

## REFERENCES

- Abdi, H., & Williams, L. J. (2010). Principal component analysis. *Wiley Interdisciplinary Reviews: Computational Statistics*, 2(4), 433–459. <https://doi.org/10.1002/wics.101>
- ABRAF. (2013). Anuário Estatístico ABRAF 2013: Ano base 2012. In *Yearbook*. IPEF. [www.abraflor.org.br](http://www.abraflor.org.br)
- Absalom, E., Turner, A., Clements, M., Croft, H., & Edmondson, J. (2025). Impact of phytophthora disease on the growth, physiology and ecosystem services of common lime (*Tilia* × *europaea*) street trees. *Plant-Environment Interactions*, 6(3), e70054.
- Ahuja, M.-R., & Libby, W. J. (2012). *Clonal forestry II: conservation and application*. Springer Science & Business Media.
- Aljuboori, A., & Abdulrazzq, M. (2024). Enhancing Accuracy in Predicting Continuous Values through Regression. *Iraqi Journal for Computer Science and Mathematics*, 5(4), 25.
- Amrutha, S., Muneera Parveen, A. B., Muthupandi, M., Sivakumar, V., Nautiyal, R., & Dasgupta, M. G. (2019). Variation in morpho-physiological, biochemical and molecular responses of two *Eucalyptus* species under short-term water stress. *Acta Botanica Croatica*, 78(2), 125–134. <https://doi.org/10.2478/botcro-2019-0021>
- Atkinson, J. A., Wingen, L. U., Griffiths, M., Pound, M. P., Gaju, O., Foulkes, M. J., Le Gouis, J., Griffiths, S., Bennett, M. J., & King, J. (2015). Phenotyping pipeline reveals major seedling root growth QTL in hexaploid wheat. *Journal of Experimental Botany*, 66(8), 2283–2292. <https://doi.org/10.1093/jxb/erv006>
- Auger, S., & Shipley, B. (2013). Inter-specific and intra-specific trait variation along short environmental gradients in an old-growth temperate forest. *Journal of Vegetation Science*, 24(3), 419–428. <https://doi.org/10.1111/j.1654-1103.2012.01473.x>
- Bai, W., Zhang, H., Zhang, Z., Teng, F., Wang, L., Tao, Y., & Zheng, Y. (2010). The evidence for non-additive effect as the main genetic component of plant height and ear height in maize using introgression line populations. *Plant Breeding*, 129(4), 376–384. <https://doi.org/10.1111/j.1439-0523.2009.01709.x>
- Bailleres, H., Hopewell, G., & Redman, A. (2016). *Enhancement of veneer*

*products from acacia and eucalypt plantations in Vietnam and Australia.*

- Baltunis, B. S., Huber, D. A., White, T. L., Goldfarb, B., & Stelzer, H. E. (2005). Genetic effects of rooting loblolly pine stem cuttings from a partial diallel mating design. *Canadian Journal of Forest Research*, 35(5), 1098–1108. <https://doi.org/10.1139/x05-038>
- Bayala, J., Dianda, M., Wilson, J., Ouedraogo, S. J., & Sanon, K. (2009). Predicting field performance of five irrigated tree species using seedling quality assessment in Burkina Faso, West Africa. *New Forests*, 38, 309–322. <https://doi.org/10.1007/s11056-009-9149-4>
- Beaulieu, J., Lenz, P., & Bousquet, J. (2022). Metadata analysis indicates biased estimation of genetic parameters and gains using conventional pedigree information instead of genomic-based approaches in tree breeding. *Scientific Reports*, 12(1), 3933.
- Begna, T. (2020). *The role of genotype by environmental interaction in plant breeding.*
- Berger, R., & Junior, J. B. P. (2009). Importância econômica e social do setor florestal. *Curitiba: Julho.*
- Bhuiyan, M., Kim, Y., Lee, D., Chung, Y., Lee, D., Kang, J., & Lee, S. (2024). Evaluation of non-additive genetic effects on carcass and meat quality traits in Korean Hanwoo cattle using genomic models. *Animal*, 18(5), 101152.
- Bocianowski, J., Wronska-Pilarek, D., Krysztofiak-Kaniewska, A., Matusiak, K., & Wiatrowska, B. (2024). Comparison of pearson's and spearman's correlation coefficients for selected traits of *Pinus sylvestris* L. *Biom Lett*, 61(2), 115–135.
- Boonkum, W., Chankitisakul, V., Duangjinda, M., Buaban, S., Sumreddee, P., & Sungkhapreecha, P. (2023). Genomic Selection Using Single-Step Genomic BLUP on the Number of Services per Conception Trait in Thai–Holstein Crossbreeds. *Animals*, 13(23), 3609. <https://doi.org/10.3390/ani13233609>
- Bouvet, J.-M., Vigneron, P., Saya, R.-A., & Gouma, R. (2004). Early selection of *Eucalyptus* clones in retrospective nursery test using growth, morphological and dry matter criteria, in Republic of Congo. *The Southern African Forestry Journal*, 200(1), 5–17. <https://doi.org/10.1080/20702620.2004.10431756>
- Brawner, J. T., Bush, D., Macdonell, P., Warburton, P., & Clegg, P. (2010). Genetic parameters of red mahogany breeding populations grown in the tropics. *Australian Forestry*, 73(3), 177–183.

