Field experiences and new observations with PRRSv L1C.5 and other virulent PRRS viruses

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About myself….

College of Veterinary Medicine
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- DVM: University of Minnesota
- PhD: University of Minnesota – Influenza A virus epidemiology

- Holden Farms, Inc. (Northfield, MN, USA)
  - Veterinarian and research lead (2009-current)

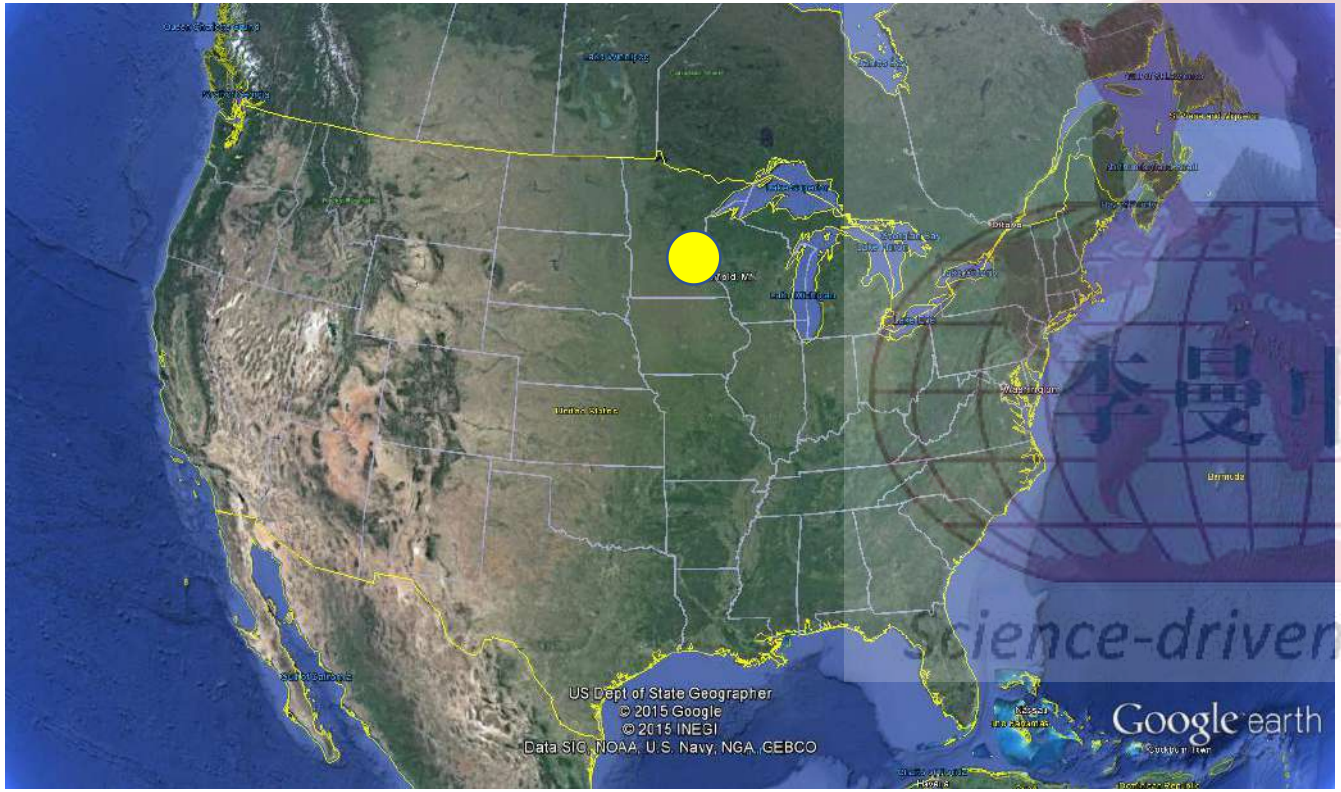
HOLDEN farms

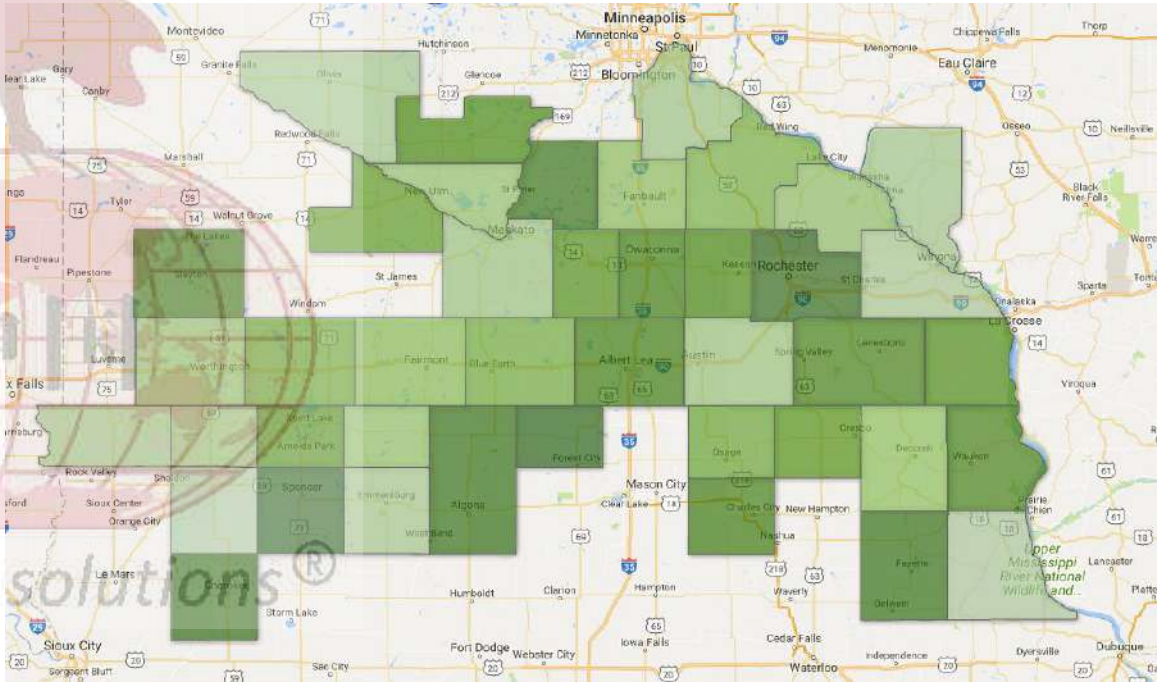
Holden Farms today

- Based in Northfield, MN, USA
- 100% Family Owned
  - 5th Generation
- Primary focus is the hog division
  - Sell ~1.7 million hogs/year
  - Also sell ~500,000 turkeys/year
  - Half owner of Daisyfield Packing in Sandusky, Ohio ~ 800,000 hogs/year

