

Announcement Information Digest

Genus tackles major pig disease with breakthrough technology

ABOUT THIS DOCUMENT:

On 8th December 2015, Genus plc announced an exclusive global licensing agreement with the University of Missouri for intellectual property relating to Porcine Reproductive and Respiratory Syndrome Virus (“PRRSv”) resistant pigs. The press release and more information about the company can be found online at www.genusplc.com.

This information digest provides an additional resource to support the announcement, including important facts about the disease and technology used. It also delivers answers to frequently asked questions around the topics raised. The document is intended to act as a handy compendium for those interested in finding out more about the news or those seeking materials to support their own onward communication of the facts surrounding the breakthrough discovery and Genus.

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KEY FACTS ABOUT THE ANNOUNCEMENT

- As a pioneer in agricultural biotechnology, Genus is committed to the responsible exploration of new technologies that benefit the health and well-being of livestock, farmers and ultimately consumers.
- Genus is developing breakthrough technology designed to alleviate the impact of a devastating disease in the pork industry. This innovation will lower the impact on the animals, improve their well-being, and improve farm productivity, which will help meet global demand for pork products.
- The currently incurable disease called Porcine Reproductive and Respiratory Syndrome Virus (“PRRSv”) seriously affects global pork production, causing suffering or often premature death of millions of affected pigs every year.
- PRRSv is a devastating disease that can cause persistent infection in pigs and lead to reproductive failure, reduced growth and premature death.
- In addition to improvement in animal well-being, the ability to breed PRRSv resistant pigs has potential for significant benefits in sustainability. PRRSv causes premature death and reduced productivity in pigs. This leads to the waste of feed, water, energy and other resources given to pigs affected by PRRSv. This waste could be avoided if PRRSv is eliminated.
- Genus has announced an exclusive global licensing agreement with the University of Missouri for the intellectual property that resulted in the technology responsible for PRRSv resistant pigs.
- This is early stage technology, and it will be at least five years until disease resistant animals are available to pig producers.
- Genus-PIC has a long-standing reputation for genetic improvement and responsible development of technology. This innovation towards breeding of PRRSv resistant pigs is another example of Genus pioneering animal genetic improvement to help nourish the world.

ABOUT PRRSV

- Porcine Reproductive and Respiratory Syndrome Virus (“PRRSV”) has challenged the swine industry in many parts of the world for more than 25 years. It is the most significant pig disease faced by many farmers.
- PRRSv is a devastating disease that can cause persistent infection in pigs and lead to reproductive failure, reduced growth and premature death.
- There is currently no cure for the disease, which leads to the suffering or death of millions of animals each year. Current treatment has limited effectiveness.
- PRRSv is considered to be the most burdensome viral disease of pig farms in Asia, Europe and North America. Financial losses are mainly due to increased death loss, poor reproductive performance and increased use of vaccines and medications. Secondary diseases following a PRRSv outbreak on a farm can further reduce productivity and lead to additional costs. Diagnostic testing and herd monitoring after a PRRSv introduction are necessary to develop comprehensive control or eradication strategies, which are costly and have limited effectiveness.
- A 2011 Iowa State University study estimated PRRSv cost the U.S. pork industry \$664 million per year. This translates into \$1.8 million per day or \$115 per sow annually. The previous economic study in 2005 calculated PRRSv losses at \$560 million annually, which suggests the problem is growing.
- At the European PRRSpective Symposium 2015 it was revealed that in Europe alone PRRS is now believed to be costing more than 1.5 billion euros per year. Inevitably the impact varies widely from one country to another in Europe, but in most cases the cost is estimated between 5 and 10 euros per marketed pig or 100 and 200 euros per sow per year.
- In 2006, a more severe form of PRRSv decimated pig populations throughout China. According to the China Animal Disease Control Center (CADC), in the summer of 2006, a new severe variant of PRRSv affected over 2 million pigs. Pigs infected with PRRSv often die as a result.

ABOUT GENE EDITING TECHNOLOGY

- The results produced are encouraging, but they are early stage and based on small proof of concept studies. To verify the safety and efficacy of this process, numerous additional trials will be conducted, which will take a significant period of time. We are several years from market availability.
- Gene editing allows precise changes to be made in the genome of the animal without introducing genetic material from another organism. In the case of the PRRSv resistant pigs, small changes were made to remove a single gene from the pigs that produces a protein, known as CD163. The CD163 protein is required by the PRRS virus for infection to occur. The gene editing technology used to create protection from PRRSv does not involve transplanting genes from one species to another.

ABOUT GENUS' LICENSING AGREEMENT FOR PRRSV RESISTANT PIGS

- Genus has signed an exclusive global licensing agreement with the University of Missouri (MU) for the intellectual property that resulted in the technology responsible for “PRRSV” resistant pigs.
- Using precise gene editing, MU was able to breed pigs that do not produce a specific protein necessary for the virus to spread in the animals.
- The MU technology is the result of a longstanding collaborative R&D effort and the results were recently published in the preeminent scientific journal Nature Biotechnology in December 2015 (“Gene-edited pigs are protected from porcine reproductive and respiratory syndrome virus”).
- Pigs produced with the MU technology were shown to be fully resistant to the PRRS virus strains tested. The early stage studies conducted by the University demonstrate that these PRRSv resistant pigs, when exposed to the virus, do not get sick and continue to gain weight normally.
- Given the impact of PRRSv, pork producers have for many years been interested in ways to safeguard their animals against the impact of this disease. Therefore the introduction of a disease resistant pig is a potential game changer for the pork industry.

