FERNAND LAMBEIN
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NEWS LETTER

What's new around *Lathyrus*?

People

Dr. Anjali Verma recently completed her PhD in Agricultural Biotechnology, specializing in *Lathyrus sativus*. In 2024, she was selected as an Open Doors Fellow for the slot sponsored by the Fernand Lambein Fund. Through this fellowship, she completed a three-month Short Research Stay at the VIB-PSB laboratory under the supervision of Prof. Dr. Frank Van Breusegem in Belgium. In this interview, Dr. Verma discusses her research interest in understanding the production of ODAP in grasspea under stress conditions.

Science

Vigouroux *et al.* (2024) present a high-quality, chromosome-scale reference genome for *Lathyrus sativus*. The assembled genome, with a total size of 5.96 gigabase pairs, will help identify agronomic traits and support breeding programs.

Bekele-Alemu *et al.* (2024) explore the potential of CRISPR/Cas9 technology to address the issue of β-ODAP, a neurotoxin in grasspea that limits its wider adoption.

Good to know

Join us for the first Online Café on *Lathyrus* on March 25, 2025, at 12:00 CET. This webinar will bring together experts who explore *Lathyrus sativus* from diverse perspectives, including genetics, agronomic traits, and resilience

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ANJALI VERMA

Dr. Anjali Verma is a plant molecular biologist specialising in functional genomics and plant genetic engineering. Her research focuses on understanding and engineering plant metabolic pathways, particularly in the orphan legume grasspea. She earned her Bachelor's and Master's degrees in Biotechnology before pursuing a PhD in Biotechnology with a specialization in agricultural biotechnology at the BRIC-National Agri-Food and Biomanufacturing Institute (NABI), formerly the National Agri-Food Biotechnology Institute, India. Her doctoral research was conducted in collaboration with the Regional Centre for Biotechnology (RCB), India. As a PhD student, Anjali investigated the molecular cloning and functional analysis of key genes involved in the biosynthesis of β-ODAP, a neurotoxic compound found in *Lathyrus sativus*. Her work focused on reducing ODAP levels through gene editing while exploring its role in stress adaptation. She has also examined the varying stress tolerance among different ODAP-containing varieties of grasspea, aiming to integrate these findings into a broader project on plant stress resistance.

Dr. Verma further expanded her research as an Open Doors Fellow. During the Short Research Stay at the Oxidative Stress Signaling Group, VIB Center for Plant Systems Biology, she worked under the supervision of Prof. Dr. Frank Van Breusegem. Her research focused on enhancing the understanding of stress responses in grasspea, contributing insights into stress resistance mechanisms and the role of ODAP in plant adaptation.

Anjali's fellowship under the Open Doors Fellowship Program was funded by the Fernand Lambein Fund, supporting her research on *Lathyrus sativus*. Through her work, she aims to advance strategies for improving the nutritional and agronomic value of grasspea, making it a more resilient and safer crop for cultivation in stress-prone environments.

What initially sparked your interest in studying biotechnology and pursuing a career in plant science?

My interest in science began in childhood and grew stronger during my undergraduate studies. I grew up in Northern India, a region dominated by agriculture, and I soon realized the importance of agriculture in sustaining communities. During my studies, I learned more about agriculture's challenges and biotechnology's potential to address these issues. Understanding that science could

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address real-world agricultural challenges motivated me to pursue further plant sciences and biotechnology studies.

How did you become interested in *Lathyrus sativus*?

At NABI, when enrolling in the PhD program, candidates have the opportunity to interact with their principal investigators to choose a project that aligns with their interests. This is when I was introduced to grasspea. It took just a 30-minute meeting with my PI for me to be convinced to study this crop. I was immediately intrigued by its potential to address real-world problems. Its incredible resilience to harsh climatic conditions, combined with the presence of a neurotoxin, presented both an opportunity and a challenge for meaningful societal contribution.

Among legumes, grasspea is one of the most resilient, capable of withstanding extreme weather conditions such as drought and waterlogging. Therefore, it is a promising crop for sustenance in regions where other crops fail due to its high protein content and essential amino acids. However, ODAP production increases under stress conditions, underscoring the complexity of the crop's biology. Reducing the neurotoxin while preserving resilience is a complex and intriguing research challenge, essential for making grasspea a safer and more widely accepted food source. I took up the challenge and made it the subject of my PhD studies.

Could you discuss your research focus? What specific aspects do you investigate?

