Scientific Electronic Archives
Issue ID: Sci. Elec. Arch. Vol. 16 (9)
September 2023
DOI: http://dx.doi.org/10.36560/16920231780
Article link: https://sea.ufr.edu.br/SEA/article/view/1780

ISSN 2316-9281

Influence of controlled release fertilizer on the production of *Enterolobiumschomburgkii* (Benth.)

Thiago José Lavareda Lima
Universidade Federal do Acre

Cleverson Agueiro de Carvalho
Universidade Federal do Acre

Correspondingauthor
Márcio Chaves da Silva
Universidade Federal do Acre
m.chaves2019@hotmail.com

Bárbara Barbosa Mota
Universidade Federal do Acre

Márcia Chaves da Silva
Universidade Federal do Acre

Roger Ventura Oliveira
Universidade Federal do Acre

Regina Lúcia Felix Ferreira
Universidade Federal do Acre

Abstract. The forest species *Enterolobiumschomburgkii* Benth. It is a fast-growing legume with potential for use in plantations and recovery of degraded areas. Thus, knowing the nutritional demands of this species in the seedling formation stage is essential for the success of its implantation in the field. Therefore, the objective of this work is to evaluate the development of seedlings of *E. schomburgkii Benth*. with the application of controlled release fertilizer doses. The experiment was carried out at the seedling production nursery of the Technology Foundation of the State of Acre, from May to September 2022. The experimental design used was completely randomized, with 8 treatments and 10 replications. The treatments were at different doses of controlled release fertilizer, as follows: T1 = 0 g/L^{-1}; T2 = 2 g/L^{-1}; T3 = 4 g/L^{-1}; T4 = 6 g/L^{-1}; T5 = 8 g/L^{-1}; T6 = 10 g/L^{-1}; T7 = 12 g/L^{-1} and T8 = 14 g/L^{-1}. The morphological parameters evaluated were the stem diameter (DC) and height (H) of the seedlings, carried out 120 days after sowing. The use of a dose of 6 g/L-1 of controlled release fertilizer indicates optimization of the production of *Enterolobium schomburgkii* seedlings.

Keywords: Seedling nutrition. Forest Species. Recovery of degraded areas.

Introduction

In Brazil, deforestation is one of the main environmental problems to be fought, aiming to reach signed agreements regarding the protection of the environment. The Amazon region is the center of this problem and with greater visibility, where it is observed that in the last decade an increase in illegal activities of exploitation of natural resources, resulting in social, economic and environmental damage (Castelo et al., 2018; Copertino et al., 2019; Maurano et al., 2019).

The result of deforestation is the emergence of degraded areas, mainly a consequence of the disturbances caused in the biological, hydrological, atmospheric and geological interactions of the soil, leading to the loss of the natural capacity for regeneration. Therefore, the need to carry out interventions aimed at recovering the environment is necessary, and one of the most used techniques for this purpose is the regeneration of these places, with ecological succession being one of these methods, simple and low cost, which uses plantations to the natural restructuring of the area (Gomes; Fobris, 2019; Lima et al., 2020).

In the initial phase of the regeneration process, it is essential to use quality seedlings with the maximum capacity to survive the local characteristics. Species of the fabaceae family are an option for regeneration, especially trees and shrub species, since they have important characteristics for revegetation projects, as they grow fast and provide organic matter, increasing amounts of carbon and nutrients in the soil (Rodrigues et al., 2020; Silva Dantas et al., 2021).

Thus, the forest species *Enterolobium schomburgkii* Benth., belonging to the fabaceae family, is an option to be considered in the recovery of degraded areas, observing its high tolerance to poor soils, ability to establish symbiotic relationships with soil-fixing rhizobacteria nitrogen and thus enable the regeneration and conduction of other species in the area. In addition, the wood of this species has a high economic value and may be a source of cushioning the costs of implantation of planting (Junior, 2019; Costa, 2022).