ABOUT RESPONSIBLE PIONEERING OF NEW TECHNOLOGY BY GENUS-PIC

- Genus is a world leader in applying responsible innovation to animal genetics, creating advances through technology and selling added value products to help farmers and food producers nourish the world.
- Genus has a long association with research institutions across the globe with significant research capabilities in this area.
- We believe the potential benefits of this technology are significant and it is prudent for us to explore possible benefits for animals, farmers, and consumers.
- At Genus we are always focused on how to improve outcomes for our customers. We are dedicated to helping customers thrive. We anticipate their needs and help them seize opportunities, acting as partners to improve quality, safety, and affordability.
- We recognise that, with new technologies, there will be discussions about appropriate application in society. As a responsible corporate citizen, Genus is ready to actively take part in that discussion.
- As a global business Genus knows from experience that technology acceptance varies in our different markets. We are committed to meeting customers' technology needs with transparency and in a way that respects these differences and is responsible.

FREQUENTLY ASKED QUESTIONS

1. What is PRRSv?
2. Where did PRRSv come from?
3. Is herd size or housing environment a factor in the spread of PRRSv?
4. How is Genus helping to combat the disease?
5. What is 'gene editing'?
6. How does gene editing differ from genetic modification (GM) as it is understood today?
7. When will Genus be able to offer disease-resistant pigs to customers?
8. Have PIC customers expressed interest in this?
9. What is Genus' perspective on food labelling?
10. How will this innovation impact sustainability of pork production?
11. What other gene editing projects is Genus considering?

1. What is PRRSv?

Porcine Reproductive and Respiratory Syndrome virus (PRRSv) belongs to a group of arteriviruses which can cause severe disease, persistent infection and often premature death in pigs. The disease symptoms caused by PRRSv were first reported in the United States in 1987 and in Europe in 1990. Infection with PRRSv results in respiratory disease for the pig including cough and fever, reproductive failure during late gestation, and reduced growth performance. The disease leads to suffering or premature death of millions of pigs each year, and current treatment is expensive with limited effectiveness.

2. Where did PRRSv come from?

The precise origins of the disease are unknown. There are areas in the world that are free from the virus, and the pig farms in these areas operate under similar management styles as farms in regions that suffer from PRRSv outbreaks. The virus has been identified in farms of a variety of sizes and with a range of housing environments. Genus-PIC is focused on developing genetics that are resistant to this devastating disease, which will reduce the unnecessary animal suffering and help meet global demand for pork.

3. Is herd size or housing environment a factor in the spread of PRRSv?

PRRSv does not discriminate. Unfortunately, the virus has affected thousands of pigs in herds of varying sizes and housing environments. Regardless of farm size, the pigs in any herd infected with PRRSv are dealt a devastating blow. The utmost priority is to improve the health and well-being of pigs and reduce the suffering created by the disease.

4. How is Genus helping to combat the disease?

Using precise gene editing, the University of Missouri (MU) was able to breed pigs that do not produce a specific protein necessary for PRRSv to spread. The early stage studies conducted at MU have bred the first pigs known to be resistant to PRRSv. When exposed to the virus, these pigs do not get sick and they continue to gain weight normally. This long-term research study was conducted in collaboration with Dr. Randy Prather at the University of Missouri and the results were recently published in Nature Biotechnology, a peer-reviewed scientific journal.

5. What is 'gene editing'?

Gene editing allows precise changes to be made in the genome of the animal without introducing genetic material from another organism. In the case of the PRRSv resistant pigs, small changes were made to inactivate a single gene from the pigs that produces a protein, known as CD163, which the PRRS virus requires for infection to occur. The gene editing technology used to create protection from PRRSv does not involve transplanting genes from one species to another.

6. How does gene editing differ from genetic modification (GM) as it is understood today?

'Genetic modification' takes many forms. The earliest 'genetic modifications' of livestock were the domestication events which occurred thousands of years ago. These days, people using the term GM are often referring to transgenic genetic modification technologies. In transgenic genetic modification, the genetic material of the organism has been altered by the addition of genetic material from another species. These types of transgenic 'genetically modified organisms' would likely not exist if not for human intervention. The gene editing technology used to create protection from PRRSv does not involve transplanting genes from one species to another; rather it involves the simple inactivation of one of the pig's gene products.

7. When will Genus be able to offer disease-resistant pigs to customers?

This is early stage technology, and it will be at least five years until disease resistant pigs are available to pork producers.

8. Have PIC customers expressed interest in this?

Given the devastating impact of PRRSv for nearly three decades, pork producers have been very interested in ways to protect their animals against this disease. The introduction of a disease resistant pig is potentially a game changer for them. We are always focused on ways to improve animal well-being, enhance productivity and help pork producers and consumers thrive.

9. What is Genus' perspective on food labelling?

We believe that consumers should have access to information about what is in their food and how it was grown or produced. Research indicates consumers are interested in a wide range of issues including ingredient sourcing, treatment of workers, animal care practices, environmental impact, etc. While that is more information than can be practically captured on a label, we encourage the food chain to continue exploring ways to provide consumers the information they want about the food they eat. Those sources could include websites, bar codes on packages, and other systems that would allow consumers to access more information.

10. How will this innovation impact sustainability of pork production?

The ability to breed PRRSv resistant pigs has potential for significant benefits in sustainability. PRRSv causes premature death and reduced productivity in pigs. This leads to the waste of feed, water, energy and other resources given to pigs affected by PRRSv. This waste could be avoided if PRRSv is eliminated.

11. What other gene editing projects is Genus considering?

We constantly assess opportunities that may improve the health and well-being of animals and help livestock farmers to thrive. As we do so, we are always guided by our core values, including "Responsible" and "Pioneering". As a responsible corporate citizen, we explore new technologies with ethical practice and in line with all relevant regulations. In areas of innovation, our aim is to balance pioneering animal genetic improvement with the safe and responsible use of technology to help meet animal protein demand.

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