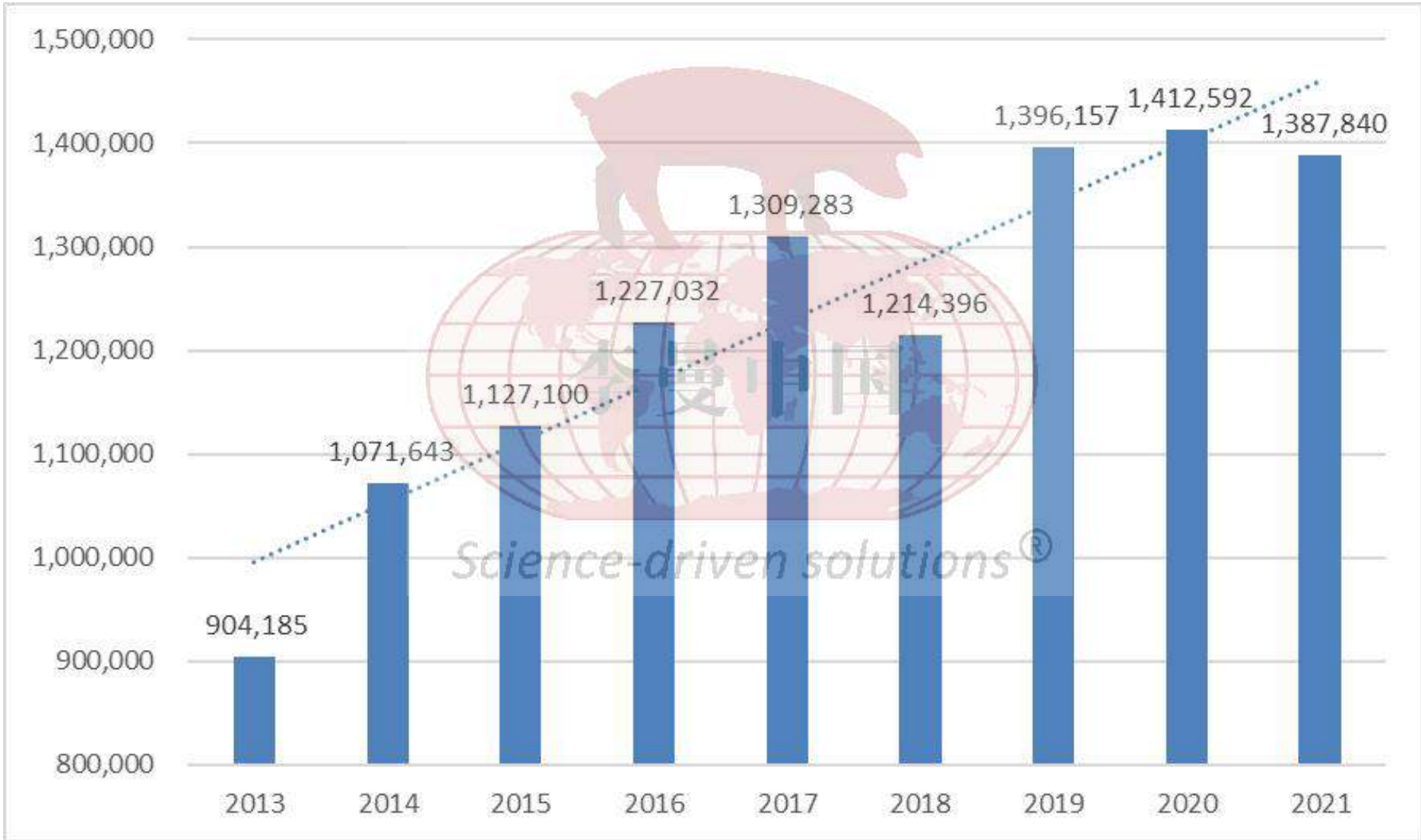
HOLDEN FARMS
50
YEARS
1970 - 2020

Holden Farms territory/area



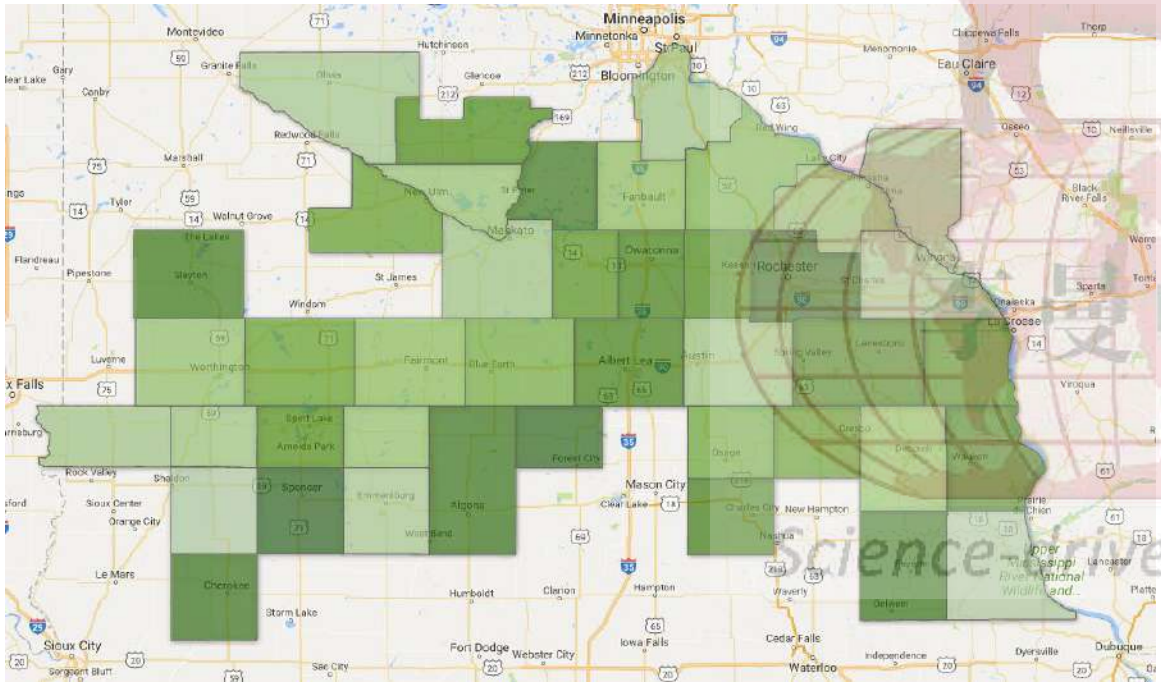


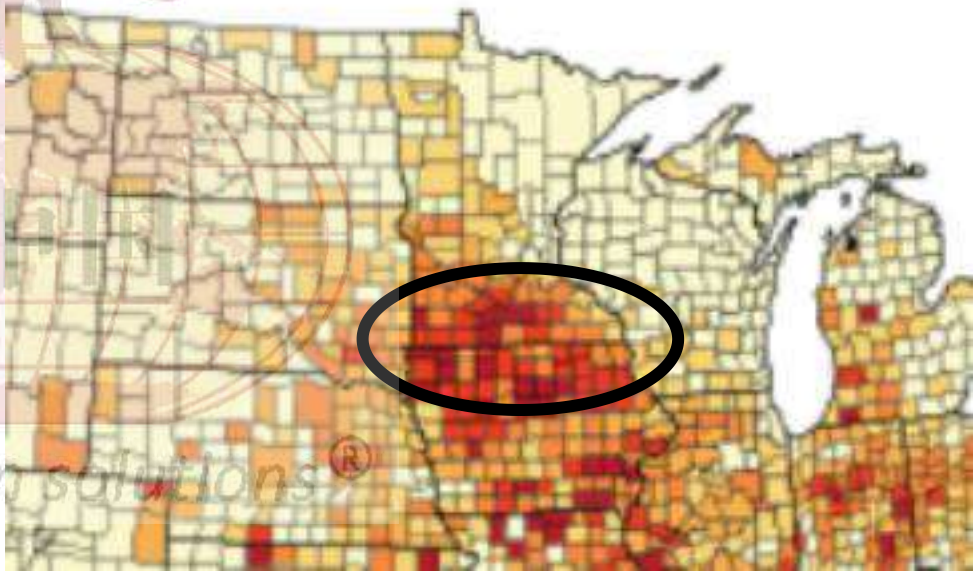
Market hogs - Sales growth



Sow inventory

PRRSv – continues to be a challenge……





PRRSv terminology

- Refining PRRSV-2 ORF5 genetic classification system (Yim-im et al., 2023, VanderWaal et al., 2024)
  - Lineage (L1), sub-lineage (L1C), and variant (L1C.5)

1 2 3

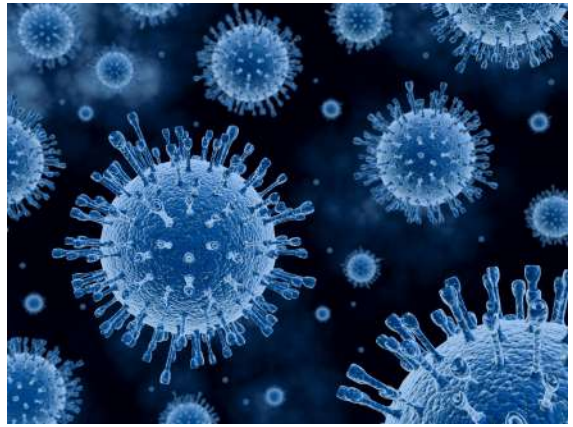
- RFLP based typing and nomenclature leads to inaccurate conclusions
