Making Connections: Interdisciplinary Science to Solve Real World Problems

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Declaration of Interests

I have no actual or potential conflict of interest in relation to this presentation.
Outline

Very brief introduction to the ILSI Research Foundation

Exploring today’s theme through some examples:

- Environmental risk assessment of genetically engineered organisms
- Crop compositional data
- Micronutrient fortification of rice
About the ILSI Research Foundation

As a non-profit, public charitable organization, the ILSI Research Foundation collaborates with experts to respond to relevant issues that have a global impact through applied research, capacity building, education, and outreach.

How we work

All our programs are for public benefit and focus on contributing to long-term solutions. Multi-sectoral, multidisciplinary approach
Highlights from Around the World

In the past year, the ILSI Research Foundation’s work contributed to the following sustainable development goals (SDGs). Icons attached to each pin help signal how our work ties to the SDGs.

Zero Hunger

Good Health and Well-Being

Sustainable Cities and Communities

Responsible Consumption and Production

Climate Action

Partnerships for the Goals

In the past 12 months, our team engaged with an audience of 2,000+ people in 15 countries through meetings, presentations, seminars, conferences, workshops, and symposia. The ILSI Research Foundation website reached 21,700 users.
Environmental risk assessment of genetically engineered organisms
Risk assessment and GE plants

Image courtesy of D.J. MacKenzie, Donald Danforth Plant Science Center
“Problem formulation” in environmental risk assessment

Is the first step in framing a risk assessment

Organized and deliberative process

- Identification of relevant environmental protection goals
- Formulation of risk hypotheses: “pathways to harm”

Dynamic role and importance of sti for assessing potential adverse effects of genetically engineered insecticide-resistant non-target organisms

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Biosafety organism RNAi-based

K. Rieger | D. Schell | S. Köhler | M. Schippers

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INTRODUCTION

The term RNA interference (RNAi) is conserved across major eukaryote lineages through which gene regulatory networks are transcribed into small interfering RNAs (siRNAs) and Argonaute proteins. The homology of RNAi and its role in transcriptional silencing was demonstrated by RNA interference (RNAi) in Drosophila melanogaster (Fire et al., 1998). The discovery of the RNAi machinery in Drosophila was critical for understanding the role of RNAi in developmental biology. The mechanism of RNAi involves the assembly of an RNA-induced silencing complex (RISC), which targets and cleaves messenger RNA (mRNA) transcripts that are complementary to the siRNA sequence. This leads to the degradation of the mRNA and hence to the silencing of the gene.

Proposed criteria for identifying GE crop plants that pose a low or negligible risk to the environment under conditions of low-level presence in seed

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Biosafety organism RNAi-based

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ABSTRACT

The low-level presence (LLP) of genetically engineered (GE) seeds that have been approved in the country of origin may not the country of impact presents challenges for regulators in both the importing and exporting countries, as well as for the international scientific community. The risk posed by LLP is not yet fully understood. In addition, legal, financial and regulatory challenges, such as LLP situations, may also require an environmental risk assessment by the countries of import. Such assessments have typically been informed by the national framework established to support decision-making on wide-scale cultivation, and

Transportability of confined field trial data for evaluation of environmental risk assessment of genetically engineered plants: a conceptual framework

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Biosafety organism RNAi-based

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ABSTRACT

It is commonly held that confined field trials (CFTs) need to evaluate the potential adverse environmental impacts of a genetically engineered (GE) plant should be conducted in each country where cultivation is intended, even when relevant and potentially sufficient data are already available from studies conducted elsewhere. The acceptability of data generated in CFTs “out of country” can only be validated in practice if the agro-climatic zone where a CFT is conducted is demonstrably representative of the agro-climatic zones in those geographical areas to which the data will be transferred. An attempt to elaborate this idea, a multi-disciplinary Working Group of scientists collaborated to develop a conceptual framework and associated process that can be used by the regulatory and regulatory communities to support transportability of CFT data for environmental risk assessment (ERA). As proposed here, application of the conceptual framework provides a scientifically defensible process for evaluating if existing CFT data from remote sites are relevant and/or sufficient for local SRIs. Additionally, it promotes a strategic approach to identifying CFT site locations so that field data will be transportable from one regulatory jurisdiction to another. Application of the framework and process should be particularly beneficial to public sector product developers and small enterprises that develop innovative GE events but cannot afford to replicate redundant CFTs, and to regulatory authorities seeking to improve the deployment of limited institutional resources.

