

## Supplementary Material

**Tab. S1** - General information on 44 publications used for the meta-analysis in the present study.

Country	Reference
Argentina	Faustino et al. (2013)
Argentina	Fernandez et al. (1999)
Argentina	Ibañez et al. (2004)
Brazil	Adam et al. (2021)
Brazil	Batista et al. (2015)
Brazil	Consalter et al. (2021)
Brazil	Hashimoto et al. (2011)
Brazil	Martins et al. (2011)
Brazil	Moro et al. (2014)
Brazil	Paim (2007)
Brazil	Pereira et al. (2022)
Brazil	Pértle et al. (2011)
Brazil	Piva and Dlugosz (2018)
Brazil	Rabel et al. (2021)
Brazil	Rodrigues (2004)
Brazil	Rodriguez et al. (2018)
Brazil	Sass et al. (2020)
Brazil	Schneider (2011)
Brazil	Stahl (2018)
Brazil	Trazzi et al. (2019)
Brazil	Zucon et al. (2020)
USA	Albaugh et al. (1998)
USA	Albaugh et al. (2004)
USA	Albaugh et al. (2008)
USA	Albaugh et al. (2012)
USA	Albaugh et al. (2014)
USA	Albaugh et al. (2017)
USA	Campoe et al. (2013)
USA	Coyle et al. (2008)
USA	Fox et al. (2005)
USA	Lee and Jose (2003)
USA	Maggard et al. (2016)
USA	Maggard et al. (2017)
USA	Maier and Kress (2000)
USA	Moschler et al. (1970)
USA	Piatek & Allen (2000)
USA	Samuelson et al. (2008)
USA	Samuelson et al. (2009)
USA	Sayer et al. (2004)
USA	Schulte et al. (2020)
USA	Scott and Bliss (2012)
USA	Torbert Jr & Burger (1984)
USA	Van Lear (1980)
USA	Vance (2019)

## Supplementary references

- Adam, WM, Rodrigues, VDS, Magri, E, Motta, ACV, Prior, SA, Moraes Zambon, L, Lima, RLD (2021). Mid-rotation fertilization and liming of *Pinus taeda*: growth, litter, fine root mass, and elemental composition. iForest-Biogeosciences and Forestry 14(2): 195-202. <https://doi.org/10.3832/ifor3626-014>
- Albaugh, TJ, Allen, HL, Fox, TR (2008). Nutrient use and uptake in *Pinus taeda*. Tree Physiology 28(7): 1083-1098. <https://doi.org/10.1093/treephys/28.7.1083>
- Albaugh, TJ, Allen, HL, Dougherty, PM, Johnsen, KH (2004). Long term growth responses of loblolly pine to optimal nutrient and water resource availability. Forest Ecology and Management 192(1): 3-19. <https://doi.org/10.1016/j.foreco.2004.01.002>
- Albaugh, TJ, Allen, HL, Dougherty, PM, Kress, LW, King, JS (1998). Leaf area and above-and belowground growth responses of loblolly pine to nutrient and water additions. Forest Science 44(2): 317-328. <https://doi.org/10.1093/forestscience/44.2.317>
- Albaugh, TJ, Allen, HL, Stape, JL, Fox, TR, Rubilar, RA, Price, JW (2012). Intra-annual nutrient flux in *Pinus taeda*. Tree Physiology 32(10): 1237-1258. <https://doi.org/10.1093/treephys/tps082>
- Albaugh, TJ, Fox, TR, Rubilar, RA, Cook, RL, Amateis, RL, Burkhart, HE (2017). Post-thinning density and fertilization affect *Pinus taeda* stand and individual tree growth. Forest Ecology and Management 396: 207-216. <https://doi.org/10.1016/j.foreco.2017.04.030>
- Albaugh, TJ, Kiser, LC, Fox, TR, Allen, HL, Rubilar, RA, Stape, JL (2014). Ecosystem nutrient retention after fertilization of *Pinus taeda*. Forest Science 60(6): 1131-1139. <https://doi.org/10.5849/forsci.13-159>
- Batista, AH, Motta, ACV, Reissmann, CB, Schneider, T, Martins, IL, Hashimoto, M (2015). Liming and fertilisation in *Pinus taeda* plantations with severe nutrient deficiency in savanna soils. Acta Scientiarum, Agronomy 37(1): 117-125. <https://doi.org/10.4025/actasciagron.v37i1.18061>
- Campoe, OC, Stape, JL, Albaugh, TJ, Allen, HL, Fox, TR, Rubilar, R, Binkley, D (2013). Fertilization and irrigation effects on tree level aboveground net primary production, light interception and light use efficiency in a loblolly pine plantation. Forest Ecology and Management 288: 43-48. <https://doi.org/10.1016/j.foreco.2012.05.026>
- Consalter, R, Motta, ACV, Barbosa, JZ, Vezzani, FM, Rubilar, RA, Prior, SA, Nisgoski, S, Bassaco, MVM (2021). Fertilization of *Pinus taeda* L. on an acidic oxisol in southern Brazil: growth, litter accumulation, and root exploration. European Journal of Forest Research 140: 1095-1112. <https://doi.org/10.1007/s10342-021-01390-z>
- Coyle, DR, Coleman, MD, Aubrey, DP (2008). Above-and below-ground biomass accumulation, production, and distribution of sweetgum and loblolly pine grown with irrigation and fertilization. Canadian Journal of Forest Research 38(6): 1335-1348. <https://doi.org/10.1139/X07-231>
- Faustino, LI, Bulfe, NM, Pinazo, MA, Monteoliva, SE, Graciano, C (2013). Dry weight partitioning and hydraulic traits in young *Pinus taeda* trees fertilized with nitrogen and phosphorus in a subtropical area. Tree Physiology 33(3): 241-251. <https://doi.org/10.1093/treephys/tps129>

