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IMPORTANCE OF SEED QUALITY FOR THE FORESTRY SECTOR

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Abstract – *Plant production is essential for the maintenance of human activity on Earth, and as seeds are the main tool for plant propagation, obtaining high-quality seeds is essential for successful planting. Forest species are applied in different areas, such as timber, the pharmaceutical industry, landscaping projects, and degraded area recovery. The search for seedlings of forest species has increased due to the intense exploitation of ecosystems and the need to recover degraded areas. Therefore, it is necessary to use high-quality seeds that are composed of a complex set of attributes, including genetic, physical, physiological, and sanitary factors that directly influence the performance of seeds in the field and their longevity in storage. Forest seeds have peculiarities, such as variable size and shape, nonuniform water content and germination speed, as well as different drying and storage capacities. In addition, they have high genetic variability, which implies difficulties in their management, such as the presence of dormancy, which can affect seed quality and seedling production. Seed germination and vigor are critical factors for the quality of forest seeds, but many species have not yet identified their germination requirements. The lack of information about the peculiarities of each forest species and the high genetic variability among them makes it difficult to standardize methods for analyzing the physiological quality of seeds, in addition to becoming an obstacle to their use in reforestation projects, since the lack of diversity in the use of native species is a concern, as it reduces variety and endangers biodiversity*

Keywords: *Seeds quality; Seeds vigor; Forest seeds.*

1. INTRODUCTION

Since time immemorial, seeds have been the basis of production for most species relevant to human activity. Whether for an agricultural crop of economic interest or a native plant used in reforestation programs, seed is the easiest and most efficient method of propagation. However, it is essential to ensure that high-quality seeds are obtained to guarantee successful planting. This requires considering a wide range of factors, especially in regard to seeds of forest species, which have peculiarities compared to cultivated species.

Forest species are widely applied in various areas of human activity. For example, species such as eucalyptus, pine, cedar, and sucupira are used in the wood industry, while others, such as copaiba and aroeira, are used as inputs for the pharmaceutical industry. In addition, there are species of interest for landscape projects and, more importantly, for degraded area recovery projects. Regarding degraded area recovery, it is important to highlight the increasing demand for new projects. Human activity has intensively exploited ecosystems, and large areas have been deforested. Additionally, a high number of accidents, such as those that occurred in Mariana (2015) and Brumadinho (2019) (Minas Gerais – Brasil), have also resulted in large damage to natural landscapes. As a result, increasing interest in recovering these degraded areas has been observed, and consequently, demand for forest species seedlings follows.

We also may cite here the interest of forest species in urban afforestation as well as landscaped projects. The population has been conscientized regarding the benefits of urban arborization and the construction of parks and squares. Consequently, demand for the construction of those areas increased, together with interest in the use of different species in landscaping projects, as some trees have also been used due to their beauty. All of these factors together have resulted in a remarkable increase in the demand for native species seedling production.

In the establishment of these projects, the importance of seeds stands out for their success. Although asexual propagation is widely used in commercial plantations aimed at timber production, as in the case of eucalyptus, the seed is still the main means of seedling production. For a successful reforestation project, it is fundamental to conserve the genetic variability of the populations. Genetic variability is essential for maintaining the resistance of populations to adversities after establishment. In this sense, the use of seeds for seedling production in such projects is essential because it is the best way to maintain the genetic variability of the population and ensure the success of the project.

Because seeds are the main method for the propagation of native species, it is interesting to highlight the importance of seed quality for successful plant production. On this matter, we must consider all factors contributing to seed quality, as none of those are individually defined. Several factors must be considered to ensure the best seed quality, taking into account the peculiarities of forest seeds and the needs of each species. These factors include knowledge of plant characteristics, seed production, physiological aspects, and the factors necessary for quality analysis.

Seed quality refers to a complex set of attributes that encompass genetic, physical, physiological, and sanitary factors that influence the performance of seeds in the field as well as their longevity in storage. Most seed quality standards are, in general, defined based on the knowledge and necessities for crop species, such as soybean, maize, and wheat. However, there is a set of peculiarities in native seeds that made some of those standards difficult to apply at that time. As an example, we can mention seed size and form. As most crop species have a more uniform size and form, which is essential for mechanized processes such as harvest and sowing, the same is not observed in native species. On a single batch, a wide range of sizes can be observed for harvested seeds, which can also be allied to a diversity of forms. As a result, mechanized processing and sowing of those seeds is difficult, which may require manual processing in some situations. Here, we highlight that this diversity of form and size can be observed in a single seed-producing tree.