Currently, controlled release fertilizers - CRF are among the main tools to meet the need for macro and micro nutrients of the seedlings, mainly during the nursery stage, since this product makes nutrients available for a longer period than conventional fertilizers, as it has a lower leaching tendency, thus enabling a reduction in operating costs in the stage (Souza et al., 2020; Oliveira et al., 2021; Santos et al., 2021).

In this way, developing techniques aimed at producing high-quality seedlings and promoting the available information are essential, especially for the establishment of plantations. Therefore, the objective of this work is to evaluate the development of seedlings of *E. schomburgkii Benth*. with the application of controlled release fertilizer doses.

Methods

The experiment was carried out in the seedling nursery production of the Fundação de Tecnologia do Estado do Acre, located in the municipality of Rio Branco, Acre, from May to September 2022. The climate of the region is classified according to Köppen as type Am, with an annual average temperature of 25.5°C, average rainfall of 2200 mm and relative humidity of 82% (Climate-data, 2022).

Seeds for the production of seedlings of *E. schomburgkii* Benth. were collected from matrices located in the Zoobotanical Park of the Federal University of Acre, with central coordinates 67° 52' 14” and 9° 52' 14”. In the germination process, the tegumentary dormancy of the seeds was broken using the topping technique, making a cut on the opposite side of the radicle emission to expose a small part of the cotyledons and facilitate gas exchanges (Souza; Varela, 1989).

Sowing was carried out in polypropylene trays, using a commercial substrate. After germination and selection of the seedlings, they were transplanted into non-toxic polypropylene tubes measuring 5 cm in diameter, 18 cm in height and volume of 180 cm³, filled with commercial substrate, with vermiculite composition, coal dust, phenolic foam and bark, bio-stabilized pinus, manually adding fertilizer doses.

After the transplanting stage, the tubes were accommodate in plastic trays under benches in the nursery, suspended at a height of 1.0 m, arranged in rows, leaving a space between rows. The irrigation performed was of the sprinkler type, lasting 10 minutes, twice a day.

The experimental design was complete randomized, with 8 treatments and 10 replications, totaling 80 sample units. The treatments consisted of eight different concentrations of controlled release fertilizer (Basacote® Plus 6M, N-P-K composition of 16-8-12), with the treatments being: T1 = 0 g/L^{-1}; T2 = 2 g/L^{-1}; T3 = 4 g/L^{-1}; T4 = 6 g/L^{-1}; T5 = 8 g/L^{-1}; T6 = 10 g/L^{-1}; T7 = 12 g/L^{-1} and T8 = 14 g/L^{-1}.

The controlled release fertilizer presented a composition of macronutrients with 16% nitrogen (N), 8.0% neutral ammonium citrate and water-soluble phosphate (P2O5) and 12% water-soluble potassium oxide (K2O), 2.0% total magnesium oxide (MgO), 5.0% total sulfur (S), 0.02% boron (B), 0.05% copper (Cu), 0.4% iron (Fe), 0.06% manganese (Mn), 0.015% molybdenum (Mo) and 0.02% zinc (Zn).

The chemical composition of the commercial substrate was carried out by the Laboratory of Soil and Plant Analysis of the Instituto Agronômico de Campinas, the result being: pH 5.6, humidity 39.6% m/m, total porosity 85.4% v /v with 4.0 g/kg N, 2.5 g/kg P, 6.9 g/kg K, 10.4 g/kg calcium (Ca), 14.1 g/kg magnesium (Mg), 3.9 g/kg S, 10.7 g/kg Fe, 0.5 g/kg Mn, 114.6 mg/kg B, 29.7 mg/kg Cu and 190 .7 mg/kg of Zn.

Biometric measurements of height (H) and collar diameter (CD) were performed 120 days after sowing. The height was performed with the aid of a ruler graduated in cm, where the starting point of the measurements was the transition of the root and the collar, and the final point of the measurement was the apical bud. The measurement of the diameter of the collar was obtained using a digital caliper, considering the transition between the root and the area for measurement.

