ARE THERE GERMINATION PATTERNS FOR CERRADO SPECIES?

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Summary

Fragmentation and degradation of the cerrado Biome has stimulated the researchers to ask some questions. Are the species of the remaining original areas able to produce viable and vigorous seeds? Are the seeds produced by these plants able to germinate according to their natural rhythm, associated with the climatic seasonality of the region? Are there germination and emergence seedling patterns for these species? Trying to answer these questions, 49 tree species belonging to 20 families, 10 pioneers, 18 early secondary, 15 late secondary, and six without classification because they occur in savanna formations were studied in relation to the germination and seedling emergence processes. At the end of the dry season and during the first months of the wet season, seeds of the anemochorous species predominate in the environment and during the wet season several zoochorous species disperse their seeds. About 113 000 seeds from individuals occurring in gallery, deciduous, and semi-deciduous forests of the Araguari River Valley, Minas Gerais, Brazil were studied. Seeds with water content from 10 to 19.9% were the dominant class, most of them anhydrobiotic seeds. Near 24% of the species presented seeds with water content above 50%, most of them non-anhydrobiotic seeds. About 67% of the studied species have seeds with some type of dormancy, predominantly mechanical and relative dormancy. The mean germination or emergence time ranged from 1-4 to 201-231 days. Most of the studied species presented seeds with high quality, with more then 80% of germinability or seedling emergence. A few

species presented seeds with the germination and emergence processes synchronized, such as *Inga laurina*, *I. sessilis*, and *Tapirira guianensis*. Asynchrony was the predominant characteristic due to the dormancy of seeds and the time from the first to the last germination ranged from 1 (*Inga laurina* seeds) to 476 days (*Trema micrantha* seeds). The germination and emergence patterns are associated with dormancy or non-dormancy condition, independent of the fruiting period and about 85.4% of the studied species have seeds germinating in synchrony with the water rhythm of the cerrado Biome.

1. Introduction

The cerrado *sensu lato* is the second largest Brazilian ecoregion, with about 2 000 000 km^2 that represent 23% of the area of Brazil. This ecosystem is one of the most threatened on Earth and was included in the biodiversity hotspots list of Conservation International (2005) due to it having the highest plant diversity of all tropical savanna regions (6429 vascular species as at 1998, and nearly 12 000 in more recent floristic surveys), high level of endemism (about 44% for vascular plants) and, unfortunately, being subject to fragmentation and degradation due to urbanization and agricultural expansion (3% per year). The original and the actual green area of this biome are presented in Figures 1 and 2. About 20% of this area remains in a natural or little disturbed condition and by 1998, less than 1.5% was protected in conservation areas. Currently, 2.61% of the cerrado region is included in conservation areas, 1.75% in areas of sustainable use, and 0.04 in Private Reserves (RPPN - Reserva Particular do Patrimônio Natural).

