

NEWS LETTER

What's new around *Lathyrus*?



Science

Kumar *et al.* (2024) unveiled new genes associated with β -ODAP regulation and elucidated the molecular mechanisms through which a low β -ODAP-containing cultivar develops tolerance to salinity stress.

The research conducted by Amiratashani *et al.* (2024) highlights how the Maillard reaction can enhance the properties of grass pea protein, presenting opportunities for the food industry to develop a diverse range of plant-based foods.

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People

As PI of the PlantX Lab at ITQB NOVA, Portugal, Dr. Carlota Patto leads a team focused on molecular quantitative genetics applied to plant breeding. Matilde Sanches, a PhD student under her mentorship, studies the water stress tolerance in *Lathyrus sativus*. Dive into the impactful work and visionary perspectives of these talented women in the field of grass pea.

Good to know

The first International Lathyrus Day, organised by the Fernand Lambein Fund, will take place in Ghent on the 3rd of June 2024. Secure your ticket! Travel funds available.



People

Science

Good to know

CARLOTA PATTO & MATILDE SANCHES

Dr. Carlota Patto is an Agronomic Engineer with a rich academic background. After her B.Sc. from the University of Lisbon, Carlota gained a M.Sc. in Plant Genetic Breeding from IAMZ-CIHEAM in Zaragoza, Spain, and a Ph.D. in Production Ecology and Resource Conservation from Wageningen University and Research in The Netherlands. With an extensive post-doctoral journey spanning Bologna University in Italy, IAS-CSIC in Córdoba, Spain, and ITQB NOVA in Oeiras, Portugal, Dr. Patto has emerged as a seasoned expert in the field of Plant Quantitative Genetics (PQG).

Her interest and passion for agronomy were generated from a Portuguese TV show, TV Rural, which showcased technological advancements in agriculture. Carlota and her family would get together every Sunday at lunch to watch the show. Carlota was fascinated to discover how



The PlatX Laboratory at ITQB NOVA.

creative people working in the agricultural sector could be in solving their problems and decided she wanted to be part of that world.

Today, Dr. Patto is the Principal Investigator of the Genetics and Genomics of Plant Complex Traits (PlantX) Laboratory at the research institute ITQB NOVA (Instituto de Tecnologia Química e Biológica António Xavier) in Oeiras, Portugal. Here, she leads 11 early-stage scientists interested in molecular quantitative genetics applied to plant breeding. Their research delves into

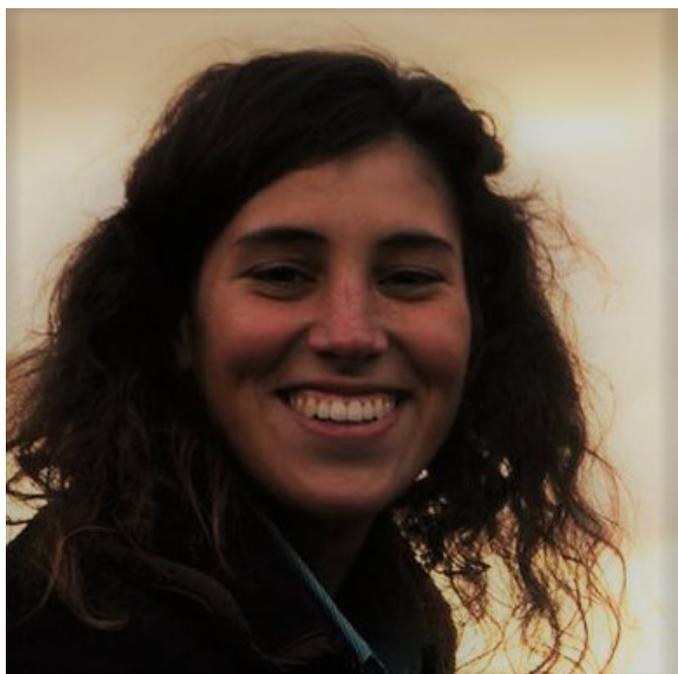
Dr. Carlota Patto has extensive experience as a researcher in the agricultural sector. Currently, she is a PI at the institute ITQB NOVA.

identifying genes controlling complex traits, such as end-user quality (nutritional/health, organoleptic, processing), resistance to biotic (fungal diseases), and abiotic (drought) stress on cereals and legumes (maize, common bean, and grass pea). The final goal is to develop control models, scientific methods, and molecular tools to improve precision breeding programs.