My research aims to understand and modify the biosynthetic pathway of β-ODAP in *Lathyrus sativus*. Through RNA sequencing (RNA-seq) of contrasting ODAP-producing Indian cultivars, we identified the genetic basis of ODAP production and its regulatory mechanisms. We further explored ODAP's role in stress tolerance by subjecting these cultivars to drought conditions. Using this RNA-seq dataset, we identified pathway genes and designed targets for gene editing. However, due to the limited genomic information available and the absence of functional study tools, we developed an Agrobacterium-mediated hairy root system for targeted gene editing. Through this system, we demonstrated, for the first time, gene editing in *Lathyrus sativus* using the CRISPR/Cas approach. Additionally, I contributed to a collaborative project that resulted in the sequencing and assembly of the genome of an Indian cultivar, Pusa-24.

Sponsored by the Fernand Lambein Fund, I have joined the Open Doors Fellowship Program. During my short research stay in Belgium, I joined the VIB

> Genomics and metabolomic techniques are essential to grasspea research and have the potential to significantly accelerate the crop's improvement.

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-PSB Oxidative stress group led by Prof. Dr. Frank Van Breusegem. There, I focused on exploring the mechanism of abiotic stress resistance in grasspea. My goal was to gain insight into the genetic response underlying reactive oxygen species production (ROS) and ODAP accumulation during flooding and drought stress. The insights will not only advance our understanding of stress resistance, but also provide useful information on ODAP biosynthesis, allowing us to identify potential genetic targets for ODAP level modification. Furthermore, I investigated root development in different ODAP Indian cultivars to better understand how ODAP influences plant adaptation. Hosted by Prof. Dr. Carlota Vaz-Patto, I also had the opportunity to visit grasspea field trials in Portugal, which gave me a deeper understanding of the challenges faced by the farmers.

Grasspea field in Portugal.

What notable advancements or discoveries have emerged from your research?

Our research has led to several advancements. We conducted a de novo RNA-seq analysis of contrasting ODAP cultivars, which led to the identification of key genes associated with ODAP production and its regulatory mechanisms. This work also uncovered the potential role of ODAP in stress tolerance, highlighting its importance in environmental resilience.

Additionally, we successfully established an *Agrobacterium rhizogenes*-mediated hairy root transformation system, a critical tool for gene functional studies in the highly recalcitrant grasspea. Through this system, we successfully used the CRISPR/Cas approach to edit a key pathway gene, paving the way for developing safer grasspea varieties.

I also contributed to the genome sequencing and assembly of a popular Indian cultivar, Pusa-24, providing a valuable resource for future genetic and breeding efforts. These advancements broaden our understanding of grasspea and help develop better strategies for improving its agronomic traits, ensuring agricultural sustainability and food security.

Overall, developing genome-editing tools for *Lathyrus sativus* benefits both researchers and agricultural stakeholders. These tools will accelerate the genetic improvement of grasspea, making it safer and more widely accepted for consumption. Furthermore, our discoveries related to stress tolerance mechanisms provide valuable insights for breeding more resilient legume varieties, contributing to global food security and agricultural sustainability.

How do you approach breeding or genetic improvement strategies for grasspea? Are there any specific goals or traits to enhance?

My approach integrates traditional breeding techniques with modern molecular tools. The primary goal is to

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reduce or eliminate ODAP in grasspea to develop safer varieties suitable for human consumption. At the same time, we aim to preserve its resilience to extreme environmental conditions, ensuring its continued role as a climate-resilient crop.

What are your next endeavours, and how can the Lambein Fund support you and the broader *Lathyrus sativus* community?

The research conducted during my PhD was a step toward improving the agronomic potential of neglected crops like grasspea through molecular and biotechnological interventions. By advancing grasspea research, I aim to contribute to food security and agricultural sustainability. My long-term goal is to establish myself as an independent researcher in plant science and agriculture, making a meaningful impact through my work.

To achieve this, I am committed to further exploring stress resilience mechanisms in grasspea and identifying genetic targets to enhance its adaptability and safety. Expanding research on ODAP biosynthesis and drought resistance will be central to my future projects, ensuring that grasspea becomes a viable crop option for farmers facing challenging environmental conditions.

By sponsoring my participation in the Open Doors Fellowship Program, the Fernand Lambein Fund provided me with the opportunity to further my research, acquire new skills, and expand my professional network.

Dr. Verma presenting at the Lathyrus Day.

This reflects the Fund's crucial role in supporting *Lathyrus sativus* research—providing financial assistance, facilitating collaborations, and increasing research visibility.

By funding resources, training programs, conferences, and knowledge-sharing platforms, the Fund can help researchers like me develop safer and more resilient grasspea varieties. Continued advocacy for *Lathyrus sativus* as an important crop for food security and sustainability will be essential in encouraging global recognition and investment in its improvement.