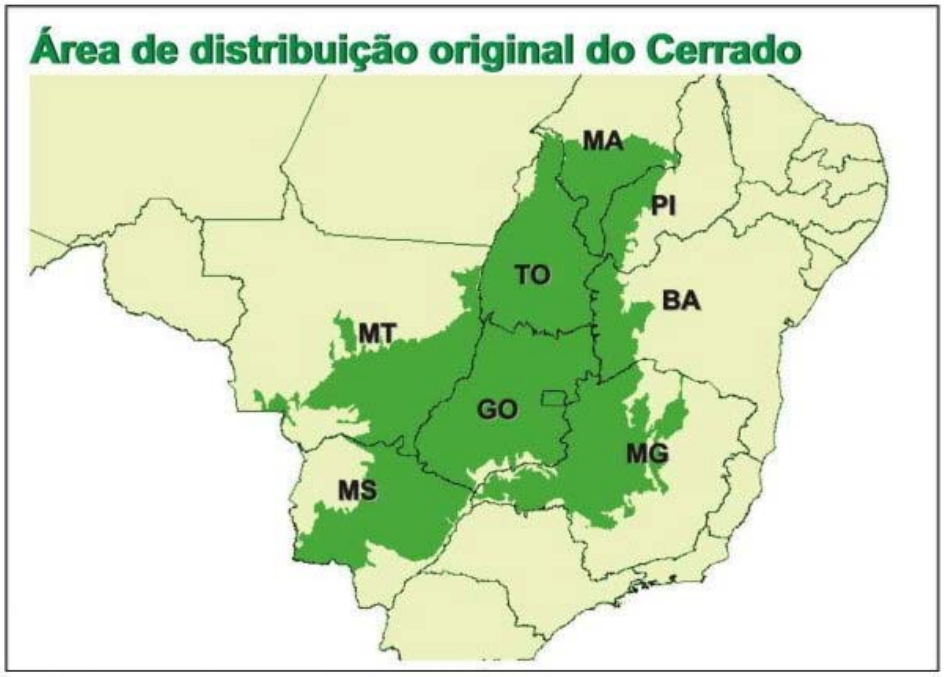

Figure 1. Original green area of the Brazilian cerrado biome.

About 57% of the original green area of the Brazilian cerrado biome has been destroyed and the remaining areas are seriously threatened (Figure 2).

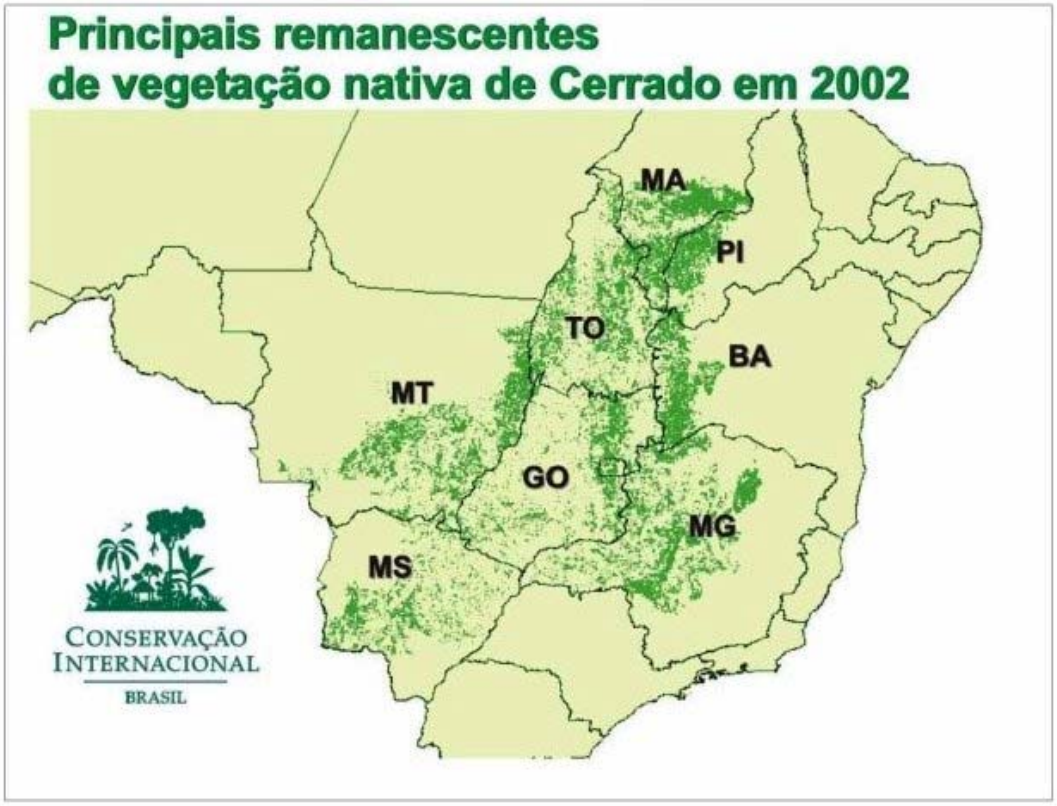

Figure 2. Main native vegetation remnants of the Brazilian cerrado biome in 2002.

