



## Sergei KUSHNIR

**Technology centre:** Food for Health Ireland (FHI), Teagasc

**Academic Mentor:** Dr. Susanne Barth

**Commercial Partner:** Goldcrop

**Commercial Mentor:** Dr. Patrick Cashman

Sergei received his bachelor's degree in Kiev State University, Ukraine, USSR. In 1983, Sergei started his doctoral degree in Institute of Plant Physiology and Genetics, Ukrainian Academy of Sciences, doing research on interspecific cytoplasmic hybrids in a family Solanaceae. Some of Sergei's achievements during his research career were the first mechanistic understanding example of nucleus-plastid incompatibility in the plant kingdom; discovery of a plant gene family that play a role in genome maintenance and stress responses; designs and development of transferred-DNA (T-DNA) vectors based on a principle of exon-trap; mosaic analysis vector system for studies of post-embryonic phenotypes of embryo lethal mutations. He was also a long-term fellow of Human Frontier Science Program (HFSP) and European Environmental Research Organisation (EERO).

### Dr. Susanne Barth

Dr. Susanne Barth is a Teagasc Senior Research Officer and a Research Associate with Trinity College Dublin (TCD). Her broad knowledge base is indispensable to increase the impact of the proposal through the exploration of the perennial ryegrass genome editing pipeline utility for trait engineering in grain crops, alternative forage grass species and bioenergy crops. Dr. Barth is a handling editor with the journal *Annals of Botany* and an editor with *Global Change Biology-Bioenergy*. Her managing experience includes coordination of the European Union FP7 funded network project, membership on external scientific advisory committees and panels.

### Dr. Patrick Cashman

The Company Mentor Dr. Patrick Cashman is a Grass and Forage Development Manager. His knowledge of grass endophytes is a very important element in applicant training. Patrick has been also working as a dairy farm manager, and a visiting researcher on dairy farms. Patrick has been involved in research and training programs, collaborated with higher education and research performing organizations; mentored students and post-doctoral researchers; is dedicated to publishing his findings and dissemination of his knowledge; has excellent social and public relation skills that enable him to promote new crop varieties among farming community.

### Food for Health Ireland (FHI) Technology Centre

Food for Health Ireland (FHI) unites world-class science and industry expertise to improve health through innovation in food. Its purpose is to identify novel ingredients coming from milk to develop functional food ingredients that will offer health benefits to consumers. FHI links world-class academic research with industry vision for the potential of successful market innovations. The industry-focused research strategy within FHI includes the identification, development and exploitation of novel milk-derived bioactive compounds for improving health and wellbeing.

## Goldcrop

Goldcrop Ltd is the largest seed assembler and wholesaler in Ireland. Grass seed, forage seed, cereal seed and protein crops supplied by Goldcrop generate the feedstock that feed the ruminant livestock sector in Ireland. Company works with various breeding partners to develop innovative cultivars that can offer solutions to the agri-food sector. Company actively works with forage breeding partners in Teagasc Oak Park to develop new grass cultivars with improved physical and chemical properties that can improve the quality of meat and milk production. Goldcrop produces and markets new cultivars produced in the Teagasc breeding programme worldwide and are profoundly aware of market demand across Europe.

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## Sergei's project

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### **“Applied genome editing to enable hybrid breeding in perennial ryegrass for the higher yield of quality animal feed that supports competitiveness, profitability and sustainability of Ireland's low-cost dairy and meat production”**

Fertile soils, a temperate climate and favourable annual rainfall profile position Ireland as a major player for farming the land to produce food, fibre and fuel. The agri-food sector in Ireland contributes a value of €24 billion to the national economy, generates 6.3% of gross value added and provides 7.4% of national employment. Ireland is the largest beef and dairy exporter in Europe and one of the largest in the world.

The research community believes that innovation must be focused on the factors that influence the quality and marketability of meat and milk produced on Irish grassland. Perennial ryegrass is by far the most important species for grassland development in Ireland. The dietary quality of the ryegrass influences the live weight gain of suckling lambs and milk protein synthesis in dairy cows. Cows grazing on rain fed grassland produce the so-called grassmilk that has excellent fatty acid profile, indicating its potential to reduce the risk of cardiovascular and other metabolic diseases.

The development of ryegrass cultivars both for increased biomass productivity, and of quality tailored to downstream industrial applications are the critical goals to maintain sustainability and competitiveness of the Ireland's agri-food sector on global and European markets. The historical success of hybrid corn and rice demonstrated that exploitation of hybrid vigour (heterosis) is an effective practical mean to enhance crop productivity. Thus, hybrid ryegrass seed production on industrial scale is the central overarching goal of the proposal.

Hybrid seed production requires human control over plant reproduction, which we will achieve by the incorporation of genome-editing technology into the ryegrass breeding pipelines. The project conclusive “know how”, accumulated in the Host Research Institution Teagasc and Irish seed company Goldcrop, will be applicable for the trait-by-design breeding of any crop within the Ireland agri-food sector interests.