Declaration

Statements and opinions expressed in this publication are those of the authors and do not necessarily represent the views of their employers.

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Malaria in Sub-Saharan Africa

Worldwide, there are over 3,500 species of mosquitoes. Of those species, 837 are in Africa. Targeting these mosquitoes can HELP SAVE many of the 395,000 people who die from malaria in Africa EVERY YEAR. The vast majority of which are children.

Target Malaria's work specifically targets only 3 species: Anopheles gambiae, Anopheles coluzzii, Anopheles arabiensis.

Image courtesy of D. Thizy, Target Malaria
Gene Drives – Spreading Desirable Traits

Normal inheritance

Gene drive inheritance

www.ilsirf.org
Gene drives are challenging for ERA

Although the concept is not new and gene drives exist in nature, gene drive organisms are very different from GE organisms that have been previously released (predominantly plants)

- Intended to spread and potentially persist in nature
- May cause substantial changes to ecosystems or biodiversity
- Address very different problems than previous GE organisms

Hype and deliberate misinformation are already creating confusion about the potential risks from the use of gene drives
Problem formulation
- Plan of action/use
- Plausible hazards
- Exposure pathways
- Assessment endpoints
- Limits of concern

Hazard and exposure characterisation
- Routes of exposure
  - Planned
  - Unintended
- Rate and scale of exposure to hazards
  - Literature
  - Lab experiments
    - Lab or cage observation
    - Models
- Explicit uncertainty

Risk characterisation
- Distributions of outcomes
- Assumptions
- Evidence
- Conflicting evidence or opinion

Management strategies
- Standard operating procedures
- Responsive management
- Capacity and competence
- Operational assurance

Risk conclusion
- With National Regulatory Authorities
  - Approval
  - Approval with management
  - Not approved
- With local communities/other stakeholders
  - Accepted
  - Not accepted

Image courtesy of D. Thizy, Target Malaria
Gene drives present a somewhat unique challenge in regard to environmental risk assessment

- The “driving” nature of the genetic element makes realistic testing in the environment unlikely
- In addition the way a drive functions in the environment may provide critical information to inform the risk assessment

It is generally expected that modelling will provide a much more substantial role for informing ERA than with previous genetic technologies (i.e. GE crops and insects)

*Gene Drive Modeling Conference* (June 11-12) + webinars
Crop composition data

**Primary Search Criteria**

The first step in searching the Crop Composition Database is to select your primary search criteria to filter the data sets.

You must select one Crop Type and one Tissue Type. You can further filter your results by optionally choosing one or more Crop Years, and Locations.

To select contiguous items, press the Shift key and highlight the items. To select more than one non-contiguous item, hold the Control key and click on the selected items.

If you make no selections other than Crop Type and Tissue Type, all data sets for the chosen Crop-Tissue selection will be included.

**Crop Source / Crop Type / Tissue Type**

- **Crop Type**: Apple - Malus domestica
- **Tissue Type**: Golden Delicious

**Crop Year**

- All Years
- 2017
- 2016
- 2015
- 2014

**Location**

- **Country(s)**: CANADA
  - CA - ALBERTA
  - CA - MANITOBA
  - CA - ONTARIO
  - CA - QUEBEC
  - CAPE VERDE
  - CAYMAN ISLANDS
  - CENTRAL AFRICAN REPUBLIC
  - CHAD
- **Region(s)**: All Regions

**Analyte Filters (Optional)**
ILSI Crop Composition Database

Provides analytical data about the natural variability of crop composition (nutrients and anti-nutrients) of conventional crop varieties

Data uses:
- Assessment of natural variation
- Nutritional studies
- Nutritional components of interest for breeding
Data acceptance criteria

Production of Samples

- Known field trials (plot location, region, country), agronomic (seeding and harvesting date) and genetic data \textit{i.e.} variety name

Sample Collection

- Composite sample from representative plants from one plot
- Adequate storage to ensure no nutrient degradation
- Known sample chain of custody of the samples from harvest to analysis including storage conditions, must be known (traceability)

Sample Analysis

- Samples analyzed within 12 months
- Analyses by accredited/certified/experienced laboratories, and analyses done with validated methods and certified/historically verified standards
Micronutrient fortification of rice in Sub-Saharan Africa
Summary remarks

Meeting the food and nutrition security demands of our current and projected global population is an enormous challenge.

Engaging in interdisciplinary research that looks at food systems holistically is essential to meeting this challenge.

Opportunities for interdisciplinary research are strengthened by including other non-traditional partners.