There are eight main hydrographic basins in Brazil, and the upper sources of six of them are in the cerrado region, including the Amazonian basin with Xingu, Madeira, and Trombetas rivers; Tocantins basin with Araguaia and Tocantins rivers; North/Northeastern Atlântico basin with Parnaíba and Itapecuru rivers; São Francisco basin with São Francisco, Pará, Paraopeba, das Velhas, Jequitaí, Paracatu, Urucuia, Carinhanha, Corrente, and Grande rivers; East Atlântico basin with Pardo and Jequitinhonha rivers, and finally the Paraná basin with Paranaíba, Grande, Sucuriú, Verde, Pardo, Cuiabá, São Lourenço, Taquari, Aquidauana rivers among others (Figure 3).

The cerrado is therefore essential for water supply to a very large area and it represents a very important ecological corridor that needs to be protected to preserve its water resources, animal and plant biodiversity. The local population need a systemic vision to make the practice of its sustainable use possible.

The cerrado region includes several different physiognomic vegetation forms:

- Mesophytic forests (semi-deciduous, deciduous and gallery forests);
- Dystrophic cerradão (dense cerrado with almost closed woodland and sparse or absent herbaceous layer);
- Mesotrophic cerradão (dense cerrado, with almost closed woodland with higher soil fertility than the dystrophic cerradão);
- Dense cerrado (with plant density less than the above),

- Cerrado *sensu stricto* (closed vegetation dominated by trees and shrubs with discontinuous canopy and dense herbaceous stratus between them);
- Campo cerrado (closed field with sparse trees and shrubs, and a large area of grassland);
- Campo sujo (dirty field, i.e. grassland with scattering of shrubs and trees);
- Campo limpo or campo úmido (clean field or wet grassland), and
- Veredas (palm swamp).

