Circovirus Disease in Kansas

What a Difference a Year Can Make!

Your K-State PCV_2 Team

KSU Swine Day

November 15, 2007

History

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Disease appears in multiple Kansas farms with many stunted and wasting pigs, mortality 8-30%, we don't know much!

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Feb 2006

Funding from NPB, KSA producers and affected farms, virus identified as PCV_{2b} strain

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Nov 2006 - Swine Day!
Almost all farms are affected at some level. Early vaccine trial results = reduced mortality

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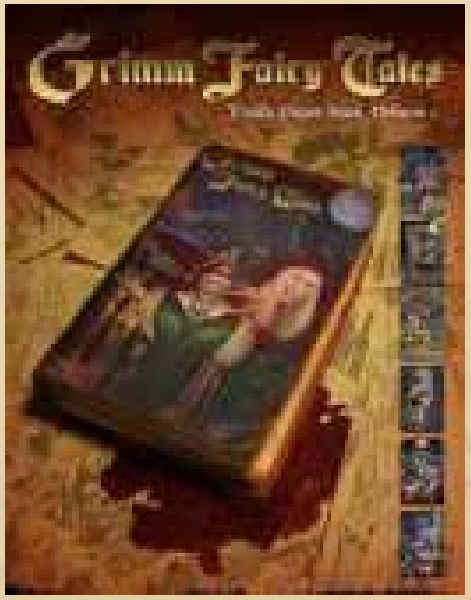
Case closed?
Not by a long ways! Many trials are completed, others are ongoing, many questions and puzzles that need answers.

Your K-State Team is busy at work!

Where we were a year ago Swine Day 2006?

- It was still a pretty grim story last year.
- Mortality rates were rising in herds across Kansas.
- We left you with the following slide at last year's Swine Day……



Even if vaccine stops the bleeding
What about the future?

- Field experience is limited and a great deal is to be learned yet (need field research, Dr. Dritz!)
  - How does this virus move around?
  - Impact on morbidity, will growth benefit?
  - 4-2-2 vaccine and 3-2-1 virus?
  - Timing of vaccination, does it vary with immune status of pigs?
  - Does pre-existing viremia compromise vaccination?
  - How is breeding herd vaccination best managed and what is the benefit/lack of benefit?
  - Need tools to measure immunity!
  - These other viruses – Why? What? How serious?

What has been learned?

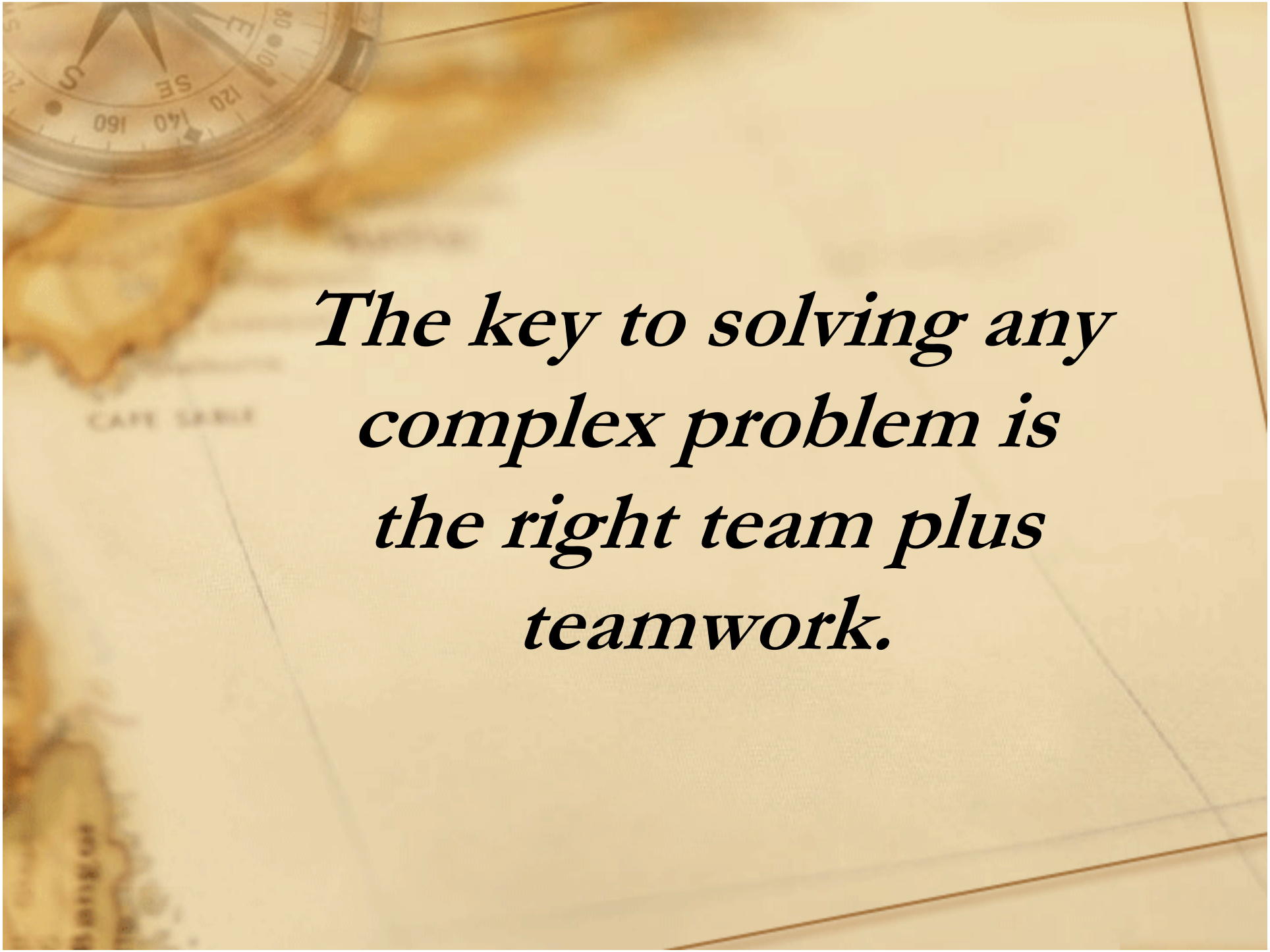
- Nearly *all* herds are affected at some level by circovirus infections, not just those infected with PRRSv and other agents.
- Immunization results in dramatic reduction in mortality
- Immunization results in an amazing and surprising improvement in growth in all trials

Vaccines to the forefront

- Three companies have vaccines licensed in the US
  - **Intervet** – 2 dose baculovirus-vectored, killed vaccine
  - **Fort Dodge** – 1 dose chimera, killed vaccine
  - **Boehringer-Ingelheim** – 1 dose baculovirus-vectored, killed vaccine
- All cost about the same, all result in reduced mortality and improved performance
- Unlike last year, vaccines are now readily available
- Trials comparing vaccine performance – some are completed, others still underway

Topics to review today

- **Vaccines** – how do they work, differences?
- **Growth** – what is the impact in immunized animals?
- **Immunity** – how can we use antibody to guide best vaccine use?
- **Genetics** – is there a difference between genetic lines in response to vaccine?
- **Diagnostic methods** – next generation methods from the K-State VDL
- **PCV_2 itself** – is it changing and what does that mean?
- **New tools** – tests needed to differentiate strains in infections, vaccinated successfully vs. failed to immunize
- **Virus elimination** – is it possible?


The key to solving any complex problem is the right team plus teamwork.

Coach Prince has his version…

Now we bring you our own K-State PCV_2 Team version of the **CATS 2007!**

Bring on the Cats

- At Center, taking in cases as they come

~ Dr. Jerome Nietfeld

Bring on the Cats

- Wide receiver, taking the ball and running it in new directions – 'get that man the ball!'

~ Dr. Bob Rowland

Bring on the Cats

- Veteran at quarterback, calling the next play

~Dr. Dick Hesse

Bring on the Cats

- At safety, preventing disaster, "not in OUR house!"

~Dr. Steve Dritz

"In God we trust; all others must bring data!"

Bring on the Cats

- Punt returner, sending it right back at you

~Dr. Dick Oberst

Kansas State
VDL
DIAGNOSTIC SOLUTIONS
Collaboration • Innovation • Research

Bring on the Cats ~ Offensive line

Getting the job done.

Dr. Jay Jacela
(outstanding walk-on)

Dr. Megan Potter
(new top recruit
out of Purdue)

Dr. Kyle Horlen
(lost to aggressive
recruiter from Texas)

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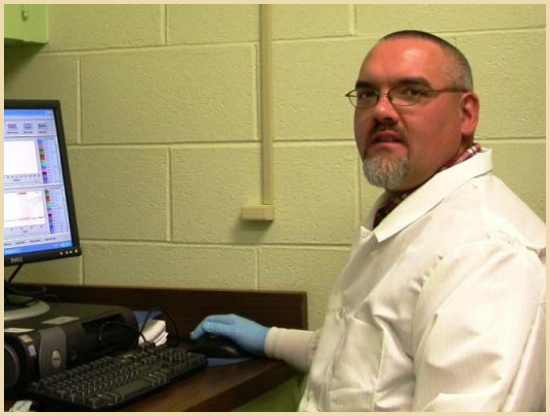
Bring on the Cats ~ Defensive Line

Joe Anderson and
Jessica Jewell



Mike Hays

Su-Ann Murdock

Amanda McGarry

Heather Wisdom

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Bring on the Cats ~ Special Teams

Maureen Kerrigan

Ben Trible

Scott Hahn

Brandi Struve

Sean Smith

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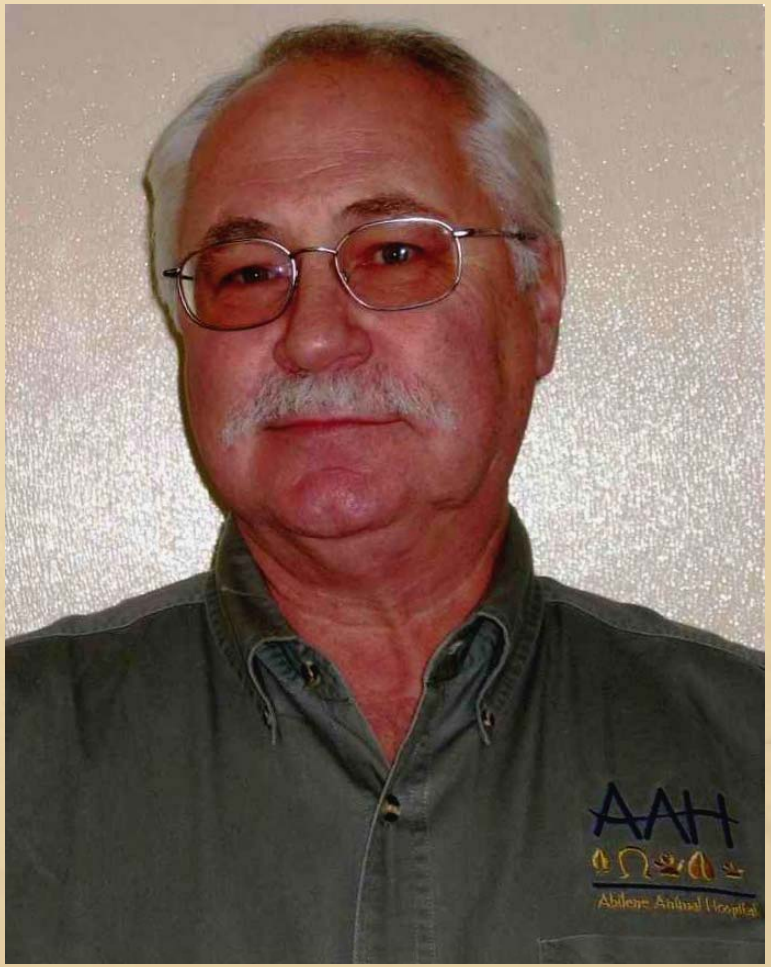
Bring on the Cats

- Recruiter, Athletic Director and Funding Pitch-man

~ Dr. Steve Henry



"In God we trust; all others must bring money!"

Bring on the Cats

- Punter, for those 4th and long situations (and several game-saving tackles!)

~ Dr. Lisa Tokach

It Takes Teamwork!

PIC

B&K Livestock Farms Inc. Clay Center, KS

Kansas State University College of Veterinary Medicine

Keesecker Agri Business, Inc. Washington, Kansas

Kansas State VDL Diagnostic Solutions Collaboration • Innovation • Research

Suther Farms

J-Six Enterprises Livestock Division

Henrys Limited

AAH

Iowa State University Science with Practice of Science and Technology

SDSU

Kansas Swine Alliance

Kansas State University College of Veterinary Medicine

K-State

NHF New Horizon Farms LLP

Critical Support and Key Efforts

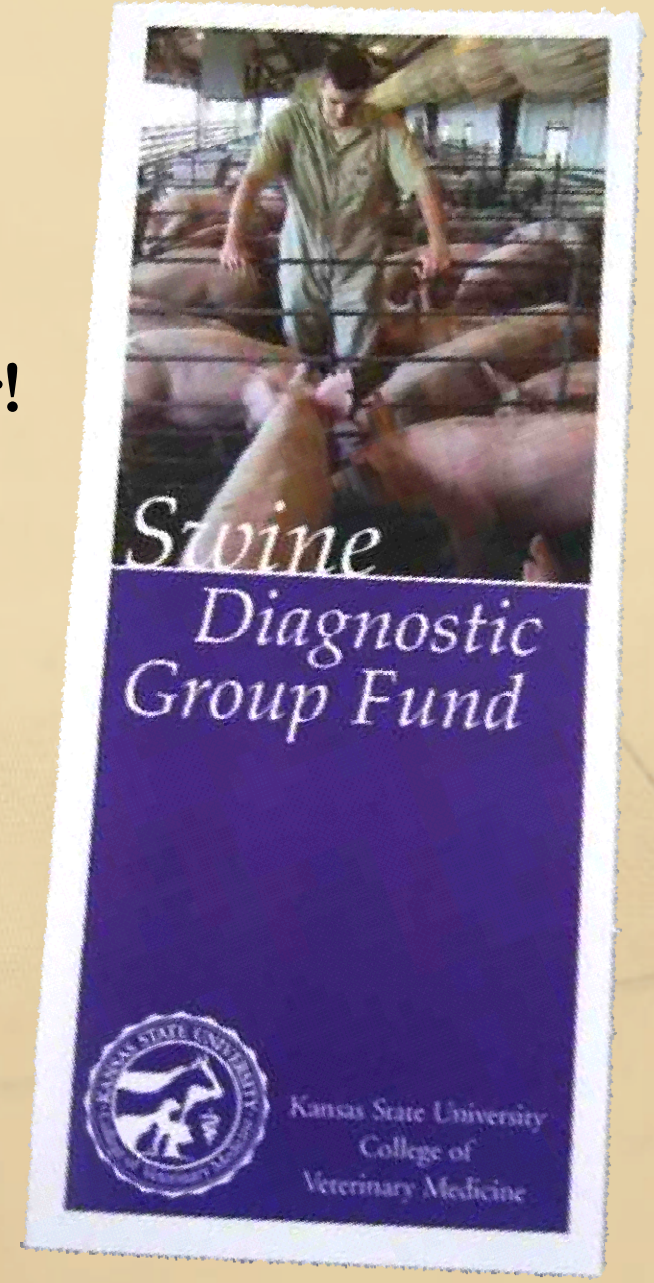
- **K-State administrative support – Drs. Wefald, Richardson, Chengappa and Anderson**
- **K-State VDL team – Drs. Rowland, Nietfeld, Hesse and Oberst developed methods in efficient diagnosis**
- **K-State developed the PCR test to differentiate PCV_{2b} from PCV_{2a} (Rowland)**
- **Whole genome sequences for specific, unique identification (Rowland)**
- **Identified other (unexpected) viruses in affected animals (Hesse)**
- **Linked vaccinology/immunology between the lab and the field (Hesse)**
- **Adaptation of the long-respected K-State Swine Team methodology in nutrition investigations to disease interventions (Dritz)**

Critical Funding

- K-State (Horlen, Dritz) and Suther Farms –vaccine research trial funded by National Pork Board
- KSA farms provided 50¢ per weaned pig for a year to support KSU investigations ($32,000)and still contributing!
- Dr. Rowland's lab and research budget
- K-State VDL services
- Pork producers and production systems both in and outside of Kansas
- More grants have been awarded, more funding is being sought

Critical Funding

- **Your contributions matter!**



Publications

- Kansas herds are affected by PCV_{2b} (321) strain of PCV2
  - Paper on the KS Cluster – published **JSHAP** 2007
- Immunized animals respond with decreased mortality, increased growth rate - even in herds with mild clinical signs
  - Suther study – accepted **JAVMA**
- A specific, differential PCR test was developed (Rowland) to sort out PCV_{2a} (422) and PCV_{2b} (321) infections and co-infections
  - 24 of 97 cases were co-infected with PCV_{2a} and PCV_{2b}
  - Recent discovery of a 321/422 recombinant virus at K-State, first to document recombination in North America Manuscript submitted - **Virus Research**
- And more coming…

K-STATE AAH

Key points we've learned since we last met

- Circovirus disease is a population-base immunological dysfunction
- PCV_{2b} *is* a primary pathogen in swine
- Immunization dramatically improves growth performance and lowers mortality
- "Vaccination" and "Immunization" are not equivalent definitions with current vaccines
- Animal genetic lines differ greatly in response to immunization
- Reassortments and new variants are being discovered

Key points we've learned since we last met

- Immunization effectively lowers mortality, consistently improves growth rate with evidence of improved feed efficiency
- Immunized animals have low concentrations of virus
  - Identified by differential QPCR methods developed at K-State and the only differential available in the US
- "Vaccination" is not always "Immunization"
  - Antibody titer profiling

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AAH

Knowing more about this virus

- **PCV_2 is a non-enveloped, single stranded, circular DNA virus**

- **Inactivation, lack thereof:**
  - **Stable at pH 3 (eats concrete)**
  - **Resistant to dry heat of 120°C (248°F)**
    - **30 minutes only led to 1 log reduction in titer**
  - **Resistant to pasteurization (wet heat)**
    - **65° C (150°F) for 30 minutes had no reduction of titer**
    - **75° C (who cares) for 30 minutes only reduced 1.59 logs**

Welch J, Bienek C, Gomperts E, Simmonds P: 2006, Resistance of porcine circovirus and chicken anemia virus to virus inactivation procedures used for blood products. Transfusion 46: 1951-1958.