The data were submitted to verification of outliers by Grubbs’ test (1969), normality of residuals by Shapiro-Wilk test (1965) and homogeneity of variances by the Bartlet test (1937). After analyzing the assumptions, analysis of variance was performed using the F test at 5% significance. Noting the significance, regression analyzes were performed. Statistical analyzes were performed using the open source program R.

Results and discussion

There was a significant effect ($p<0.05$) of controlled release fertilizer concentrations on the variables evaluated in *Enterolobium schomburgkii* seedlings (Table 1). Therefore, there was influence on the development of the seedlings for the variable height (H) and diameter (CD).

Table 1. Summary of statistical analysis for height (H) and stem diameter (DC) of E. schomburgkii seedlings at different concentrations of controlled-release fertilizer

Source of Variation	DF	Middle Square	
		H	CD
Concentration	7	23.2194*	0.3171*
Residuals	72	1.4744	0.0719
CV (%)	-	10.63%	17.62%

DF - Degrees of freedom; * significant at the 5% probability level ($p<0.05$).

The concentrations of 6 g/L^{-1} and 8 g/L^{-1} showed superior performance for the variables evaluated in the development of seedlings, with 12.52 cm in height and 12.78 mm in diameter, while the control (0 g/L^{-1}) had the lowest average.

Increasing the dose from g/L-1 did not result in greater growth in height, with seedlings with less development, indicating the treatment with the use of 8 g/L-*1* of controlled release fertilizer as the maximum efficiency for this characteristic (Figure 1). Oliveira et al. (2021) when studying the influence of CRF on the initial development of *Parkia gigantocarpa* Ducke seedlings obtained similar results. Noting that the greatest increase in height was expressed at this dosage, showing a reduction in growth at higher doses of fertilizer.

Menegatti et al. (2017) testing seedling formation of *Aspidosperma parvifolium* A. DC. in different combinations of hydrogel with the use of controlled release fertilizer, observed that growth is directly linked to the increase in the fertilizer dose, with an increase occurring in the range of 0-8 g/L^{-1}.

The stem diameter (CD) responded positively to the presence of controlled release fertilizer, with higher averages and growth at doses of 8 g/L^{-1} and 10 g/L^{-1}, as well as growth in height. However, the growth in diameter only accompanies the intensification of the dosage of up to 8 g/L^{-1}, with a dose of 14 g/L^{-1} showing similar results to the control treatment, in which it did not receive a dose of fertilizer (Figure 2).

Silva et al. (2019) verified highest averages for diameter in the development of seedlings of the legume *Inga heterophylla* Willd with the application of controlled release fertilizer of the Osmocote® for the dose range between 4 and 8 g/L^{-1} exhibiting that at higher doses a smaller average for the diameter and thus a smaller development.

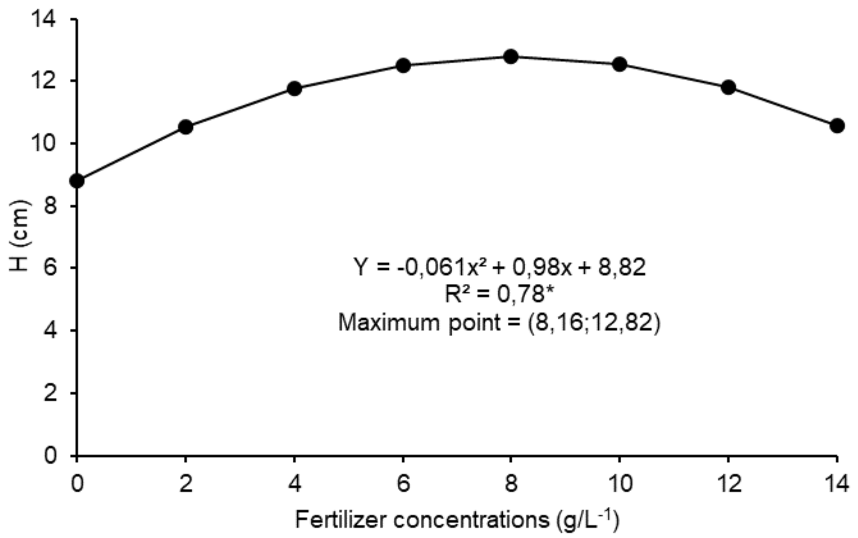

Figure 1. Height (H) of *Enterolobium schomburgkii* seedlings in controlled-release fertilizer concentrations. Rio Branco, Acre, 2023