Matilde Sanches is a Ph.D. student in the Plants for Life program, a collaboration between Carlota's lab and VIB (Vlaams Instituut voor Biotechnologie) in Belgium. Her work focuses on plant breeding and quantitative genetics, with a strong emphasis on plant physiology and biochemical aspects (oxidative stress).

Matilde holds a B.Sc. in Biology from the University of Coimbra (Portugal) and a M.Sc. in Plant Biodiversity and Biotechnology. During her Master's program, she spent nine months at the CSIC Center for Biologic Research in Madrid, Spain.

As a botanist and plant enthusiast, her grandfather was the first to draw her attention to the green world. Later, two books increased her interest in biology and plants: "A Brief History of Nearly Everything" by Bill Bryson and "L'évolution vue par un Botaniste" by Jean-Marie Pelt. Finally, in 2018, Matilde had the opportunity to live in Mozambique for a few months. Here, she realized how contradictory agricultural markets are.



On one side, they are determinants for farmers needing healthy seeds and robust crop variety; on the other, they are fragile and perverse in their economy and politics. At that moment, Matilde decided her career would address the future of agricultural systems and the subsistence of the planet.

How did you approach the study of *Lathyrus sativus*? What attracted you to dive into this crop?

Carlota: I discovered this plant species at the university while studying agronomical engineering. I did not know it before: grass pea doesn't grow in my hometown as the soil is too acidic. I was fascinated by it because it looked a bit pre-historical with its winged branches. I found it similar to an insect I knew from my youth, *Mantis religiosa*, the European Mantis (Louva-a-Deus in Portuguese). While I learned more about it, I was fascinated by this legume for its characteristics of resilience and sustainability and the critical social and economic value it still plays in some Portuguese regions.

Matilde Sanches is a PhD student in the Plants for Life program, a collaboration between ITQB Nova and VIB.

Matilde: For me, grass pea is a perfect example of an underrated crop that has potential benefits for the future of agriculture and food.

Carlota is the promotor of my Ph.D. and she introduced me to it. I was inspired by the belief that if we study it and unravel the 'secrets' (physiologic, genetic, etc.) underlying *Lathyrus*'s robustness, we can probably also progress in generating better (more adapted and robust) varieties in other legume species.

What are some of the key challenges or issues specific to the cultivation or improvement of *Lathyrus sativus*?

Carlota: Farmers' primary concern in Portugal is yield and resistance to pests and diseases. Because it is an understudied legume crop, with fewer existing tools developed, studying the genetic basis of its attractive traits can be more challenging.

Matilde: Another significant challenge is the public acceptance and awareness of *Lathyrus sativus*'s potential. Some decades ago, grass

studying the genetic basis of different quantitative disease resistances in grass peas against foliar pathogens such as powdery mildew and rust. Responding to concerns from Portuguese grass pea farmers, our focus expanded to include the resistance to soil diseases like Fusarium wilt and various pests.

At the moment, we are delving into grass pea's tolerance to drought and flood, given the evolving climate conditions affecting traditional production regions in Portugal. Additionally, we're addressing nutritional and organoleptic quality aspects, major concerns for grass pea consumers in Portugal. We identified considerable variation for all the traits we analyzed, which helped us understand their genetic foundations

The main challenges around the study of grass pea are the lack of tools to study its genetic basis, but also its public acceptance. Until some decades ago, this legume was mainly famous for causing a neurological disease. Today we know its consumption can be safe but the stigma remains.

pea was sadly mainly famous for a toxic component of its seed that can cause neurological disease. It is proven that *Lathyrus sativus* consumption is not dangerous if seeds are adequately cooked and consumed in a balanced diet, but the stigma remains.

Could you discuss your research focus within the realm of this crop? What specific aspects do you investigate?