Courtesy of Dr. Darin Madson, ISU, AASV Jul '07

Table 2: Reduction in infectivity of porcine circovirus type 2 (PCV2) after a 10-minute exposure of the virus to commercial and laboratory disinfectants

Disinfectant	Mean titer after disinfection (log_{10})	SD	Reduction of mean titer[1] (%)
Control (no disinfectant)[2]	6.00	0.00	NA[3]
Nolvasan	5.17	0.72	13.9
DC&R	4.42	0.14	26.4
Weladol	4.33	0.52	27.8
Ethanol	4.25	0.25	29.2
Tek-Trol	4.17*	0.29	30.6
Fulsan	3.92*	1.13	34.7
1-Stroke Environ	3.58*	0.63	40.3
Clorox Bleach	3.25*	1.15	45.8
Roccal D Plus	3.00*	0.43	50.0
Sodium hydroxide	2.33*	1.04	61.1
Virkon S	1.58*	0.80	73.6

1 For each disinfectant, titers were means of an indirect immunofluorescence assay performed on porcine kidney cells (PK-15) 48 hours after inoculation with PCV2 virus stock that had been treated with disinfectant (three replicates). Titers were compared to the negative control.
2 Untreated PCV2 stock used as negative control.
3 NA=not applicable.
* Statistically different ($P<.05$) from negative control (Dunnett's test).

Formaldehyde based

Royer RL, Nawagitgul P, Halbur PG, et al. Susceptibility of porcine circovirus type 2 to commercial and laboratory disinfectants. *J Swine Health Prod.* 2001;9(6):281-284.

Courtesy of Dr. Darin Madson, ISU, AASV Jul '07

The Suther Trial

"This trial was the breakthrough in how to do trial work applied to vaccine, the growth impact, and the first trial to link laboratory virology to field performance."

K-State / AAH / Suther Farms

Suther Trial

- Fantastic support from Micki, Grace, Dan and Ron!
- 300 sow Farrow to Finish Farm
- Nursery groups: One week weaning and AIAO
- Finisher Groups: Two nursery groups combined into a group for hoop barn finishing ~200 head per hoop barn
- PRRS negative
- Historical, recent W->F mortality of >12.5%
- History of PCVD - PCV_{2b} (321) infection

K-State / AAH / Suther Farms

Study Design

- 485 pigs
  - 250 controls & 235 vaccinates
  - Within litter allotment
- Randomized blind clinical trial – 6 weaning groups and 4 finisher groups
- Vaccination - 2 doses(3 & 6 wks age) Intervet
- Pigs weighed at weaning, end of nursery and just prior to market
- Controls and vaccinated pigs housed in the same pen

K-STATE / AAH / Suther Farms

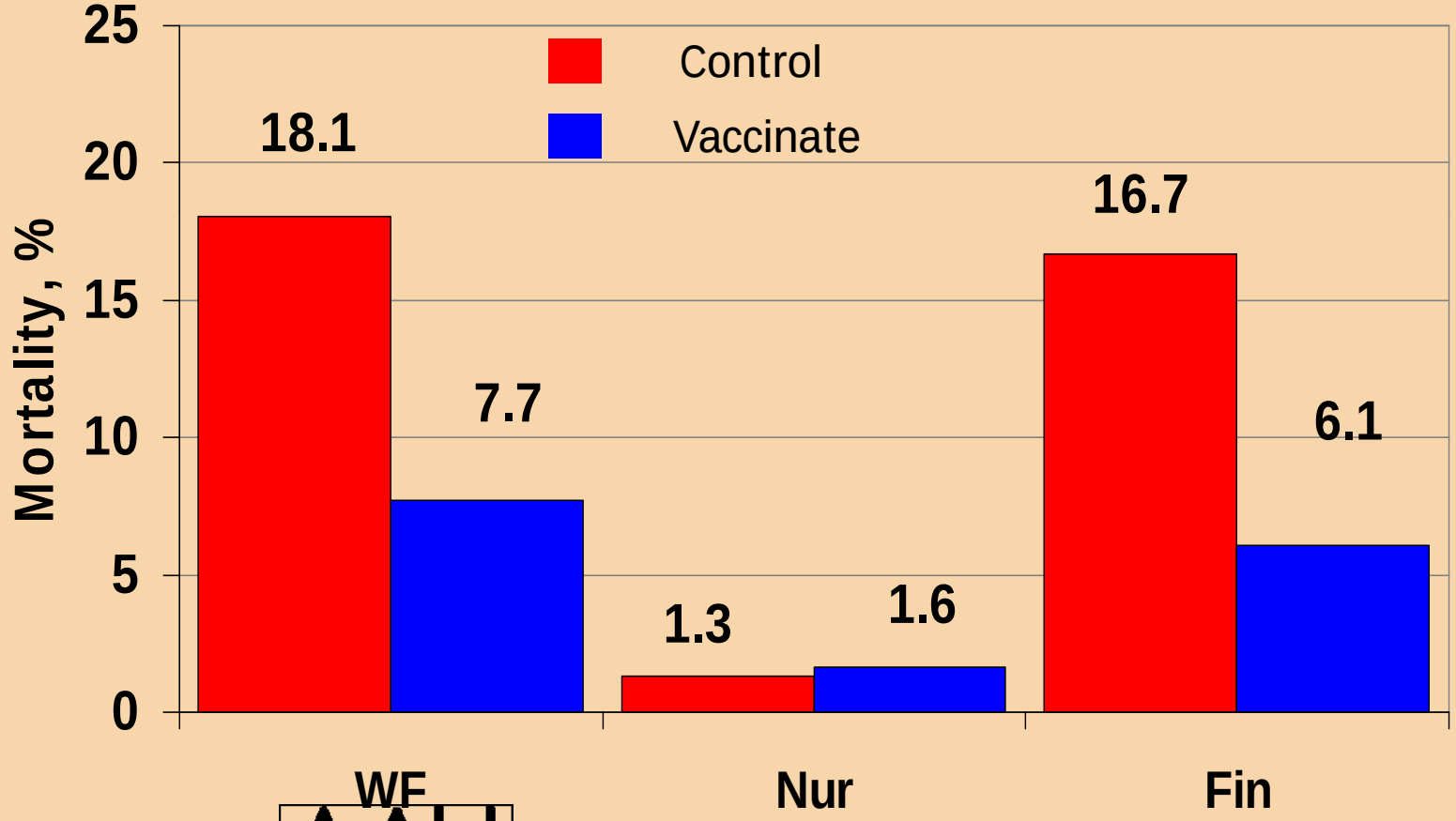
The Suther Trial

Mortality and Growth Responses

K-State / AAH / Suther Farms

Effect of PCV_2 Vaccination on Mortality Rate

WF & Fin Vaccine Effect P < 0.01

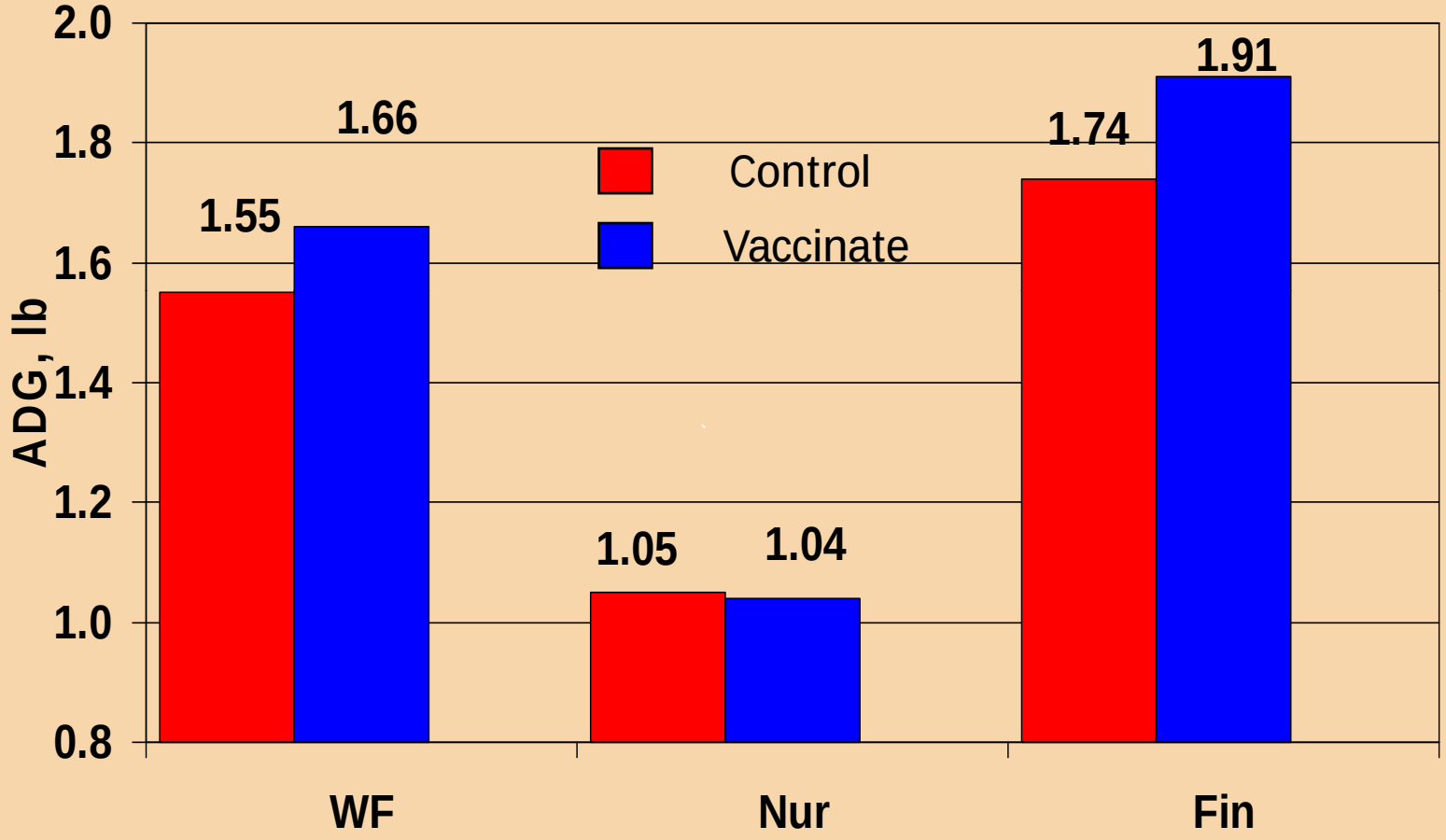


K-State / AAH / Suther Farms

Horlen et al. KSU 2007

Effect of PCV_2 Vaccination on ADG

WF & Fin Vaccine Effect P < 0.01



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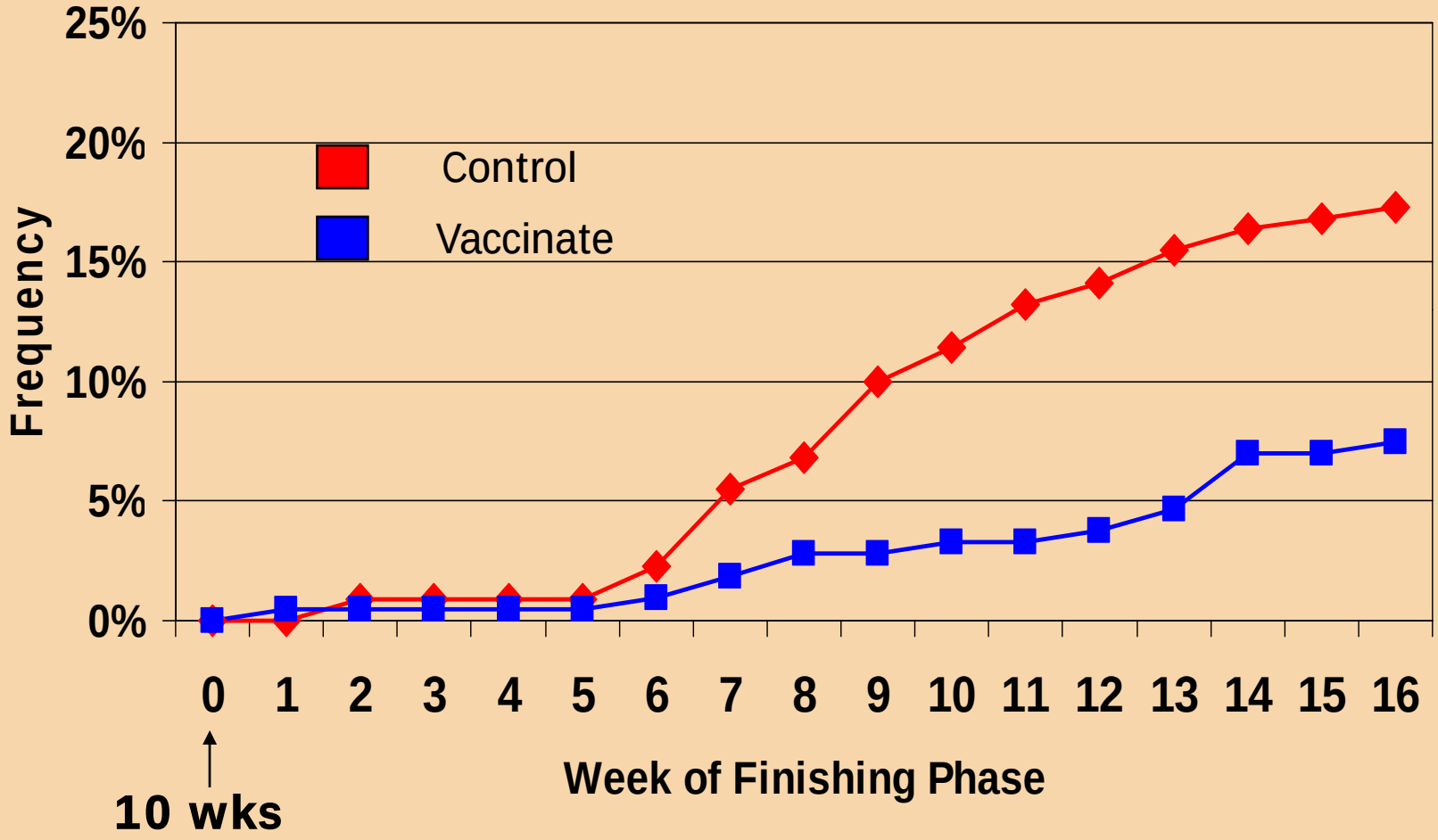
Horlen et al. KSU 2007

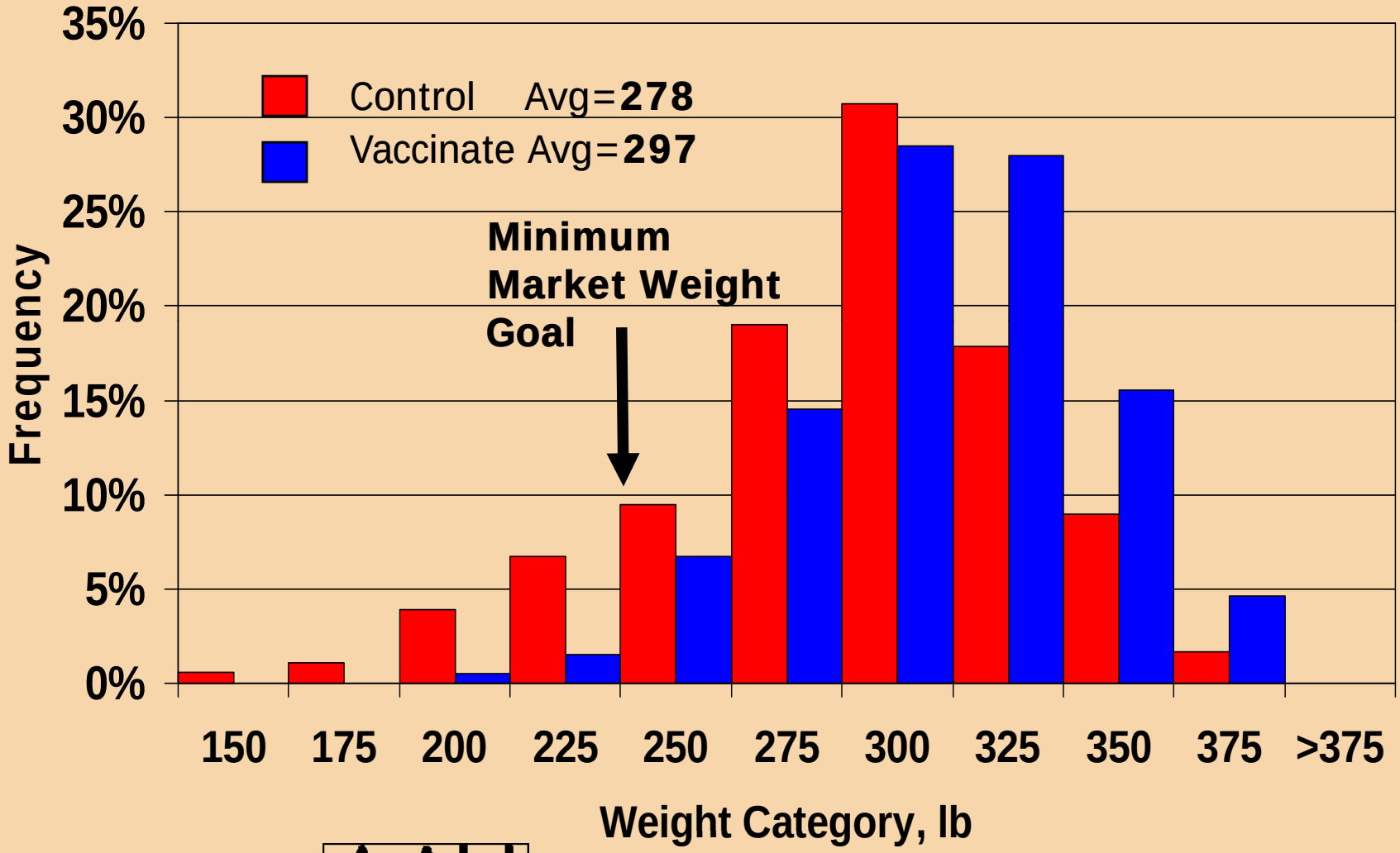
Cumulative Mortality During the Finishing Phase