In the work carried out by Dutra et al. (2017) with the species *Peltophorum dubium* (Spreng.), the maximum point of increment for the collar diameter corresponded to the dosage of 5 g/L^{-1}, with lower growth means for this variable. The lower performance can be explained by the difference in the formulations of the agents used, observing that in the species I. heterophylla Willd, the formulation of N-P-K was 15-09-12 and for P. dubium (Spreng.) it was 06-19-10.

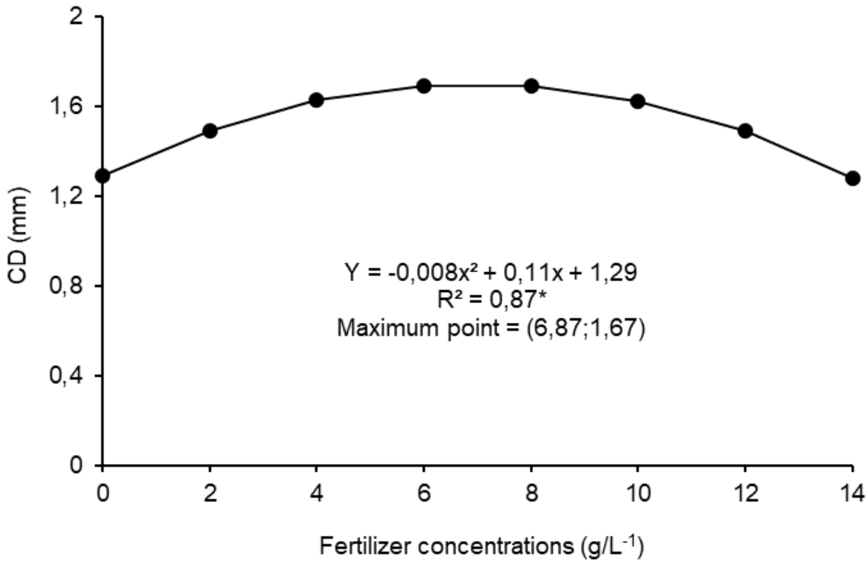

Figure 2. Collet diameter (CD) in Enterolobiumschomburgkii seedlings in controlled release fertilizer concentrations. Rio Branco, Acre, 2023

The growth behavior using the fertilizer dosage applied in the seedling production phase is very important in the formation of quality seedlings. The result of an optimal dosage for the use of controlled release fertilizer at this stage maybe related to the antagonistic effect of nutrients that are saturated in that medium, resulting in high quality seedlings.

For Taiz et al., (2017), this behavior is classified into zones, where the deficiency zone corresponds to the first phase, the adequate zone is where the addition of nutrients does not translate into increased growth and/or productivity, and the the last is the toxic zone, in which the decline of these factors occurs.

According to Costa (2014), the nutrients required by plants can trigger deficiencies both in their low availability and in their excessive concentration, occurring through the interaction between the elements released by fertilizers, with the potential to interfere directly and indirectly in the development of plants. Seedlings, with the direct effects caused by the toxicity of the high presence of the nutrient and the indirect ones when this presence inhibits or interferes with the absorption of other nutrients.

The excess of nitrogen in the form of NH4, calcium (Ca) and potassium (K) affects the absorption of magnesium (Mg), an essential micronutrient, where its deficiency causes reduced growth and loss of vigor. The presence of too much phosphorus (P) can cause manganese (Mn) deficiency, which can also result in reduced seedling development. In addition to these indirect effects, the accumulation of nitrogen and copper (Cu) can directly cause this reduction in the growth rate (Faquin, 2005; Barros, 2020).