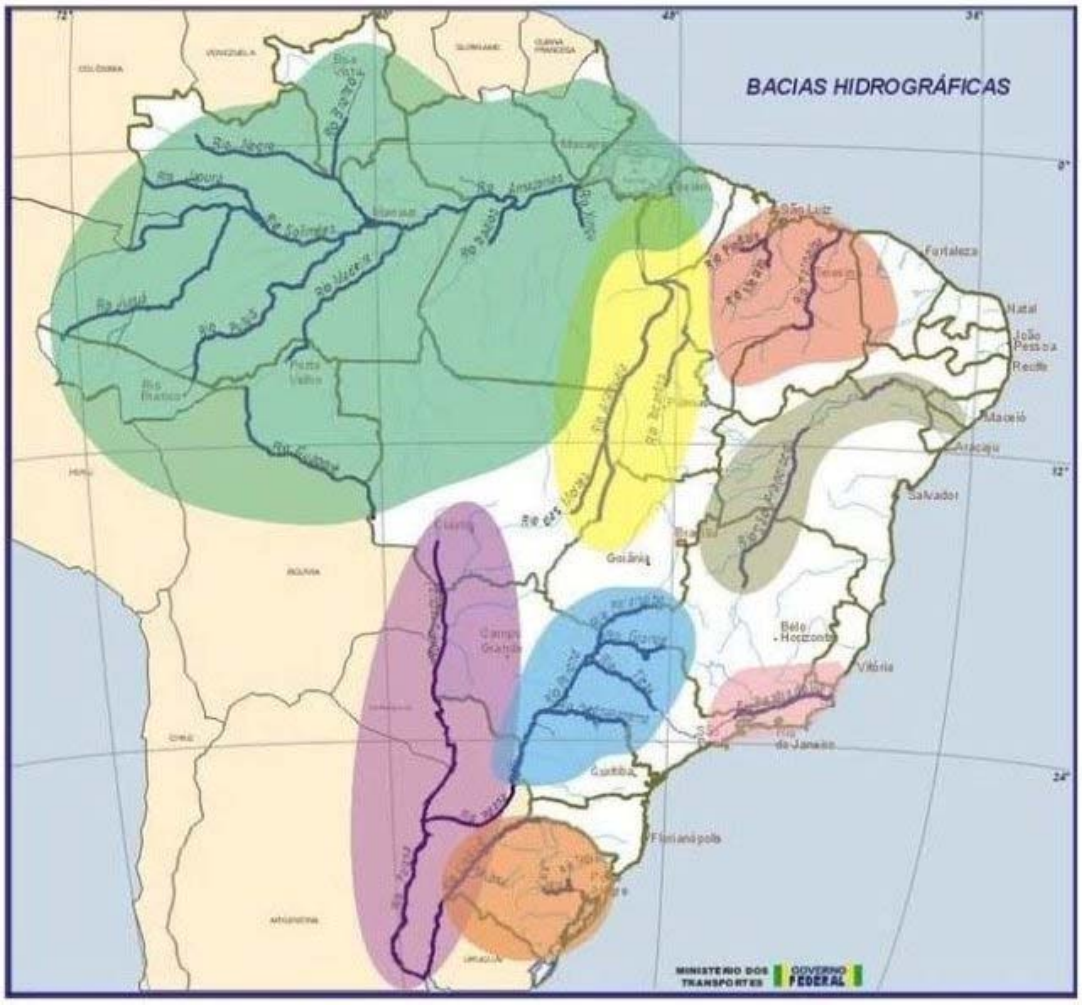

Figure 3. Hydrographical basins, the upper sources of which are in the Brazilian cerrado region.

Figure 4 illustrates much of this range of variation. The vegetation has a gradient of tree densities and aboreous cover from 2,231 trees ha^{-1} and 93% (cerradão) to 203 trees ha^{-1} and 6% (grasslands). Along with the vegetation, the animal, water and soil resources are all affected by common factors, e.g. macroclimatic conditions.