K-State / AAH / Suther Farms

Horlen et al. KSU 2007

Market Weight Histogram



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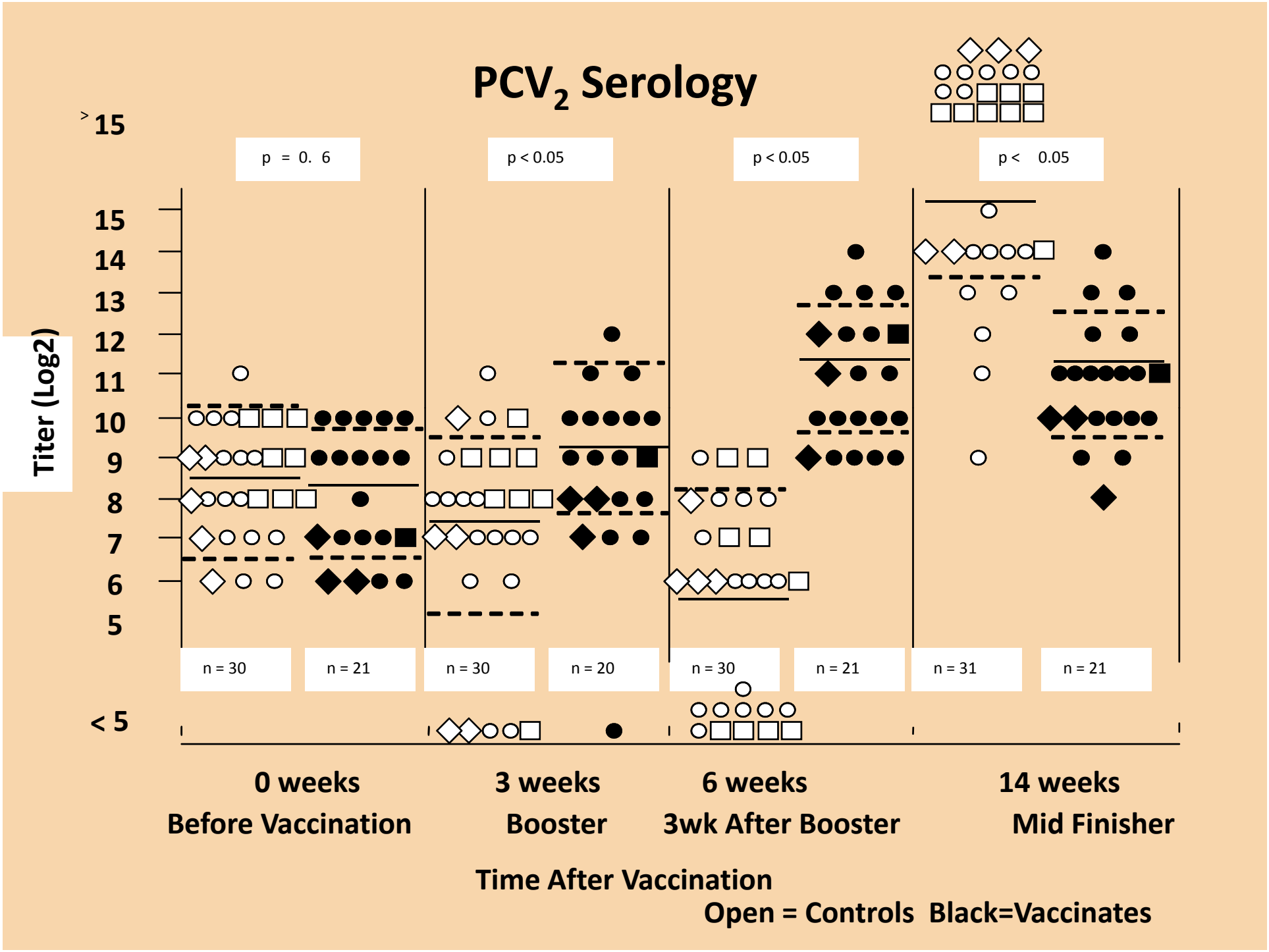
Horlen et al. KSU 2007

The Suther Trial

Immune responses

K-State / AAH / Suther Farms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n = 21
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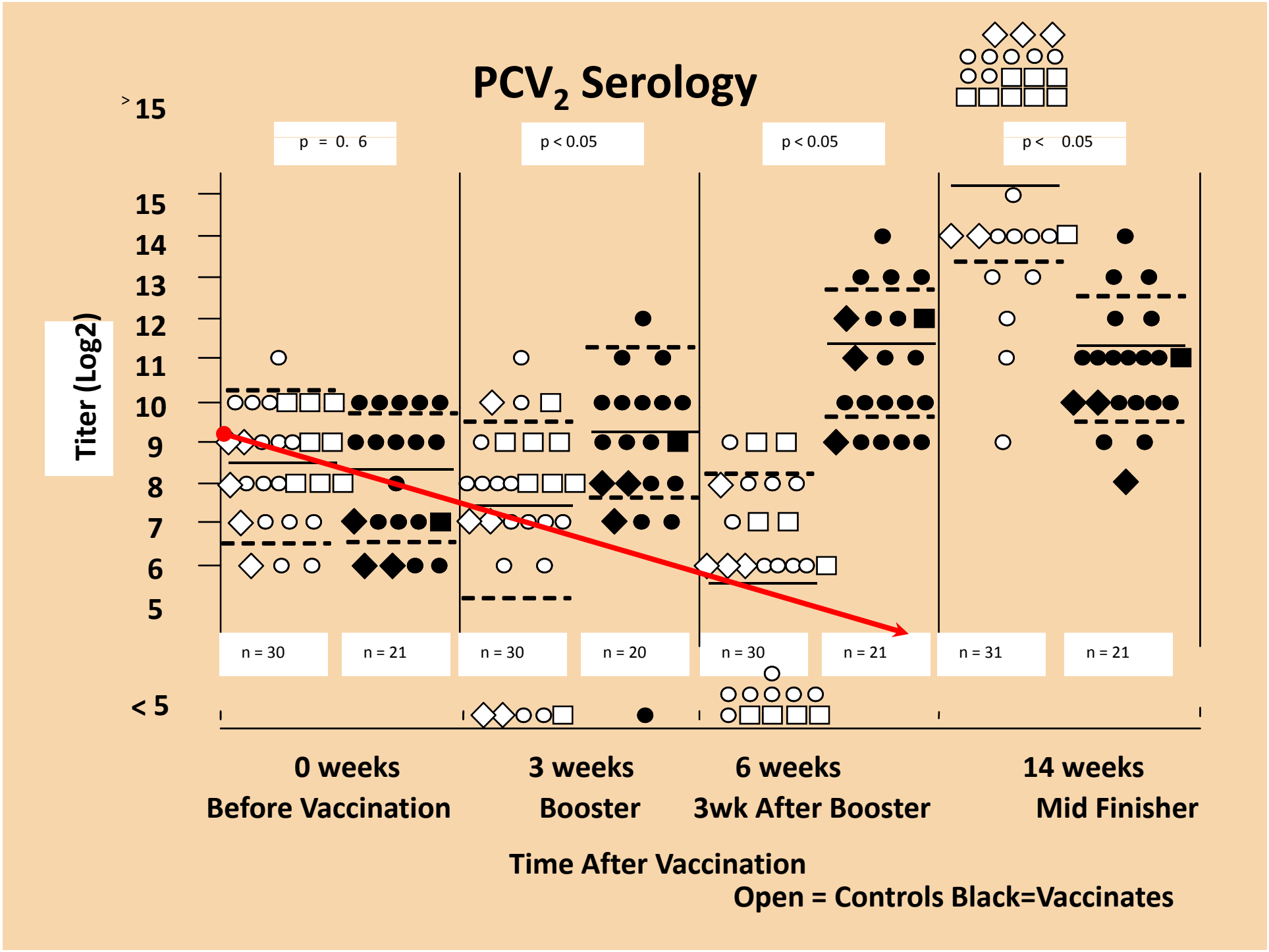
Before Vaccination
3 weeks
Booster
6 weeks
3wk After Booster
14 weeks
Mid Finisher
Time After Vaccination
Open = Controls Black=Vaccinates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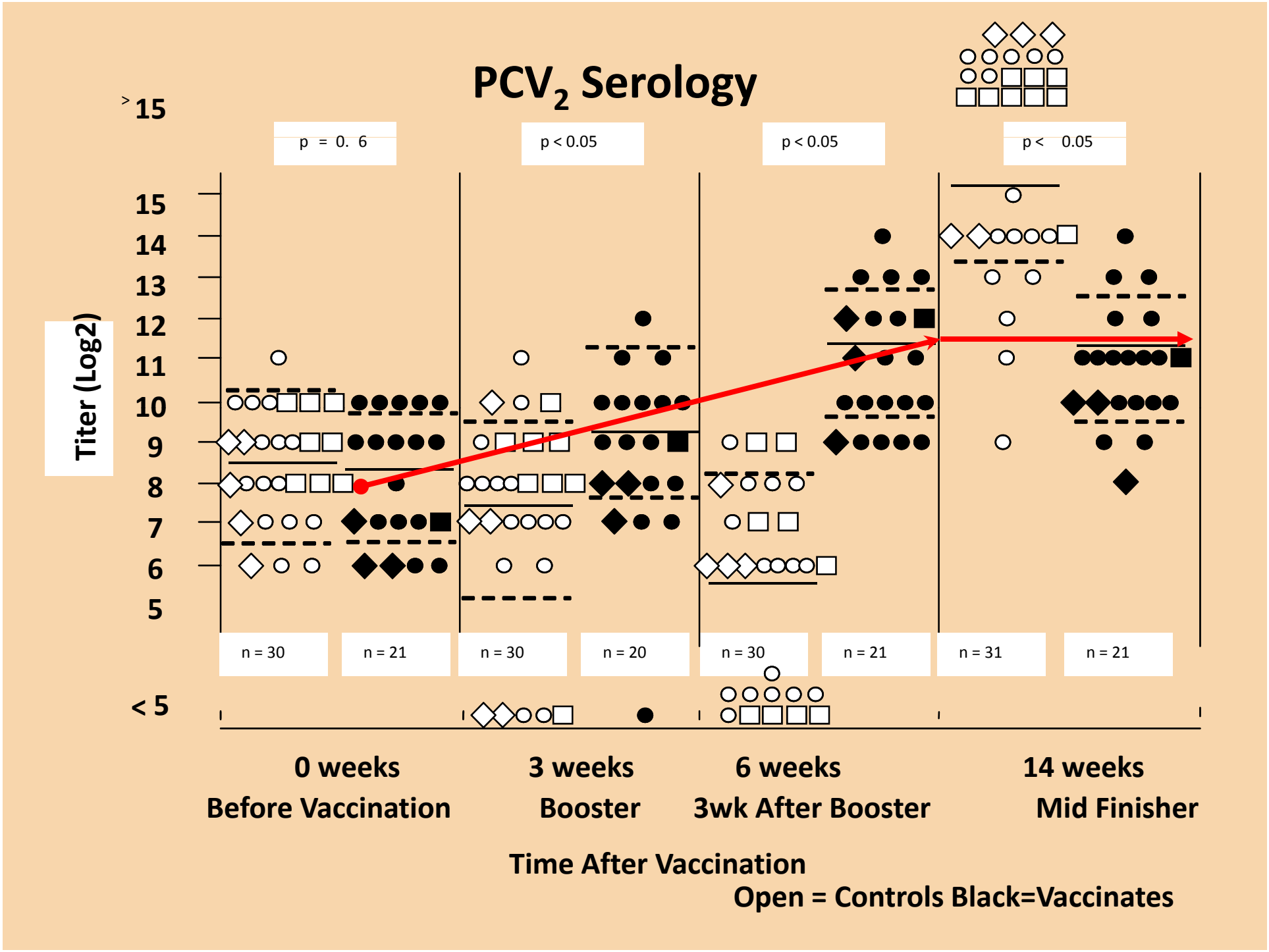
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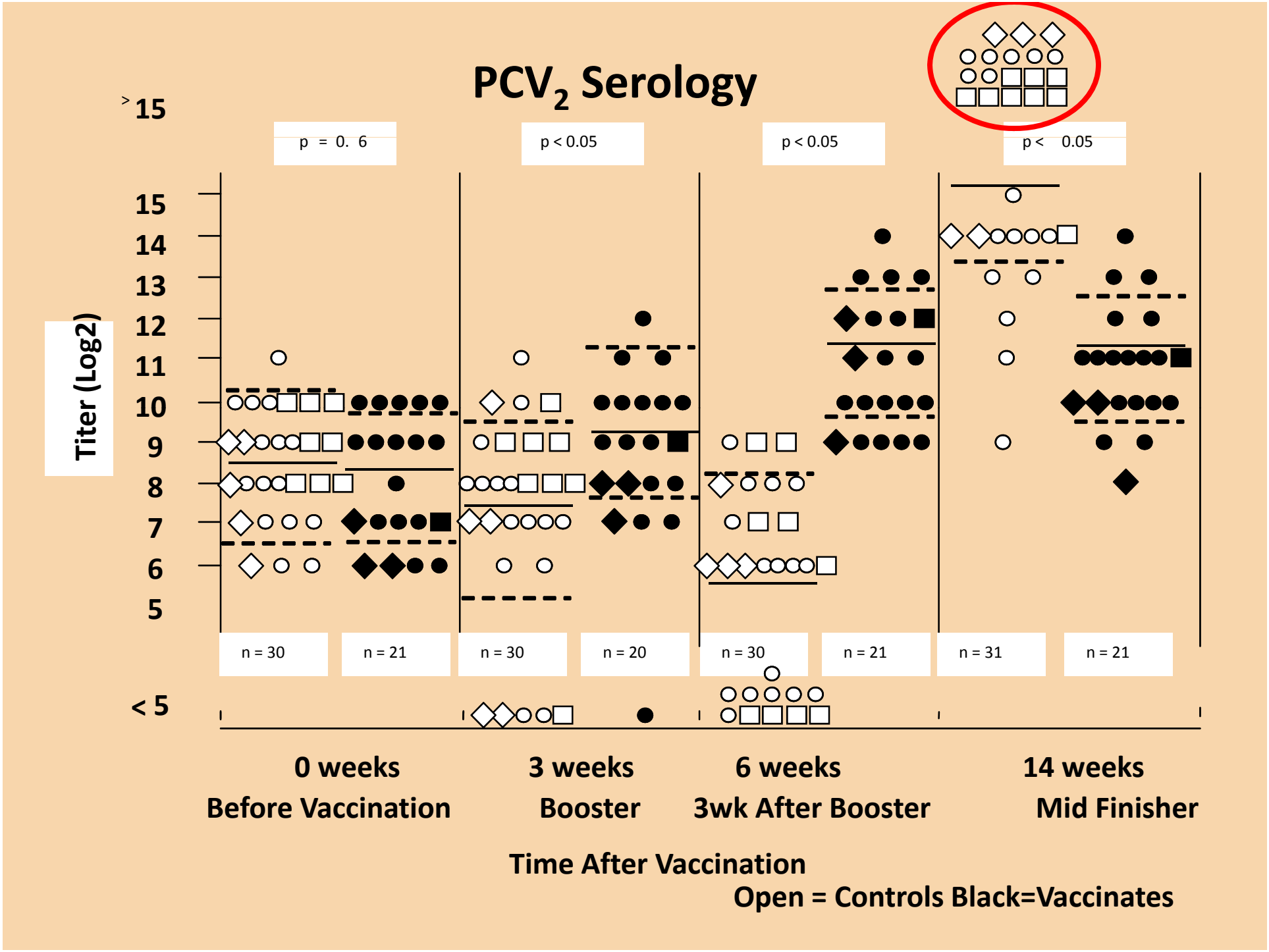
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Summary of The Suther Trial

- Significant reductions in mortality, increased finisher pig growth rate, and fewer lightweight pigs at market
- Suggests an effective level of cross-protection (vaccine is 422, field virus is 321)

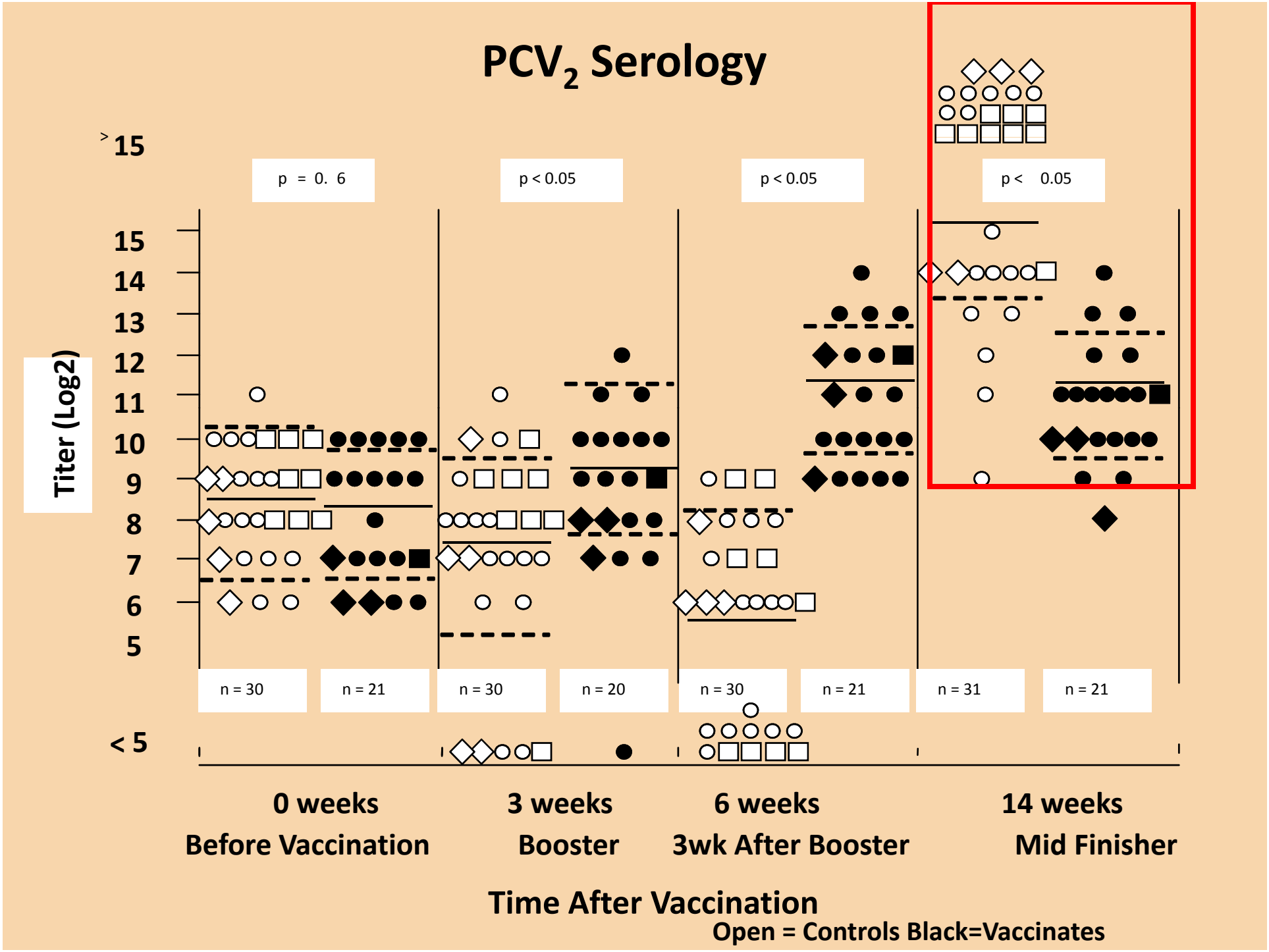
<u>Bottom Line</u>

- Vaccine is an *effective tool* to aid in the control of PCVD
- Significant economic benefit in vaccinated pigs
- First field study to link virology and growth performance