- Brien, C. (2020). *Package 'asremlPlus.'*
- Budiman, B., Sudrajat, D. J., Lee, D. K., & Kim, Y. S. (2015). Effect of initial morphology on field performance in white jabon seedlings at Bogor, Indonesia. *Forest Science and Technology*, *11*(4), 206–211. <https://doi.org/10.1080/21580103.2015.1007897>
- Butler, D. G., Cullis, B. R., Gilmour, A. R., Gogel, B. J., & Thompson, R. (2019). *ASReml-R Reference Manual Version 4 ASReml estimates variance components under a general linear mixed model by residual maximum likelihood (REML)*. <http://asreml.org>
- Campinhos, E. (1999). Sustainable plantations of high-yield shape Eucalyptus trees for production of fiber: The Aracruz case. *New Forests*, *17*, 129–143. <https://doi.org/10.1023/A:1006562225915>
- Cappa, E. P., de Lima, B. M., da Silva-Junior, O. B., Garcia, C. C., Mansfield, S. D., & Grattapaglia, D. (2019). Improving genomic prediction of growth and wood traits in Eucalyptus using phenotypes from non-genotyped trees by single-step GBLUP. *Plant Science*, *284*, 9–15. <https://doi.org/10.1016/j.plantsci.2019.03.017>
- Cappa, E. P., Ratcliffe, B., Chen, C., Thomas, B. R., Liu, Y., Klutsch, J., Wei, X., Azcona, J. S., Benowicz, A., & Sadoway, S. (2022). Improving lodgepole pine genomic evaluation using spatial correlation structure and SNP selection with single-step GBLUP. *Heredity*, *128*(4), 209–224. <https://doi.org/10.1038/s41437-022-00508-2>
- Castro, C. A. de O., Resende, R. T., Bhering, L. L., & Cruz, C. D. (2016). Brief history of Eucalyptus breeding in Brazil under perspective of biometric advances. *Ciência Rural*, *46*, 1585–1593. <https://doi.org/10.1590/0103-8478cr20150645>
- Cattell, R. B. (1966). The scree test for the number of factors. *Multivariate Behavioral Research*, *1*(2), 245–276. [https://doi.org/10.1207/s15327906mbr0102\\_10](https://doi.org/10.1207/s15327906mbr0102_10)
- Chamshama, S. A. O., & Hall, J. B. (1987). Effects of nursery treatments on Eucalyptus camaldulensis field establishment and early growth at Mafiga, Morogoro, Tanzania. *Forest Ecology and Management*, *21*(1–2), 91–108. [https://doi.org/10.1016/0378-1127\(87\)90074-0](https://doi.org/10.1016/0378-1127(87)90074-0)
- Chen, S., Weng, Q., Li, F., Li, M., Zhou, C., & Gan, S. (2018). Genetic parameters for growth and wood chemical properties in Eucalyptus urophylla × E. tereticornis hybrids. *Annals of Forest Science*, *75*(1), 16. <https://doi.org/10.1007/s13595-018-0694-x>
- Chen, Y., & Lübberstedt, T. (2010). Molecular basis of trait correlations. *Trends in Plant Science*, *15*(8), 454–461.

<https://doi.org/10.1016/j.tplants.2010.05.004>

- Close, D. C., Bail, I., Hunter, S., & Beadle, C. L. (2006). Defining seedling specifications for *Eucalyptus globulus*: Effects of seedling size and container type on early after-planting performance. *Australian Forestry*, *69*(1), 2–8. <https://doi.org/10.1080/00049158.2006.10674981>
- Cockerham, C. C., & Weir, B. S. (1977). Quadratic analyses of reciprocal crosses. *Biometrics*, 187–203.
- Colodette, J. L., Gomes, C. M., Gomes, F. J., & Cabral, C. P. (2014). The Brazilian wood biomass supply and utilization focusing on eucalypt. *Chemical and Biological Technologies in Agriculture*, *1*, 1–8. <https://doi.org/10.1186/s40538-014-0025-x>
- Conner, J. K., Franks, R., & Stewart, C. (2003). Expression of additive genetic variances and covariances for wild radish floral traits: Comparison between field and greenhouse environments. *Evolution*, *57*(3), 487–495. <https://doi.org/10.1111/j.0014-3820.2003.tb01540.x>
- Corrêa, T. R., de Toledo Picoli, E. A., de Souza, G. A., Conde, S. A., Silva, N. M., Lopes-Mattos, K. L. B., de Resende, M. D. V., Zauza, E. A. V., & Oda, S. (2017). Phenotypic markers in early selection for tolerance to dieback in *Eucalyptus*. *Industrial Crops and Products*, *107*, 130–138. <https://doi.org/10.1016/j.indcrop.2017.05.032>
- Costa, L. da S., Vuralhan-Eckert, J., & Fromm, J. (2022). Effect of Elevated CO<sub>2</sub> and Drought on Biomass, Gas Exchange and Wood Structure of *Eucalyptus grandis*. *Plants*, *12*(1), 148.
- Dale, A. G., & Frank, S. D. (2022). Water availability determines tree growth and physiological response to biotic and abiotic stress in a temperate North American urban forest. *Forests*, *13*(7), 1012.
- Davidowitz, G., Nijhout, H. F., & Roff, D. A. (2012). Predicting the response to simultaneous selection: Genetic architecture and physiological constraints. *Evolution*, *66*(9), 2916–2928. <https://doi.org/10.1111/j.1558-5646.2012.01644.x>
- Davidson, J. (1993). Ecological aspects of *Eucalyptus* plantations. *Proceedings of the Regional Expert Consultation on Eucalyptus*, *1*, 35–60.
- de Assis, T. F., Fett-Neto, A. G., & Alfenas, A. C. (2004). Current techniques and prospects for the clonal propagation of hardwoods with emphasis on *Eucalyptus*. *Plantation Forest Biotechnology for the 21st Century*, 303–333. <https://doi.org/10.13140/2.1.1901.2806>
- de Sá, L. F., Lohmann, G. T., Bandeira Peres, F. S., & Tambarussi, E. V. (2024). Genetic Variability for Clonal Propagation of *Acacia mearnsii*. *Forest*