  - 1-4-4 = 1A.2
  - 1-4-4 = 1C.5

89% similar via ORF5 sequence

- Since 2020, we have ~430 L1C.5 ORF-5 sequences
  - All >95% similarity via ORF-5 sequencing
  - In 2021 only – all >98% similarity via ORF-5 sequencing

PRRSv

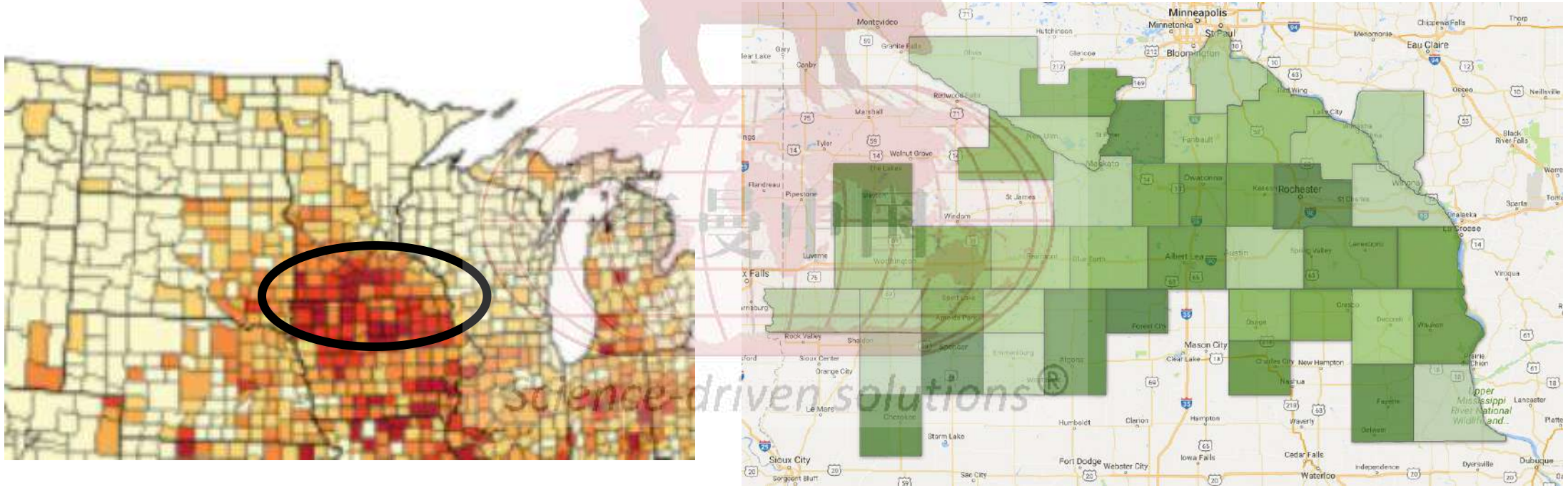
- Porcine reproductive and respiratory syndrome virus (PRRSv)
- Emerged in the late 1980's as "mystery" disease
- Continues to be a major disease challenge today



- Estimated $1.2 billion per year in lost production in the U.S. in the period of 2016 to 2020 (Holtkamp et al., 2024)