K-STATE / AAH / Suther Farms

Virology

Things we've learned about this nasty little virus…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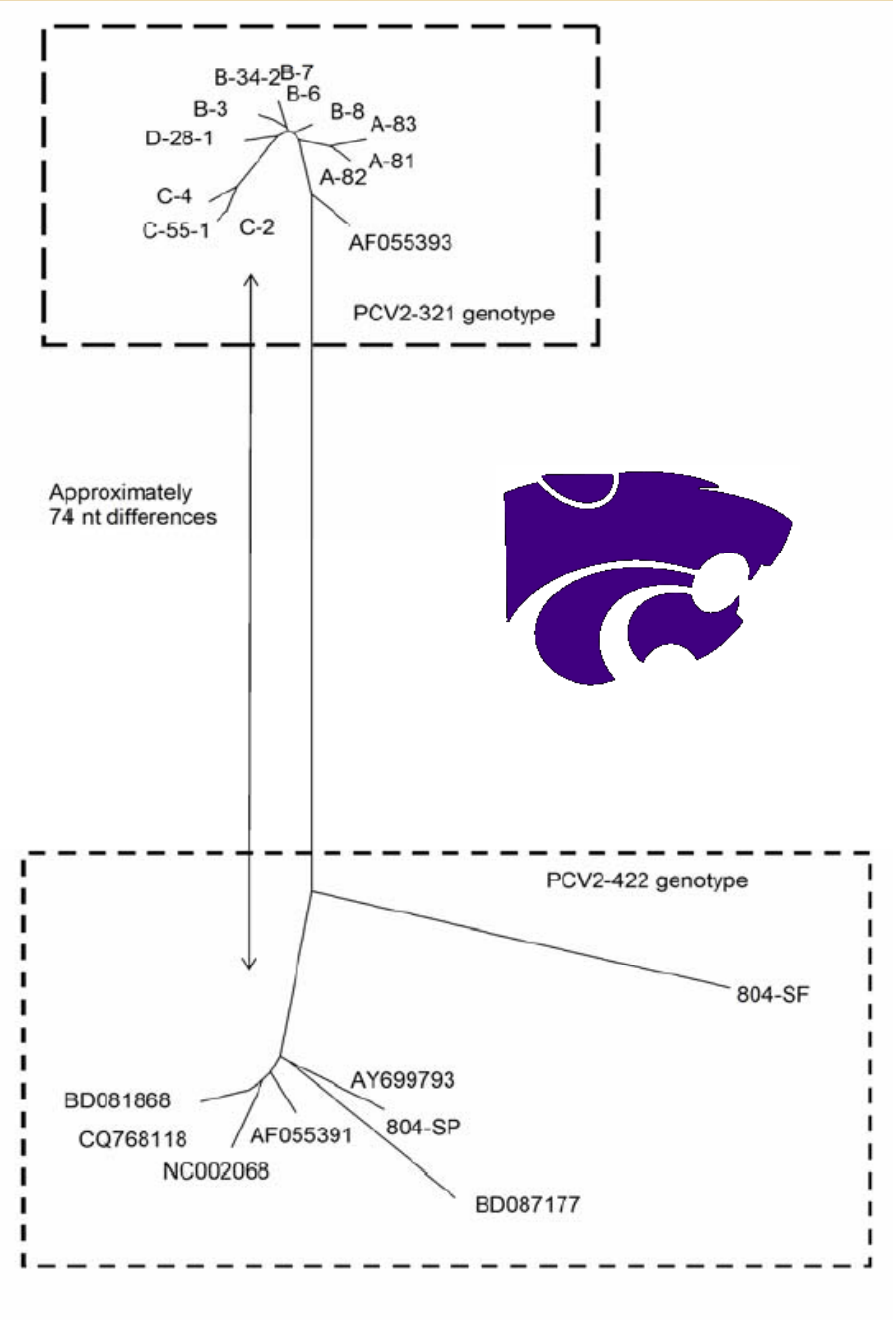
Genome sequences of four separate farm isolates from clinical cases cluster closely together, most like the RFLP 3-2-1 and AF055393 (French isolate)

Are substantially different than the RFLP 4-2-2 variants found also in affected herds and in all unaffected tested thus far.



Differential PCV_2 PCR

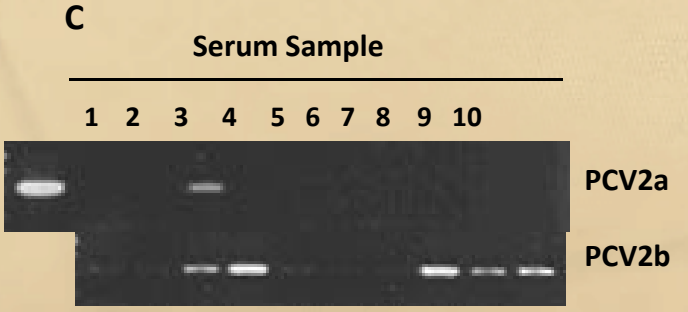
PCV_2 signature motif

```
PCV2a (422) 1463-TATGAGATTTTGTTG
PCV2b (321) 1462-C.C...CGGGGG..A
```

A

B

C



24 of 97 samples Dx lab submissions showed the presence of both PCV2a and PCV2b in the same pig

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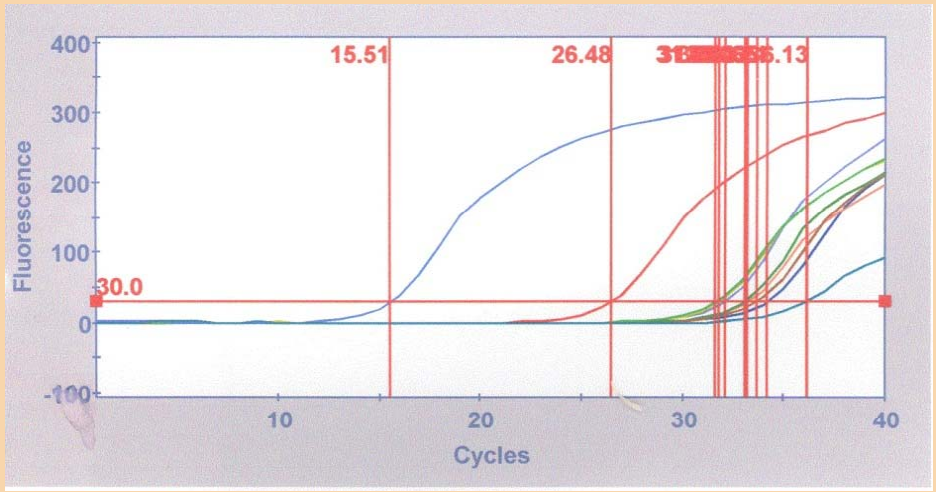
Differential PCR

SYBR Green and TaqMan

High Con → Low Con



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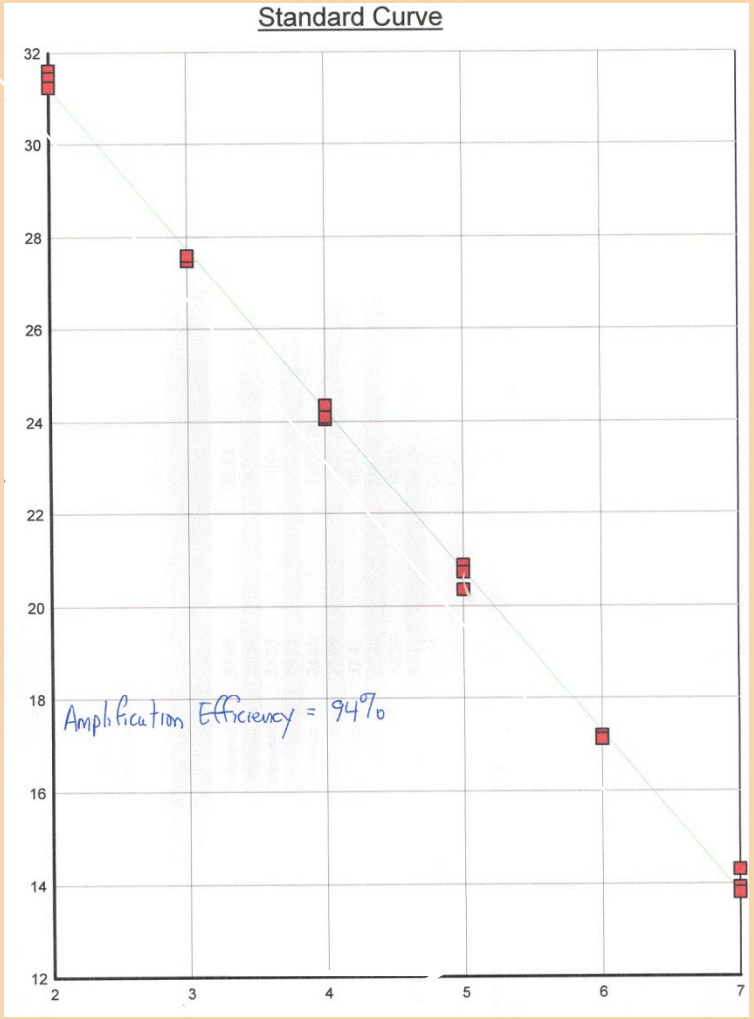
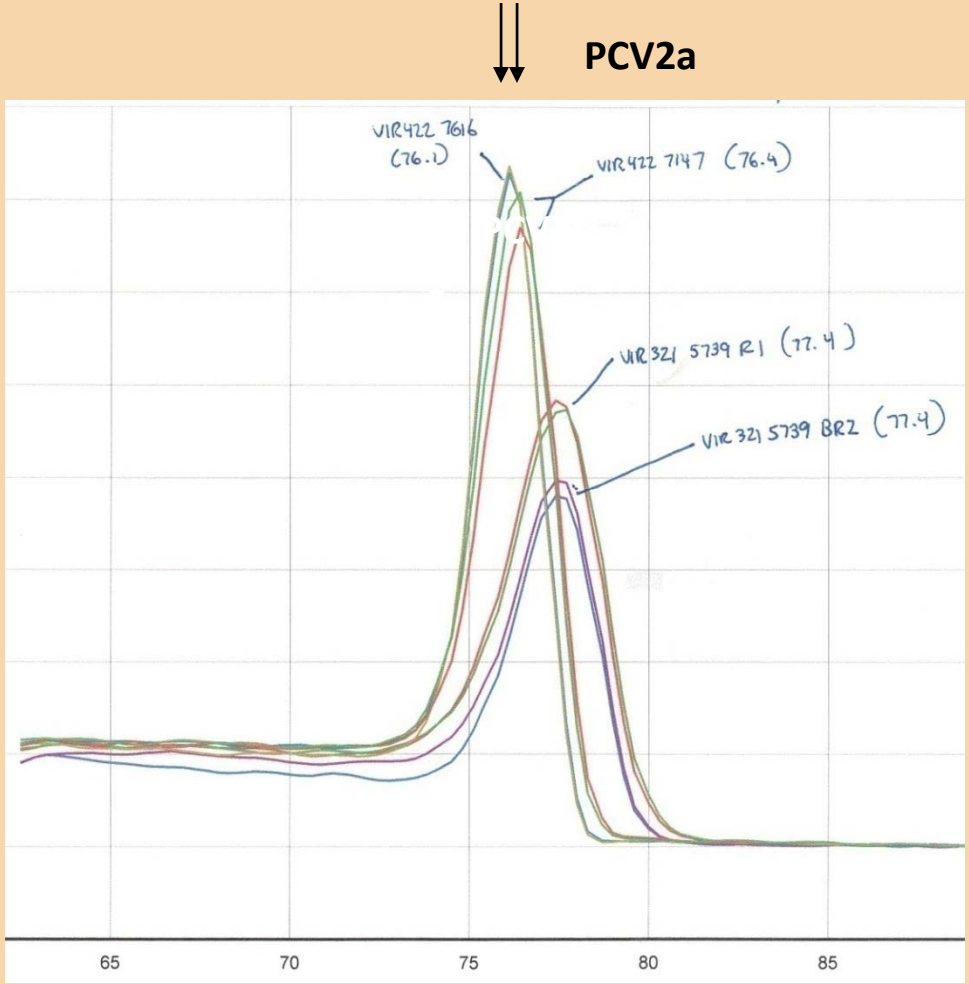