*Science*, 70(5–6), 365–375. <https://doi.org/10.1093/forsci/fxae026>

- Dean, C., Cotterill, P., & Burdon, R. (2006). Early selection of radiata pine. *Silvae Genetica*, 55(1–6), 182–191. <https://doi.org/10.1515/sg-2006-0025>
- Diao, S., Hou, Y., Xie, Y., & Sun, X. (2016). Age trends of genetic parameters, early selection and family by site interactions for growth traits in *Larix kaempferi* open-pollinated families. *BMC Genetics*, 17(1), 104. <https://doi.org/10.1186/s12863-016-0400-7>
- Dickson, A., Leaf, A. L., & Hosner, J. F. (1960). Quality appraisal of white spruce and white pine seedling stock in nurseries. *The Forestry Chronicle*, 36(1), 10–13. <https://doi.org/10.5558/tfc36010-1>
- dos Santos, G., Nunes, A., de Resende, M., Silva, L. D., Higa, A., & de Assis, T. (2016). An index combining volume and Pilodyn penetration to study stability and adaptability of *Eucalyptus* multi-species hybrids in Rio Grande do Sul, Brazil. *Australian Forestry*, 79(4), 248–255. <https://doi.org/10.1080/00049158.2016.1237253>
- Du Toit, B., & Dovey, S. B. (2005). Effect of site management on leaf area, early biomass development, and stand growth efficiency of a *Eucalyptus grandis* plantation in South Africa. *Canadian Journal of Forest Research*, 35(4), 891–900. <https://doi.org/10.1139/x04-205>
- Dubansky, B. (2018). The interaction of environment and chronological and developmental time. In *Development and environment* (pp. 9–39). Springer. [https://doi.org/10.1007/978-3-319-75935-7\\_2](https://doi.org/10.1007/978-3-319-75935-7_2)
- Eamus, D., Chen, X., Kelley, G., & Hutley, L. (2002). Root biomass and root fractal analyses of an open *Eucalyptus* forest in a savanna of north Australia. *Australian Journal of Botany*, 50(1), 31–41. <https://doi.org/10.1071/BT01054>
- Espey, M., Md. Tahir, P., Lee, S. H., Muhammad Roseley, A. S., & Meder, R. (2021). Incidence and Severity of End-Splitting in Plantation-Grown *Eucalyptus pellita* F. Muell. In North Borneo. *Forests*, 12(3), 266. <https://doi.org/10.3390/f12030266>
- Fadwati, A. D., Hidayati, F., & Mohammad, N. (2023). Evaluation of genetic parameters of growth characteristics and basic density of *Eucalyptus pellita* clones planted at two different sites in East Kalimantan, Indonesia. *Journal of the Korean Wood Science and Technology*, 51(3), 222–237. <https://doi.org/10.5658/WOOD.2023.51.3.222>
- Falconer, D. S., & Mackay, T. F. C. (1996). *Introduction to Quantitative Genetics*. 4th Edition. Addison Wesley Longman.
- Ferraz Filho, A. C., Scolforo, J. R. S., & Mola-Yudego, B. (2014). The

coppice-with-standards silvicultural system as applied to *Eucalyptus* plantations—A review. *Journal of Forestry Research*, 25(2), 237–248. <https://doi.org/10.1007/s11676-014-0455-0>

Figueiredo, F. A. M. M. de A., Carneiro, J. G. A., Penchel, R. M., Thiebaut, J. T. L., Abad, J. I. M., Barroso, D. G., & Ferraz, T. M. (2019). Correlations between *Eucalyptus* clonal cutting quality and performance after planting. *Floresta e Ambiente*, 26(4), e20160163. <https://doi.org/10.1590/2179-8087.016316>

Frampton, J., Isik, F., & Goldfarb, B. (2002). Effects of nursery characteristics on field survival and growth of loblolly pine rooted cuttings. *Southern Journal of Applied Forestry*, 26(4), 207–213. <https://doi.org/10.1093/sjaf/26.4.207>

França, F. J. N., França, T., Arango, R. A., Woodward, B. M., & Vidaurre, G. B. (2017). Variation in natural durability of seven *Eucalyptus grandis* × *Eucalyptus urophylla* hybrid clones. *Forest Products Journal*, 67(3–4), 230–235. <https://doi.org/10.13073/FPJ-D-16-00029>

Freschet, G. T., Roumet, C., Comas, L. H., Weemstra, M., Bengough, A. G., Rewald, B., Bardgett, R. D., De Deyn, G. B., Johnson, D., & Klimešová, J. (2021). Root traits as drivers of plant and ecosystem functioning: Current understanding, pitfalls and future research needs. *New Phytologist*, 232(3), 1123–1158. <https://doi.org/10.1111/nph.17072>

Fresnedo-Ramírez, J., Yang, S., Sun, Q., Karn, A., Reisch, B. I., & Cadle-Davidson, L. (2019). Computational analysis of ampseq data for targeted, high-throughput genotyping of amplicons. *Frontiers in Plant Science*, 10, 599. <https://doi.org/10.3389/fpls.2019.00599>

Friedman, J. H. (2001). Greedy function approximation: A gradient boosting machine. *Annals of Statistics*, 1189–1232. <https://doi.org/10.1214/aos/1013203451>

Fukuda, Y., Hiraoka, Y., Ohira, M., Takahashi, M., Iki, T., Miura, M., Kurita, M., & Watanabe, A. (2018). Genetic variation of root traits of cuttings and their relation to early shoot growth in *Cryptomeria japonica*. <https://doi.org/10.4005/jjfs.100.218>

Galeano, E., Cappa, E. P., Bousquet, J., & Thomas, B. R. (2023). Optimizing a regional white spruce tree improvement program: SNP genotyping for enhanced breeding values, genetic diversity assessment, and estimation of pollen contamination. *Forests*, 14(11), 2212. <https://doi.org/10.3390/f14112212>

Garbowski, M., Johnston, D. B., & Brown, C. S. (2021). Leaf and root traits, but not relationships among traits, vary with ontogeny in seedlings. *Plant and Soil*, 460(1), 247–261.

- Gezan, S. A., de Oliveira, A. A., Galli, G., & Murray, D. (2022). User's manual for ASRgenomics v. 1.1. 0: An R package with complementary genomic functions. *VSN International*.
- Godoy, T. G., & Rosado, S. C. da S. (2011). Estimates of genetic gains for growth traits in young plants of *Eucalyptus urophylla* ST Blake. *Cerne*, *17*, 189–193. <https://doi.org/10.1590/S0104-77602011000200005>
- Gomez, G., Valdivieso, M., De La Cuesta, D., & Kawano, K. (1984). Cyanide content in whole-root chips of ten cassava cultivars and its reduction by oven drying or sun drying on trays. *International Journal of Food Science and Technology*, *19*(1), 97–102. <https://doi.org/10.1111/j.1365-2621.1984.tb00329.x>
- Grossnickle, S. C., & MacDonald, J. E. (2018). Why seedlings grow: Influence of plant attributes. *New Forests*, *49*(1), 1–34. <https://doi.org/10.1007/s11056-017-9606-4>
- Hardner, C. M., Healey, A. L., Downes, G., Herberling, M., & Gore, P. L. (2016). Improving prediction accuracy and selection of open-pollinated seed-lots in *Eucalyptus dunnii* Maiden using a multivariate mixed model approach. *Annals of Forest Science*, *73*(4), 1035–1046. <https://doi.org/10.1007/s13595-016-0587-9>
- Harwood, C. (1998). *Eucalyptus pellita: An annotated bibliography*. CSIRO Forestry and Forest Products.
- Harwood, C. (2011). New introductions—doing it right. *Developing a Eucalypt Resource: Learning from Australia and Elsewhere: University of Canterbury*. Christchurch, New Zealand: Wood Technology Research Centre, 43–54.
- Harwood, C. E. (1998). *Eucalyptus pellita: An Annotated Bibliography*. <https://www.researchgate.net/publication/325336036>
- Harwood, C., & Nambiar, E. K. S. (2014). Productivity of acacia and eucalypt plantations in Southeast Asia. 2. Trends and variations. *International Forestry Review*, *16*(2), 249–260. <https://doi.org/10.1505/146554814811724766>
- Hassan, A., Balachandran, P., & Khamis, K. R. (2021). *Early Root Development of Eucalyptus pellita F. Muell. Seedlings from Seed and Stem Cutting Propagation Methods at Nursery Stage*. <https://doi.org/10.1155/2021/6624266>
- Hauke, J., & Kossowski, T. (2011). Comparison of values of Pearson's and Spearman's correlation coefficients on the same sets of data. *Quaestiones Geographicae*, *30*(2), 87–93.