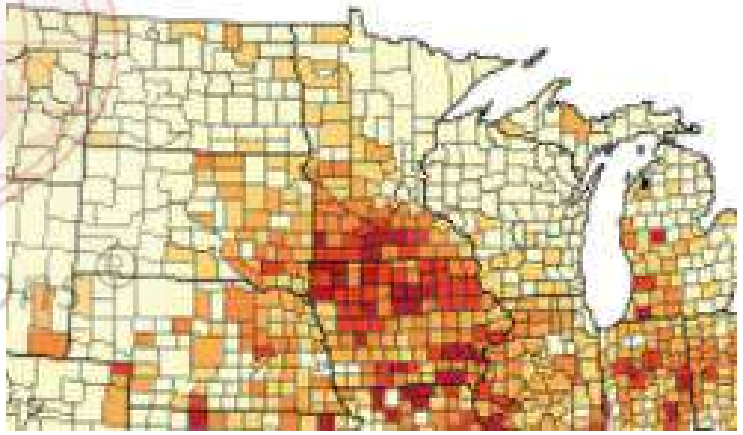
PRRSv risk factors

- High pig density (Velasova等人，2012）

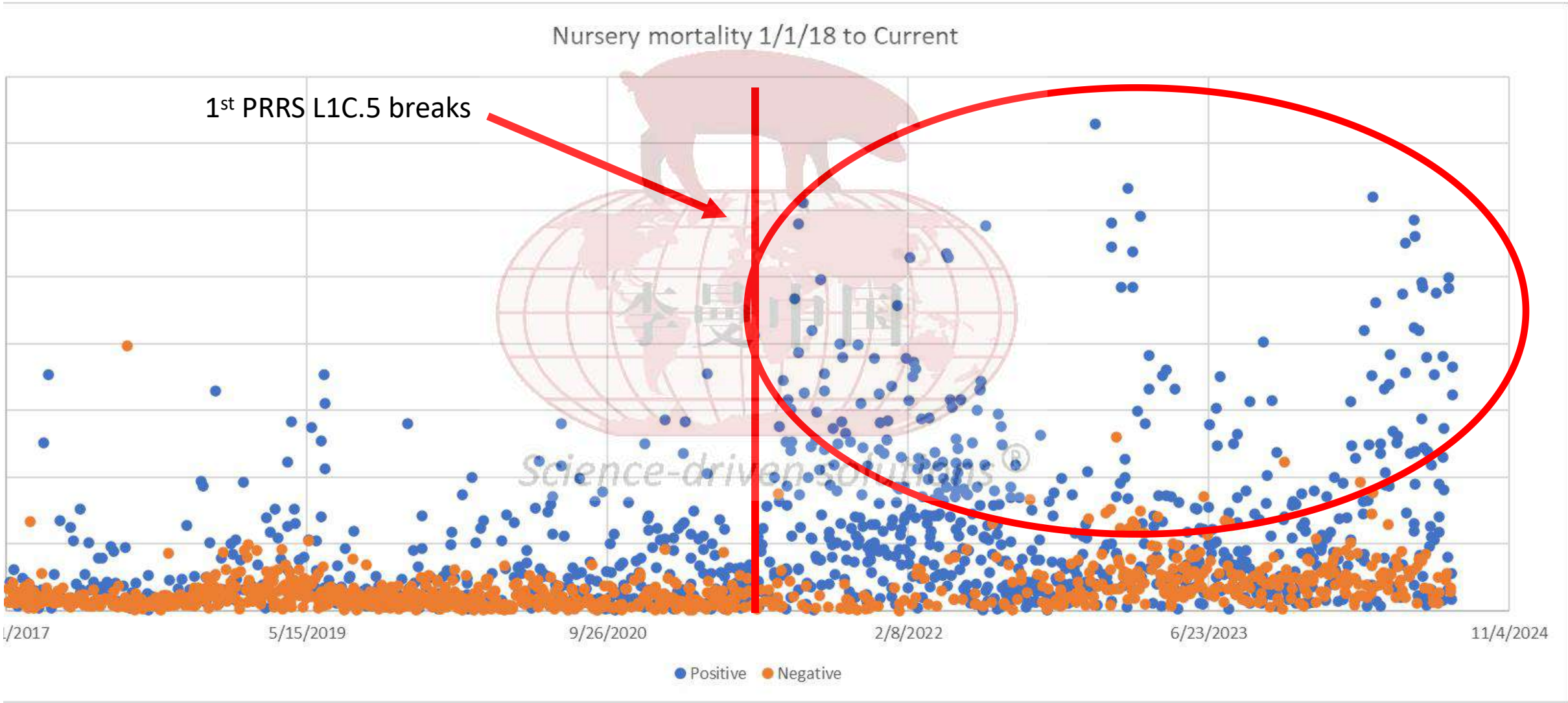


PRRSv transmission

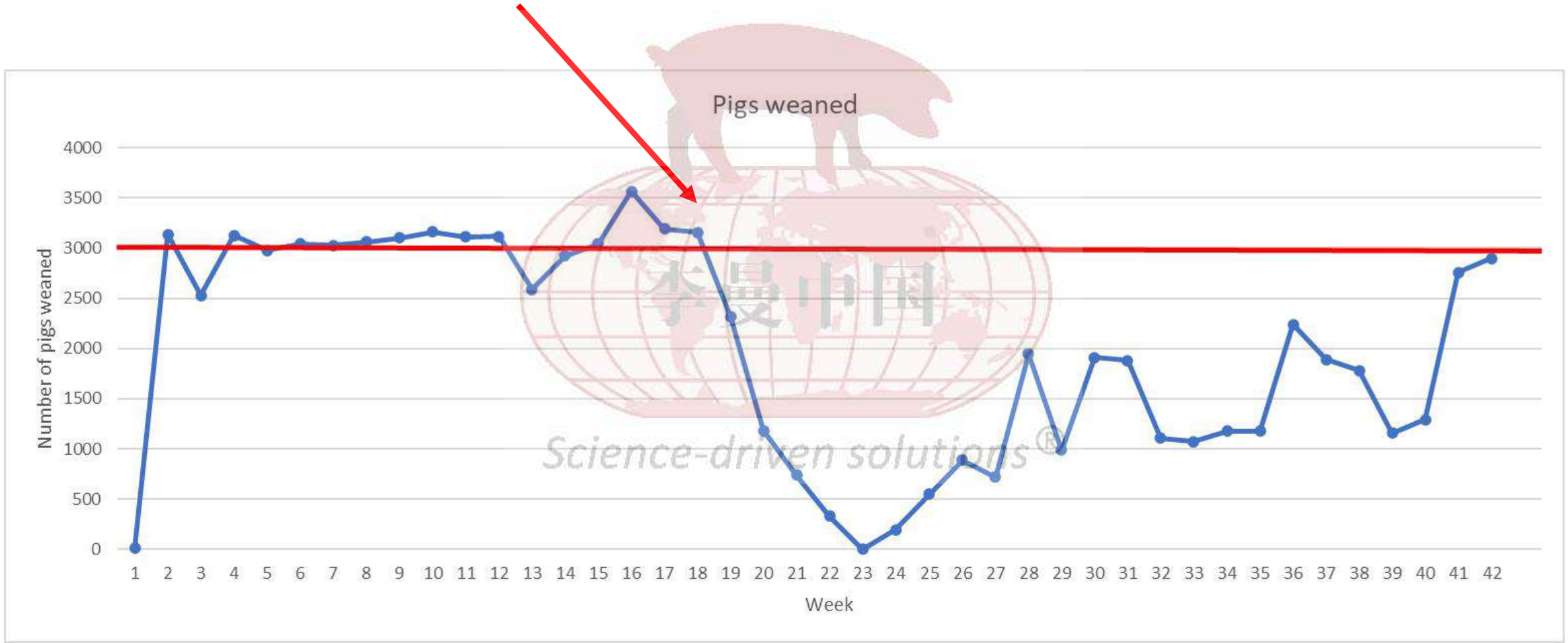
- Airborne spread (Pitkin et al., 2009)
- Mechanical transmission (Dee et al., 2003)
- Semen
- Animal entry/gilts