- Fernandez, RA, Rodríguez Aspíllaga, F, Lupi, AM, Hernández, A, Reis, H (1999). Efectos de diferentes prácticas de preparación del terreno y fertilización sobre el crecimiento inicial del *Pinus* spp en el NE Argentino. Bosque, 20(1): 47-55. <https://doi.org/10.4206/bosque.1999.v20n1-05>
- Fox, TR, Kyle, KH, Andrews, LJ, Aust, WM, Burger, JA, Hansen, GH (2005). Long-term effects of drainage, bedding, and fertilization on growth of loblolly pine (*Pinus taeda* L.) in the Coastal Plain of Virginia. Southern Journal of Applied Forestry 29(4): 205-214. <https://doi.org/10.1093/sjaf/29.4.205>
- Hashimoto, MO (2011). Avaliação de diferentes técnicas de extração de nutrientes do solo e de plantas de *Pinus taeda* L [Evaluation of different techniques for nutrient extraction from soil and plants of *Pinus taeda* L]. Dissertação de mestrado, Departamento de Solos e Engenharia Agrícola, Setor de Ciências Agrárias, Universidade Federal do Paraná, Curitiba, PR, Brazil, pp. 64.
- Ibañez, C, Nuñez, P, Pezzutti, R, Rodríguez, F (2004). Efectos de la roturación del suelo y fertilización con fósforo en el crecimiento inicial de plantaciones de *Pinus taeda*, en suelos rojos del Noreste de la provincia de Corrientes, Argentina [Effects of soil plowing and phosphorus fertilization on the initial growth of *Pinus taeda* plantations, in red soils of the Northeast of the province of Corrientes, Argentina]. Bosque 25(2): 69-76. <http://dx.doi.org/10.4067/S0717-92002004000200007>
- Lee, KH, Jose, S (2003). Soil respiration, fine root production, and microbial biomass in cottonwood and loblolly pine plantations along a nitrogen fertilization gradient. Forest Ecology and Management, 185(3): 263-273. [https://doi.org/10.1016/S0378-1127\(03\)00164-6](https://doi.org/10.1016/S0378-1127(03)00164-6)
- Maggard, AO, Will, RE, Wilson, DS, Meek, CR, Vogel, JG (2016). Fertilization reduced stomatal conductance but not photosynthesis of *Pinus taeda* which compensated for lower water availability in regards to growth. Forest Ecology and Management 381: 37-47. <https://doi.org/10.1016/j.foreco.2016.08.046>
- Maggard, AO, Will, RE, Wilson, DS, Meek, CR, Vogel, JG (2017). Fertilization can compensate for decreased water availability by increasing the efficiency of stem volume production per unit of leaf area for loblolly pine (*Pinus taeda*) stands. Canadian Journal of Forest Research 47(4): 445-457. <https://doi.org/10.1139/cjfr-2016-0422>
- Maier, CA, Kress, LW (2000). Soil CO<sub>2</sub> evolution and root respiration in 11 year-old loblolly pine (*Pinus taeda*) plantations as affected by moisture and nutrient availability. Canadian Journal of Forest Research 30(3): 347-359. <https://doi.org/10.1139/x99-218>
- Martins, IL (2011). Análise nutricional do P em um povoamento de *Pinus taeda* L., submetido a um ensaio de omissão de nutrientes [Nutritional analysis of P in a *Pinus taeda* L. stand submitted to a nutrient omission test]. Dissertação de mestrado, Departamento de Solos e Engenharia Agrícola, Setor de Ciências Agrárias, Universidade Federal do Paraná, Curitiba, PR, Brazil, pp. 90.
- Moro, L, Gatiboni, LC, Simonete, MA, Cassol, PC, Chaves, DM (2014). Resposta de *Pinus taeda* com diferentes idades à adubação NPK no Planalto Sul Catarinense [Response of *Pinus taeda* at different ages to NPK fertilization in the Southern Plateau of Santa Catarina]. Revista Brasileira de Ciência do Solo 38: 1181-1189. <https://doi.org/10.1590/S0100-06832014000400014>

