



Lucia Gutierrez

Subject: OECD Co-operative Research Programme: Sustainable Agricultural and Food Systems (CRP)

Theme 3 - Transformation Technologies and Innovation

Title: 'Advanced breeding tools for meeting sustainable production and resilience: from satellites to genes'

Host Institution: Swedish University of Agricultural Sciences (SLU)

Host Collaborator: Prof. Dr. Rodomiro Ortiz

Dates: March 1st, 2023 to August 2nd, 2023.

I give consent to have the report posted





1. What were the objectives of the research project? Why is the research project important?

Agriculture sits at the nexus of almost all of humanities grand challenges, including food security, climate change, and global poverty. Specifically, plant breeding has historically had a fundamental role in shaping agricultural practices and can therefore have a large impact in the development of a more sustainable and resilient agriculture. The goal of this fellowship is to push the boundaries of plant breeding by deploying state of the art tools from satellites to genomics to breed for sustainable agricultural systems using cereals as an example. Specifically, we will provide new designs for large genomic evaluations of breeding programs as well as improved genomic prediction methods with additional layers of phenomics and environomics to breed for emerging ecosystem services traits.

2. Were the objectives of the fellowship achieved?

Yes, the goals of the fellowship were achieved.

3. What were the major achievements of the fellowship? (up to three)

To advance the frontier of designs of experiments for large genomic and plant breeding data we worked with on a synthesis of strategies on experimental design optimization under sparse testing and genotype by environment interaction. Results from this component were presented at the Statistical Methods in Variety Testing invited-only conference held in Poznan, Poland; the International Biometrics Conference held in Riga, Latvia; the Biometrics section of the Eucarpia meetings held in Paris, France; the Applied Statistics in Agriculture conference held in West Lafayette, USA; and some seminar presentations at research institutes and Universities.

We also worked on the development of successful collaborations with academic and industry partners and pursued public-private partnerships in oat and wheat breeding. Dr. Ortiz is the Chair Professor of Genetics and Plant Breeding and is a world-leader in plant breeding with extensive experience at CGIAR centers and a long tradition of successful public-private partnerships for breeding efforts. Collaborations were established with several groups in northern Europe, and especially in Scandinavia. See below for a full list of activities and collaborations. Some of the most relevant collaborations included an invitation to submit a European project in collaboration with breeding companies and Universities in northern Europe. The project will work on adapting oats to the Arctic region for sustainable production and includes the following institutions: Lantmannen (breeding company, Sweden), Boreal (breeding company, Finland), Graminor (breeding company, Norway), Swedish Agricultural University (SLU, Sweden), Norwegian University of Life Sciences (NMBU, Norway), Finish Natural Resource Institute (LUKE, Finland), ScanOat (public-private partnership, Sweden), Irish Agriculture and Food Development Authority (Teagasc, Ireland), and the Agricultural University of Iceland (LBHI, Ireland). Other substantial collaborations included the invitation to submit a grant in collaboration with Lantmannen to develop improved genomic selection tools for developing sustainable production systems, and consulting work with BOREAL on genomic selection implementation strategies for cereals breeding for sustainable production in Finland. Additionally, collaborations were established with Dr. Bengtsson (SLU, Sweden) to work on environmental and genetic components involved in Cadmium accumulation in oat and wheat. This collaboration is an example of a public-private partnership between SLU and Lantmannen, and the collaboration will continue in the future including visit exchanges among post-doctoral fellows planned for the Spring semester. Another collaboration was established with Dr. Geleta (SLU, Sweden) to support the work on genomic selection in the clover breeding program. This collaboration is another example of a public-private collaboration, and the collaboration will continue in the future as I was invited to be a part of the mentoring committee of the Ph.D. student working on the project with an expected graduation date in the Spring of 2024. A collaboration with ScanOats, a public-private industrial research center focused on oat research, led to an invitation to be a committee member for a Ph.D. student working on the annotation of the recently sequenced and published oat genome. ScanOats was the lead institution in the oat genome sequencing. We also established collaborations with Oatly, an oat drink company with a strong focus on sustainable agricultural practices and desire of supporting breeding efforts in the U.S. Finally, I was also invited to be an opponent for a Ph.D. thesis in Norway.

In addition to the first-hand experience in these collaborations, several invitations to co-teach courses during the fellowship were instrumental in advancing ideas for new training material. I was invited to teach a





module at the SLU advanced plant breeding course in Sweden, a section of a NOVA course in genomic-based breeding tools in Norway, an international course for senior breeders in India, and an advanced breeding and quantitative genetics course at SLU for graduate students, researchers, and industry breeders.

4. Will there be any follow-up work?

Is a publication envisaged? Will this be in a journal or a publication? When will it appear?

Yes. Several publications are under development including a summary paper on experimental design optimization for sparse testing expected by the end of the year, a publication about the Cadmium project expected by next Fall, and a publication on the clover collaboration expected by next Spring.

Is your fellowship likely to be the start of collaboration between your home institution and your host?

Yes, in the short term of the fellowship, we were successful in establishing strong research collaborations that are continuing for the next few years, and that are expected to be developed into long term research collaborations.

Is your research likely to result in protected intellectual property, novel products or processes?

No intellectual property is expected in the short term.

5. How might the results of your research project be important for helping develop regional, national or international agro-food, fisheries or forestry policies and, or practices, or be beneficial for society?

This research proposal will support the sustainable agricultural development by advancing breeding cereal crops efforts for high performance to sustain a growing population while providing ecosystem services and mitigating climate change using the latest technological tools including big-data, digital tools, and genomics. Specifically, applications of genomic tools for enhanced crop breeding will increase productivity and reduce stress on natural capital.

6. How was this research relevant to:

This research proposal supports the CRP goals by strengthening the scientific knowledge and providing relevant scientific information in the area of sustainable agricultural development. Specifically, this research proposal supports breeding cereal crops efforts for high performance to sustain a growing population while providing ecosystem services and mitigating climate change using the latest technological tools including big-data, digital tools, and genomics. Specifically, this research program aligns with the 'Theme III objective: Transformational technologies and innovation' and with the 'Advanced breeding tools/genetic and genomic technologies' by developing applications of genomic tools for enhanced crop breeding increasing productivity and reducing stress on natural capital. Although not the main topic of development, our strategies heavily rely on the use of 'Digital Technologies' for advancing the genomic breeding goals.

7. Satisfaction

- Did your fellowship conform to your expectations?
Yes, the fellowship provided a great opportunity for establishing research collaborations.
- Will the OECD Co-operative Research Programme fellowship increase directly or indirectly your career opportunities? Please specify.
Yes, the fellowship provided the opportunity to expand my research collaborations in Europe. This will have a positive impact on my career advancement. Several collaborations have already created significant impact being invited to participate in large multi-disciplinary research teams in Europe and being invited to present my research broadly.
- Did you encounter any practical problems?





Not really.

- Please suggest any improvements in the Fellowship Programme.
Everything worked very smoothly.

8. Advertising the Co-operative Research Programme

- How did you learn about the Co-operative Research Programme?
A colleague who was a fellow of the program recommended it.
- What would you suggest to make it more “visible”?
Communication through established channels such as professional societies and research groups.
- Are there any issues you would like to record?
No