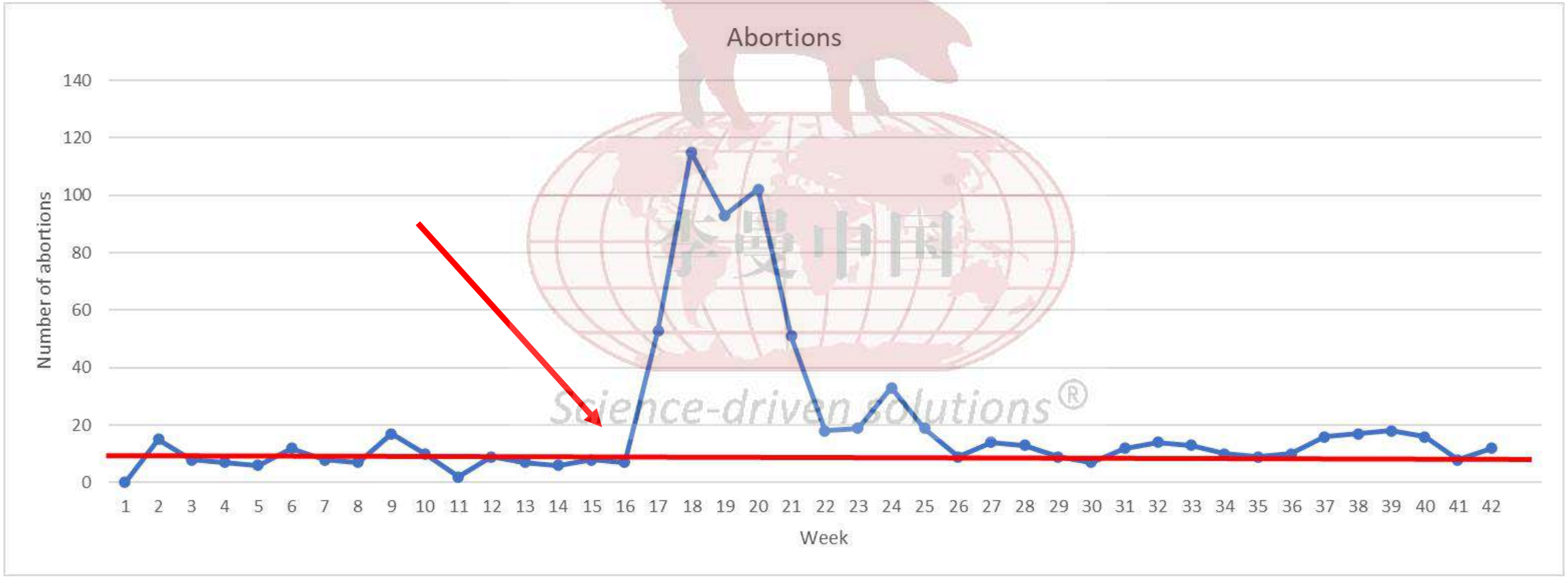
PRRSv was just PRRSv until….