Co

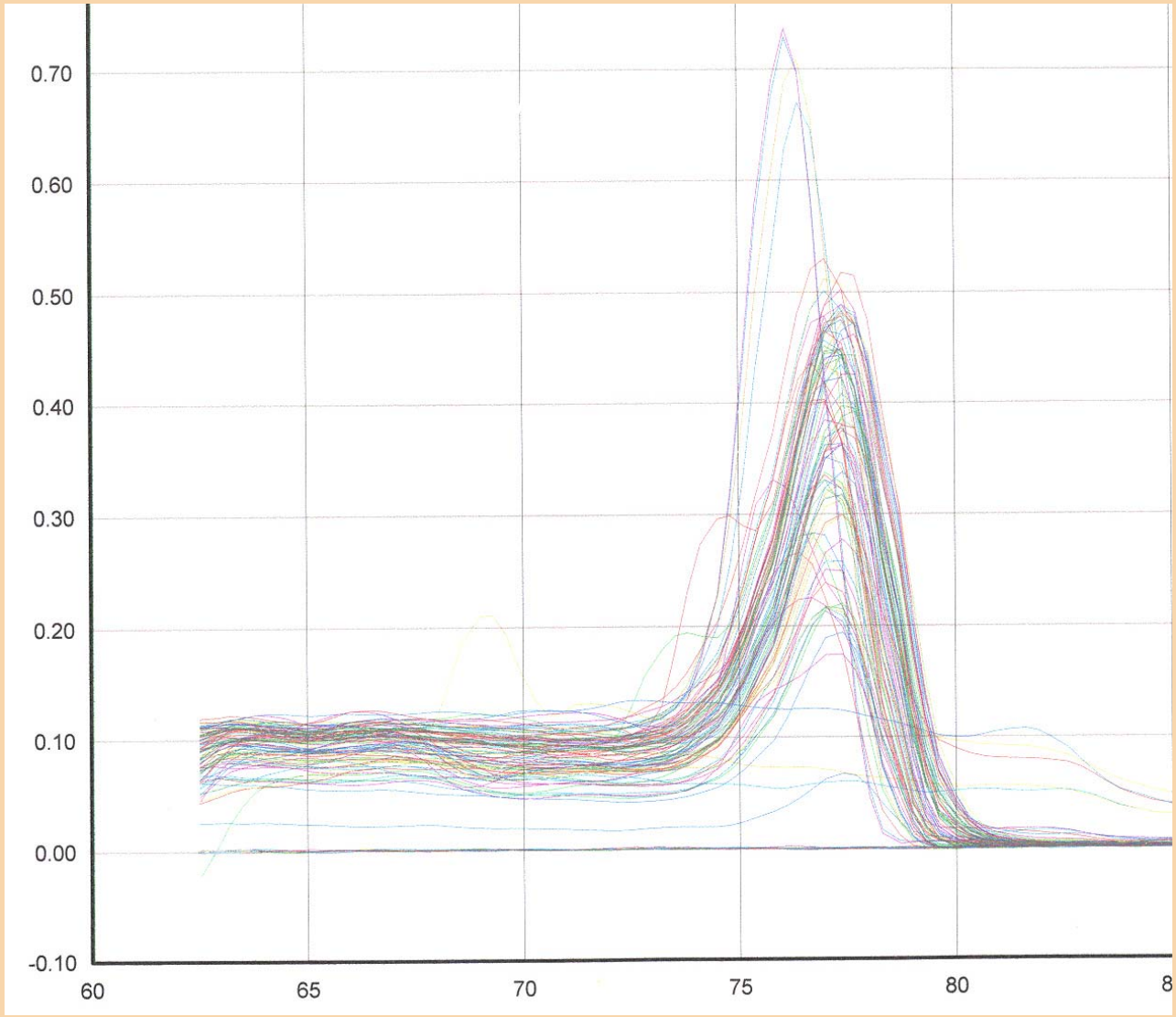
K-State

Kansas State VDL Diagnostic Solutions

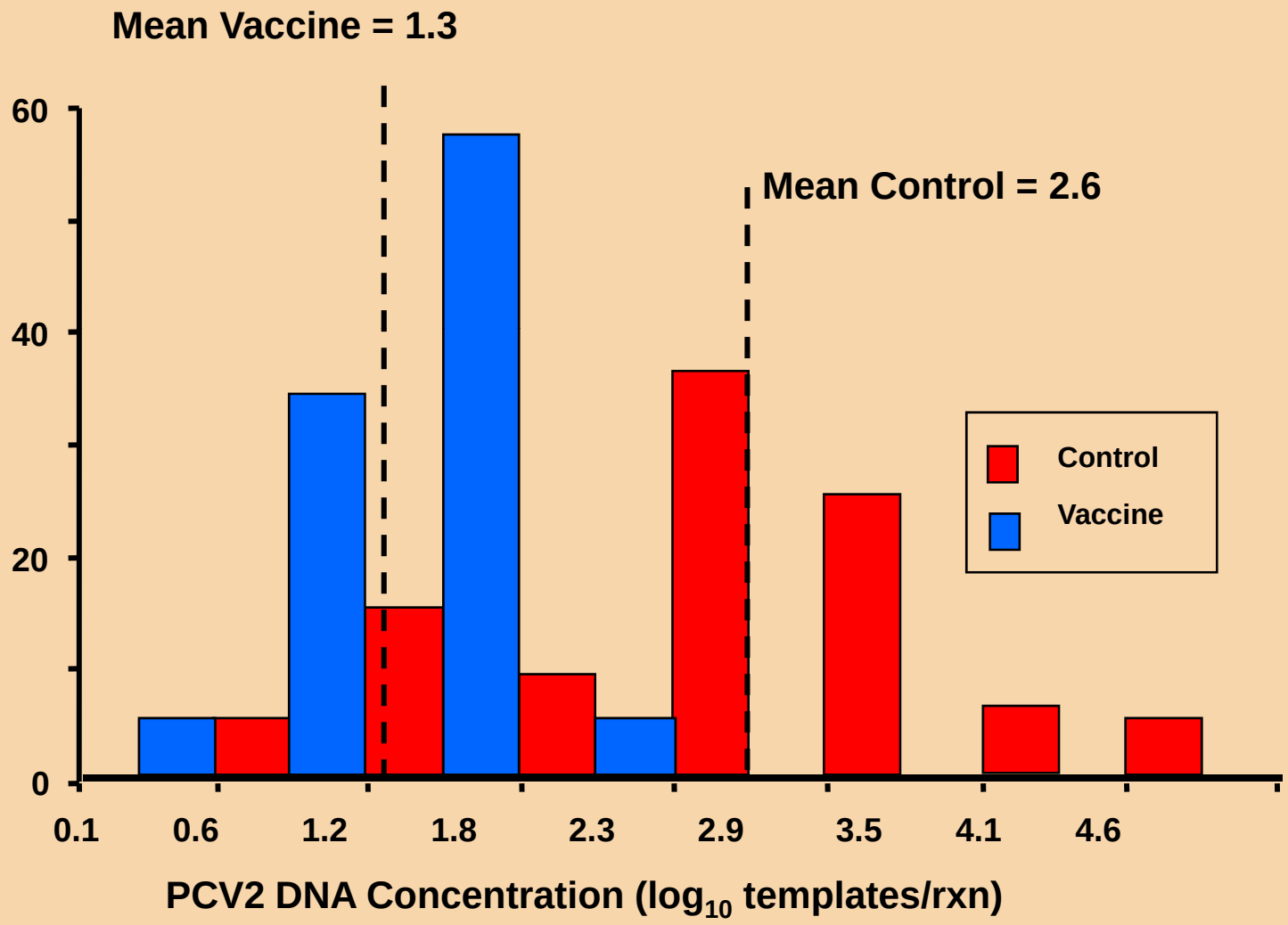
Differential qPCR
SYBR Green and TaqMan



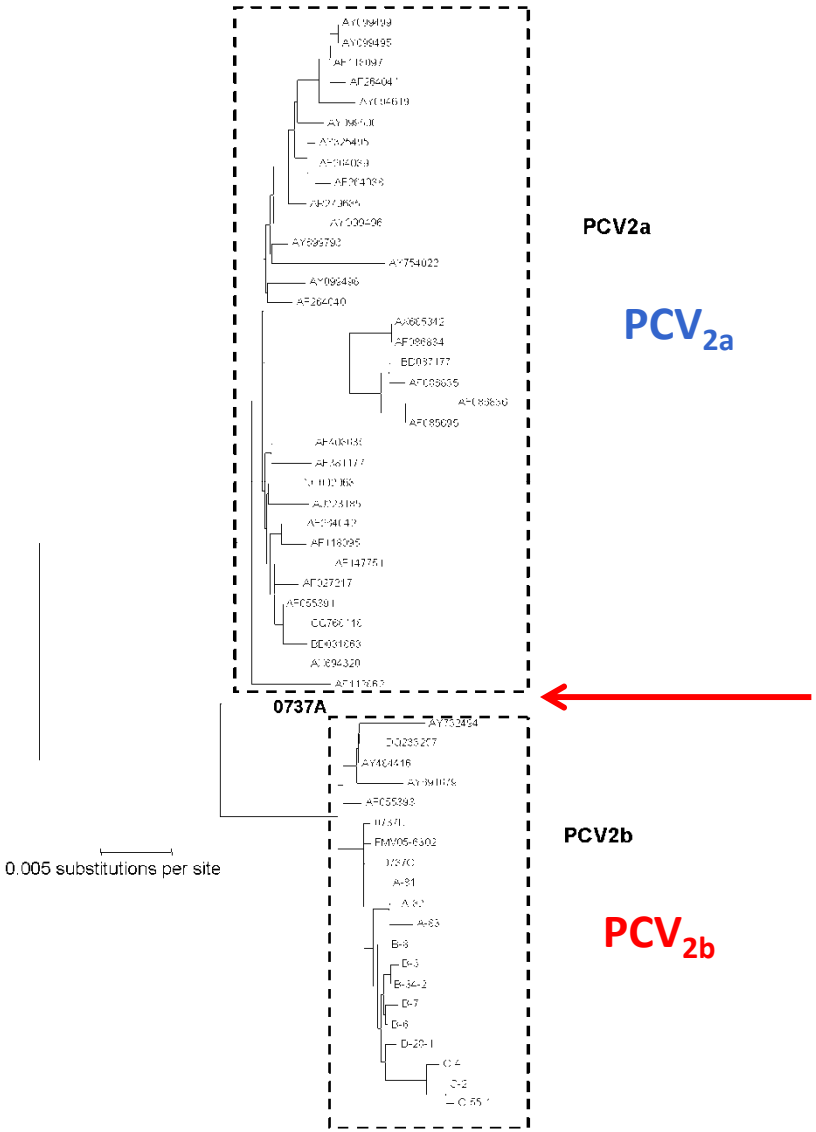
Melting Curve Results



PCR Results

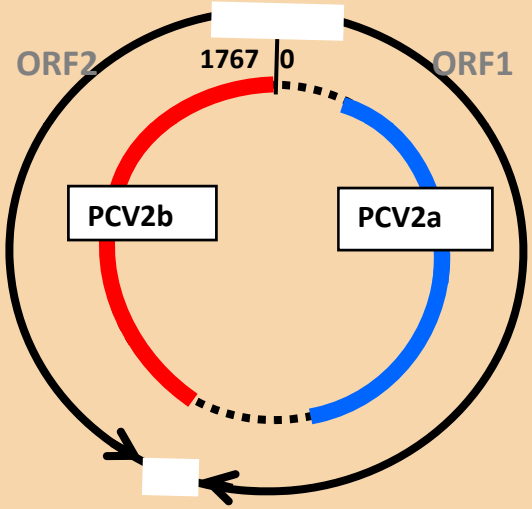

Mean Vaccine = 1.3
Mean Control = 2.6
60
40
20
0
Control
Vaccine
0.1
0.6
1.2
1.8
2.3
2.9
3.5
4.1
4.6
PCV2 DNA Concentration (log10 templates/rxn)

Whole Genome Sequencing



PCV$_{2a}$

PCV$_{2b}$



0723A

K-STATE

The Pipestone/KSU Research Trial #1

"This trial investigated field performance results of PCV_2 vaccinated pigs in a controlled commercial production setting."

K-State / NHF New Horizon Farms LLP

Evaluation of PCV_2 Vaccination in a Commercial Research Finishing Barn (Trial 1)

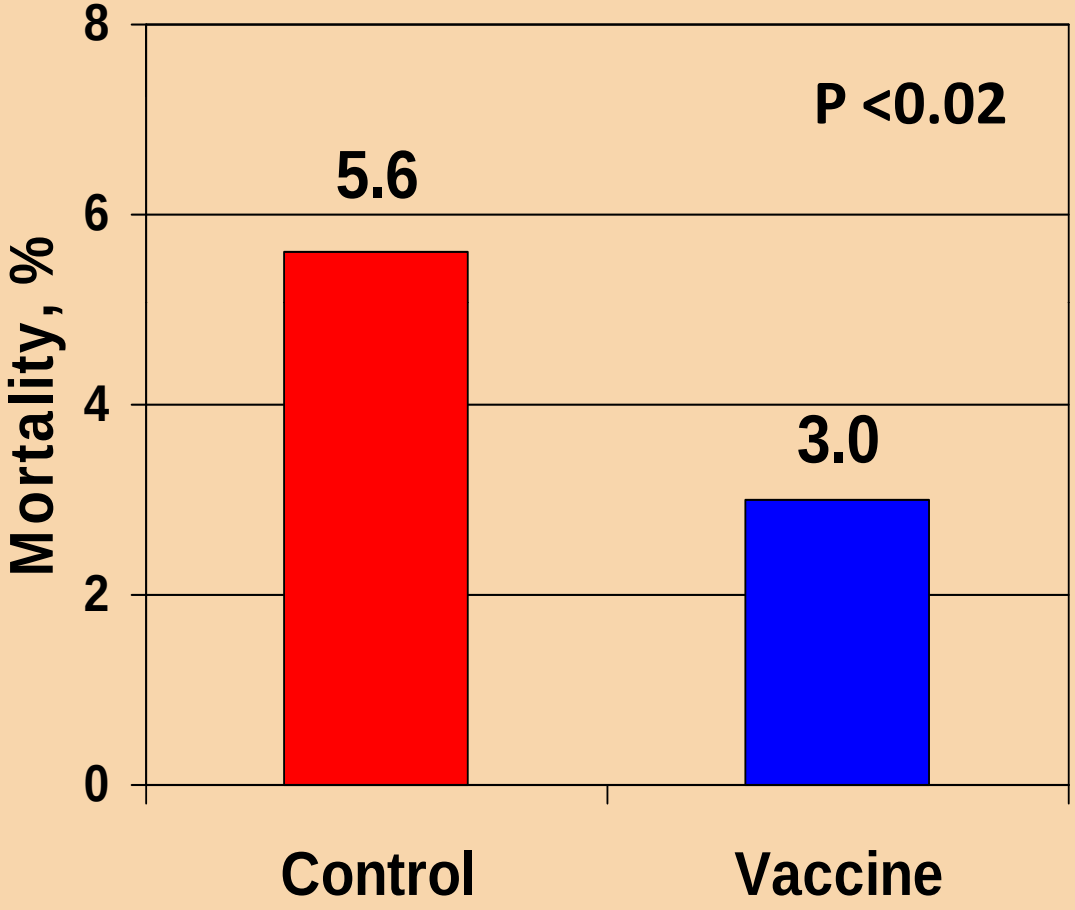
- PRRS POS - Historical Finisher Mortality ≈ 6%
- Histopath lesions of PCVD had been previously characterized
- Genetic Background: PIC 337/280 x 1050

- Commercial PCV2 Vaccine became available

- Pigs were vaccinated at 9 and 11 weeks of age (Late!)
- Pigs housed within pens by vaccination or controls in a single finisher
- 24 pens (650 pigs) controls and 24 pens (650 pigs) vaccinates

K-STATE / NEW HORIZON FARMS LLP

Effect of PCV_2 Vaccination on Mortality - Trial 1

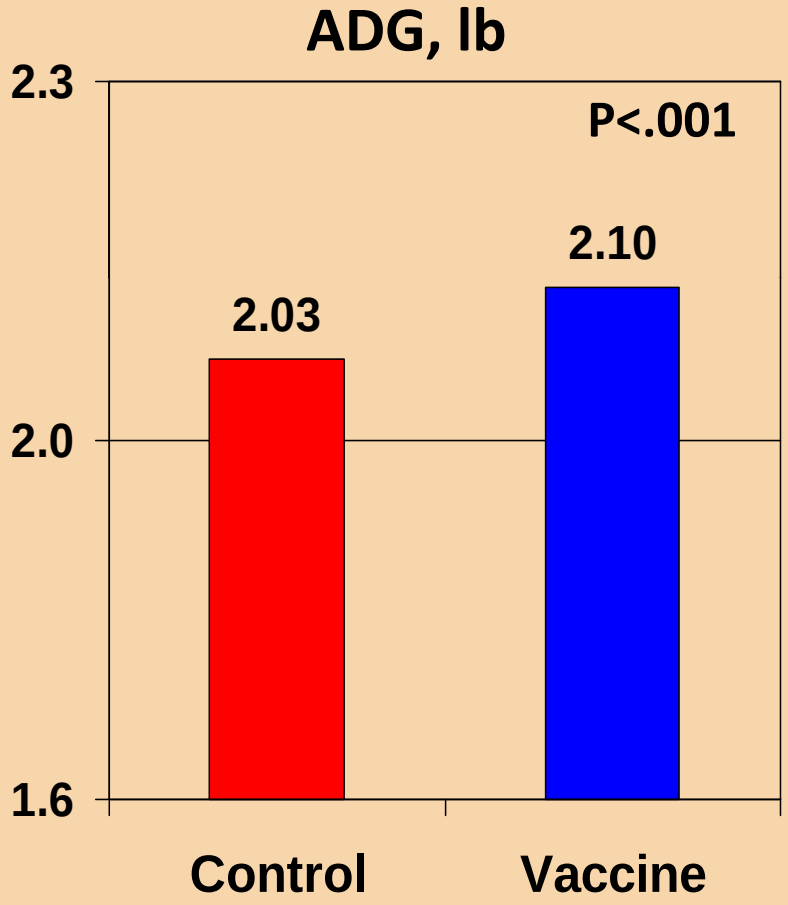


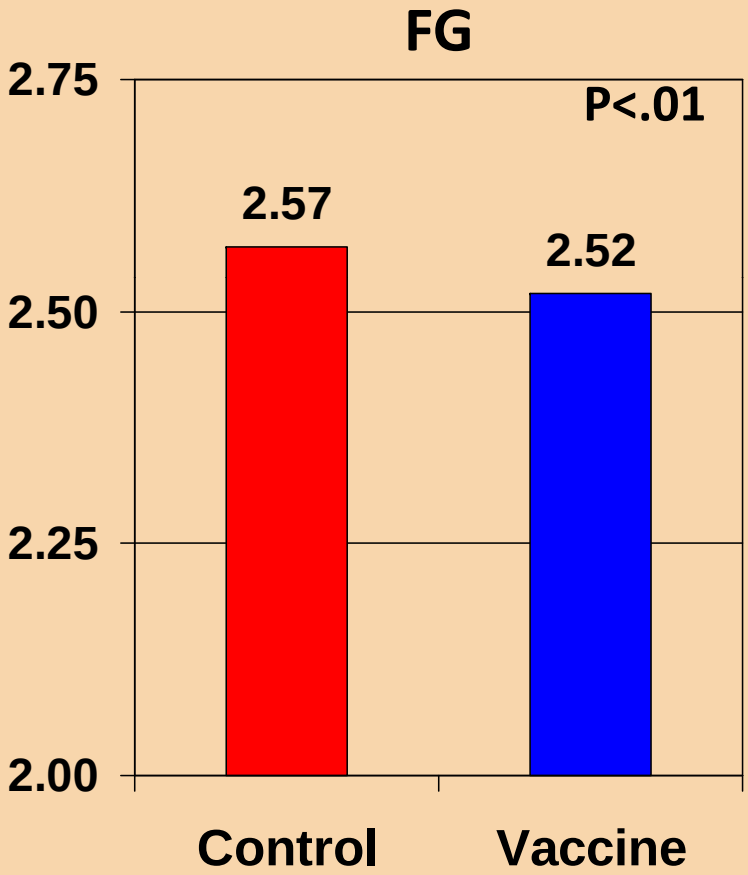
Clinical signs and histopath lesions consistent with PCVD were noted in pigs from this barn

K-STATE

NEW HORIZON FARMS LLP

Effect of PCV_2 Vaccination on ADG and Feed Efficiency - Trial 1





K-STATE

NEW HORIZON FARMS LLP

Economics: Mortality, growth rate, and feed efficiency improvements were calculated to result in a benefit of **$3.94** per pig

K-STATE / NEW HORIZON FARMS LLP

The Pipestone/KSU Research Trial #2

"Repeated Trial #1 with a younger vaccination age closer to label recommendations with the next group in the barn."