The characteristic observed with imbalance in the supply of nitrogen (N), P and/or K is the reduction or stagnation of vegetative growth, observing the functions that these macronutrients perform in the plant physiological system. N is an element required in large quantities because it is an important member of several cellular components such as nucleic acids, chlorophyll and amino acids, so its main impact is on growth, in relation to phosphorus, which participates in energy storage processes (Taiz et al. al., 2017).

Conclusion

Application of a dosage of 6 g/L-1 of controlled release fertilizer provides optimization of *Enterolobium schomburgkii* Benth seedlings.

Acknowledgments

To the seedling, production nursery of the Fundação de Tecnologia do Estado do Acre for the support and space granted to carry out this research.

References

BARROS, J. Fertilidade do solo e nutrição das plantas. 2020. 10p.

BARTLETT, M. S. Properties of sufficiency and statistical tests. Proceedings of the Royal Society of London, v. 160A, n. 901, p. 268-282, 1937.

CASTELO, T. B.; ADAMI, M.; ALMEIDA, C. A.; DE ALMEIDA, O. T. Governos e mudanças nas políticas de combate ao desmatamento na Amazônia. Revibec: revista de laRed Iberoamericana de Economia Ecológica, v. 28, p. 0125-148, 2018.

CLIMATE-DATA. ORG. Dados climáticos para cidades mundiais. 2022. Disponível em: www.clima/Rio Branco: Temperatura, Tempo e

Dados climatológicos Rio Branco - Climate-Data.org. Acesso em: 4 de abril de 2022.

COPERTINO, M.; PIEDADE, M. T. F.; VIEIRA, I. C. G.; BUSTAMANTE, M. Desmatamento, fogo e clima estão intimamente conectados na Amazônia. Ciência e Cultura, v. 71, n. 4, p. 4-5, 2019.

COSTA, A. R. Nutrição Mineral de Plantas Vasculares. Escola de Ciências e Tecnologia da Universidade de Évora, Portugal. 2014. 147 p.

COSTA, J. M. Seleção de espécies estruturantes para a restauração florestal em uma unidade de conservação. Orientador: Rafael de Paiva Salomão. 2022. 231p. Dissertação (Mestrado em Ciências Biológicas) - Universidade Federal Rural da Amazônia e ao Museu, Paraense Emílio Goeldi, Belém, 2022.

DUTRA, T. R.; MASSAD, M. D.; SARMENTO, M. F. Q.; MATOS, P. S.; DE OLIVEIRA, J. C. Fertilizante de liberação lenta no crescimento e qualidade de mudas de canafístula (*Peltophorumdubium* (Spreng.) Taub.). Floresta, v. 46, n. 4, p. 491-498, 2017.

FAQUIN, V. Nutrição mineral de plantas Lavras: ESAL/FAEPE, 1994. 227p.

GOMES, S. H. M.; GONÇALVES, F. B.; FERREIRA, R. A.; PEREIRA, F. R. M.; DE JESUS RIBEIRO, M. M. Avaliação dos parâmetros morfológicos da qualidade de mudas de *Paubrasiliaechinata* (pau-brasil) em viveiro florestal. Scientia Plena, v. 15, n. 1, 2019.

GRUBBS, F. E. Procedures for detecting outlying observations in samples. Technometrics, v. 11, n. 1, p. 1-21, 1969.

JUNIOR, E. A. A. Vigor de sementes de *Enterolobiumschomburgkii*Benth por meio do teste de envelhecimento acelerado. 2019. 39p. Trabalho de Conclusão de Curso (Bacharelado em Engenharia Florestal) - Universidade Federal do Acre, Acre, 2019.

