Gene Editing
What it is, how it works and what’s being developed

August 2023
HELPING TODAY’S FOOD SYSTEM BUILD CONSUMER TRUST
Trust is every organization’s most valuable intangible asset
CFI PROGRAM FOCUS: Key Areas Impacting Trust

- Sustainability
- Health & Well Being
- Food Security
- Innovation
A Critical Time For Innovation in Agriculture
Chatham House Rules

In order to encourage meaningful and open discussion, this session is held under Chatham House Rules. You are free to use the information received, but neither the identity nor the affiliation of the speaker(s), nor that of any other participant, may be revealed unless explicitly approved by the speaker or participant.
Why We Need Ag Technology

- Historically, there has been low felt need for new technologies in food and ag
- That has changed due to:
  - COVID-19 pandemic
  - Global supply chain disruptions
  - Food inflation
  - War in Ukraine
  - Climate change and localized severe weather events
  - Concerns about animal welfare
  - Farm sustainability
Gene Editing Defined

Gene editing encompasses a suite of technologies that can be designed to cut, or otherwise alter predetermined DNA sequences in the genome and result in targeted insertions, deletions or other changes for genetic improvement.

(Definition from the CFI Coalition for the Responsible Use of Gene Editing)
Plants, Animals and Microbes
Pivot Bio PROVEN N40
A BETTER NITROGEN FOR CORN

The Nitrogen You Need. Now On-Seed.

Predictable Nitrogen for Your In-Furrow Program.
PRRS Resistant Pig

What’s Driving the Pork Industry in 2023?

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INTRODUCING CONSCIOUS FOODS

Whether it's the food you eat or the causes you support, you consciously make decisions that feel right for you.

LEARN MORE →

JOIN THE CONSCIOUS MOVEMENT FOR EXCITING NEWS AND SPECIAL OFFERS
Gene Editing Democratizes Biotech

- First generation biotech in agriculture was expensive to develop and took a decade or more to clear regulatory hurdles. The total cost of bringing a biotech crop to market often exceeded $100 million.
- The high cost of development and approval meant only the largest companies were involved in development.
- The economics of development meant that new varieties were limited to the largest commodities with a singular focus on agronomic traits.
Gene Editing Democratizes Biotech

- The relative affordability of gene editing technology is stimulating development and investment across sectors.
- In 2021 alone, more than $1.3 billion was invested in gene editing research and development.
- Researchers are developing new applications to address a wide range of challenges in human medicine and agriculture.

Source: SM Strategic Market Research
Gene Editing Democratizes Biotech

- Gene therapy in human medicine holds promise for treating a wide range of diseases, such as cancer, cystic fibrosis, heart disease, diabetes, hemophilia and AIDS.
Gene Editing Democratizes Biotech

• Currently there are 3,649 gene therapies being developed for human medicine – 49% targeting cancer. 32 gene therapies are currently approved for people.

• In agriculture, more than 500 products are being developed globally in crops of interest, with the private sector responsible for 43% of product development.

• 5% of products are in pre-commercialization with 49% in the advanced research phase.

• 55% of products being developed are grains or oilseeds.

• 23% vegetables, 7% fruit, 3% each for ornamentals, legumes and forages and grasses.

Source: SPGlobal & American Society for Gene and Cell Therapy
Gene Editing is Software for Agriculture

- Gene editing allows developers to make precise changes in the genome to achieve a beneficial outcome without introducing foreign DNA.
- Like software, farmers can choose to use gene edited plants, animals or microbes based on their markets and needs.
- Food companies can work with their supply chain to order the “software” that can help them meet specific needs.
Illustrations of How Gene Editing is Being Applied
Our Panel

Sarah Davidson
Evanega
Pairwise

Marc Cool
Corteva

Lucina Galina
PIC

Christi Dixon
Benson Hill
Gene Editing
Consumer and Market Acceptance
August 2023
Current and emerging technologies offer many solutions for farming and food production.

Market and consumer acceptance is imperative to realize the benefits they deliver.
When Acceptance Fails...
Technologies that Failed to Achieve Potential

- U.S. Army developed irradiation in 1950s to kill germs that cause foodborne illness. FDA approved for use on red meat in 1997.

- CDC estimates irradiating half of all ground and processed meat would prevent **900,000 cases of foodborne illness and 350 deaths each year.**¹

- Irradiated ground beef sales never took off because consumers associated it with radiation.