- Heid, I. M., Lamina, C., Küchenhoff, H., Fischer, G., Klopp, N., Kolz, M., Grallert, H., Vollmert, C., Wagner, S., & Huth, C. (2008). Estimating the single nucleotide polymorphism genotype misclassification from routine double measurements in a large epidemiologic sample. *American Journal of Epidemiology*, *168*(8), 878–889. <https://doi.org/10.1093/aje/kwn208>
- Henderson, C. (1985). Best linear unbiased prediction of nonadditive genetic merits in noninbred populations. *Journal of Animal Science*, *60*(1), 111–117.
- Henderson, C. R. (1976). Inverse of a matrix of relationships due to sires and maternal grandsires in an inbred population. *Journal of Dairy Science*, *59*(9), 1585–1588. [https://doi.org/10.3168/jds.S0022-0302\(76\)84409-8](https://doi.org/10.3168/jds.S0022-0302(76)84409-8)
- Henderson, C. R. (1984). *Applications of linear models in animal breeding* (Vol. 462). University of Guelph Guelph.
- Hermann, K., & Kuhlemeier, C. (2011). The genetic architecture of natural variation in flower morphology. *Current Opinion in Plant Biology*, *14*(1), 60–65. <https://doi.org/10.1016/j.pbi.2010.09.012>
- Hubbard, R. M., Carneiro, R. L., Campoe, O., Alvares, C. A., Figura, M. A., & Moreira, G. G. (2020). Contrasting water use of two *Eucalyptus* clones across a precipitation and temperature gradient in Brazil. *Forest Ecology and Management*, *475*, 118407. <https://doi.org/10.1016/j.foreco.2020.118407>
- Hung, T. D., Brawner, J. T., Meder, R., Lee, D. J., Southerton, S., Thinh, H. H., & Dieters, M. J. (2015). Estimates of genetic parameters for growth and wood properties in *Eucalyptus pellita* F. Muell. To support tree breeding in Vietnam. *Annals of Forest Science*, *72*, 205–217. <https://doi.org/10.1007/s13595-014-0426-9>
- Hutapea, F. J., Weston, C. J., Mendham, D., & Volkova, L. (2023). Sustainable management of *Eucalyptus pellita* plantations: A review. *Forest Ecology and Management*, *537*, 120941. <https://doi.org/10.1016/j.foreco.2023.120941>
- IBÁ. (2024). *Annual report 2024*. IBÁ – Brazilian Tree Industry. <https://iba.org/en/publicacoes/annual-reports>
- Isik, F., Holland, J., & Maltecca, C. (2017). Multivariate models. In *Genetic data analysis for plant and animal breeding* (pp. 165–201). Springer. <https://doi.org/10.1007/978-3-319-55177-7>
- Ivetić, V., Devetaković, J., & Maksimović, Z. (2016). Initial height and diameter are equally related to survival and growth of hardwood seedlings in first year after field planting. *Reforest*, *2*, 6–21. <https://doi.org/10.21750/REFOR.2.02.17>

- Ivetić, V., Grossnickle, S. C., & korić, M. (2017). Forecasting the field performance of Austrian pine seedlings using morphological attributes. *Iforest - Biogeosciences and Forestry*, 10, 99–107. <https://doi.org/10.3832/ifor1722-009>
- Janmohammadi, M., Movahedi, Z., & Sabaghnia, N. (2014). Multivariate statistical analysis of some traits of bread wheat for breeding under rainfed conditions. *Journal of Agricultural Sciences, Belgrade*, 59(1), 1–14. <https://doi.org/10.2298/JAS1401001J>
- Jiang, L., Ye, M., Zhu, S., Zhai, Y., Xu, M., Huang, M., & Wu, R. (2016). Computational identification of genes modulating stem height–diameter allometry. *Plant Biotechnology Journal*, 14(12), 2254–2264. <https://doi.org/10.1111/pbi.12579>
- Jolliffe, I. T. (2002). *Principal component analysis* (2nd ed). Springer New York.
- Jolliffe, I. T., & Cadima, J. (2016). Principal component analysis: A review and recent developments. *Philosophical Transactions of the Royal Society A: Mathematical, Physical and Engineering Sciences*, 374(2065), 20150202. <https://doi.org/10.1098/rsta.2015.0202>
- Kaiser, H. F. (1960). The application of electronic computers to factor analysis. *Educational and Psychological Measurement*, 20(1), 141–151. <https://doi.org/10.1177/001316446002000116>
- Kalita, U., & Upadhaya, L. (2001). Genetic analysis of some root and shoot characters in rice under rainfed upland situation. *Indian Journal of Genetics and Plant Breeding*, 61(02), 107–111.
- Kang, M. S. (2002). Genotype–environment interaction: Progress and prospects. *Quantitative Genetics, Genomics and Plant Breeding*, 221–243. <https://doi.org/10.1079/9780851996011.0221>
- Kassambara, A., & Mundt, F. (2017). Package ‘factoextra.’ *Extract and Visualize the Results of Multivariate Data Analyses*, 76(2), 10–18637.
- Kholi, A. A., Dhillon, G. P. S., & Singh, B. (2024). Variation among *Eucalyptus* Species for Morphological, Physiological and Biochemical Traits under Simulated salt stress conditions: *Eucalyptus* traits under salt stress. *Journal of Soil Salinity and Water Quality*, 16(1), 85–93. <https://doi.org/10.56093/jsswq.v16i1.149852>
- Kinho, J., Halawane, J., Irawan, A., & Kafiar, Y. (2015). *Evaluasi pertumbuhan tanaman uji keturunan eboni (Diospyros rumphii) umur satu tahun di persemaian*. 1(4), 800–804.
- Klápště, J., Dungey, H. S., Telfer, E. J., Suontama, M., Graham, N. J., Li, Y., & McKinley, R. (2020). Marker selection in multivariate genomic prediction