LATEST PUBLICATIONS

A chromosome-scale reference genome of grasspea (*Lathyrus sativus*).

Vigouroux M, Novák P, Oliveira LC, Santos C, Cheema J, Wouters RHM, Paajanen P, Vickers M, Koblížková A, Vaz Patto MC, Macas J, Steuernagel B, Martin C, Emmrich PMF.

Sci Data. 2024, 11(1):1035.
doi: 10.1038/s41597-024-03868-y.

In this study, researchers have successfully assembled a high-quality, chromosome-scale reference genome for grasspea (*Lathyrus sativus*), a legume known for its resilience to harsh environmental conditions. The assembled genome spans 5.96 gigabase pairs (Gbp), with 5.03 Gbp organized into seven pseudo-chromosomes. This comprehensive genomic resource is expected to facilitate the identification of key agronomic traits and support breeding programs aimed at enhancing the crop's adaptability and nutritional value.

The Potential of CRISPR/Cas9 to Circumvent the Risk Factor Neurotoxin β-N-oxalyl-L-α, β-diaminopropionic acid Limiting Wide Acceptance of the Underutilized grasspea (*Lathyrus sativus* L.).

Bekele-Alemu A, Girma-Tola D, Ligaba-Osena A.

Curr Issues Mol Biol. 2024, 46(9):10570-10589.
doi: 10.3390/cimb46090626.

Grasspea (*Lathyrus sativus L.*) is a protein-rich legume known for its resilience to environmental stresses, particularly drought. However, its broader cultivation is limited due to the presence of the neurotoxin β-N-oxalyl-L-α,β-diaminopropionic acid (β-ODAP), which is associated with neurolathyrism—a neurological disorder. Traditional breeding methods have developed low β-ODAP varieties, but environmental factors often influence toxin levels.

Recent advancements have identified key enzymes in the β-ODAP biosynthetic pathway, notably β-ODAP synthase and β-cyanoalanine synthase. These discoveries open avenues for precise genetic interventions. CRISPR/Cas9 gene-editing technology offers a promising strategy to target and suppress the genes encoding these enzymes, potentially reducing or eliminating β-ODAP production. This approach could enhance the safety and acceptance of grasspea as a food source.

Additionally, grasspea is deficient in sulfur-containing amino acids like methionine and cysteine. Gene-editing strategies aimed at increasing these amino acids could improve its nutritional profile, making it a more valuable crop for human consumption.

LATEST PUBLICATIONS

Investigating Genetic Diversity and Correlations Between Mineral Concentration and Neurotoxin (β-ODAP) Content in the *Lathyrus* Genus.

Abdallah F, Kehel Z, El Kalchi MA, Amri A, El Baouchi A, Triqui ZEA, Amri M, Kumar S.
Plants (Basel), Nov 2024; 13(22):3202.
doi: 10.3390/plants13223202.

Selection for domestication favored taxa characterized by fast growth and tolerance of high intraspecific density.

de Casas, R. R., Martín-Brull, I., Milla, R., & Ocaña-Calahorro, F. J.
Plants, People, Planet. 2024 Oct.
doi: 10.1002/ppp3.10596

Quantitative analysis of β-ODAP neurotoxin among different varieties of grasspea (*Lathyrus sativus* L.) flour: A comparative study.

Miah MK, Alim MA, Haque MA, Begum R.
Heliyon, 2024 Sep; 10(18):e37746.
doi: 10.1016/j.heliyon.2024.e37746.

Unveiling reproductive biology, phenology, and pollen viability in *Lathyrus* species to enhance crop improvement.

Shankar, M., Gowthami, R., Tripathi, K., Deepak, D. A., Raghavendra, K. V., & Agrawal, A.
Genetic Resources and Crop Evolution, 2024 Sep; 13:1-9.
doi: 10.1007/s10722-024-02180-3

Fabrication and characterization of novel electrospun nanofibers based on grasspea (*Lathyrus sativus* L.) protein isolate loaded with sumac (*Rhus coriaria* L.) extract.

Rezaei M., Sedaghat N., Hedayati S., Golmakani MT.
AIP Conference Proceedings, June 2024; Vol. 3184, No. 1.
doi: 10.1016/j.crfs.2024.100891.

Wild *Lathyrus*-A Treasure of Novel Diversity.

Singh A, Balech R, Barpete S, Gupta P, Bouhlal O, Tawkaz S, Kaul S, Tripathi K, Amri A, Maalouf F, Gupta S, Kumar S.
Plants (Basel). 2024 Oct 29;13(21):3028.
doi: 10.3390/plants13213028.

LATEST PUBLICATIONS

Genome editing of an oxalyl-CoA synthetase gene in *Lathyrus sativus* reveals its role in oxalate metabolism.

