Gene Editing: Providing Benefits to Animal Agriculture

February 21, 2019
World Leading Animal Genetics

- 50,000+ Customers
- 70+ countries
- >2700+ employees
Genetics Evolution

**Domestication**
- 13,000 BC

**Selective breeding**
- 1900 AD
- 2000
- 2010
- 2015

**Directed recombination?**

**Efficiency & sustainability**
- Prolificacy, feed efficiency, health & robustness

**Meat quality**
- Taste, leanness, yield

- Darwin develops evolution theory
- Mendel ‘invents’ genetic science
- Shull describes heterosis
- Watson & Crick describe DNA molecule
- First transgenic Crop introduced
- Cost to sequence drops factor 1000 in 3 years
- Human Genome Project completed
- PIC introduces relationship Based Genomics
- Gene editing ‘invented’
- MU & PIC develop PRRS resistant pig
Selective Breeding Works

<table>
<thead>
<tr>
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<th>1960s</th>
<th>2010s</th>
<th>Change</th>
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<tbody>
<tr>
<td><strong>Prolificacy</strong></td>
<td>14 pigs Per year</td>
<td>28 pigs Per year</td>
<td>+100%</td>
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<tr>
<td><strong>Feed conversion</strong></td>
<td>900 lbs of feed each pig</td>
<td>550 lbs of feed each pig</td>
<td>-40%</td>
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<tr>
<td><strong>Meat quality</strong></td>
<td>75 lbs of lean each pig</td>
<td>120 lbs of lean each pig</td>
<td>+60%</td>
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Manure per lbs of lean meat reduced by more than 60%
PRRSv causes losses along the pig life cycle

- **Sow farm**
  - Sow mortality
  - Abortions
  - Stillborns
  - Pre-wean mortality

- **Nursery**
  - Low weaning weight
  - Morbidity
  - Mortality

- **Finishing**
  - Morbidity
  - Mortality
  - Slow growth
  - Poor feed efficiency

- Animal suffering – increased use of antibiotics –
- Lower farm productivity – larger environmental footprint –
The Promise of Gene Editing

Source: University of Missouri, “Gene-edited pigs are protected from porcine reproductive and respiratory syndrome virus” Published 2015 in Nature Biotechnology by Prather et. Al.
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Genus Edited Animal Generation & Commercial Pyramid

L02

L02 E0

L02 E0

L02

E1

Genus PLC confidential

Genus PLC confidential
The Genus Journey to Commercialization

Technology
- Validation of technology
- No unintended consequences

Regulatory
- Approval in key markets
- International harmonization

Market acceptance
- Industry willing to produce
- Consumers willing to eat
Genus Position on Regulatory for PRRSv Technology

• **Strongly supports the appropriate regulation of gene editing technologies.**

• **Needed:** common sense, science-based and structured regulatory pathway for such technologies that meets three main criteria:
  – (1) Be focused on food safety;
  – (2) Be practical and science-based so as not to stifle innovation; and
  – (3) Provide clarity on the scope of regulatory jurisdiction across agencies.

• **We believe these specific criteria would create a common-sense regulatory environment that would stimulate innovation and discussion around technology, ensure food safety and further build transparency and trust in modern agriculture.**
International Regulatory Opinions on Gene Editing Vary

More favorable to gene editing

- Gene edited animals considered “non-GMO” if trait exists in nature
- Animals without foreign DNA not regulated as GMO (initial indication)
- Pre-market assessment required if edited trait is novel to the animal
- Gene Editing regulated through FDA Guidance 187

Less favorable to gene editing

- Gene edited animals regulated as GMO, for which implementation rules are lacking
- Gene edited animals considered GMO thereby subject to adverse regulation
- Bans cultivation & breeding of GM/GE plants/animals – no ban on imported food or feed products
It’s all about Responsibility

• We are committed to the responsible use of gene editing technology.
  – We understand that there are risks.
    • We’re engaging the best and brightest.

  – We know that many consumers will have questions.
    • We want to engage in a robust dialogue with customers and consumers about how this technology can benefit them.

  – We want to build trust.
    • We’re engaged in several coalitions dedicated to building consumer engagement and improving understanding of gene editing.
    • We’re gathering research that unequivocally demonstrates the benefit of this technology to animal health and wellbeing.
Genetics Evolution, Not Revolution.

13,000 BC  
Evolution

2016  

Revolution?

2020  

Genus Vision: Pioneering animal genetic improvement to help nourish the world.