- improves accuracy of low heritability traits. *Frontiers in Genetics*, 11, 499094. <https://doi.org/10.3389/fgene.2020.499094>
- Kruse, J., Turnbull, T., Rennenberg, H., & Adams, M. A. (2020). Plasticity of leaf respiratory and photosynthetic traits in *Eucalyptus grandis* and *E. regnans* grown under variable light and nitrogen availability. *Frontiers in Forests and Global Change*, 3, 5. <https://doi.org/10.3389/ffgc.2020.00005>
- Kruuk, L. E., & Hadfield, J. D. (2007). How to separate genetic and environmental causes of similarity between relatives. *Journal of Evolutionary Biology*, 20(5), 1890–1903. <https://doi.org/10.1111/j.1420-9101.2007.01377.x>
- Kuha, J. (2004). AIC and BIC: Comparisons of assumptions and performance. *Sociological Methods and Research*, 33(2), 188–229. <https://doi.org/10.1177/0049124103262065>
- Kuyah, S., & Rosenstock, T. S. (2015). Optimal measurement strategies for aboveground tree biomass in agricultural landscapes. *Agroforestry Systems*, 89(1), 125–133. <https://doi.org/10.1007/s10457-014-9747-9>
- LaVerriere, E., Schwabl, P., Carrasquilla, M., Taylor, A. R., Johnson, Z. M., Shieh, M., Panchal, R., Straub, T. J., Kuzma, R., & Watson, S. (2022). Design and implementation of multiplexed amplicon sequencing panels to serve genomic epidemiology of infectious disease: A malaria case study. *Molecular Ecology Resources*, 22(6), 2285–2303. <https://doi.org/10.1111/1755-0998.13622>
- Lee, D. J. (2007). Achievements in forest tree genetic improvement in Australia and New Zealand 2: Development of *Corymbia* species and hybrids for plantations in eastern Australia. *Australian Forestry*, 70(1), 11–16. <https://doi.org/10.1080/00049158.2007.10676256>
- Legarra, A., Aguilar, I., & Misztal, I. (2009). A relationship matrix including full pedigree and genomic information. *Journal of Dairy Science*, 92(9), 4656–4663.
- Legarra, A., & Ducrocq, V. (2012). Computational strategies for national integration of phenotypic, genomic, and pedigree data in a single-step best linear unbiased prediction. *Journal of Dairy Science*, 95(8), 4629–4645. <https://doi.org/10.3168/jds.2011-4982>
- Li, X., Zeng, R., & Liao, H. (2016). Improving crop nutrient efficiency through root architecture modifications. *Journal of Integrative Plant Biology*, 58(3), 193–202.
- Li, Y., Dutkowski, G. W., Apiolaza, L. A., Pilbeam, D., Costa e Silva, J., & Potts, B. (2007). *The genetic architecture of a Eucalyptus globulus full-sib breeding population in Australia.*

- Li, Y., Suontama, M., Burdon, R. D., & Dungey, H. S. (2017). Genotype by environment interactions in forest tree breeding: Review of methodology and perspectives on research and application. *Tree Genetics & Genomes*, *13*(3), 60.
- Lopez, G. A., Potts, B. M., Vaillancourt, R. E., & Apiolaza, L. A. (2003). Maternal and carryover effects on early growth of *Eucalyptus globulus*. *Canadian Journal of Forest Research*, *33*(11), 2108–2115.
- Lourenco, D. A. L., Tsuruta, S., Fragomeni, B. O., Masuda, Y., Aguilar, I., Legarra, A., Bertrand, J. K., Amen, T. S., Wang, L., & Moser, D. W. (2015). Genetic evaluation using single-step genomic best linear unbiased predictor in American Angus. *Journal of Animal Science*, *93*(6), 2653–2662. <https://doi.org/10.2527/jas.2014-8836>
- Lu, P., & Yeh, F. C. (2024). Seedling Growth Responses to Nutrient and Water Treatments Among Jack Pine Open-Pollinated Families. *Forests*, *15*(12), 2062. <https://doi.org/10.3390/f15122062>
- Luo, Y., & Lin, S. (2003). Information gain for genetic parameter estimation with incorporation of marker data. *Biometrics*, *59*(2), 393–401. <https://doi.org/10.1111/1541-0420.00046>
- Makouanzi, G., Bouvet, J.-M., Denis, M., Saya, A., Mankessi, F., & Vigneron, P. (2014). Assessing the additive and dominance genetic effects of vegetative propagation ability in *Eucalyptus*—Influence of modeling on genetic gain. *Tree Genetics & Genomes*, *10*, 1243–1256. <https://doi.org/10.1007/s11295-014-0757-6>
- Malpani, K. (2019). Detecting Outliers for Single Dimensional Data Using Interquartile Range. *Kamlesh Malpni Journal of Engineering Research and Application Wwww.Ijera.Com*, *9*, 31–35. <https://doi.org/10.9790/9622-0909013135>
- Mangi, N., Iqbal, M. S., Shuli, F., Iqbal, M. T., Alharthi, B., Jatoi, G. H., Sarfraz, Z., Ma, Q., & Sun, X. (2024). Empowering cotton breeding programs through the strategic exploration and exploitation of phenotypic diversity of genetic resources under climate change conditions. *Plant Stress*, *13*, 100548. <https://doi.org/10.1016/j.stress.2024.100548>
- Melo, R. C. de, Trevisani, N., Corrêa, S. C., Guidolin, A. F., & Coimbra, J. L. M. (2018). Inheritance of root distribution in common bean and selection strategy. *Crop Breeding and Applied Biotechnology*, *18*, 373–381.
- Meuwissen, T. H. E., Hayes, B. J., & Goddard, M. (2001). Prediction of total genetic value using genome-wide dense marker maps. *Genetics*, *157*(4), 1819–1829. <https://doi.org/10.1093/genetics/157.4.1819>
- Mexal, J. G., & Landis, T. D. (1990). Chapter 3: Target Seedling Concepts: Height

and Diameter. *Target Seedling Symposium: Proceedings, Combined Meeting of the Western Forest Nursery Associations. General Technical Report RM-200, USDA Forest Service, Fort Collins, CO.*