K-State / NHF New Horizon Farms LLP

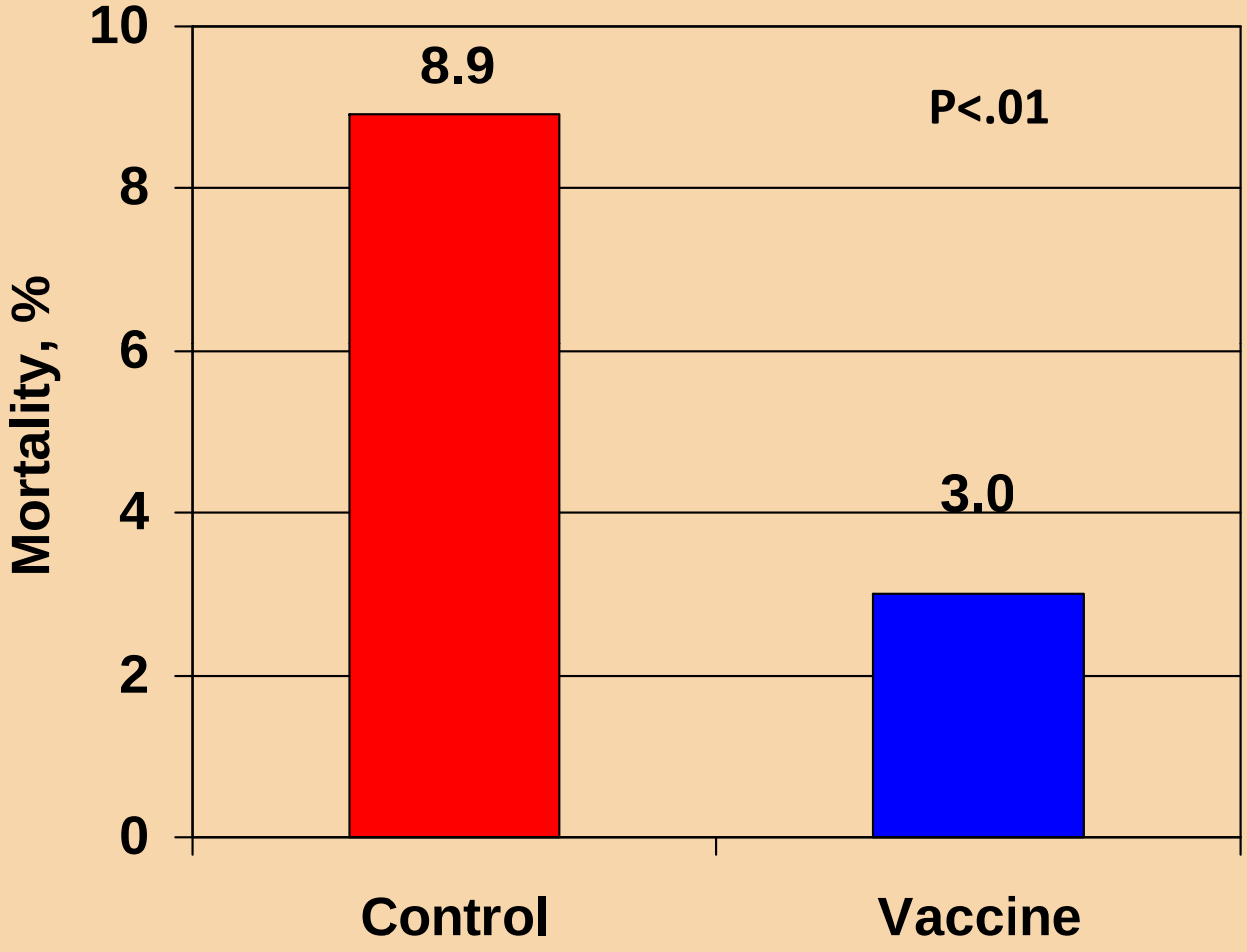
Evaluation of PCV_2 Vaccination in a Commercial Research Finishing Barn (Trial 2)

- Same production system and commercial PCV_2 Vaccine as Trial 1
- Pigs were vaccinated at 5 and 7 weeks of age
- Pigs were housed in the same barn as Trial 1

- Pigs housed within pens by vaccination or controls in a single finisher
- 21 pens (592 pigs) controls and 24 pens (661 pigs) vaccinates

K-State / New Horizon Farms LLP

Effect of PCV_2 Vaccination on Removal Rate, Trial 2 d 0 to 105

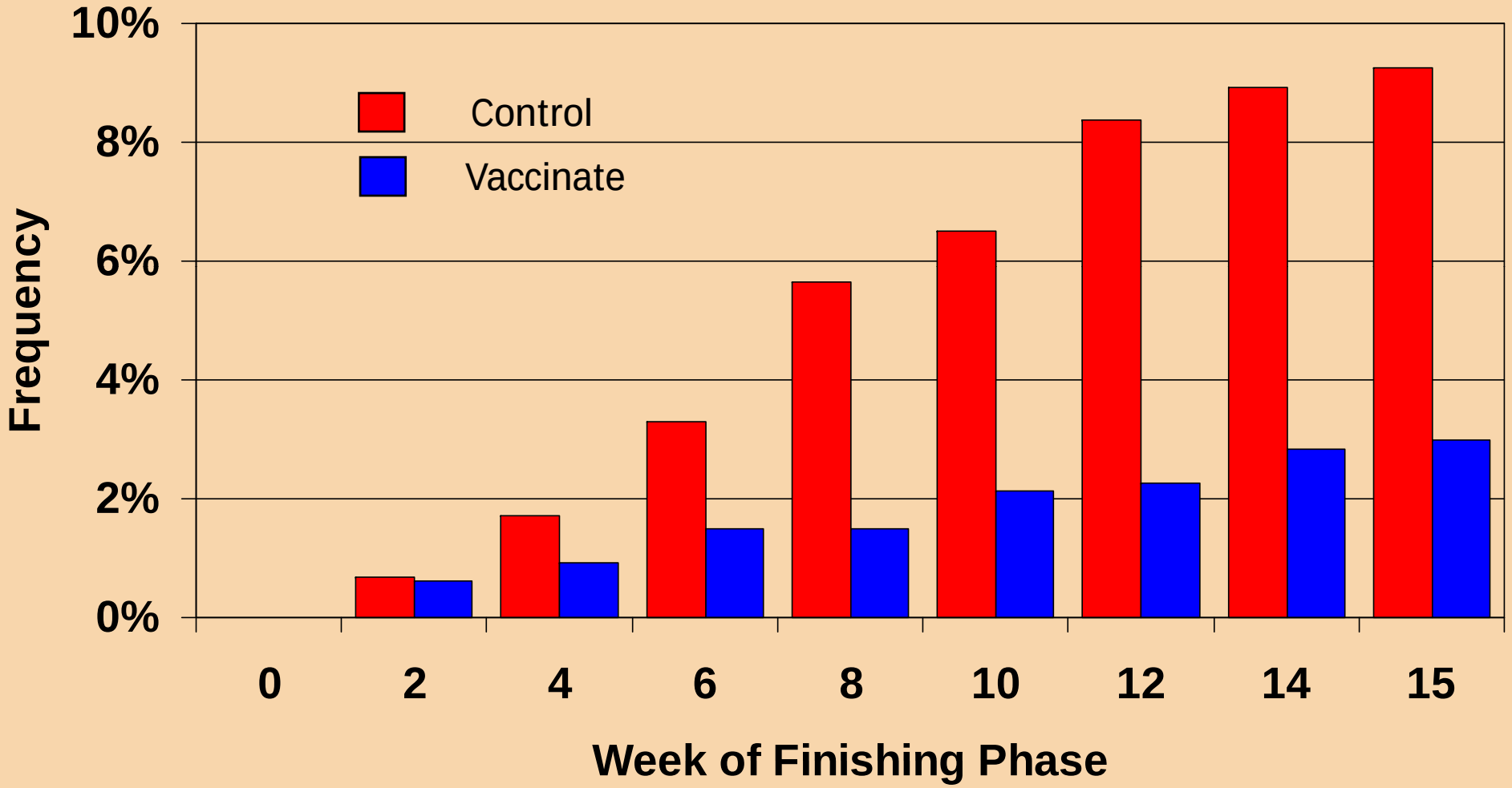


Clinical signs and histopath lesions consistent with PCVD have been noted in pigs from this barn

K-STATE

NEW HORIZON FARMS LLP

Effect of PCV_2 Vaccination on Cumulative Removal Rate - Trial 2 d 0 to 105



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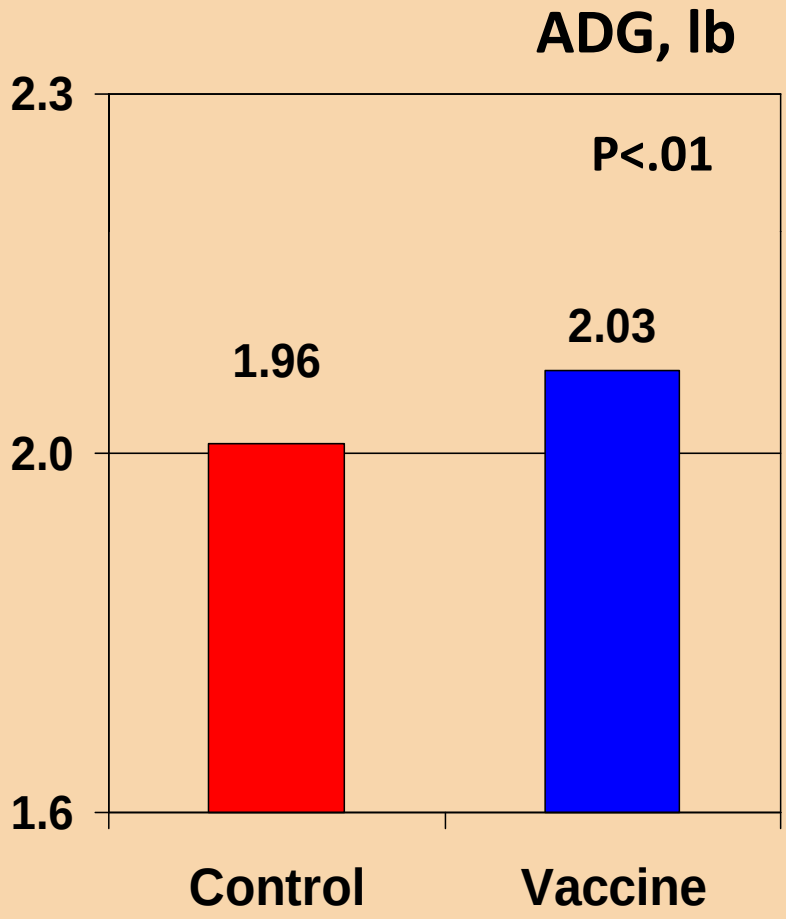
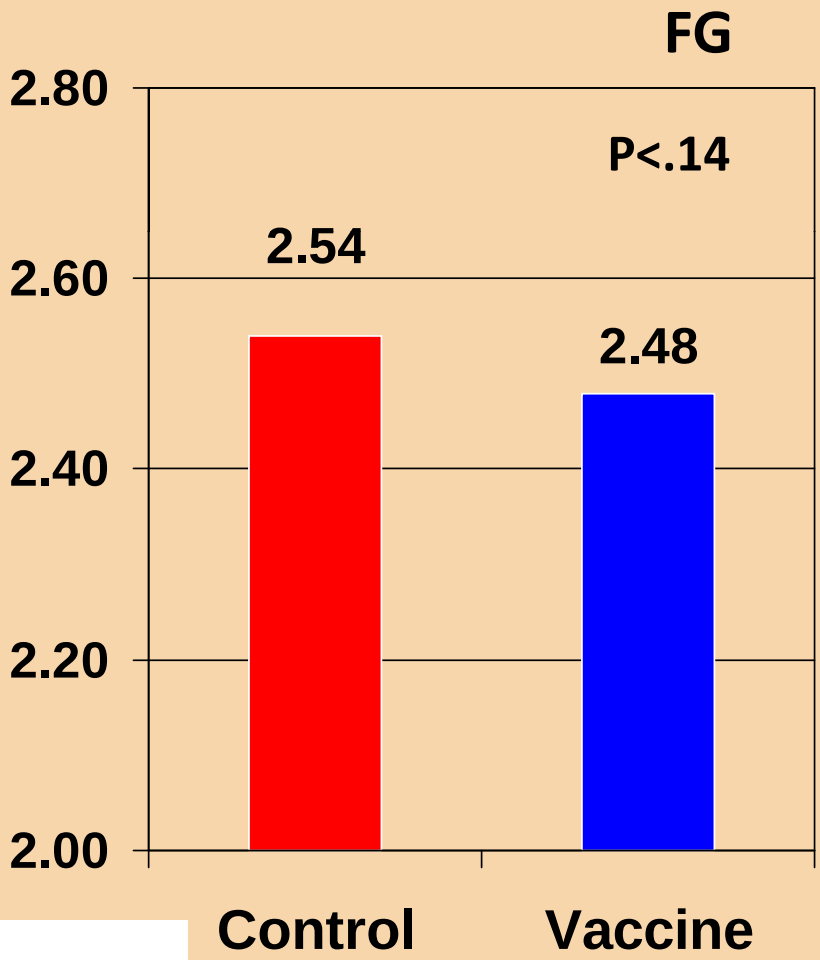
Effect of PCV_2 Vaccination on ADG and FE Trial 2 d 0 to 105





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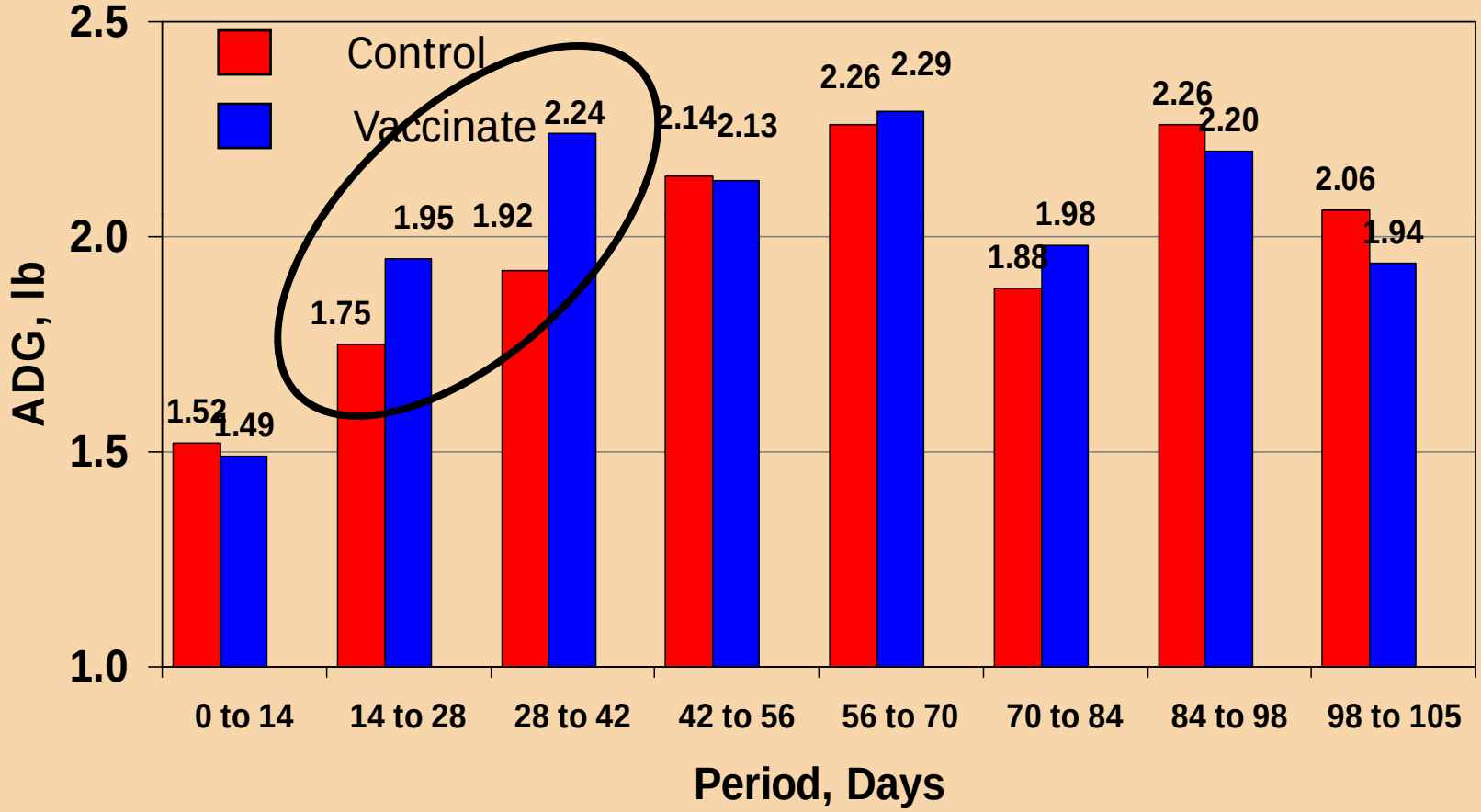
NEW HORIZON FARMS LLP

Effect of PCV_2 Vaccination on ADG over Time Trial 2 d 0 to 105



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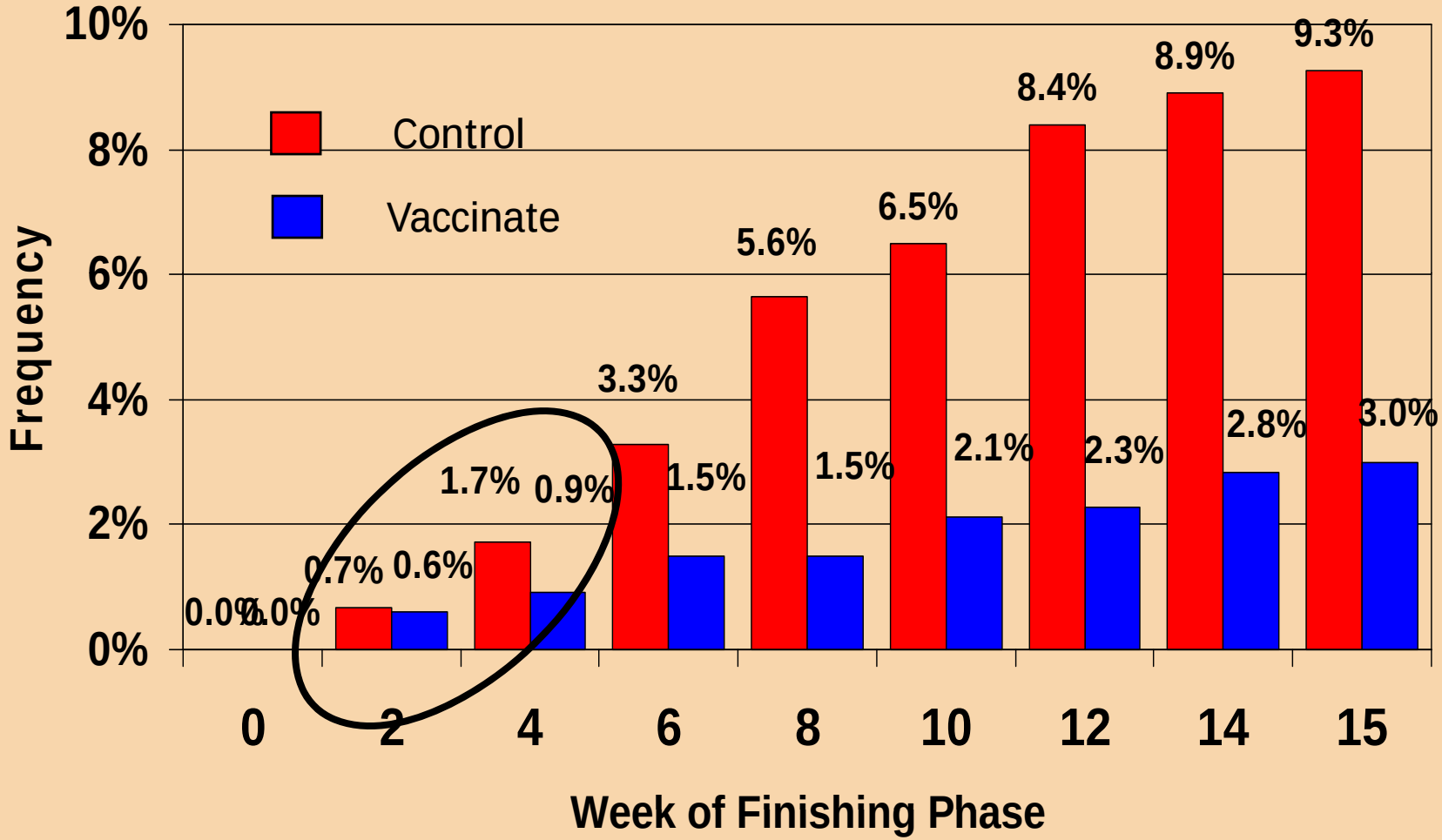
Effect of PCV_2 Vaccination on Cumulative Removal Rate - Trial 2 d 0 to 105