Moschler, WW, Jones, GD, Adams, RE (1970). Effects of loblolly pine fertilization on a Piedmont soil: Growth, foliar composition, and soil nutrients 10 years after establishment. *Soil Science Society of America Journal* 34(4): 683-685. <https://doi.org/10.2136/sssaj1970.03615995003400040039x>

Paim, RM (2007). Efeito do uso de lama de cal e cloreto de potássio no solo, estado nutricional e crescimento do *Pinus taeda* L., sobre Latossolo [Effect of the use of lime mud and potassium chloride in the soil, nutritional status and growth of *Pinus taeda* L., on Oxisol]. Dissertação de mestrado, Departamento de Engenharia Florestal da Universidade Federal do Paraná, Curitiba, PR, Brazil, pp. 123.

Pereira, M, Bassaco, MVM, Motta, ACV, Maeda, S, Prior, SA, Marques, R, Magri, E, Bognola, IA, Gomes, JBV (2022). Influence of industrial forest residue applications on *Pinus taeda*: soil, litter, growth, nutrition, and wood quality characteristics. *New Forests* 1-24 <https://doi.org/10.1007/s11056-021-09902-w>

Pértile, P (2011). Resíduo alcalino da indústria de celulose em solos ácidos e área degradada [Alkaline residue from the cellulose industry in acid soils and degraded area.]. 2011. Dissertação (Mestrado em Manejo do Solo) - Universidade do Estado de Santa Catarina. Programa de Pós-Graduação em Ciências Agrárias, Lages, SC, Brazil, pp. 106.

Piatek, KB, Allen, HL (2000). Site preparation effects on foliar N and P use, retranslocation, and transfer to litter in 15-year old *Pinus taeda*. *Forest Ecology and Management* 129(1-3): 143-152. [https://doi.org/10.1016/S0378-1127\(99\)00150-4](https://doi.org/10.1016/S0378-1127(99)00150-4)

Piva, T, Dlugosz, F (2018). Adubação de cobertura na cultura do *Pinus taeda* com diferentes dosagens de nitrogênio [Cover fertilization in the *Pinus taeda* crop with different nitrogen dosages]. *Tech & Campo* 1(1): 48-60.

Rabel, DDO, Maeda, S, Araujo, EM, Gomes, JB, Bognolla, IA, Prior, SA, Magri, E, Frigo, C, Brasileiro, BP, Santos, MC, Pedreira, GQ, Motta, ACV (2021). Recycled alkaline paper waste influenced growth and structure of *Pinus taeda* L. forest. *New Forests* 52: 249-270. <https://doi.org/10.1007/s11056-020-09791-5>

Rodrigues, CM (2004). Efeito da aplicação de resíduos da indústria de papel e celulose nos atributos químicos, físicos e biológicos do solo, na nutrição e biomassa do *Pinus taeda* L [Effect of the application of residues from the pulp and paper industry on the chemical, physical and biological soil attributes, nutrition and biomass of *Pinus taeda* L]. Dissertação de mestrado, Departamento de Solos e Engenharia Agrícola, Setor de Ciências Agrárias, Universidade Federal do Paraná, Curitiba, PR, Brazil, pp. 121.