- Miranda, I., & Pereira, H. (2015). Variation of wood and bark density and production in coppiced *Eucalyptus globulus* trees in a second rotation. *iForest-Biogeosciences and Forestry*, 9(2), 270.
- Misztal, I., Aggrey, S. E., & Muir, W. M. (2013). Experiences with a single-step genome evaluation. *Poultry Science*, 92(9), 2530–2534. <https://doi.org/10.3382/ps.2012-02739>
- Misztal, I., Legarra, A., & Aguilar, I. (2009). Computing procedures for genetic evaluation including phenotypic, full pedigree, and genomic information. *Journal of Dairy Science*, 92(9), 4648–4655.
- Molenaar, H., Boehm, R., & Piepho, H.-P. (2018). Phenotypic selection in ornamental breeding: It's better to have the BLUPs than to have the BLUEs. *Frontiers in Plant Science*, 9, 1511. <https://doi.org/10.3389/fpls.2018.01511>
- Monyo, J., & Whittington, W. (1970). Genetic analysis of root growth in wheat. *The Journal of Agricultural Science*, 74(2), 329–338.
- Moreira, G. G., Hakamada, R., Silva, R. M. L. da, Lemos, C. C. Z. de, Florentino, A. L., & Gonçalves, J. L. de M. (2023). Seedling Morphological Characteristics on Survival, Uniformity, and Growth during a Full Short Rotation in *Eucalyptus grandis* × *E. urophylla* Plantation. *Forests*, 14(9), 1756. <https://doi.org/10.3390/f14091756>
- Mphahlele, M. M., Isik, F., Hodge, G. R., & Myburg, A. A. (2021). Genomic breeding for diameter growth and tolerance to *Leptocybe* gall wasp and *Botryosphaeria/Teratosphaeria* fungal disease complex in *Eucalyptus grandis*. *Frontiers in Plant Science*, 12, 638969. <https://doi.org/10.3389/fpls.2021.638969>
- Muñoz, P. R., Resende Jr, M. F., Gezan, S. A., Resende, M. D. V., de Los Campos, G., Kirst, M., Huber, D., & Peter, G. F. (2014). Unraveling additive from nonadditive effects using genomic relationship matrices. *Genetics*, 198(4), 1759–1768.
- Nambiar, E. K. S., Harwood, C. E., & Mendham, D. S. (2018). Paths to sustainable wood supply to the pulp and paper industry in Indonesia after diseases have forced a change of species from acacia to eucalypts. *Australian Forestry*, 81(3), 148–161. <https://doi.org/10.1080/00049158.2018.1482798>
- Netam, U., Sharma, D., Dixit, A., Bargah, A. S., & Rajwade, A. K. (2025). A Comprehensive Review of *Terminalia arjuna* Seedling Growth Dynamics

in Nursery Condition. *Journal of Scientific Research and Reports*, 31(8), 916–926.

- Nyquist, W. E., & Baker, R. (1991). Estimation of heritability and prediction of selection response in plant populations. *Critical Reviews in Plant Sciences*, 10(3), 235–322. <https://doi.org/10.1080/07352689109382313>
- Oliveira, J. A. A., Bruckner, C. H., Silva, D. F. P. da, Santos, C. E. M. dos, Penso, G. A., & Aquino, C. F. (2018). Estimation of genetic parameters and selection for rooting capacity in peach. *Crop Breeding and Applied Biotechnology*, 18(03), 320–324. <https://doi.org/10.1590/1984-70332018v18n3n47>
- Ousmael, K. M., Cappa, E. P., Hansen, J. K., Hendre, P., & Hansen, O. K. (2024). Genomic evaluation for breeding and genetic management in *Cordia africana*, a multipurpose tropical tree species. *BMC Genomics*, 25(1), 9. <https://doi.org/10.1186/s12864-023-09907-z>
- Pace, J., Gardner, C., Romay, C., Ganapathysubramanian, B., & Lübberstedt, T. (2015). Genome-wide association analysis of seedling root development in maize (*Zea mays* L.). *BMC Genomics*, 16(1), 47. <https://doi.org/10.1186/s12864-015-1226-9>
- Papaioannou, A., Kitikidou, K., & Seilopoulos, D. (2011). Factor analysis of nursery seedling data in different compost substrates. *Bulgarian Journal of Agricultural Science*, 17(2), 182–190.
- Paul, A., Foster, G. S., Caldwell, T., & McRae, J. (1997). Trends in genetic and environmental parameters for height, diameter, and volume in a multilocation clonal study with loblolly pine. *Forest Science*, 43(1), 87–98.
- Perry, A., Beaton, J. K., Stockan, J. A., Iason, G. R., Cottrell, J. E., & Cavers, S. (2025). Tree nursery environments and their effect on early trait variation. *Forestry: An International Journal of Forest Research*, cpaf011.
- Petrishchev, E. (2021). *Investigation of the relationship between biometric parameters of Scots pine juvenile seedlings from conditioned seeds when assessing the results of reforestation*. *Forestry Engineering Journal* 11, 14.
- Piepho, H. P., Möhring, J., Melchinger, A. E., & Büchse, A. (2008). BLUP for phenotypic selection in plant breeding and variety testing. *Euphytica*, 161(1–2), 209–228. <https://doi.org/10.1007/s10681-007-9449-8>
- Piñera-Chavez, F., Berry, P., Foulkes, M., Jesson, M., & Reynolds, M. (2016). Avoiding lodging in irrigated spring wheat. I. Stem and root structural requirements. *Field Crops Research*, 196, 325–336.
- Pinto, J. R. (2011). Morphology targets: What do seedling morphological