- Approved by USDA in 2014, The Simplot Innate Potato produces less acrylamide, a potential carcinogen formed when potatoes are fried. (Industry average cost for GMO product development - $136 million)

- Before approval, McDonald’s announced it would not use the potatoes, even though Simplot supplies the vast majority of McDonald’s fries.

¹. Centers for Disease Control 2. WISTV 3. Scientific American
Technologies that Failed to Achieve Potential

- Improvest developed by Zoetis, approved by FDA in 2011 as a chemical alternative to physical castration in pigs.
- Improvest can also affect humans. Men and women of childbearing age should use extreme caution and use protective equipment.
- Improvest is not widely used due to concerns of worker safety and consumer perceptions.\(^2\)
What Drives Consumer/Food System Acceptance?
Very positive or somewhat positive impression of use of technology to grow food in the U.S. today

2 out of 3 consumers

Millennials and Early Adopters are more positive
Target Market Influences Acceptance
A Higher Bar
Rogers’ Model - Adoption/Diffusion of Innovation

**Early Adopters** - Opinion leaders and influencers who adopt innovations early and have a high degree of social status.
Highly Predictive Research Model

R² for all technologies tested was between .76 and .84
Factors Driving Consumer Acceptance

Belief that food resulting from technology use is safe to consume

Information on food produced through technology is readily available so consumers can make an informed, voluntary choice

Benefits outweigh perceived risks

Technology can help ensure a consistent supply of food

Technology promotes greater sustainability by making more with less environmental impact
# Factors Driving Food System Acceptance

<table>
<thead>
<tr>
<th>Likely to Increase Acceptance</th>
<th>Likely to Increase Rejection</th>
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<tbody>
<tr>
<td>• Consumers will accept it</td>
<td>• Consumers will not accept it</td>
</tr>
<tr>
<td>• Improves profitability by increasing sales, reduces costs or improves efficiency</td>
<td>• Insufficient testing or proof that it is safe</td>
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<td>• Scalable to be commercially viable</td>
<td>• Potential supply chain problems</td>
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<td>• Aligns with company values</td>
<td>• Serves no clear purpose for the company – low “felt need”</td>
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<tr>
<td>• Fills an existing market need</td>
<td>• Lack of regulatory approval; not accepted in international markets</td>
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<td>• Gives consumers more choices</td>
<td>• Cost considerations</td>
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CFI Trust Building Strategies for Ag Tech Companies

Conduct research to better understand customer and consumer awareness, comprehension and opinions about an emerging application.

Study successful tech introductions and use these case studies to inform product development, launch and external strategies.

Engage with key influencers early in the process.

When engaging with food companies, emphasize how technology can help mitigate pain points like affordability, production costs, food shortages and supply chain disruptions.

Introduce the technology – or resulting products – at a price point that aligns with benefits and value to the marketplace.
Adoption/Diffusion Stages + CFI Research & Insights
CFI Research and Insights – Factors Impacting Acceptance

**Individual is exposed to new product or idea**

1. Communication channels
   - Identify the channels most relevant to your target.
   - Channels vary widely. Hyper-targeting allows for efficient impact.
2. Content
   - Create concise, compelling content that aligns with values of target to create felt need.
   - Focus on impact. What are the benefits to your target and those downstream?
3. Leverage Early Adopters/Opinion leaders
   - Cultivate relationships and secure content to leverage their credibility and influence.
   - Transfer the credibility and trust in these individuals to your technology.
Adoption/Diffusion + CFI Insight

**Interest in learning more**

1. Relative advantage
   - Is it better than current option?
   - Belief that previous/natural is better.

2. Compatibility
   - Does it fit with existing tech, values, beliefs or lifestyles?
   - Is it aligned with cultural values/personal identification?

3. Complexity
   - Is it easy to use or understand?
   - Attitudes toward new technology?

4. Trialability
   - Can I try it before I buy it?
   - Voluntary exposure/perceived control.

5. Observability
   - Can I see or experience the benefits or results?
   - Positive or negative images associated with the technology.
CFI Research and Insights – Factors Impacting Acceptance

Analysis and consulting with others to determine whether to accept or reject

1. Information availability
   - Assure accurate information is easily accessible to support informed decisions.
   - Transparency is the foundation of trust.