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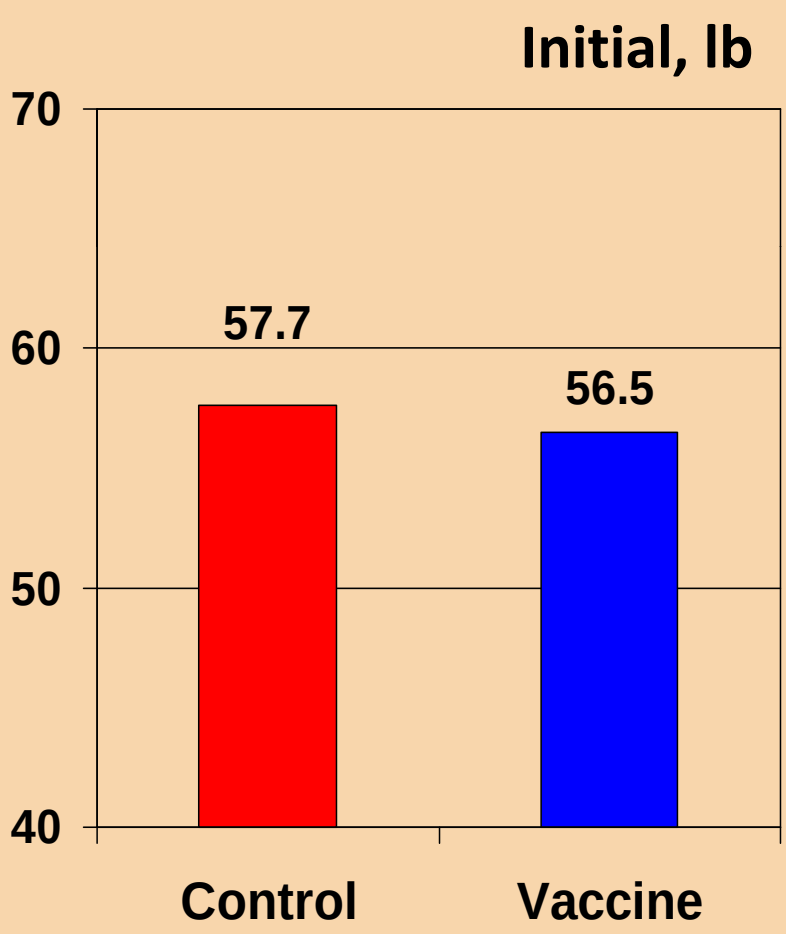
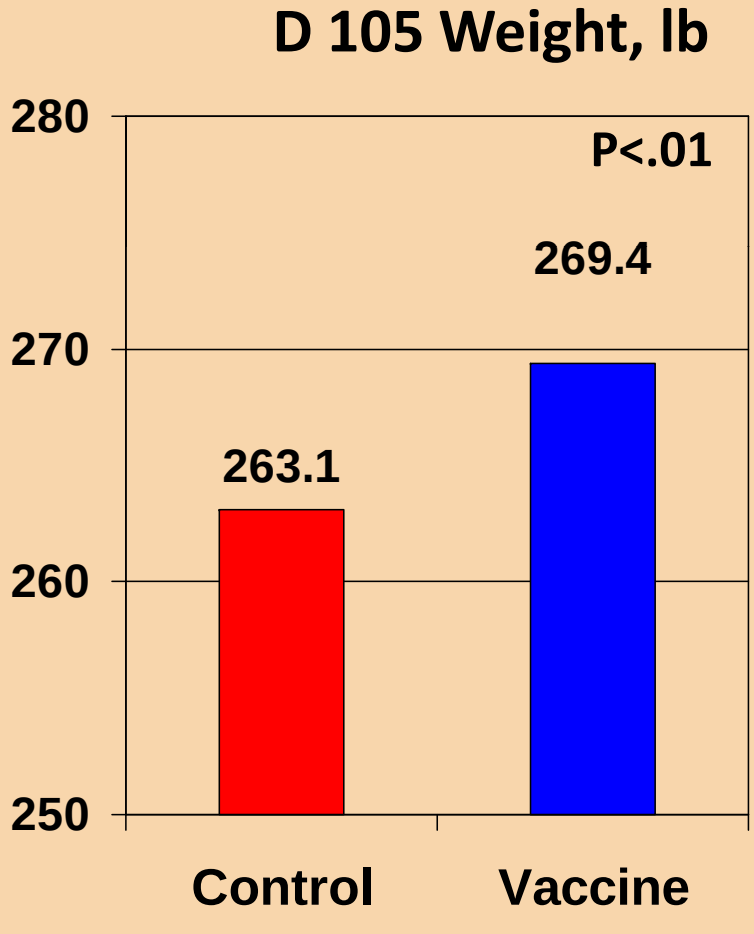
New Horizon Farms LLP

Effect of PCV_2 Vaccination on Average Initial and Final Pig Weight - Trial 2





K-State

NEW HORIZON FARMS LLP

Economics: Mortality, growth rate, and feed efficiency improvements were calculated to result in a benefit of **$8.68** per pig ($3.94 in Trial 1)

K-STATE / NEW HORIZON FARMS LLP

The J-Six Antibody Trial

"Can we vaccinate pigs in the farrowing house at younger ages and will ½ dose of vaccine be equivalent to full dose?"

K-State / AAH / J-SIX ENTERPRISES LIVESTOCK DIVISION

J-Six Antibody Trial

- Genetic Background: Triumph TR4 x PIC C22
- PRRS positive
- Multi-site KS production system

J-Six Antibody Trial

Experimental Design:

- 25 pigs per treatment 1 pig per litter for each treatment,
- Bled at weaning, end of nursery and mid finishing

Treatments:

Control – No vaccination

Young Full – 1 and 3 weeks of age and 2 x 2 ml dose

Old Full - 3 and 5 weeks and 2 x 2 ml

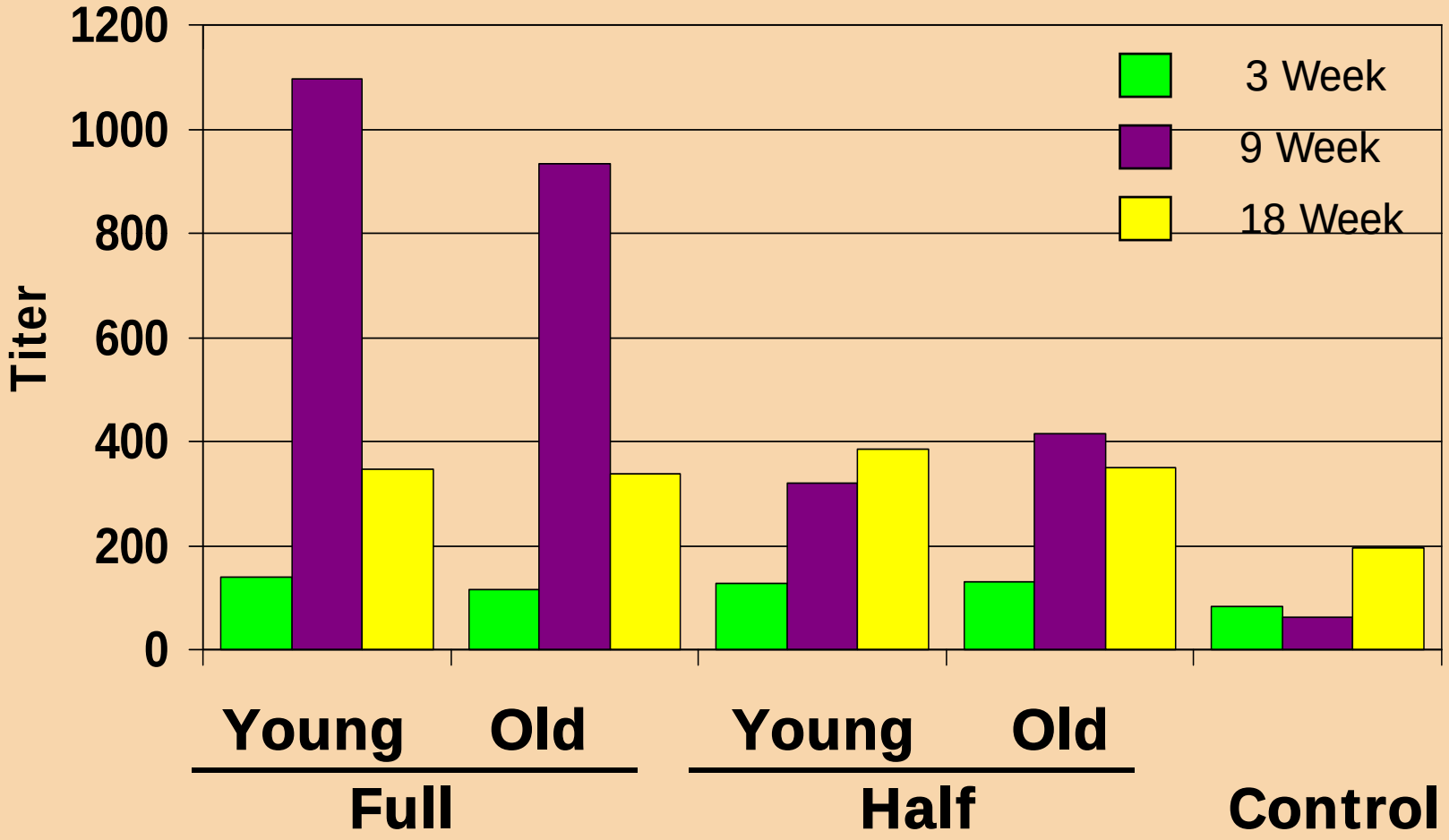
Young Half – 1 and 3 weeks and 2 x 1 ml

Old Half – 3 and 5 weeks and 2 x 1 ml

K-State / AAH / J-SIX ENTERPRISES LIVESTOCK DIVISION

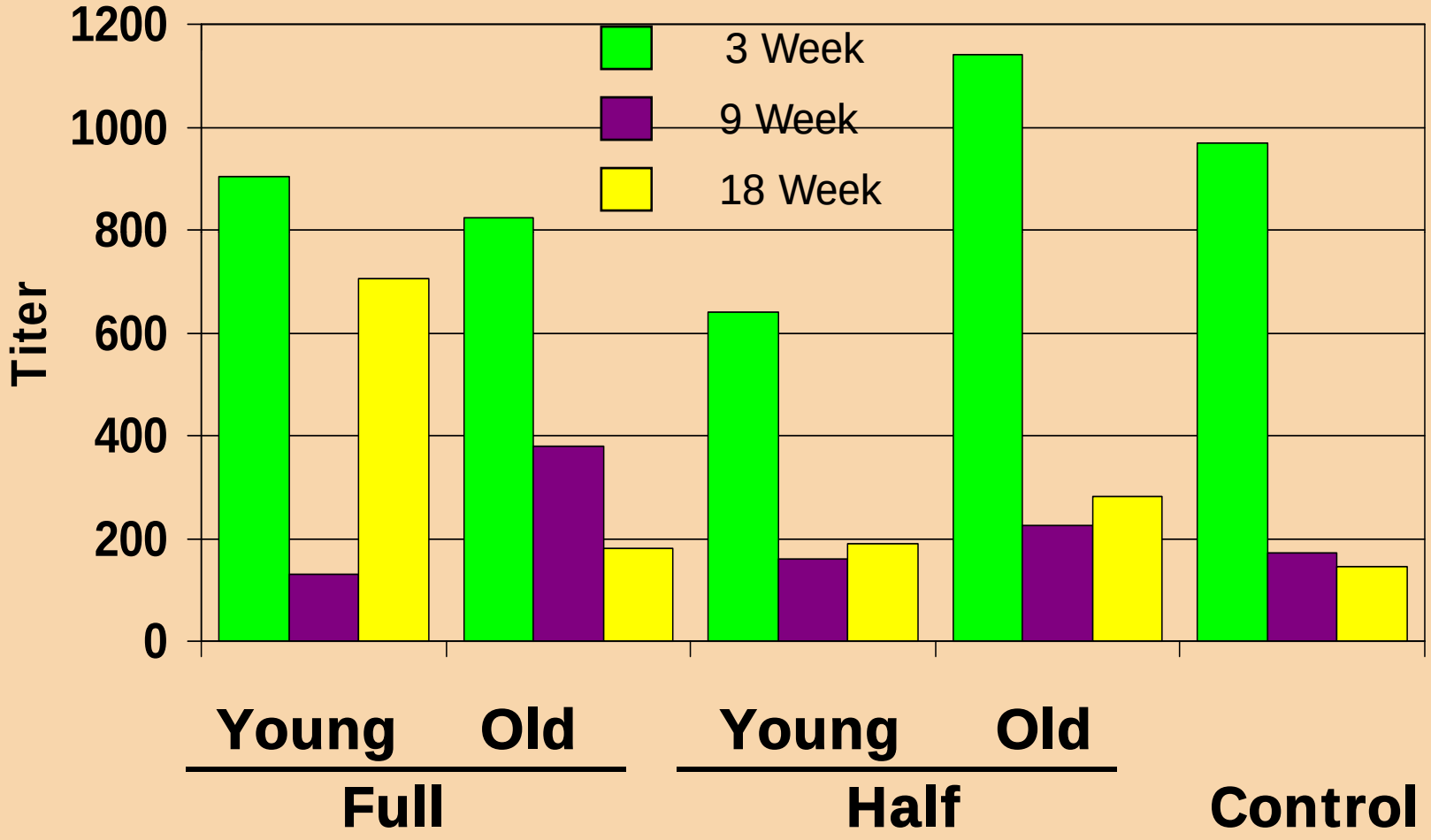
Geometric Mean Titer

Pigs with ≤ 320 at 3 weeks



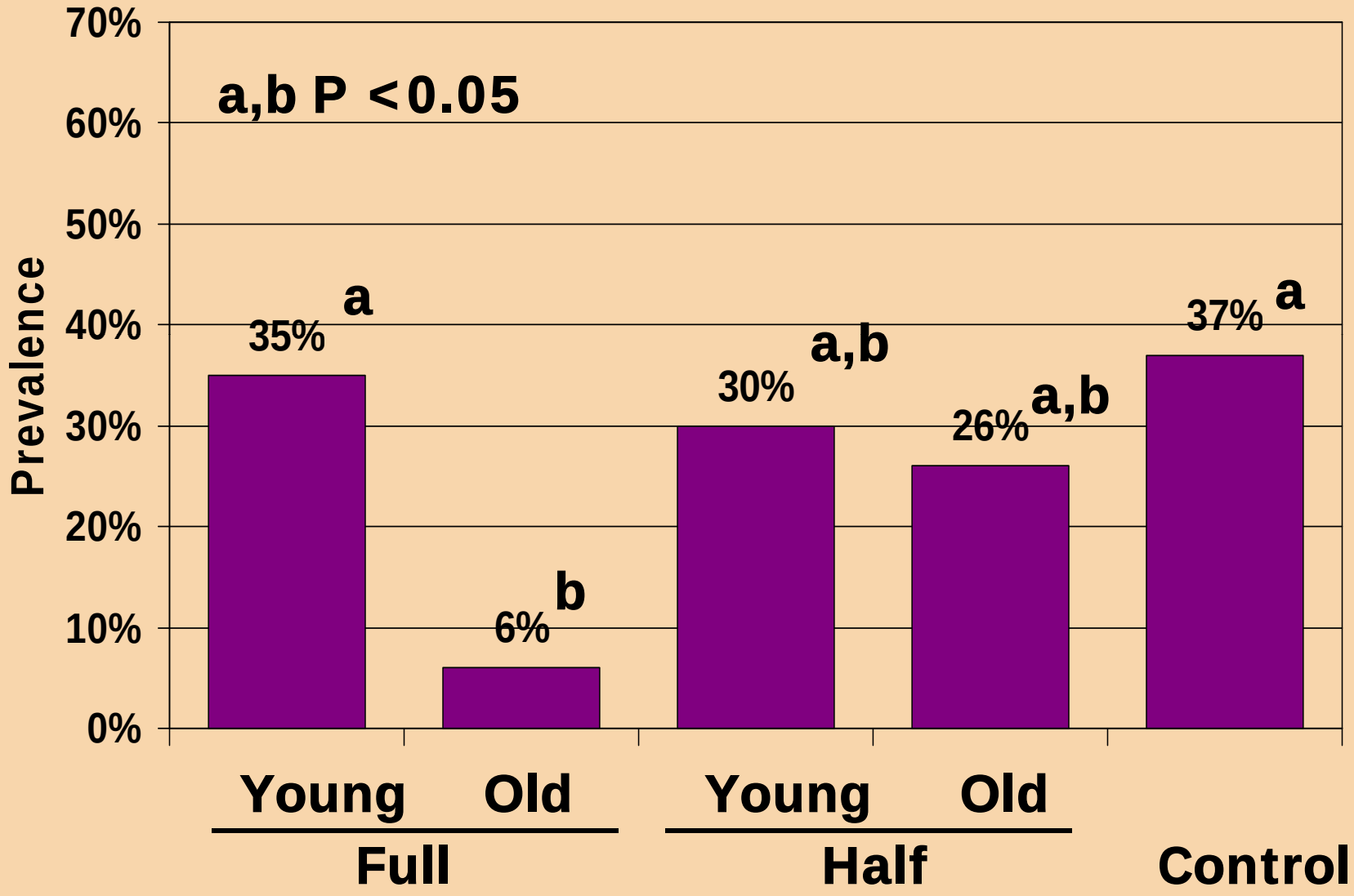
Geometric Mean Titer

Pigs with > 320 at 3 weeks



Prevalence of Natural Infection

Defined as a rise in titer from the 9 to 18 week sample



Passive maternal antibody interference with immunization?

- Appears that pigs with ≤320 develop a post-vaccination response
- Suggests antibody response is inhibited by antibody titer >320
- Many new questions….