- attributes tell us? In: Riley, LE; Haase, DL; Pinto, JR, Tech. Coords. National Proceedings: Forest and Conservation Nursery Associations-2010. Proc. RMRS-P-65. Fort Collins, CO: USDA Forest Service, Rocky Mountain Research Station. p. 74-79., 65, 74–79.
- Porfirio, K. D. P., Ribeiro, A., Farias, S. G. G. D., Sousa, T. S. D., Ciccheto, D. F., Barroso, P. A., Santos, F. S. D., Silva, D. Y. B. D. O., & Ferraz Filho, A. C. (2024). Genetic parameters estimated in the early growth of *dimorphandra mollis* benth. Progenies. *Forests*, 15(7), 1184. <https://doi.org/10.3390/f15071184>
- Prasetyo, A., Aiso, H., Ishiguri, F., Wahyudi, I., Wijaya, I. P. G., Ohshima, J., & Yokota, S. (2017). Variations on growth characteristics and wood properties of three *Eucalyptus* species planted for pulpwood in Indonesia. *Tropics*, 26(2), 59–69. <https://doi.org/10.3759/tropics.ms16-15>
- R Core Team. (2025). *R: A Language and Environment for Statistical Computing*. <https://www.gnu.org/copyleft/gpl.html>.
- Raîche, G., Walls, T. A., Magis, D., Riopel, M., & Blais, J.-G. (2013). Non-graphical solutions for Cattell's scree test. *Methodology*. <https://doi.org/10.1027/1614-2241/a000051>
- Ratcliffe, B., El-Dien, O. G., Cappa, E. P., Porth, I., Klápště, J., Chen, C., & El-Kassaby, Y. A. (2017). Single-step BLUP with varying genotyping effort in open-pollinated *Picea glauca*. *G3: Genes, Genomes, Genetics*, 7(3), 935–942.
- Rehfeldt, G. (1992). Early selection in *Pinus ponderosa*: Compromises between growth potential and growth rhythm in developing breeding strategies. *Forest Science*, 38(3), 661–677. <https://doi.org/10.1093/forestscience/38.3.661>
- Rezende, G. D. S. P., de Resende, M. D. V., & de Assis, T. F. (2013). *Eucalyptus* breeding for clonal forestry. In *Challenges and Opportunities for the World's Forests in the 21st Century* (pp. 393–424). Springer. [https://doi.org/10.1007/978-94-007-7076-8\\_16](https://doi.org/10.1007/978-94-007-7076-8_16)
- Ribaski, N. G. (2018). Conhecendo o setor florestal e perspectivas para o futuro. *Brazilian Journal of Animal and Environmental Research*, 1(1), 44–58.
- Ridgeway, G., & Developers, G. B. M. (2024). *gbm: Generalized Boosted Regression Models*. <https://CRAN.R-project.org/package=gbm>
- Ritchie, G. A., & Dunlap, J. R. (1980). Root growth potential: Its development and expression in forest tree seedlings. *NZJ For. Sci*, 10(1), 218–248.
- Roka, P., Shrestha, S., Adhikari, S. P., Neupane, A., Shreepaili, B., & Bista, M. K. (2024). A review on genetic parameters estimation, trait association, and

- multivariate analysis for crop improvement. *Archives of Agriculture and Environmental Science*, 9(3), 618–625.  
<https://doi.org/10.26832/24566632.2024.0903029>
- Rweyongeza, D., Yeh, F., & Dhir, N. (2010). Genetic Parameters for Bud Flushing and Growth Characteristics of White Spruce Seedlings. *Silvae Genetica*, 59(4), 151. <https://doi.org/10.1515/sg-2010-0018>
- Sankaran, K. V., Chacko, K. C., Pandalai, R. C., Kallarackal, J., Somen, C. K., Sharma, J. K., Balagopalan, M., Balasundaran, M., Kumaraswamy, S., & Sankar, S. (2000). Effects of site management on Eucalyptus plantations in the monsoonal tropics—Kerala, India. *Site Management and Productivity in Tropical Plantation Forests: A Progress Report. Center for International Forestry Research, Bogor, Indonesia*, 51–60.
- Scholtens, M., Lopez-Villalobos, N., Lehnert, K., Snell, R., Garrick, D., & Blair, H. T. (2020). Advantage of including genomic information to predict breeding values for lactation yields of milk, fat, and protein or somatic cell score in a New Zealand dairy goat herd. *Animals*, 11(1), 24. <https://doi.org/10.3390/ani11010024>
- Schroeder-Georgi, T., Wirth, C., Nadrowski, K., Meyer, S. T., Mommer, L., & Weigelt, A. (2016). From pots to plots: Hierarchical trait-based prediction of plant performance in a mesic grassland. *Journal of Ecology*, 104(1), 206–218. <https://doi.org/10.1111/1365-2745.12489>
- Seck, W., Torkamaneh, D., & Belzile, F. (2020). Comprehensive genome-wide association analysis reveals the genetic basis of root system architecture in soybean. *Frontiers in Plant Science*, 11, 590740. <https://doi.org/10.3389/fpls.2020.590740>
- Sedio, B. E., Archibold, A. D., Echeverri, J. C. R., Debyser, C., & Wright, S. J. (2019). A comparison of inducible, ontogenetic, and interspecific sources of variation in the foliar metabolome in tropical trees. *PeerJ*, 7, e7536. <https://doi.org/10.7717/peerj.7536>
- Setyaji, T., Sunarti, S., & Nirsatmanto, A. (2016). Early growth and stand volume productivity of selected clones of *Eucalyptus pellita*. *Indonesian Journal of Forestry Research*, 3(1), 27–32. <https://doi.org/10.20886/ijfr.2016.3.1.27-32>
- Shepherd, M., Pomroy, P., Dieters, M., & Lee, D. (2007). Genetic control of propagation traits in a single *Corymbia torelliana* × *Corymbia variegata* family. *Canadian Journal of Forest Research*, 37(12), 2563–2574. <https://doi.org/10.1139/X07-111>
- Simons, A. M., & Roff, D. A. (1994). The effect of environmental variability on the heritabilities of traits of a field cricket. *Evolution*, 48(5), 1637–1649. <https://doi.org/10.1111/j.1558-5646.1994.tb02201.x>

