



INSTITUTE OF DENDROLOGY

POLISH ACADEMY OF SCIENCES

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Kórnik, 03/10/2024

**Announcement about recruitment to the Poznań Doctoral School
of the Institutes of the Polish Academy of Sciences
at the Institute of Dendrology Polish Academy of Sciences
No. 21/2024/ID/PSD**

I. Position type: doctoral student

II. Number of vacancies: 1

III. Discipline: biological sciences

IV. Application deadline: 31/10/2024

V. Detailed information about recruitment process can be found on the website:

<http://www.idpan.poznan.pl/index.php/doctoral-school-pds-ipas/information-on-recruitment-at-the-institute-dendrology-pas> and <https://psd-ipan.ichb.pl/index.php/en/home/>

VI. Research topic: Significance of chlorophyll, chloroplasts, redox balance driven by nicotinamide adenine dinucleotides and metabolites in desiccation tolerance and longevity in woody plant chloroembryos

VII. Principal Investigator / Research group: dr hab. Ewa M. Kalemba, Department of Developmental Biology

VIII. Project Description:

Seed longevity is a major challenge for gene banks and forest biodiversity conservation. Knowledge of seed biology provides an opportunity for appropriate procedures to ensure seed viability during storage, particularly for plant species such as trees and shrubs that produce seeds even after decades of growth and, what is more, irregularly. About 10-15% of plant species can produce green seeds (chloroembryos) with potentially rapid aging when stored under standard seed bank conditions. Although the seeds are green, it is not known whether they have active chloroplasts.

During seed maturation in some species, chloroplasts are first formed and then degraded or transformed into the original plastids from which they were formed by differentiation. Other seeds retain active chloroplasts and then show reduced viability. Nothing is known about the fate of chloroplasts in seeds belonging to different seed categories, i.e. tolerant and sensitive to desiccation, orthodox and recalcitrant, respectively. The research will be performed to understand this phenomenon in green seeds of woody plants and to link the presence of chloroplasts with seed viability during storage and related aging. The proposed studies will provide an answer to the question whether the strategy of chloroplast preservation or dedifferentiation is related to the resistance or sensitivity of seeds to desiccation. The studies will be carried out on seeds



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of the *Acer* genus, mainly seeds of Norway maple (*Acer platanoides*) and sycamore (*Acer pseudoplatanus*), which are respectively resistant and sensitive to desiccation. The research material will be enriched with species from Costa Rica (e.g. *Enterolobium cyclocarpum*, *Caesalpinia coriaria*, *C. pulcherrima*), because more than 51% of tree species producing green seeds grow in Costa Rica. There are several strategies of chloroplast dedifferentiation. The planned microscopic studies will allow to distinguish which strategy of chloroplast dedifferentiation is used in green seeds representing different categories in the context of seed viability.

Chloroplasts are the site of metabolic processes generating NADPH – the reduced form of nicotinamide adenine dinucleotide phosphate (NAD). They are also the site of the main protein regeneration systems for NADPH-dependent reductase proteins. Therefore, the preservation of at least the protein elements of the stroma in seeds is beneficial for maintaining homeostasis in reduction and oxidation (redox) reactions. Therefore, it will be investigated whether different NAD concentrations result from different regulation of the functioning of the two synthesis pathways of this compound or the activity of enzymes that consume and degrade NAD. This is extremely important, because the NAD⁺ precursor in the salvage pathway regulates the lifespan of cells, which suggests that the lack or low activity of the NAD⁺ salvage pathway is related to seed viability.

NAD and NADP shape metabolic pathways. Metabolites directly reflect biochemical activity and cell state. Metabolic profiling will be performed in seeds displaying high and low viability and active/dedifferentiated chloroplasts. Therefore, metabolomic analyses will enable the identification of compounds responsible for reduced seed viability. ATP drives metabolic reactions. Interestingly, extracellular ATP (eATP) is an important signaling molecule acting in response to plant growth and stress, especially in the case of plant cell death. The level of endogenous ATP and eATP will be correlated with the activity of the antioxidant system and seed viability. Lipid metabolism in green seeds includes degradation of galactolipids of thylakoid membranes during chloroplast disassembly and synthesis of fatty acids (instead of hexose sugars, as in leaves) using ATP and NADPH during photosynthesis. Therefore, lipidomics will be used to investigate the lipid content of green seeds, in particular the profile of triacylglycerols will be analyzed.

The project will verify the following hypotheses:

- 1) chlorophyll levels, photochemically active chloroplasts and chloroplast dedifferentiation pathways contribute to longevity problems of chloroembryos;
- 2) NAD(P)-regulated redox homeostasis is associated with reduced seed viability through differently functioning NAD(P) synthesis/salvage/conversion/utilization pathways;
- 3) the loss of the viability of chloroembryos is associated with a decrease in crucial primary metabolites, depleted ATP levels, disturbances in the antioxidant system and lipid profile.