2.QUALITY FACTORS

Seed water content is one of the factors influencing seed quality, mainly regarding storability. It is considered common sense among seed physiologists that lowering the seed water content (drying) or temperature of the storing environment increases seed longevity (with some exceptions mentioned later). However, although the water content is uniform in crop species, this may not be observed in forest species. Additionally, the postharvest (or dispersion) drying will not be uniform. Once different sizes and forms are observed on native seeds, drying will occur at different ratios, and consequently, the water content will not be uniform in the batch. This implies that although the water content test may indicate that seeds reached a certain valor, it may be possible that these values are not uniform in the batch, with a wide range of values for water content.

Although drying is important for seed storage, not all species produce seeds that can be submitted to this process. There are three categories of seeds regarding their capability to survive drying and storing. The first group contains orthodox seeds, which can be dried up to 5-10% water content and stored for long periods. Most crop species and some forest species produce seeds that belong to this group. The second group, recalcitrant, includes seeds that cannot be dried or stored. These seeds are dispersed with higher percentages of water content and do not survive drying. The attempt to store those seeds without drying may not be effective once, under higher water content, seed metabolism is intense, resulting in reserve consumption and fast deterioration. Additionally, storing recalcitrant seeds may result in pathogen attack once high water content and amount or organic material are ideal conditions for microorganisms to reproduce. A third group is for the intermediate seeds, which are not as desiccation tolerant as orthodox seeds and not as sensitive as recalcitrant seeds.

The understanding of those factors is essential to maintain seed quality and to establish procedures for processing and sowing each species. Once recalcitrant seeds cannot be stored or dried, those species must be sown immediately. As seedlings are ready to be sent to the field, this must be done to not increase seedling costs (which increase together with the time it remains in the nursery). This results in difficulties in the use of recalcitrant species for forest recovery projects. Those species are available only for a short time after harvest and within a short window of production, restricting seed availability and potential to use for seedling production. Similarly, intermediate seeds follow the same standard, with the highlight that they can be stored longer than recalcitrant seeds.

On the other hand, orthodox seeds can be dried and stored, becoming available on demand, i.e., seedlings can be produced as there is demand for them. This makes orthodox seeds more used for seedling production; however, in forest recovery programs, all species must be included (ideally), which results in the problem of desiccation-sensitive (recalcitrant and intermediate) species. Additionally, it is highly important to know the classification of seeds produced by a species to establish the correct strategies for seed storage. This is highly important to maintain seed quality. There are a wide range of studies in the literature informing the classification of native seeds regarding desiccation tolerance, which may provide data for producers to know the right procedure for those seeds. Additionally, there are studies conducted aiming to maintain desiccation-sensitive seeds with higher physiological quality for longer periods, which are of interest, as they will make those seeds available longer.

Regarding genetic attributes, it is important to highlight the differences between cultivated and native species. Higher genetic uniformity is highly desirable for crop species, as forest species are used as wood sources. There is the need for a more uniform stand with higher production, growing speed and characteristics that allow mechanization on all production steps. In this case, breeding programs focus on obtaining those characteristics, as in wood production, which is desirable for fast growth, production and a low number of branches, which improve wood quality.

The same cannot be found for forest species, especially those used in reforestation projects. In those cases, genetic diversity is essential, which results in an increase in differences in phenotypes and consequently plant characteristics. Here, we can mention that dormancy, desiccation tolerance, seed size, form, vigor, and pathogen resistance will vary among the population. Although this is ideal for those projects, it implies that there will be difficulties in the management of those species. As there is variation in dormancy levels, there is a need for different strategies for seedling production in a single species. Additionally, strategies linked to drying will be needed. Although a species that produces recalcitrant seeds will always produce this class of seeds, the intensity of this sensitivity will vary, i.e., in different batches (and possibly in a single batch), some seeds may dry more than others.

Here, we must highlight that the genetic quality of seeds is a key factor in the success of reforestation projects. This is because the adequate selection of the matrices from which the seeds will be harvested determines the genetic quality they will have. Following Brazilian legislation, Law 10.711 and Decree 5.153 of July 23, 2004, when the objective is reforestation, the genetic diversity of the matrices must be guaranteed to ensure the conservation of genetic diversity of the populations to be established.