Rodriguez, DRO, de Castro Andrade, G, Bellote, AFJ, Tomazello-Filho, M (2018). Effect of pulp and paper mill sludge on the development of 17-year-old loblolly pine (*Pinus taeda* L.) trees in Southern Brazil. *Forest Ecology and Management* 422: 179-189. <https://doi.org/10.1016/j.foreco.2018.04.016>

Samuelson, LJ, Farris, MG, Stokes, TA, Coleman, MD (2008). Fertilization but not irrigation influences hydraulic traits in plantation-grown loblolly pine. *Forest Ecology and Management*, 255(8-9): 3331-3339. <https://doi.org/10.1016/j.foreco.2008.02.014>

Samuelson, L, Mathew, R, Stokes, T, Feng, Y, Aubrey, D, Coleman, M (2009). Soil and microbial respiration in a loblolly pine plantation in response to seven years of irrigation and fertilization. *Forest Ecology and Management* 258(11): 2431-2438. <https://doi.org/10.1016/j.foreco.2009.08.020>

- Sass, AL, Bassaco, MVM, Motta, ACV, Maeda, S, Barbosa, JZ, Bognola, IA, Bosco, JVG, Goularte, GD, Prior, SA (2020). Cellulosic industrial waste to enhance *Pinus taeda* nutrition and growth: a study in subtropical Brazil. *Scientia Forestalis* 48(126): e3165. <https://doi.org/10.18671/scifor.v48n126.13>
- Sayer, MS, Goelz, JCG, Chambers, JL, Tang, Z, Dean, TJ, Haywood, JD, Leduc, DJ (2004). Long-term trends in loblolly pine productivity and stand characteristics in response to thinning and fertilization in the West Gulf region. *Forest Ecology and Management* 192(1): 71-96. <https://doi.org/10.1016/j.foreco.2004.01.006>
- Schneider, T (2011). Crescimento e teores de B, Cu, Mn, Fe e Zn em *Pinus taeda* L, como resultado da adubação e calagem sob a técnica da omissão de nutrientes [Growth and levels of B, Cu, Mn, Fe and Zn in *Pinus taeda* L, as a result of fertilization and liming under the nutrient omission technique]. Dissertação de mestrado, Departamento de Solos e Engenharia Agrícola, Setor de Ciências Agrárias, Universidade Federal do Paraná, Curitiba, PR, Brazil, pp. 51.
- Schulte, ML, Cook, RL, Albaugh, TJ, Allen, HL, Rubilar, RA, Pezzutti, R, Caldato, SL, Campoe, O, Carter, DR (2020). Mid-rotation response of *Pinus taeda* to early silvicultural treatments in subtropical Argentina. *Forest Ecology and Management* 473: 118317. <https://doi.org/10.1016/j.foreco.2020.118317>
- Scott, DA, Bliss, CM (2012). Phosphorus fertilizer rate, soil P availability, and long-term growth response in a loblolly pine plantation on a weathered ultisol. *Forests* 3(4): 1071-1085. <https://doi.org/10.3390/f3041071>
- Stahl, J (2018). Estratégias silviculturais de manejo da adubação para povoamentos de *Pinus taeda* L. no planalto sul catarinense e na região de Telêmaco Borba, Paraná [Fertilization management silvicultural strategies for *Pinus taeda* L. stands in the southern plateau of Santa Catarina and in the region of Telêmaco Borba, Paraná]. Tese de doutorado, Departamento de engenharia florestal, Setor de Ciências Agrárias, Universidade Federal do Paraná, Curitiba, PR, Brazil, pp. 101.
- Torbert Jr, JL, Burger, JA (1984). Long-term availability of applied phosphorus to loblolly pine on a Piedmont soil. *Soil Science Society of America Journal*, 48(5): 1174-1178.  
<https://doi.org/10.2136/sssaj1984.03615995004800050044x>
- Trazzi, PA, Santos, JAD, Caldeira, MVW, Roters, DF, Carvalho, D, Dobner, M (2019). Initial growth of *Pinus taeda* by fertilization response at planting. *Floresta e Ambiente* 26(1): e20180370,  
<https://doi.org/10.1590/2179-8087.037018>
- Van Lear, DH (1980). Effects of nitrogen, phosphorus, and lime on the forest floor and growth of pole-size loblolly pine. *Soil Science Society of America Journal* 44(4): 838-841.  
<https://doi.org/10.2136/sssaj1980.03615995004400040036x>
- Vance, CL (2019). Using poultry litter ash as a fertilizer source for bermudagrass (*Cynodon dactylon*) establishment and loblolly pine (*Pinus taeda*) plantation. Doctoral Dissertations, Louisiana State University and Agricultural & Mechanical College, USA, pp.81.  
[https://digitalcommons.lsu.edu/gradschool\\_dissertations/5099](https://digitalcommons.lsu.edu/gradschool_dissertations/5099)
- Zucon, A, Dominche, R, Motta, ACV (2020) Can fertilization and liming affect the amount of litter and roots on *Pinus taeda* forest floor? *Scientia Forestalis* 48(128): e3193, <https://doi.org/10.18671/scifor.v48n128.21>

