Q., & Wang, C. Y. (2015). Effects of potassium deficiency on photosynthesis and photoprotection mechanisms in soybean (*Glycine max* (L.) Merr.). *Journal of Integrative Agriculture*, 14(5), 856–863. [https://doi.org/10.1016/S2095-3119\(14\)60848-0](https://doi.org/10.1016/S2095-3119(14)60848-0)
- Wang, Y., Chen, Y. F., & Wu, W. H. (2021). Potassium and phosphorus transport and signaling in plants. *Journal of Integrative Plant Biology*, 63(1), 34–52. <https://doi.org/10.1111/jipb.13053>
- Wang, Y., & Wu, W. H. (2013). Potassium transport and signaling in higher plants. *Annual Review of Plant Biology*, 64(January), 451–476. <https://doi.org/10.1146/annurev-arplant-050312-120153>
- Wang, Y., & Wu, W. H. (2017). Regulation of potassium transport and signaling in plants. *Current Opinion in Plant Biology*, 39, 123–128. <https://doi.org/10.1016/j.pbi.2017.06.006>
- Waraich, E. A., Ahmad, R., Halim, A., & Aziz, T. (2012). Alleviation of temperature stress by nutrient management in crop plants: A review. *Journal of Soil Science and Plant Nutrition*, 12(2), 221–244. <https://doi.org/10.4067/S0718-95162012000200003>
- Waraich, Ejaz Ahmad, Ahmad, R., Saifullah, Ashraf, M. Y., & Ehsanullah. (2011). Role of mineral nutrition in alleviation of drought stress in plants. *Australian Journal of Crop Science*, 5(6), 764–777.
- Wardiana, E., Towaha, J., Penelitian, B., Industri, T., Raya, J., Km, P., & Indonesia, S. (2017). *Morfologi Komponen Buah Grouping the 33 Accessions of Cacao Based on Morphological Characters of*. 4, 67–78.
- Yang, X., Geng, J., Li, C., Zhang, M., Chen, B., Tian, X., Zheng, W., Liu, Z., & Wang, C. (2016). Combined application of polymer coated potassium chloride and urea improved fertilizer use efficiencies, yield and leaf photosynthesis of cotton on saline soil. *Field Crops Research*, 197, 63–73. <https://doi.org/10.1016/j.fcr.2016.08.009>
- Yordanova, R., & Popova, L. (2007). Effect of exogenous treatment with salicylic acid on photosynthetic activity and antioxidant capacity of chilled wheat plants. *Gen. Appl. Plant Physiol*, 33(3–4), 155–170.
- Zak, D. L., & Keeney, P. G. (1976). Extraction and Fractionation of Cocoa Proteins as Applied to Several Varieties of Cocoa Beans. *Journal of Agricultural and Food Chemistry*, 24(3), 479–483. <https://doi.org/10.1021/jf60205a055>
- Zakariyya, F., & Indradewa, D. (2019). Biochemical Changes of Three Cocoa Clones (*Theobroma cacao* L.) Under Drought Stress. *Ilmu Pertanian (Agricultural Science)*, 3(2), 82. <https://doi.org/10.22146/ipas.37495>
- Zandalinas, S. I., Mittler, R., Balfagón, D., Arbona, V., & Gómez-Cadenas, A. (2018). Plant adaptations to the combination of drought and high temperatures. *Physiologia Plantarum*, 162(1), 2–12. <https://doi.org/10.1111/ppl.12540>
- Zargoosh, Z., Ghavam, M., Bacchetta, G., & Tavili, A. (2019). Effects of ecological factors on the antioxidant potential and total phenol content of *Scrophularia*

striata Boiss. *Scientific Reports*, 9(1), 1–15. <https://doi.org/10.1038/s41598-019-52605-8>

- Zhao, X., Du, Q., Zhao, Y., Wang, H., Li, Y., Wang, X., & Yu, H. (2016). Effects of Different Potassium Stress on Leaf Photosynthesis and Chlorophyll Fluorescence in Maize (<i>Zea Mays</i> L.) at Seedling Stage. *Agricultural Sciences*, 07(01), 44–53. <https://doi.org/10.4236/as.2016.71005>
- Zhu, H., Li, X., Zhai, W., Liu, Y., Gao, Q., Liu, J., Ren, L., Chen, H., & Zhu, Y. (2017). Effects of low light on photosynthetic properties, antioxidant enzyme activity, and anthocyanin accumulation in purple pak-choi (*Brassica campestris* ssp. *Chinensis* Makino). *PLoS ONE*, 12(6), 1–17. <https://doi.org/10.1371/journal.pone.0179305>