

GENERICE

Generation & Deployment of Genome-Edited, Nitrogen-use-Efficient Rice Varieties

ABSTRACT

The GENERICE project aims at providing rice R&D community with tailored technical methods to develop GE-assisted improved varieties and approaches to accompany such technical innovation along its journey to the small farmers' field and to the market in developing countries.

Our strategy calls in thorough dialogue between biologists, social sciences specialists and professionals, priority use of established methods with demonstrated efficiency, exploratory research to prepare the next generation of knowledge and methods, and in-the-job training of professionals, scientists, postdoc, PhD and MS fellows.

GENERICE focuses on

- (i) proof of concept of GE-assisted improvement of a trait of agronomic interest, the nue case,
- (ii) methodological development for analysis of regulatory and social (R&S) feasibility of deployment of such product for a staple crop, rice, in the context of limited resources of biosafety regulation bodies of a developing country, Madagascar, and
- (iii) empowerment of Malagasy regulation bodies and other stakeholders in making decision regarding the deployment of new crop varieties improved through GE technology.

Research questions include:

- i. optimize CRISPR/Cas9 in rice for simultaneous KO and substitution GE, including the investigation of a non-integrative approach,
- ii. establish relationships between our main target gene BT2/OsBT, plant N status, nitrate transport genes such as NRT1.1/OsNRT1.1Bs, OsCCA1& OsELF4 clock genes, and TGA transcription factors in Arabidopsis/rice,
- iii. decipher the eco-physiological components associated with GE assisted manipulation of NUE traits,
- iv. determine the conditions for the social acceptability of the new varieties proposed with regards to potential socio-economic risks and impacts, and local demands,
- v. address the needs for capacity building or institutional adaptations to implement national biosafety legislation.

The project is complementary to GENIUS, PIA3, ImpresS and Asirpa national initiatives, CGIAR RICE program, and debates within the European Biotech Councils.

The overall output will be:

- (i) data on technical, regulatory and social feasibility of generation and deployment of improved rice varieties obtained through genome editing technology in a developing country, and
- (ii) collective "intelligence"/expertise for carrying out research on a topic subject to considerable social controversy.

Specific outputs include:

- Optimized methods for genome editing in rice;
- Proof of concept of CRISPR/Cas9-based GE as a rice breeding tool, capable of targeting simultaneously at least 2 loci;
- Proof of concept of improvement of rice for NUE, using GE technology.
- Detailed description of interactions between BTB gene NRTB genes in *A. thaliana* and in rice, comparative analysis, and options for targeting GE;
- Data on practicality of the national biosafety regulations in a developing country, established in the framework of Cartagena protocol on biosafety in relation with the International Convention on biological diversity;

- Participatory-developed recommendations on organizational and regulatory adjustments needed for enhancing the practicality of the national biosafety regulations;
- Data on stakeholders' perception of risks and opportunities associated to the use of a GMP/GE-assisted variety for a staple crop such as rice, deep-rooted in Malagasy culture;
- Empowerment of the Malagasy biosafety bodies and agronomic research institute in handling application for introduction of GMP/GE-assisted varieties in Madagascar.
- A "varietal innovation platform" for participatory breeding schemes involving farmers and other stakeholders;
- Lessons on methods for analysis of innovation systems involving crop biotechnology.

Short term outcomes (i.e. at end of the project) will include improved operational capacities of biosafety bodies in Madagascar, improved capacity of stakeholders involved in the rice value chain to steer and appropriate innovation, and improved operational capacity of the research team involved in the project in implementing GE-assisted precision breeding.

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Project leader : Gilles Trouche

Project leader's institution : CIRAD

Project leader's RU : AGAP

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