Carlota: At PlantX, we initially focused on

through association studies. These steps are crucial for developing molecular tools to aid precision breeding techniques. We've discovered specific traits and integrated them into breeding materials.

We now focus on the Genome-Wide Association Study for genetic basis clarification but using a wide diversity of phenotypic approaches depending on the trait under study (microscopy,

Nuclear Magnetic Resonance, Gas Chromatography-Mass Spectrometry, Total Internal Reflection, Infrared Gas Analyzer,....).

Matilde: My project explicitly targets the study of water stress tolerance in *Lathyrus sativus*. Among its objectives are the identification of more and less tolerant accessions within a *Lathyrus* collection and exploring physiological, morphological, genetic, and biochemical mechanisms contributing to enhanced tolerance to drought and flood.

So far, I have identified some accessions that can handle drought and flooding better than others. Some of these accessions are being considered for new varieties in another European project. Also, I identified a set of genetic markers associated with water stress tolerance, which could help select plants with these traits in case of validation.

In the long run, the knowledge generated throughout my research will also help me understand how plants, especially grain legumes, can naturally cope with or be intentionally improved to handle the increasing challenges of extreme water stress.

The baseline tolerance levels can constantly be enhanced. Identifying genetic markers and developing molecular tools is essential, especially for strengthening quantitative traits such as yield and abiotic stress tolerances. Work should also be done regarding the grass pea's organoleptic and nutritional characteristics. Some months ago, the 'ODAP gene' was identified, opening doors for manipulation and editing. However, we must always be careful because, from the plant's point of view, this neurotoxin probably has an important role to play, so it would be risky, I would say, to block its synthesis completely, for example. Low-ODAP varieties have already been developed. Some

CARLOTA PATTO & MATILDE SANCHES



other exciting or desirable characteristics (lowering of saponin content, for example) are indeed prone to be bred.

Can you discuss any collaborations or partnerships you have established with other researchers, organizations, or stakeholders?

Carlota: Since embarking on my journey in grass pea research, I have fostered valuable collaborations. Our Spanish colleague, Diego Rubiales, and his research group, who share a passion for grass pea studies, have been steadfast allies from the beginning. This initial international collaboration has blossomed into a network with numerous European colleagues dedicated to advancing grass pea research.

My journey also led me to collaborate with Prof. Lambein on revision work and the team from Norwich, UK, under the guidance of Dr. Peter Emmrich.

In a more recent development, we have collaborated with VIB-Ghent.

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CARLOTA PATTO & MATILDE SANCHES

Matilde's Ph.D. is carried out in collaboration with Prof. Dr. Frank van Breusegem, focusing on grass pea tolerance to abiotic stresses.

At the national level, our enduring collaboration delves into the quality aspects of grass peas.

I have worked closely with the esteemed teams led by Rosário Bronze (FFUL, iBET, ITQB NOVA). Acknowledging the pivotal role of Alvaiázere Municipality, the primary grass pea-producing region in Portugal, and the unwavering support from Alvaiázere's farmers and processors through the ADECA local development association, I am grateful for the opportunity to engage in many grass pea participatory research activities over the years. These collaborative efforts have enriched our research and strengthened the bond between academia and the local community, fostering a shared commitment to the advancement of grass pea cultivation and knowledge.

Can you highlight any ongoing or upcoming projects or initiatives you are involved in regarding this crop?

Carlota: The work we are currently developing in grass pea with the farmers and producers from Alvaiázere is being developed under the scope of the H2020 DIVINFOOD project. Also connected to this project but more on a Citizen Science level is the Oeiras Experimental project, where we have established some grass pea field research that we are developing together with citizens from the Oeiras Municipality to elevate the local population's knowledge of the role of science.

SELECTED PUBLICATIONS

Identification of genes associated to β -N oxalyl-L- α , β -diaminopropionic acid and their role in mitigating salt stress in a low-neurotoxin cultivar of *Lathyrus sativus*.

Kumar D, Chaudhury RS, Mandal K, Pradhan P, Bhattacharya S, Das B, Mukhopadhyay R, Phani V, Prudveesh K, Nath S, Mandal R, Boro P.