Verma A., Kaur L., Kaur N., Bhardwaj A., Pandey AK., Kandoth PK.
Plant Cell Rep. 2024 Nov 13;43(12):280.
doi: 10.1007/s00299-024-03368-8.

Scenario on Production, Processing, and Utilization of Grasspea (*Lathyrus sativus* L.) in Agromarginal Geographies and Its Future Prospects.

Yegrem L, Fikre A, Alelign S.
Int J Food Sci. 2024 Sep 4;2024:8247993.
doi: 10.1155/2024/8247993.

WHAT'S GOING ON AROUND *LATHYRUS*?

8TH INTERNATIONAL FOOD LEGUME RESEARCH CONFERENCE

The 8th International Food Legume Research Conference (IFLRC) and the 5th Australian Pulse Conference (APC5) will take place in Perth, Western Australia, from the 15th to the 19th of September, 2025.

IFLRC is an international forum dedicated to the production and utilization of legumes, with past conferences held in countries such as Egypt, India, Turkey, Canada, and Morocco. This year marks the first collaboration between IFLRC and APC5, which has a rich history of fostering scientific exchange and collaboration on pulses. Participants will engage with cutting-edge research and participate in practical demonstrations of legume crop cultivation, including trials focused on legume production specific to Western Australia.

The goal of both conferences is to integrate diverse scientific disciplines and connect researchers engaged in various facets of food legume studies, encompassing breeding, production, processing, consumption, nutrition, and the environmental and health impacts.

We are pleased to announce that the Fernand Lambein Fund will be supporting contributions to this conference. Stay tuned for more updates!

WHAT'S GOING ON AROUND *LATHYRUS*?

ONLINE CAFÉ: THE POTENTIAL OF GRASSPEA

Join us on March 25, 2025, at 12:00 CET for an inspiring Online Café, *The Potential of Grasspea*: *Tools, Traits, and Future Prospects*. Two distinguished researchers in the field, Dr. Anjali Verma, a plant molecular biologist specializing in β-ODAP metabolism and genetic engineering, and Dr. Carlota Vaz Patto, Principal Investigator at ITQB NOVA, Portugal, studying genetic and genomic traits, will explore innovative approaches to improving grasspea. Register here.

We invite grasspea enthusiasts from around the world to present their research at upcoming Online Cafés. If you're interested, please send a brief message with your bio and an abstract of your presentation to contact@lambeinfund.org.

WHAT'S GOING ON AROUND *LATHYRUS*?

RECIPE: Grasspea and spinach fritters

Ingredients

- 2 cups **grasspea** grain
- 1 cup chopped **spinach**
- 1 cup chopped **onion**
- 0.5 cup **rice powder**
- 1 tablespoon **onion** and **garlic paste**
- 1 tablespoon **ginger paste**
- 1 tablespoon **chilli paste**
- 0.5 teaspoon **cumin powder**
- 0.5 teaspoon **turmeric powder**
- 1 tablespoon chopped **coriander**
- 1 tablespoon **flour**
- **Salt**
- Cooking **oil**

Instructions:

Prepare the Grasspea Dal:

- Rinse the grasspea thoroughly under running water.
- Soak it in a bowl with enough water for 4-5 hours until the dal softens.
- Once soaked, drain the water completely.
- Grind into a smooth paste using a food processor or blender. (You may add a little water if needed, but keep it thick.)

Prepare the Mixture:

- In a large mixing bowl, add the dal paste.
- Add the chopped spinach, chopped onions, and rice powder.
- Mix in the onion-garlic paste, ginger paste, chili paste, cumin powder, turmeric powder, and chopped coriander leaves.
- Add flour to help bind the mixture.
- Season with salt to taste.
- Mix everything well until it forms a thick, sticky dough. (If the mixture feels too dry, add a little water; if too wet, add more flour or rice powder.)

Shape and Fry:

- Take small portions of the mixture and shape them into round patties.
- Heat vegetable oil in a deep pan over medium heat.
- Once the oil is hot, carefully place the fritters into the pan.
- Deep fry until golden brown and crispy.
- Once they turn a reddish-brown color, reduce the heat to medium and continue frying for a few more minutes to ensure they are fully cooked inside.
- Remove from oil and place on a paper towel to drain excess oil.

Enjoy!

This recipe was kindly shared by AKM Mahbubul Alam, Ph.D.

Do you have any upcoming events relevant to the Lathyrus community that you'd like to promote? Send us an email at contact@lambeinfund.org, and we'll be happy to help spread the word!

Do you have ideas to improve our newsletter or you want to suggest some contents to be covered in the future?

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