Although not directly related to the physiological quality of the seeds, the presence of dormancy is an important aspect to be considered when talking about forest seeds. Dormancy plays an important role in germination distribution and plant establishment over time under natural conditions; however, dormancy is a problem in seedling production since germination of seeds with dormancy is slow and uneven, which hinders production and increases costs. Many forest species produce seeds with dormancy, but what many people do not know is that the depth of dormancy varies among the seeds of the same plant, depending on where they are on the branch, fruit, or even in the year of production.

Dormancy directly affects seed quality by arresting the germination process of a batch, resulting in nonuniform emergence in the field (or in the nursery). As stands will not uniformly be established, the use of those seeds will be difficult. The problem of dormancy also stands on the fact that, as dormancy level may vary even among seeds from a single fruit, the need for treatments in those cases will vary. However, it is difficult for a producer to classify seeds from a single batch regarding the level of dormancy, resulting in a need to treat seeds based on average germination. As a result, on a batch of forest seeds after treatment, some will still be dormant; for others, treatment is excessive and may result in death, while for most seeds (which may not be a high percentage), dormancy-breaking treatment will be efficient. This may imply the use of more seeds to obtain the proper required number of seedlings.

Ensuring the quality of forest seeds requires the consideration of several aspects related to their production and harvest. For this, it is important to understand the seed production season and the phenology of the species and to determine the best times for harvesting. In addition, it is essential to have knowledge about seed processing methods to remove impurities and empty seeds. During processing, the presence of straw and other residues is common, especially in species such as eucalyptus. Some species, such as candeia, produce a large volume of unviable and empty seeds, making the removal of these impurities essential to guarantee the quality of the collected lot.

The seed collection process must be carefully planned, taking into account the ideal time for collection, which varies according to the species. It is important to consider the phenology of the species, which can influence the seed production and maturation process. Harvesting should be carried out when the seeds reach physiological maturity, that is, when they are fully developed and ready to germinate. However, simple collection does not guarantee the quality of the seeds. After harvesting, it is necessary to process the seeds to remove impurities and empty seeds. This process includes the separation of seeds from other parts of the plant, such as straw, branches and stones, in addition to the separation of empty seeds. In some species, such as eucalyptus, the presence of straw can be a problem, as it can be confused with seeds, which can compromise the quality of the lot.

3.GERMINATION AND VIGOR

Another critical aspect for the quality of forest seeds is germination and vigor. These parameters, along with dormancy, are the main barriers to forest seed quality. Although there are studies related to forest seed germination, many species present low germination percentages, even when pregermination treatments are applied. It is important to note that a considerable number of native species have not yet had their germination requirements identified, even though they show germination and growth under natural conditions. In this sense, germination and vigor are critical factors for the quality of forest seeds, especially due to the lack of data related to these aspects.

Knowledge of the physiological quality of seeds is essential for the establishment of forest recovery projects. Therefore, it is crucial to establish standardized methods for the analysis of the physiological quality of seeds. However, the lack of knowledge about the production, harvest and germination of seeds of several native species hinders the standardization of analysis methods. In addition, the great variability among forest species is also an obstacle to conducting standardized germination tests.

Another important factor is the difficulty in obtaining information about several forest species. While some species of greater importance to human activity, such as those used for medicinal purposes, timber or food, and in landscape projects, have already been widely studied, other species of lesser impact lack studies in several aspects. Some species have not yet had their tolerance to desiccation studied, others have not yet had their germination requirements identified, and many species still have no information at all.

Lack of knowledge regarding native species stands out as the higher difficulty in their use in reforestation projects. Brazil holds a great diversity of species; however, there are few or no studies regarding most of them. In native seed studies, research focuses on those with some importance for human activity, such as wood production or even landscaping/urban arborization projects. This is also justified by the necessity for resources, which may be based on the importance of studying that species, which made "less-important" species to not be used and consequently the lack of information. However, we must highlight here the importance of diversity in the use of native species, especially in reforestation projects. Species with well-known seeds are prioritized, reducing diversity and endangering those species that will not be used.

In summary, the analysis of the quality of forest seeds is crucial to guarantee the success of reforestation projects. However, many native species still lack information about their germination and storage requirements. Therefore, it is essential to encourage new research to fill these gaps in knowledge and allow the use of a greater diversity of species in seed conservation projects. Only then can we guarantee the preservation of biodiversity and the restoration of degraded areas.

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