Plant Physiol Biochem. 2024 Jan 19;207:108388.
doi: [10.1016/j.plaphy.2024.108388](https://doi.org/10.1016/j.plaphy.2024.108388).

The potential of grass pea as a revolutionary crop can only be realized by removing its stigma as a toxic plant. With this premises, transcriptome analysis has been conducted on two cultivars, Nirmal and Bidhan, with high and low ODAP content under normal and salt stress conditions. This study unveiled genes associated with β -ODAP regulation, including AAO3 and ACL5, linked to ABA and polyamine biosynthesis. This underscores the importance of ABA and polyamines in enhancing β -ODAP content in Nirmal. The increased β -ODAP levels in salt-stressed Bidhan may indicate evolved tolerance, positively regulating genes involved in phenylpropanoid and jasmonic acid biosynthesis. Despite Bidhan having a lower β -ODAP concentration under salt stress than Nirmal, stress-related genes downstream of β -ODAP showed higher expression in Bidhan. This could be attributed to the fact that stress-treated Nirmal exhibits lower GSH and proline coupled with higher H₂O₂ levels, resulting in severe oxidative stress development. Overall, this research unveiled new genes associated with β -ODAP and elucidated the molecular mechanisms through which a low β -ODAP-containing cultivar develops tolerance to salinity stress.

Comprehensive structural and functional characterization of a new protein-polysaccharide conjugate between grass pea protein (*Lathyrus sativus*) and xanthan gum produced by wet heating.

Amiratashani F, Yarmand MS, Kiani H, Askari G, Naeini KK, Parandi E.

Int J Biol Macromol. 2024 Jan;254(Pt 3):127283.
doi: [10.1016/j.ijbiomac.2023.127283](https://doi.org/10.1016/j.ijbiomac.2023.127283)

This study aimed to enhance grass pea protein (GPPI) through a controlled wet-heating process, promoting the Maillard reaction (MR) with xanthan gum (XG). The resulting GPPI-XGCs showed increased glycation, reduced lightness, and altered secondary structure. MR disrupted the protein's crystalline structure, reducing Lys and Arg content. Improved functional properties included a 45.17% increase in foaming capacity, 37.17% in stability, and 98.88% solubility. GPPI-XGCs exhibited significantly enhanced antioxidant activities (ABTS-RS max value of 49.57%). This research highlights how the Maillard reaction can enhance the properties of GPPI, presenting opportunities for the food industry to develop a diverse range of plant-based foods. Notably, the foaming properties were substantially improved, positioning the final product as a promising foaming agent for incorporation into food formulations.

Effect of glyphosate on the growth and survival of rhizobia isolated from root nodules of grass pea (*Lathyrus sativus* L.)

Asrat A, Sitotaw B, Dawoud TM, Nafidi HA, Bourhia M, Mekuriaw A, Wondmie GF.
Sci Rep. 2023 Dec 6; 13(1):21535.
doi: [10.1038/s41598-023-48424-7](https://doi.org/10.1038/s41598-023-48424-7).

Impact of Heat and Drought Stress on Grasspea and Its Wild Relatives.

Aloui K, Choukri H, El Haddad N, Gupta P, El Bouhmadi K, Emmrich PMF, Singh A, Edwards A, Maalouf F, Bouhlal O, Staples J, Kumar S. Plants (Basel). 2023 Oct 8; 12(19):3501.
doi: [10.3390/plants12193501](https://doi.org/10.3390/plants12193501).

Legume Fingerprinting through Lipid Composition: Utilizing GC/MS with Multivariate Statistics.

Ilić M, Pastor K, Ilić A, Vasić M, Nastić N, Vujić Đ, Ačanski M.
Foods. 2023 Dec 9;12(24):4420.
doi: [10.3390/foods12244420](https://doi.org/10.3390/foods12244420).

A modified DNA isolation protocol for high-quality DNA and long-term storability in grasspea (*Lathyrus sativus* L.)

Ramya K.R., Gupta R., Pandey A., Tripathi K., Bhatt K.C. and Singh R
Indian J. Genet. Plant Breed. 2023 Dec; 83(4): 602-604.
doi: [10.31742/ISGPB.83.4.16](https://doi.org/10.31742/ISGPB.83.4.16)

WHAT'S GOING ON AROUND LATHYRUS?