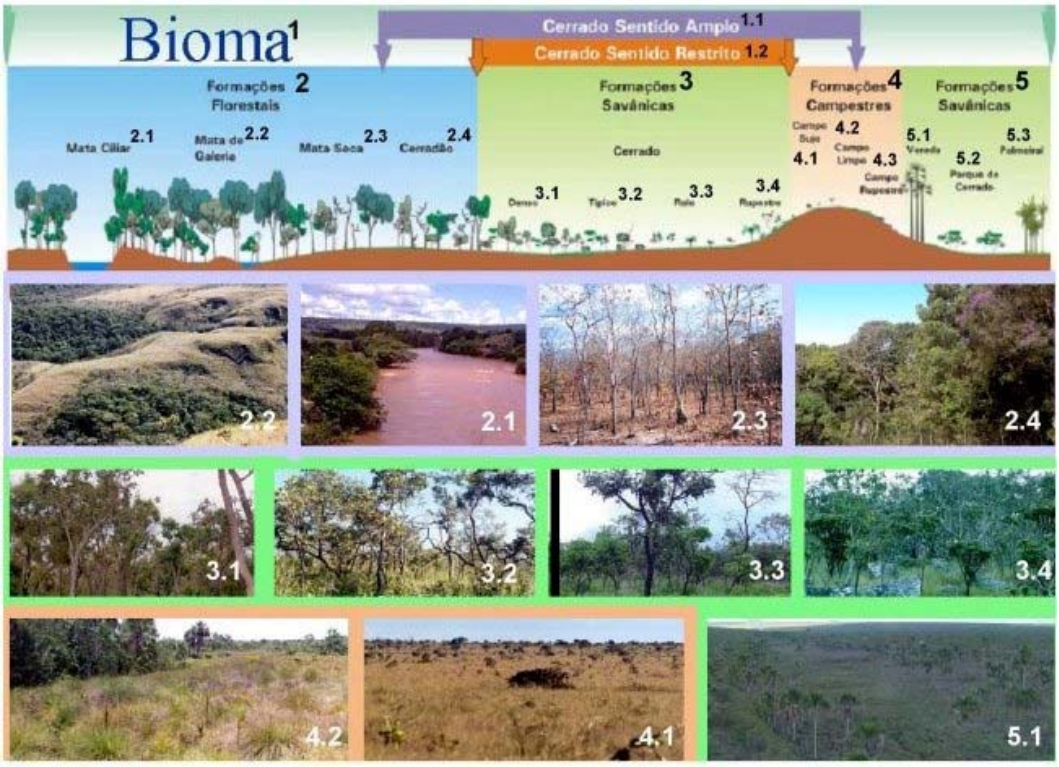

Figure 4. Vegetation profile typical of the Brazilian cerrado biome. 1. Biome; 1.1. Cerrado *sensu lato*, 1.2. Cerrado *sensu stricto*; 2. Forest formation, 2.1. Riparian forest, 2.2. Gallery forest, 2.3. Dry forest, 2.4. Cerradão; 3. Savanna formation, 3.1. Dense cerrado, 3.2. Typical cerrado, 3.3. Sparse cerrado, 3.4. Rocky outcrops (cerrado rupestre); 4. Grassland formation, 4.1. Dirty field or shrubby grassland, 4.2. Open grassland, 4.3. Rocky grasslands; 5. Savanna formation, 5.1. Palm swamp, 5.2. Cerrado Parkland, 5.3. Palm tree formation.

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Biographical Sketches

Marli A. Ranal is a Biologist (1976) and obtained her Master Degree (1983) and Doctorate (1988) titles in Plant Biology at the Universidade Estadual Paulista Júlio de Mesquita Filho. Since 1986 she is a teacher of the Federal University of Uberlândia and since 1998 she has been occupying the last level of the Academic carrier as "Titular" Professor. She has experience in Plant Biology, with emphasis in Plant Physiology, especially germination. From 1980 to 1998 her principal attention was ferns, in relation to germination, development, and establishment. In 1991 her studies about seed germination and plant development started. Then, her attention was changed from fern spores to seed germination. Since 1996 she has been recovering the history of the principal techniques to measure the germination and emergence processes. Her efforts have stimulated an up to date in this area of knowledge. She is a member of the American Fern Society, Asociación Latinoamericana de Pteridología, Asociación Latinoamericana de Botánica, Brazilian Botanical Society, and São Paulo Botanical Society. She was a member of the Editorial Board of the *Acta Botanica Brasilica* and Revista Brasileira de Botânica.

Denise Garcia de Santana is graduated in Agronomic Engineering from Federal University of Lavras, where she also got the master's degree in Technology and Production of Seeds in 1995. She received her doctorate in 2000 from "Escola Superior de Agricultura Luiz de Queiroz — ESALQ, University of São Paulo". She is one of the authors of "Análise da Germinação: enfoque estatístico", book published in 2004, in Portuguese, by the University of Brasília, a work result from seeds fusion analysis with the basic and experiments statistics. Since 2000, she is member of Brazil's Botanic Society / Nucleus of Germination Specialists and member of Brazil's Horticultura Society. She is a researcher for Forest Research Center, a governmental agency "Conselho Nacional de Desenvolvimento Científico e Tecnológico - CNPq" under the Science and Technology Ministry, designated to promote the scientific and technological research as well to graduate human resources for it's application. Her main research lines comprise of planning and statistical analyses of seed germination and seedlings emergency of native species, specially the Savanna.

Ivan Schiavini is graduate in Biological Science (Universidade Federal do Rio de Janeiro-1980), Master

Degree in Ecology (Universidade de Brasília - 1983) and Doctorate in Ecology (Universidade Estadual de Campinas -1992). I am a Associated Professor of the Universidade Federal de Uberlândia (1985 -). I have a large experience in Ecology research, mainly in ecology of ecossistems, forest ecology in cerrado biome, and ecology of plant communities and populations.