LIMA, M. T.; TONELLO, K. C.; LEITE, E. C.; FRANCO, F. S.; CORRÊA, C. J. P. Dinâmica da recuperação ambiental de pilhas de estéril em mineração de calcário por regeneração natural. Engenharia Sanitaria e Ambiental, v. 25, p. 11-19, 2020.

MAURANO, L. E. P.; ESCADA, M. I. S.; RENNO, C. D. Padrões espaciais de desmatamento e a estimativa da exatidão dos mapas do PRODES para Amazônia Legal Brasileira. Ciência florestal, v. 29, p. 1763-1775, 2019.

MENEGATTI, R. D.; NAVROSKI, M. C.; GUOLLO, K.; FIOR, C. S.; SOUZA, A. G.; POSSENTI, J. C. Formação de mudas de guatambu em substrato com hidrogel e fertilizante de liberação controlada. Revista Espacios, v. 38, n. 22, p. 35-47, 2017.

OLIVEIRA, V. P.; MENDES, R. S.; MARTINS, W. B. R.; DOS SANTOS, E. A.; DE ARAÚJO, D. G.; GAMA, M. A. P. Desenvolvimento e qualidade de mudas de *Parkiagigantocarpa*Ducke (Fabaceae) em função de fertilizante de liberação controlada. Scientia Plena, v. 17, n. 9, 2021.

RODRIGUES, A. B. M.; GIULIATTI, N. M.; JÚNIOR, A. P. Aplicação de metodologias de recuperação de áreas degradadas nos biomas brasileiros. Brazilian Applied Science Review, v. 4, n. 1, p. 333-369, 2020.

SANTOS, F. D.; WEILER, E. B.; FANTINEL, R. A.; CRUZ, J. C. Crescimento de mudas de açoita-cavalo (*Lueheadivaricata* Mart. &Zucc.) sob diferentes doses de adubação, em viveiro Growth of açoita-cavalo seedlings (Lueheadivaricata Mart. &Zucc.) under different doses of fertilization, in nursery. Brazilian Journal of Development, v. 7, n. 6, p. 63924-63932, 2021.

SHAPIRO, S. S.; WILK, M. B. An analysis of variance test for normality (complete samples). Biometrika, v. 52, n. 3/4, p. 591-611, 1965.

SILVA DANTAS, J. A.; DO CARMO RODRIGUES, A. C.; ALVES, L. B.; QUEIRES, L. C. S.; ORGE, M. D. R.; SANTOS, E. L.; SILVA, W. S. Avaliação do potencial de germinação de sementes de duas espécies, exótica e nativa, de Fabaceae como estratégia de colonização em ambiente degradado. Research, Society andDevelopment, v. 10, n. 8, p. e4120816038-e4120816038, 2021.

SILVA, E. J.; SENADO, J. A.; DA SILVA, Á. E.; GAMA, M. A.; OHASHI, S. T.; DE SOUZA, G. M.; MINERAÇÃO PARAGOMINAS, S. A. (2019). Growth and quality of *Inga heterophylla* Willd seedlings according to the slow release fertilizer. Journal of Agricultural Science, v. 11, n. 5, p. 479-484, 2019.

SNEDECOR, G. W.; COCHRAN, W. G. Statistical methods. Ames: Iowa State University Press, 1948. 503p.

SOUZA, A. C.; GAMA, M. A. P.; ARAÚJO, D. G.; SILVA, G. P.; SENADO, J. A. V. Growth and quality of *Handroanthusheptaphyllus* (Vell.) Mattos. seedlings as a function of controlled release fertilizer doses. Revista Sustinere, v. 8, n. 1, p. 124-136, 2020.

SOUZA, S. G. A. de; VARELA, V. P. Tratamentos pré-germinativos em sementes de Faveira-orelha-de-macaco (*Enterolobiumschomburgkii*Benth). Acta Amazonica, v. 19, p. 19-26, 1989.

TAIZ, L.; ZEIGER, E. Fisiologia e Desenvolvimento Vegetal, 6 ed. Porto Alegre: Artmed, 2017. 888p.