THE FERNAND LAMBEIN FUND AT ILS4

In September 2023, Lieve Ongena and Ingrid Lambein participated in the ILS4 conference in Granada, where they represented the Fernand Lambein Fund at a dedicated booth. Engaging with fellow participants, they could effectively promote the fund and distribute small boxes of Grass Pea seeds, fostering awareness and interest in the legume.

Why did you choose to attend this conference?

Lieve: The International Legume Society meeting in Granada was the first event in Europe since the Fernand Lambein Fund was established, which focused on legumes and, a.o., on grass pea research. By having a booth at the conference, we wanted to ensure the Fund received sufficient visibility within the community. We gathered some names of scientists interested in joining the Grass Pea network there.

Ingrid: My father had also attended the first ILS meeting in Novi Sad in 2013, so it made sense to connect to a community that knew him.

What significance did the grass pea hold during this gathering?

Lieve: We noticed that some research was being done already, and some conference talks covered grass pea research. Ten abstracts in the book specifically cover *Lathyrus sativus*' research. These research projects cover various areas, from crop systems over biodiversity and stress tolerance to omics analysis. Also, the toxin ODAP and how to measure or lower it got some attention.



From left: Ingrid Lambein and Lieve Ongena at ILS

Ingrid: We also met some researchers visiting our booth who were not yet into grass pea research but saw some opportunities to embark on this crop based on its strength under challenging climates (heat, wet). With climate change and a younger generation focusing more on plant-based protein, it was the perfect time to bring more attention to grass peas.

What was the outcome for the fund?

Lieve: We learned that there are some existing networks in the world focusing on grass pea, such as Grasspea.net as well as CropTrust and ICARDA. ICARDA we already knew as Prof. Lambein was recognised with a Life Time Achievement Award in 2018. We have contacted all these organizations to connect the different networks with

People

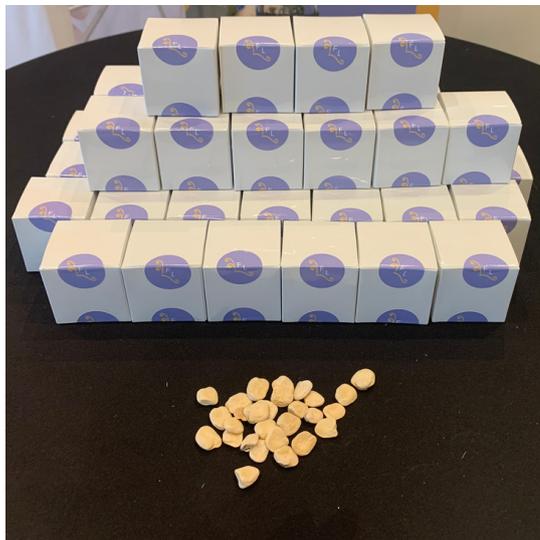
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the activities of the Lambein Fund. The goal is to have all grasspea research clustered and further stimulated by the opportunities offered through this newly established Fernand Lambein Fund.

Ingrid: We also realized that grass pea is a well-known food crop with exceptional agronomic traits in Southern Europe. We plan to collect recipes from all over the world and provide them on our website for use and distribution. If you have a grass pea recipe, please send it to contact@lambeinfund.org.



FIRST INTERNATIONAL LATHYRUS DAY

The Fernand Lambein Fund is delighted to announce the first International Lathyrus Day, scheduled for June 3, 2024, in Ghent, Belgium. Honoring the legacy of Fernand Lambein, this event extends a warm invitation to academics and professionals alike, encouraging the convergence of minds to foster connections, share knowledge, and cultivate collaborations across the globe.

Esteemed Keynote Speakers, including Dr. Carlota Patto (Instituto de Tecnologia Química e Biológica António Xavier) and Dr. Shiv Kumar Agrawal (ICARDA), will present their work on *Lathyrus sativus*.

Don't miss this exciting opportunity and take an active role in establishing this worldwide network of Lathyrus enthusiasts! Visit the [website](#) for more information regarding tickets, abstract presentations, and travel grants.