2. Comparative advantage
   - Is this better than the current option(s) for MY needs?
   - Consider the advantage in cultural context? What constitutes “better” for your target?

3. Social proof
   - Do peers, influencers and others I respect endorse or use?
   - Leverage testimonials and case studies from influencers.
CFI Research and Insights – Factors Impacting Acceptance

Product, service or subscription purchased
1. Training, education and technical support
   • Hands-on training, user manuals, online tutorials. Assuring adequate resources are available for successful implementation builds confidence in the new application. That includes consistent technical support and the flexibility to customize if possible.
2. Change management
   • Comprehensive strategy and adequate support to implement new processes and procedures.
   • Enthusiasm from internal champions inspires others. Regular evaluations and feedback will increase the likelihood of success.
CFI Research and Insights – Factors Impacting Acceptance

Finalizes and affirms decision

1. Performance feedback
   • Provide metrics, success stories, testimonials etc. that demonstrate the value of the innovation.
   • Providing feedback reinforces the decision to purchase and encourages continued use.

2. Continuous support
   • Provide further training and upskilling to empower and increase confidence.
   • Creating platforms, or social networks where adopters connect and share experiences, encourages continued engagement.

3. Reinforcement of benefits
   • Highlight new features and benefits to maintain interest and enthusiasm.
   • Reinforce satisfaction by reminding users of the value of the innovation.
Framework for Responsible Use of Gene Editing in Agriculture
About the Coalition

Vision:
Global acceptance and support for the responsible use of gene editing technology in agriculture and food.

Mission:
To cultivate support for the responsible use of gene editing in agriculture through the development and adoption of trustworthy guidelines for the responsible use of gene editing, effective stakeholder outreach and engagement, and broad-based involvement and collaboration of those engaged in gene editing.
Developing the Framework

1. Establish Diverse Steering Committee
2. Identify Other Models that Achieve Similar Outcomes
3. Identify Common Principles
4. Develop Framework
5. Gather Stakeholder Input
6. Approval from Coalition Leadership Team
7. Launch
Framework Steering Committee

**Civil Society**
- Center for Science in Public Interest
- The Nature Conservancy
- World Wildlife Fund

**Academic**
- Cornell University
- Creighton University

**Food Companies**
- Costco Wholesale
- PepsiCo

**Tech Developers**
- BASF Agricultural Solutions
- Benson Hill Biosystems
- Corteva AgriScience
- Genus
- Pivot Bio

**Associations**
- American Seed Trade Assoc.
- FMI – The Food Industry Assoc.

**Farmers**
- Good Cattle Co. (soybeans)
- Paustian Enterprises (pork)

*Participation in the Steering Committee does not imply endorsement by the individuals or their organizations.*
Principles

Reviewed other voluntary governance models and identified seven major Principles.

- Transparency
- Continuous Improvement
- Safety & Quality
- Verification
- Trade & Market Considerations
- Stakeholder Engagement
- Social Considerations
Commitments and Guidance

• Each principle within the Framework includes commitments and guidance that provide objective evidence that an organization is operating in conformance with the Framework.

• Organizations must meet 75% of the applicable commitments to achieve verification.

• Specific commitments that are foundational to a principal are mandatory to achieve verification.
Formal Endorsements to Date
Verification and Market Requirements

Costco Wholesale is the first retailer/food service company to require verification. They have started to train all their buying staff so they can confirm with suppliers that the developer of any gene edited product or ingredient derived from gene editing technology in the Costco supply chain has achieved verification and is in conformance with the Framework for Responsible Use.

Corteva Agriscience is the first company to achieve verification in the Framework. Two other companies are preparing for the process.
Learn more

Website: www.geneediting.foodintegrity.org
Email: geneediting@foodintegrity.org
Build Trust in Ag Tech Resources
Transparency Summit

November 14-15, 2023

Loew’s Chicago O’Hare Hotel | Chicago, IL

- The CFI Transparency Summit brings together leaders and stakeholder organizations from across the food/ag value chain.
- The Summit will feature learning sessions and workshops, keynote presentations and networking opportunities.
- A shared interest in building trust through transparent practices and balanced discussion.

250+ Attendees | 20+ Speakers | 10+ Sessions

Transparency As the Currency of Trust

- Build Trust & Drive Relevant Change
- Speed Progress Towards Climate Goals
- Build a More Sustainable & Resilient Food System
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