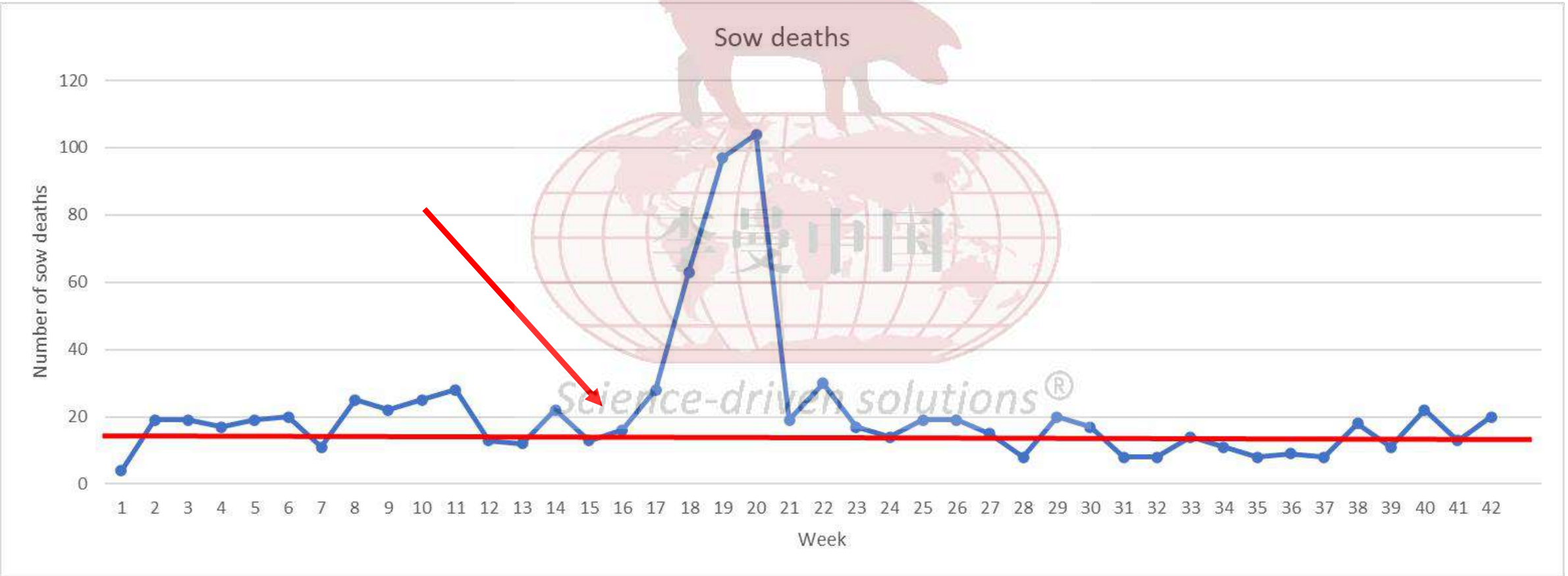
L1C. 5 Production impact



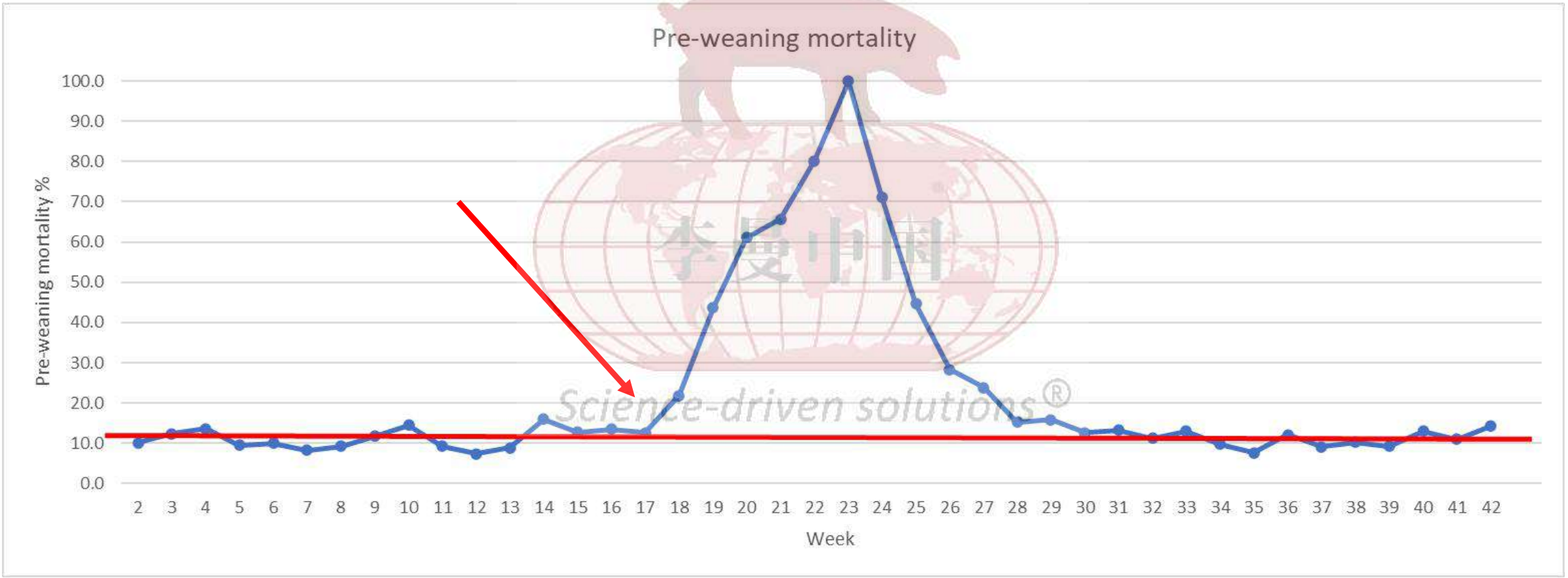
L1C. 5 Production impact



L1C. 5 Production impact



L1C. 5 Production impact



Virulence: PRRSv – L1C.5 further characterization

- Highly virulent, potential higher transmissibility (Rawal et al., 2023)
  - More severe clinical signs, higher mortality
  - Encephalitis

a. **meningoencephalitis**, lymphoplasmacytic, perivascular cuffing, scattered gliosis - cerebellum

b. **spinal cord, marked peripheral cord demyelination, lymphoplasmacytic perivasculitis, peripheral nerve root inflammation** (radiculoneuritis), North American PRRSv (15ct)

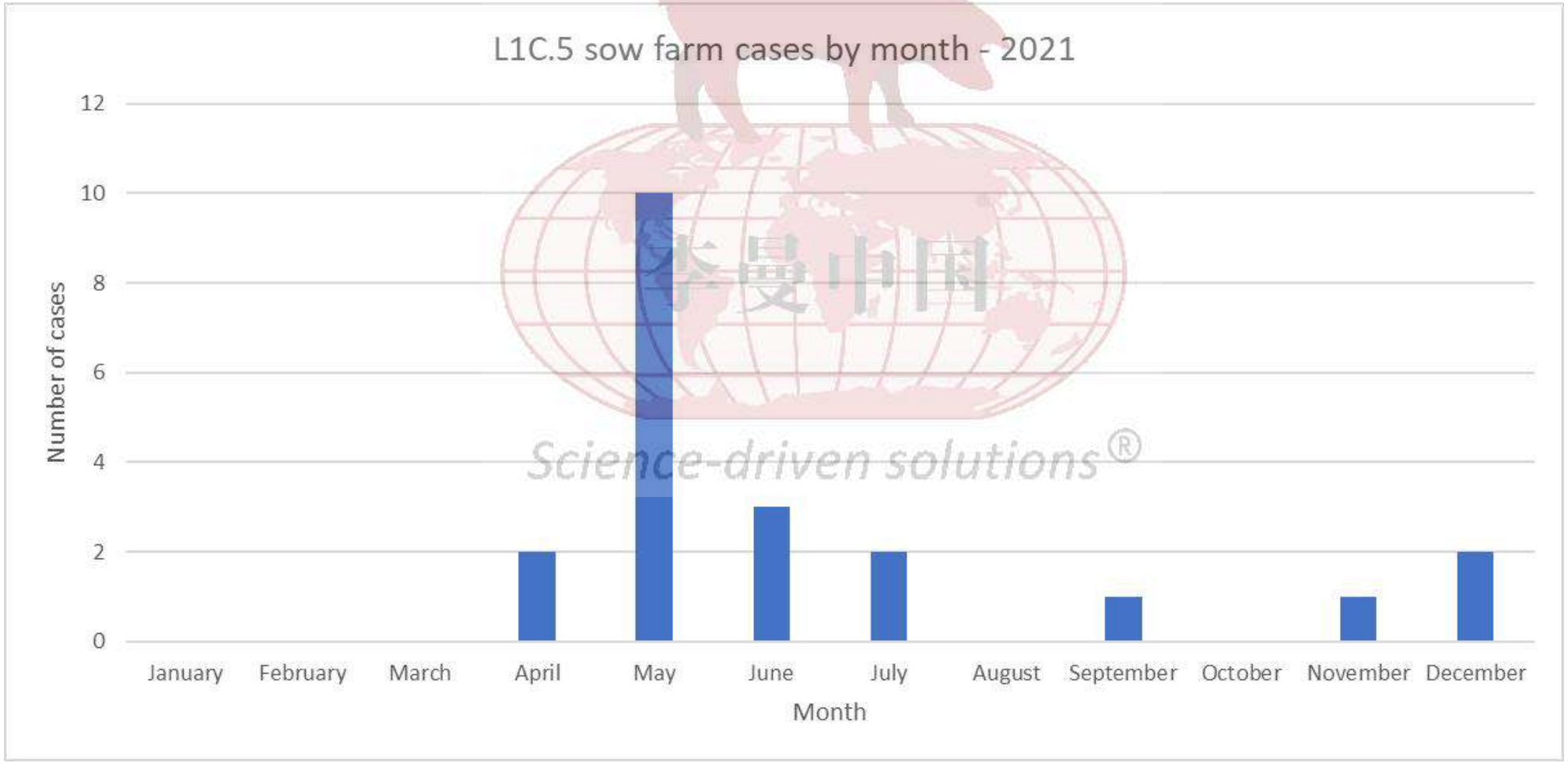
c. bronchopneumonia, necrotic, subacute, North American PRRSv (12ct), Streptococcus suis

