Viability of native forest seeds through images: Contributions to forest restoration in the Amazon

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The lack of information on the characteristics and technological potential of Amazonian seeds is one of the main limitations preventing the use of a greater number of species with desirable characteristics for restoration, thus hindering the maintenance of tropical biodiversity. Research on biometric characterization and seed viability analysis is carried out through destructive tests, with few published analysis protocols for native Amazonian species. Furthermore, the recalcitrant behavior of most of these species makes their storage unfeasible and necessitates immediate, short-term testing due to the loss of genetic material viability. This research analyzed seeds from 20 native forest species collected in three Seed Collection Areas distributed across different Amazonian ecosystems. The seeds collected at these locations were analyzed using X-ray and scanner imaging. Internal morphological characteristics, such as the presence and health of embryonic and reserve tissues, and external characteristics, such as seed size, color, shape, and texture, were recorded. Previously published germination tests were also applied to all seed lots. The intersection of all these results allowed us to detect unique viability characteristics, grouped by embryonic nature. For example, the presence (or absence) of cotyledons in exalbuminous seeds and the path of water flow in the haustorium of monocotyledonous seeds. We found a more than 90% correlation between the results of the X-ray images and the germination tests, indicating that the images can attest to the viability of the seeds in this study. The morphological characteristics determined by the Groundeye scanner also showed high efficiency in distinguishing seeds by diaspore type. In addition, we present 13 radiographic analysis protocols and make the RStudio scripts available to analysts, programmers, and other researchers in the field. This information is valuable for determining seed viability and quality using artificial intelligence and indirect methods, and supports conservation, breeding, and the sustainable use of natural resources.