- Siregar, U., Nugroho, A., Shabrina, H., Istikorini, Y., Rahmawati, R., Amin, Y., & Haneda, N. (2021). *Estimation of heritability in three months old sengon (Falcataria moluccana) seedlings at a progeny testing in Kediri, East Jawa, Indonesia.* 800(1), 012043. <https://doi.org/10.1088/1755-1315/800/1/012043>
- Soong, J. L., Janssens, I. A., Grau, O., Margalef, O., Stahl, C., Van Langenhove, L., Urbina, I., Chave, J., Dourdain, A., & Ferry, B. (2020). Soil properties explain tree growth and mortality, but not biomass, across phosphorus-depleted tropical forests. *Scientific Reports*, 10(1), 2302.
- South, D. B., & Mexal, J. G. (1984). *Growing the "best" seedling for reforestation success.*
- Spearman, C. (1904). The proof and measurement of association between two things. *The American Journal of Psychology*, 15(1), 72. <https://doi.org/10.2307/1412159>
- Stape, J. L., Gonçalves, J. L. de M., & Gonçalves, A. N. (2001). Relationships between nursery practices and field performance for Eucalyptus plantations in Brazil. *New Forests*, 22(1), 19–41. <https://doi.org/10.1023/A:1012271616115>
- Strandén, I., & Christensen, O. F. (2011). Allele coding in genomic evaluation. *Genetics Selection Evolution*, 43(1), 25. <https://doi.org/10.1186/1297-9686-43-25>
- Stryjewski, L. (2010). 40 years of boxplots. URL <https://api.semanticscholar.org/CorpusID/36975036>, 21.
- Su, G., Christensen, O. F., Ostensen, T., Henryon, M., & Lund, M. S. (2012). *Estimating additive and non-additive genetic variances and predicting genetic merits using genome-wide dense single nucleotide polymorphism markers.*
- Sumardi, S., Kurniawan, H., & Prastyono, P. (2016). Genetic parameter estimates for growth traits in an Eucalyptus urophylla st Blake progeny test in Timor island. *Indonesian Journal of Forestry Research*, 3(2), 119–127.
- Tajalifar, M., & Rasooli, M. (2022). Importance of BLUP method in plant breeding. *Journal of Plant Science and Phytopathology*, 6(2), 40–42. <https://doi.org/10.29328/journal.jpssp.1001072>
- Tan, B., Grattapaglia, D., Martins, G. S., Ferreira, K. Z., Sundberg, B., & Ingvarsson, P. K. (2017). Evaluating the accuracy of genomic prediction of growth and wood traits in two Eucalyptus species and their F1 hybrids. *BMC Plant Biology*, 17(1), 110. <https://doi.org/10.1186/s12870-017-1059-6>

- Tsagris, M., & Pandis, N. (2021). Multicollinearity. *American Journal of Orthodontics and Dentofacial Orthopedics*, 159(5), 695–696.
- Ukrainetz, N. K., & Mansfield, S. D. (2020). Prediction accuracy of single-step BLUP for growth and wood quality traits in the lodgepole pine breeding program in British Columbia. *Tree Genetics & Genomes*, 16(5), 64.
- Ulusan, M. D. (2008). Broad-sense heritability for seedling characters and its importance for breeding in scots pine. *Süleyman Demirel University Faculty of Arts and Science Journal of Science*, 3(2), 133–138.
- VanRaden, P. M. (2008). Efficient methods to compute genomic predictions. *Journal of Dairy Science*, 91(11), 4414–4423. <https://doi.org/10.3168/jds.2007-0980>
- Verbyla, A. P. (2019). A note on model selection using information criteria for general linear models estimated using REML. *Australian and New Zealand Journal of Statistics*, 61(1), 39–50. <https://doi.org/10.1111/anzs.12254>
- Waldmann, P. (2019). On the use of the Pearson correlation coefficient for model evaluation in genome-wide prediction. *Frontiers in Genetics*, 10, 899.
- Waldy, J., Kershaw Jr, J. A., Weiskittel, A., & Ducey, M. J. (2022). Diameter distribution model development of tropical hybrid Eucalyptus clonal plantations in Sumatera, Indonesia: A comparison of estimation methods. *New Zealand Journal of Forestry Science*, 52.
- Wang, C., Lan, J., Wang, J., He, W., Lu, W., Lin, Y., & Luo, J. (2023). Population structure and genetic diversity in Eucalyptus pellita based on SNP markers. *Frontiers in Plant Science*, 14, 1278427. <https://doi.org/10.3389/fpls.2023.1278427>
- Wani, A., Wani, M., & Bijalwan, A. (2012). Association Analysis for Morphological and Biomass Traits in Albizzia lebbeck Seedlings. *Indian Journal of Plant Genetic Resources*, 25(02), 161–165.
- Wei, T., Simko, V., Levy, M., Xie, Y., Jin, Y., & Zemla, J. (2017). Package ‘corrplot.’ *Statistician*, 56(316), e24.
- Welham, S., Cullis, B., Gogel, B., Gilmour, A., & Thompson, R. (2004). Prediction in linear mixed models. *Australian & New Zealand Journal of Statistics*, 46(3), 325–347.
- Xie, C., & Ying, C. (1996). Heritabilities, age-age correlations, and early selection in lodgepole pine (*Pinus contorta* ssp. *Latifolia*). *Silvae Genetica*, 45, 101–106.
- Xie, Y., Chen, S., Du, A., & Luo, J. (2017). Advances in eucalypt research in

China. *Frontiers of Agricultural Science and Engineering*, 4(4), 380–390.  
<https://doi.org/10.15302/J-FASE-2017171>

Yadav, S., Wei, X., Joyce, P., Atkin, F., Deomano, E., Sun, Y., Nguyen, L. T., Ross, E. M., Cavallaro, T., & Aitken, K. S. (2021). Improved genomic prediction of clonal performance in sugarcane by exploiting non-additive genetic effects. *Theoretical and Applied Genetics*, 134(7), 2235–2252.

Zhang, S.-Y., Olasege, B. S., Liu, D.-Y., Wang, Q.-S., Pan, Y.-C., & Ma, P.-P. (2018). The genetic connectedness calculated from genomic information and its effect on the accuracy of genomic prediction. *PLoS One*, 13(7), e0201400. <https://doi.org/10.1371/journal.pone.0201400>