d. ethmoturbinates, rhinitis, acute and lymphoplasmacytic, Streptococcus suis, Pasteurella multocida, Glaesserella parasuis (29ct), Mycoplasma hyorhinis (18ct)

e. heart, epi and endocarditis, lymphoplasmacytic

Transmission – why such quick spread?

- Historically, uncommon to find the same virus from farm to farm



Transmission

- Emergence in the US of a new lineage 1C variant, 2020-2021 (Kikuti et al., 2021)
  - 154 breeding and grow-finishing sites in the Midwestern U.S.
  - Within a 120 km radius
  - A spatial cluster (81 km radius) with 1.68 times higher the number of cases was found
- Environmental survival
  - L1C variant survived longer (Mil-Homens et al., 2023, meeting proceedings)
    - Higher temperatures
  - Newly emerged variant 1-4-4 L1.C one of the more resistant strains (Quinonez-Munoz et al., 2023)
    - 7 days at room temperature
    - 3 days at 37°C
- Requires fewer viral particles for infection (Melini et al., 2024)

Transmission – viral load

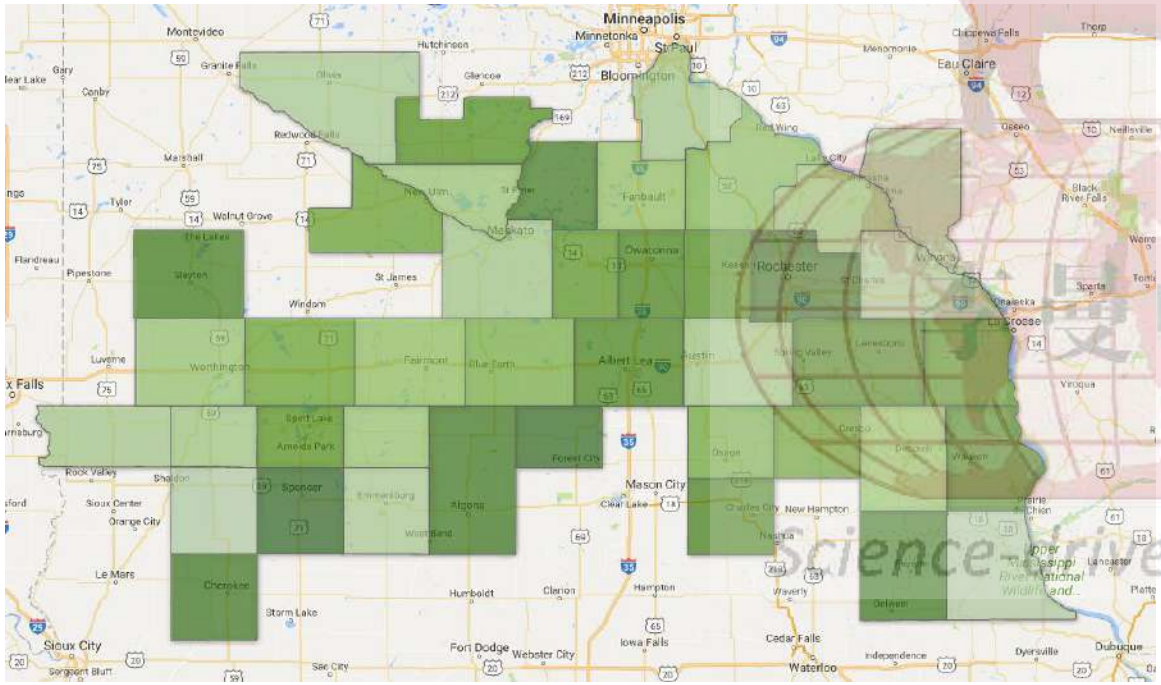
PRRSV North American Thermo Fisher real-time PCR	
1-1/SERUM	POSITIVE 14.658 Ct40
2-2/SERUM	POSITIVE 12.2756 Ct40
3-3/SERUM	POSITIVE 12.742 Ct40
4-4/SERUM	POSITIVE 10.9684 Ct40
5-5/SERUM	POSITIVE 15.0021 Ct40
6-6/SERUM	POSITIVE 12.7802 Ct40
7-7/SERUM	POSITIVE 9.6165 Ct40
8-8/SERUM	POSITIVE 12.3683 Ct40
9-9/SERUM	POSITIVE 15.2315 Ct40
10-10/SERUM	POSITIVE 12.1328 Ct40
11-11/SERUM	POSITIVE 7.2995 Ct40
12-12/SERUM	POSITIVE 10.1751 Ct40