The PhD student's tasks will include: 1) seed collection and processing of research material, 2) laboratory work (spectrophotometric and fluorometric quantification

of compounds key to the activity of the antioxidant system and redox homeostasis; determination of changes in the content of photosynthetic pigments; protein electrophoresis and Western blotting, determination of gene expression levels using Real-Time PCR), 3) analysis and interpretation of data, including data obtained from omics and microscopic analyses, 4) preparation of publications and dissemination of results. As part of the project, we offer the opportunity to conduct research in an experienced research team. We provide support in conducting work based on the latest research directions and experience in publishing research results in leading scientific journals. We create an atmosphere of good cooperation and open exchange of ideas. We expect that the research results will allow for their dissemination in the best international journals and will be the basis for a doctoral thesis, as well as being presented at international conferences.

IX. Additional information:

1. Research and doctoral dissertation will be conducted under research project: Significance of chlorophyll, chloroplasts, redox balance driven by nicotinamide adenine dinucleotides and metabolites in desiccation tolerance and longevity in woody plant chloroembryos (2023/49/B/NZ9/00828, National Science Centre).
2. The doctoral student will receive a doctoral scholarship in the amount of ca. 4180 PLN gross pay (ca. 3789 PLN net pay) monthly during the entire duration of the doctoral studies (43 months with a possible extension to 48 months).
3. The doctoral student will have the social insurance costs referred to in art. 6 clause 1 point 7b of the Act of October 13, 1998 on the social insurance system (Dz. U. z 2019 r. poz. 300, 303 i 730).

X. Requirements for candidates:

1. Master degree in discipline of biological sciences, forest sciences, Earth and environment sciences or related or meeting the conditions specified in art. 186 section 2 of the Act of July 20, 2018 Law on Higher Education and Science (Dz. U. z 2018 r., poz. 1668 z późn. zm.).
2. Very good skills in spoken and written English, allowing for preparing manuscripts of scientific publications and oral presentations during international conferences
3. Knowledge of seed biology.
4. Experience in laboratory work, knowledge of methods used in molecular biology will be an additional advantage.
5. Experience in research studies in plant biology, documented by prior scientific activity (e.g. conferences or publications).
6. Eagerness to participate in conferences and workshops.

XI. Required documents:

1. An application to PDS IPAS, including consent for the processing of personal data for the purposes of the recruitment procedure, and a declaration of familiarity with these

rules - the current application form is available at <http://www.idpan.poznan.pl/index.php/doctoral-school-pds-ipas/documents-for-candidates-and-ph-d-students>.

2. A copy of the degree certificate confirming graduation or a certificate of graduation; in the case of degree certificates issued by foreign higher education institutions, the certificate referred to in Article 326(2)(2) or Article 327(2) of the Act, giving the right to seek to obtain a doctoral degree in the country under whose higher education system the issuing institution operates. A candidate who does not have the aforementioned documents will be obliged to supply them before being admitted to PDS IPAS. Additional information on foreign diplomas is available on the website: <https://nawa.gov.pl/en/recognition/recognition-for-academic-purposes/applying-for-admission-to-doctoral-studies>

3. A curriculum vitae showing previous education and employment, information on involvement in scientific activity (membership of student scientific groups, participation in scientific conferences, completed internships and training courses, prizes and distinctions received) a list of publications.

4. A motivation letter, containing a short description of interests, scientific accomplishments, and reasons for wishing to study at the doctoral school.

5. Certificates or other documents confirming the candidate's knowledge of English, if the candidate has such.

6. Contact details of at least one previous academic supervisor or other academic employee who has agreed to provide an opinion regarding the candidate.

XII. The application should be sent by e-mail to the address psd.idpan@man.poznan.pl with the subject "**Competition for the position of doctoral student No. 21/2024/ID/PSD**" in the form of a pdf attachment. If sending by electronic means is not possible, applications sent to the address Institute of Dendrology, Polish Academy of Sciences, Parkowa 5, 62-035 Kórnik, Poland with the note on the envelope "**Competition for the position of doctoral student No. 21/2024/ID/PSD**" are also accepted. Please do not send original documents.

XIII. Application deadline: 31/10/2024

XIV. Criteria for assessing candidates:

1. The candidate's academic accomplishments, based on grades attained during studies, scientific and popular science publications, scholarships, awards and distinctions resulting from research or student activity, and other achievements.

2. The candidate's academic and professional experience, based on participation in conferences, workshops, training courses and internships, participation in research and commercial projects, involvement in scientific groups and associations, international and professional mobility, and experience in other fields.

3. Candidate's knowledge in the biological science discipline.

4. Knowledge of the topics listed in the recruitment notice.

XV. Competition results: until 22/11/2024

XVI. A description of the recruitment process can be found in the Recruitment Regulations for PDS IPAS. After the recruitment is completed, unaccepted candidates will be informed of the scores obtained at each stage of the competition.

XVII. Admission to PDS IPAS is refused by administrative procedure. The decision may be appealed with to the Director of the Institute of Dendrology of the Polish Academy of Sciences.

**Additional information may be provided Principal Investigator / Research group:
dr hab. Ewa Kalemba, ID PAS Professor, kalemba@man.poznan.pl, +48 618170033**


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