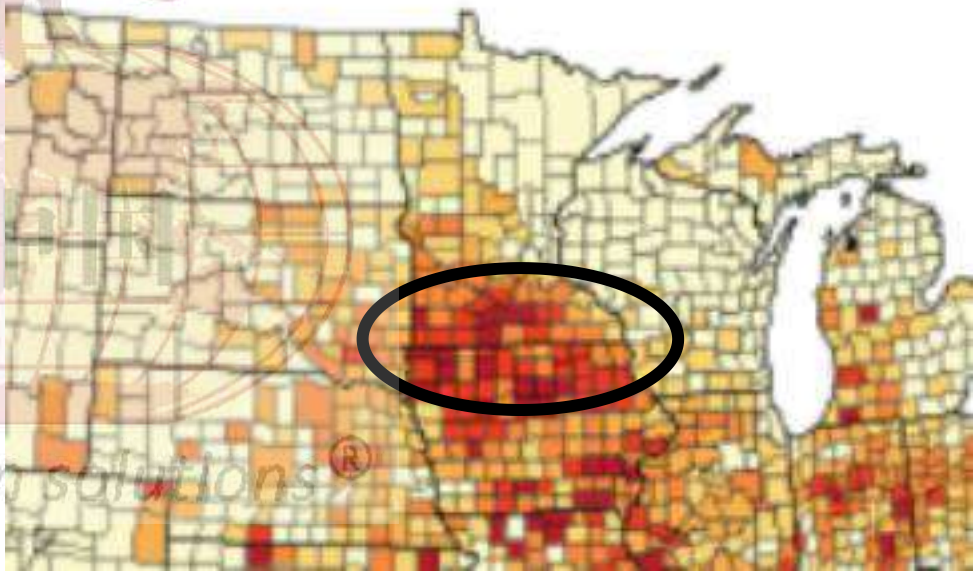
Thermo Fisher real-time NAEU PRRSV PCR - Spinal Cord		
PRRSV EU Thermo Fisher real-time PCR	1/1 NEG	
PRRSV NA Thermo Fisher real-time PCR	1/1 POS	15.07 Ct40
Thermo Fisher real-time NAEU PRRSV PCR - Tissue Homogenate		
PRRSV EU Thermo Fisher real-time PCR	3/3 NEG	
PRRSV NA Thermo Fisher real-time PCR	3/3 POS	12.2491 - 14.2207 Ct40

What have we learned?

- L1C.5 variant and other emerging variants
  - Highly transmissible
    - Large number of cases in a short period of time
    - Naïve farms in remote areas
  - Virulent
    - Extreme production impacts
      - Sow farm, nursery

PRRSv – continues to be a challenge……



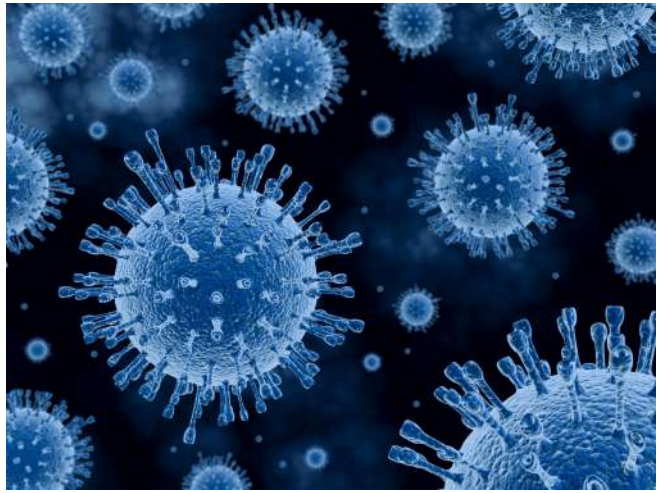


However, there is hope…

- Improvements in biosecurity can reduce incidence of PRRSv in breeding herds (Dee et al., 2024)

- PRRSv elimination can still be successful (Paiva et al., 2024)
  - Time to stability longer
  - Time to baseline production longer
  - Total losses greater

- Depopulation/repopulation
  - Economics

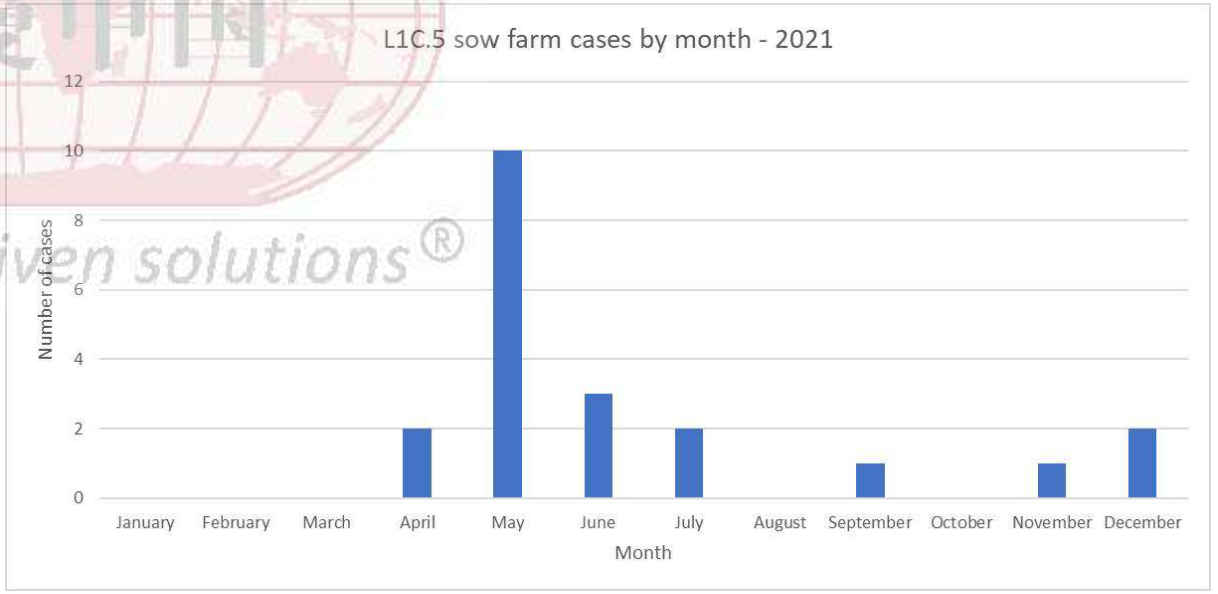


Virulence: What changes need to be made?

- No longer able to “live” with these variants
  - Overall production impact greater and nursery mortality improvement much more delayed versus other variants
- Control secondary infections
  - Timing of injectable antibiotics
  - Timing of feed and/or water antibiotics
  - Other pathogens: *Mycoplasma hyopneumoniae* elimination, virulent *Streptococcus suis*
- Control inflammation
  - Injectable and water application of anti-inflammatories
- Environment
- Nursery/finish pig flow
- Vaccination
  - Killed, MLV
- Batch farrowing or other options to break the cycle of infection

Transmission: What changes need to be made?

- Transportation
  - Reduced farm crossover
  - Inspections
  - Review downtime/heat application
- People: improved farm entry
- Fomites: improved supply entry
- Feed mitigation
- Increased diagnostic testing
- Area transmission - aerosol



Summary

- PRRSv has continued to evolve and challenge us
- L1C.5 variant and other emerging variants can be highly virulent and easily transmissible
- Biosecurity measures will continue to be important to limit introductions
- Certain management strategies can help mitigate losses, but these variants are difficult and costly to live with