Tag	3 weeks	9 weeks	18 weeks
83	40	640	160
85	80	2561	640
84	80	2561	640
100	80	1280	320
24	80	1280	320
88	160	1280	320
36	320	1280	640
93	320	2560	640
97	320		
45	320	80	80
37	640	160	2561
94	640	160	2560
96	640	160	80
92	640	160	2561
5	640	160	80
82	640	160	160
89	640	160	320
87	640	80	2561
86	640	80	2561
95	640		
98	1280	160	80
90	1280	20	2561
91	2560	80	80
18	2561	320	2561
99		320	80

K-STATE / AAH / J-SIX ENTERPRISES LIVESTOCK DIVISION

The Keesecker Agri Business Trial

"Are all PCV_2 vaccines created equally?"

K-STATE / AAH /

Keesecker Agri Business, Inc.
Washington, Kansas

KAB: comparative vaccine trial

- Treatments:
  - Unvaccinated Controls
  - One Dose PCV Chimera vaccine (Fort Dodge)
  - Two Dose Baculovirus vectored vaccine (Intervet)

K-STATE / AAH /

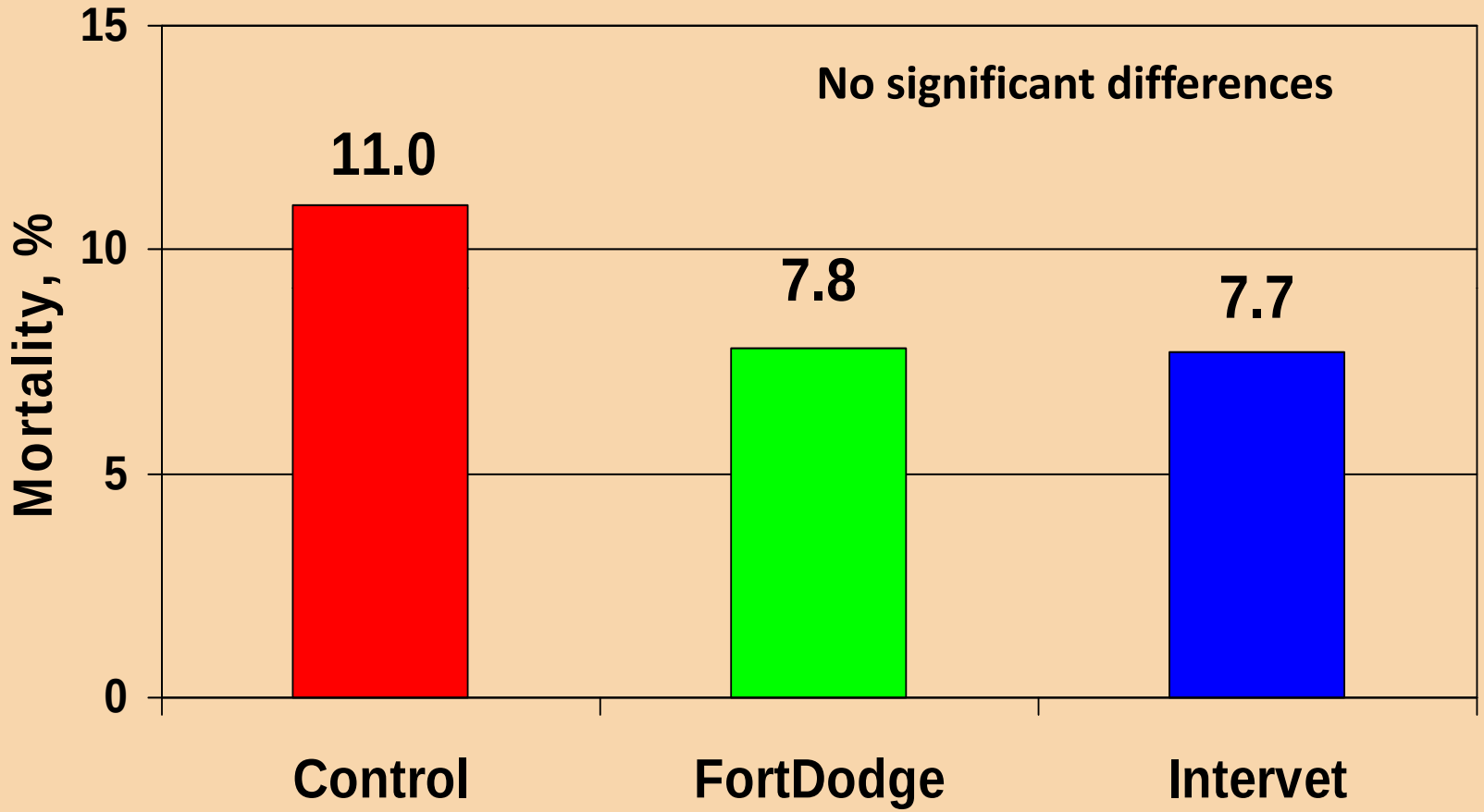
Keesecker Agri Business, Inc.
Washington, Kansas

Background Information

- Genetic Background: Triumph TR4 x PIC C22
- 1,470 Pigs randomly allotted to control or the two vaccine treatments
- Three different weaning groups
- Treatment pigs commingled within the same pens
- PCVD histopath lesions confirmed in each of the three weaning groups

K-STATE / AAH / Keesecker Agri Business, Inc. Washington, Kansas

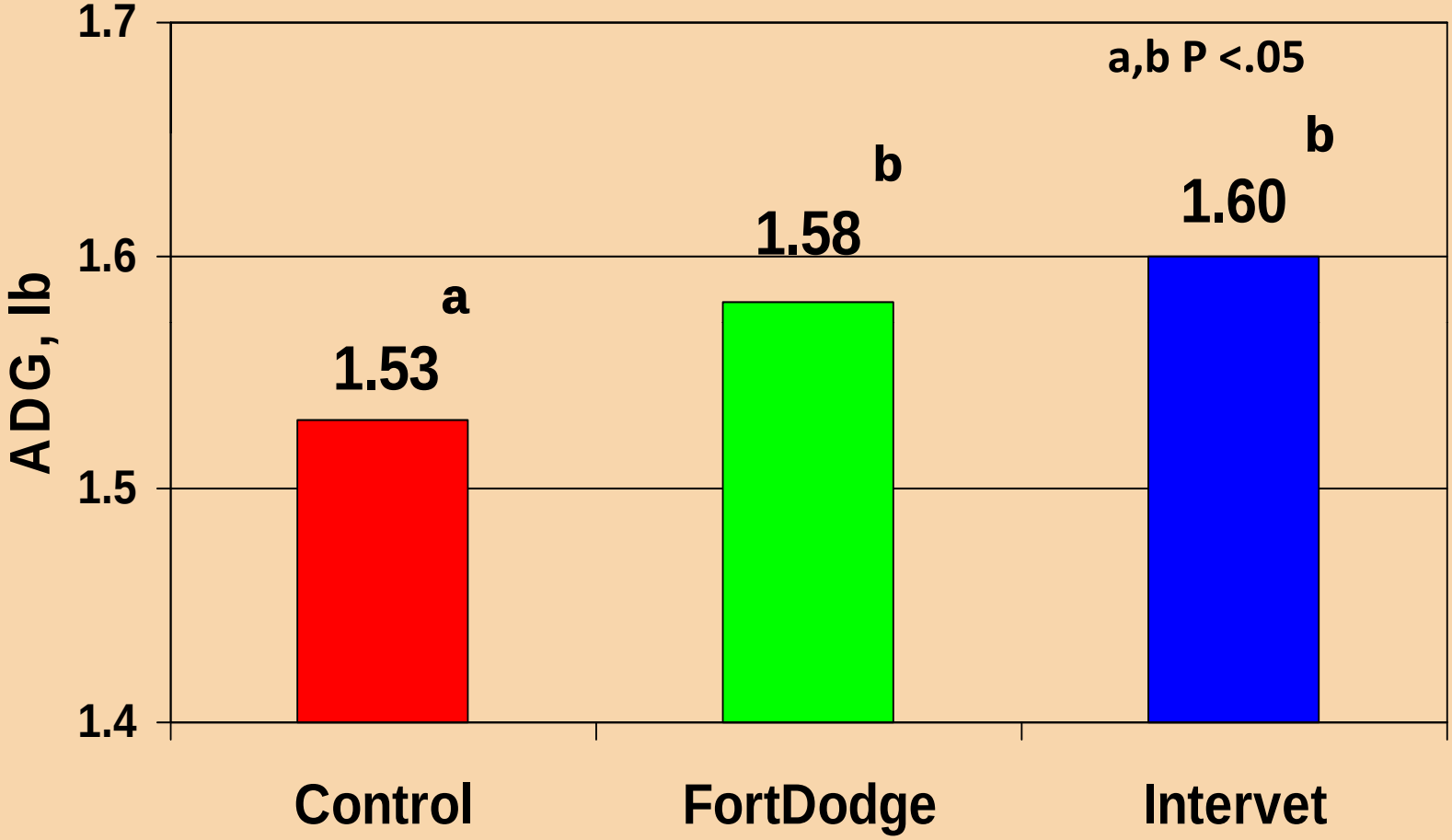
Effect of PCV_2 Vaccination on Mortality Weaning to Market



K-State / AAH / Keesecker Agri Business, Inc. Washington, Kansas

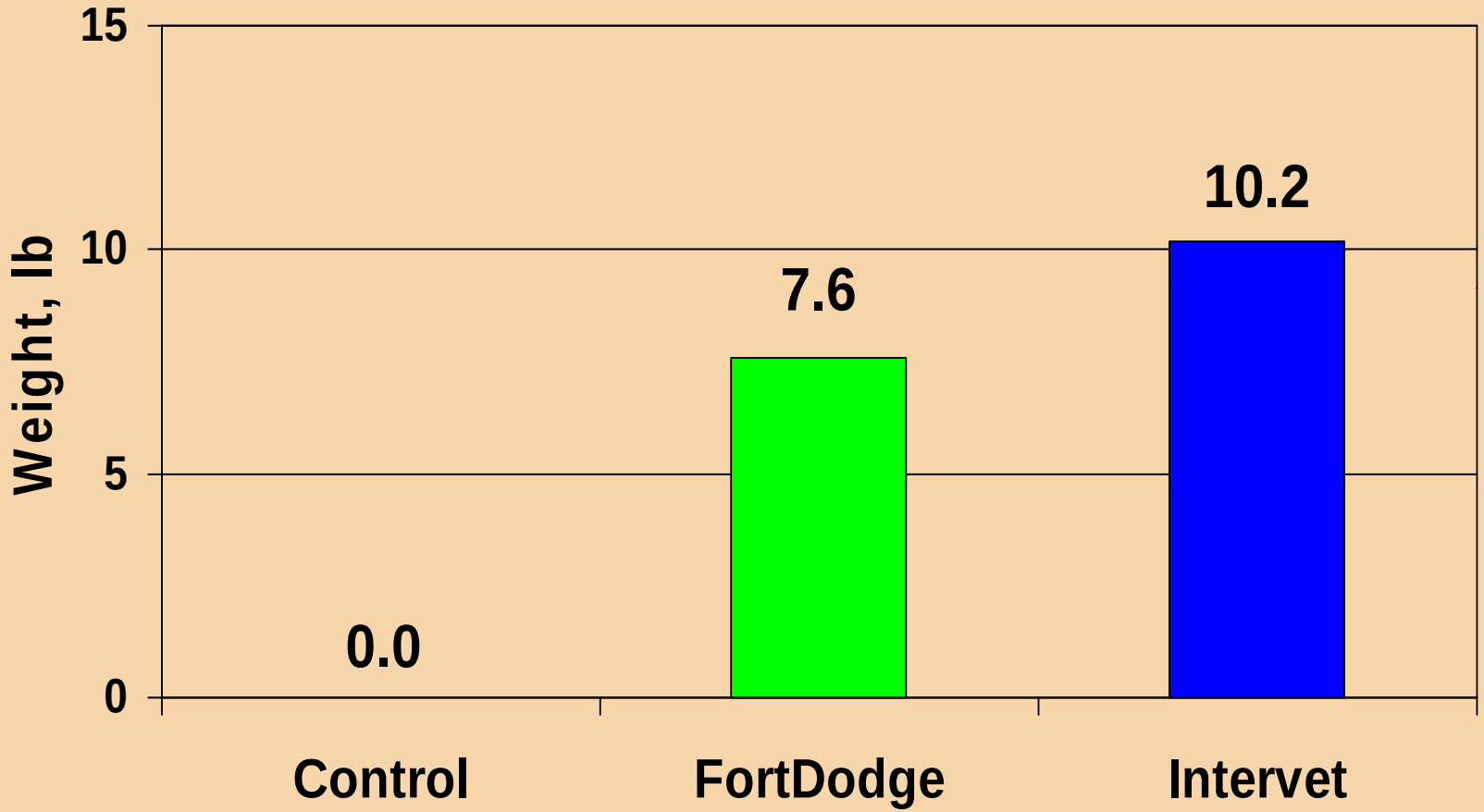
Effect of PCV_2 Vaccination on ADG

Weaning to Day 143 after weaning (just prior to first pigs marketed)



K-State / AAH / Keesecker Agri Business, Inc. Washington, Kansas

Day 143 after Weaning Difference in Average Weight

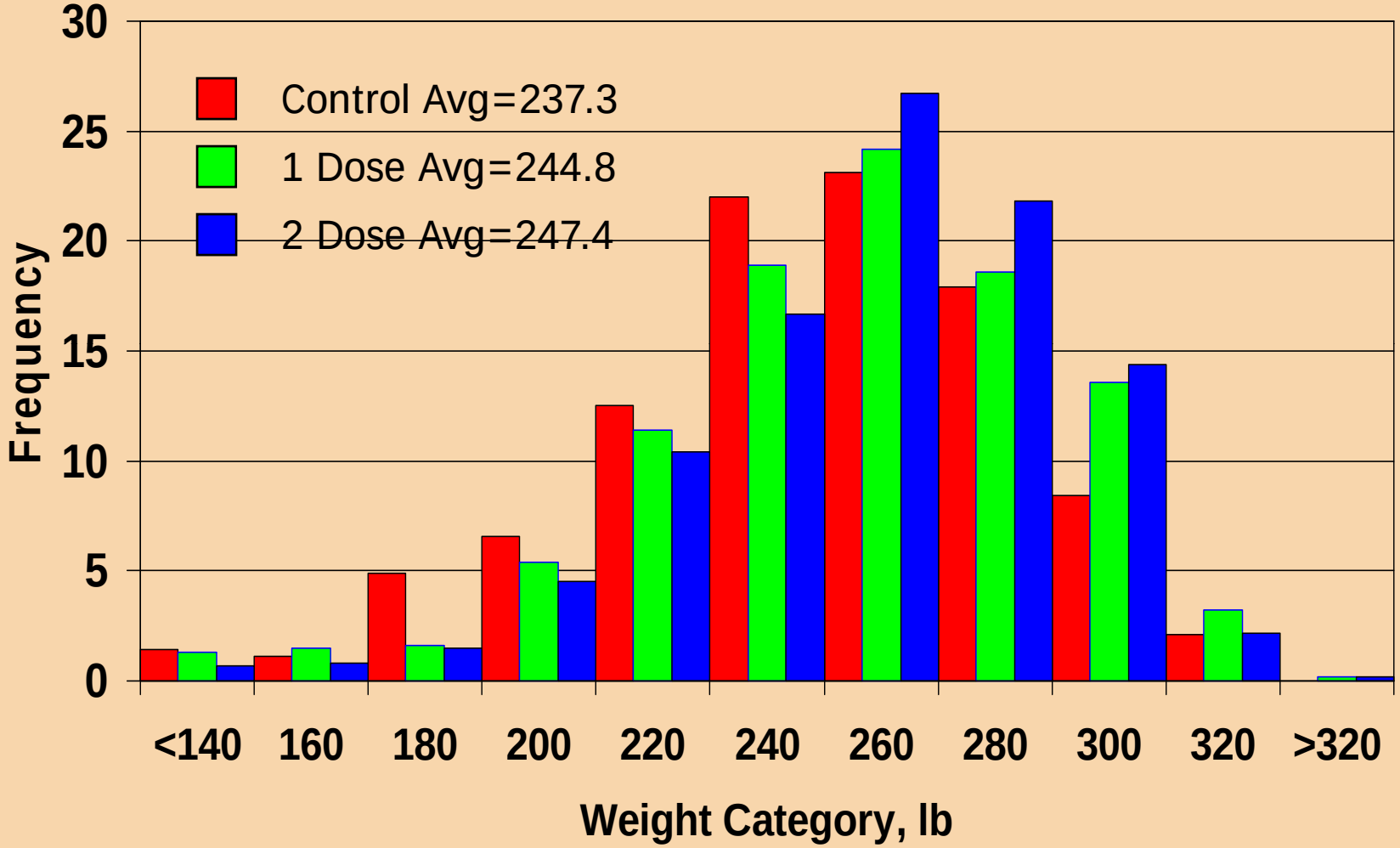


K-STATE / AAH /

Keesecker Agri Business, Inc.
Washington, Kansas

Market Weight Histogram

Day 143 after weaning (just prior to first pigs marketed)



K-State / AAH /

Keesecker Agri Business, Inc.
Washington, Kansas

The Genetic Trial

"*Do all genetic lines respond to PCV_2 virus and vaccination equally?*"

K-STATE / AAH / PIC / HENRYS LIMITED

Clinical Signs and Background

- Diagnosis of PCV_{2b} infection in early '06 based on histopathologic lesions and the presence of virus (IHC and PCR)
- Mortality was not the primary clinical sign
- Clinical manifestation was an increasing incidence of ill-thrift and stunted pigs
- Morbidity rather than mortality.

K-STATE / AAH / PIC / HENRYS LIMITED

Genetic by Vaccine Response Interaction Trial

Genetic background of the two lines:

- A: Duroc-based line
- B: Synthetic sire line
  (Duroc, Pietran & Large White)

PRRS and Myco Negative Herd

K-STATE / AAH / PIC / HENRYS LIMITED

Experimental Plan

- Randomly allot to control and vaccinate balanced within genetic combination (AxA, AxB, BxA, BxB)
- Initially 454 pigs placed on-test
- Vaccine was administered at weaning and three weeks later – Intervet Vaccine
- Controls intermingled with vaccinates

K-STATE / AAH / PIC / HENRYS LIMITED

Allotment to Treatment

- Pigs were ranked by birth weight within litter and gender
- Randomly assigned to control or vaccinate based on birth weight balanced across treatment
- Treatments:
  - Vaccine: Control or PCV2 Vaccine
  - Genetic: AxA AxB BxA BxB
  - Gender: Boar or Gilt
- Birth weight was balanced across vaccine treatment within each genetic combination

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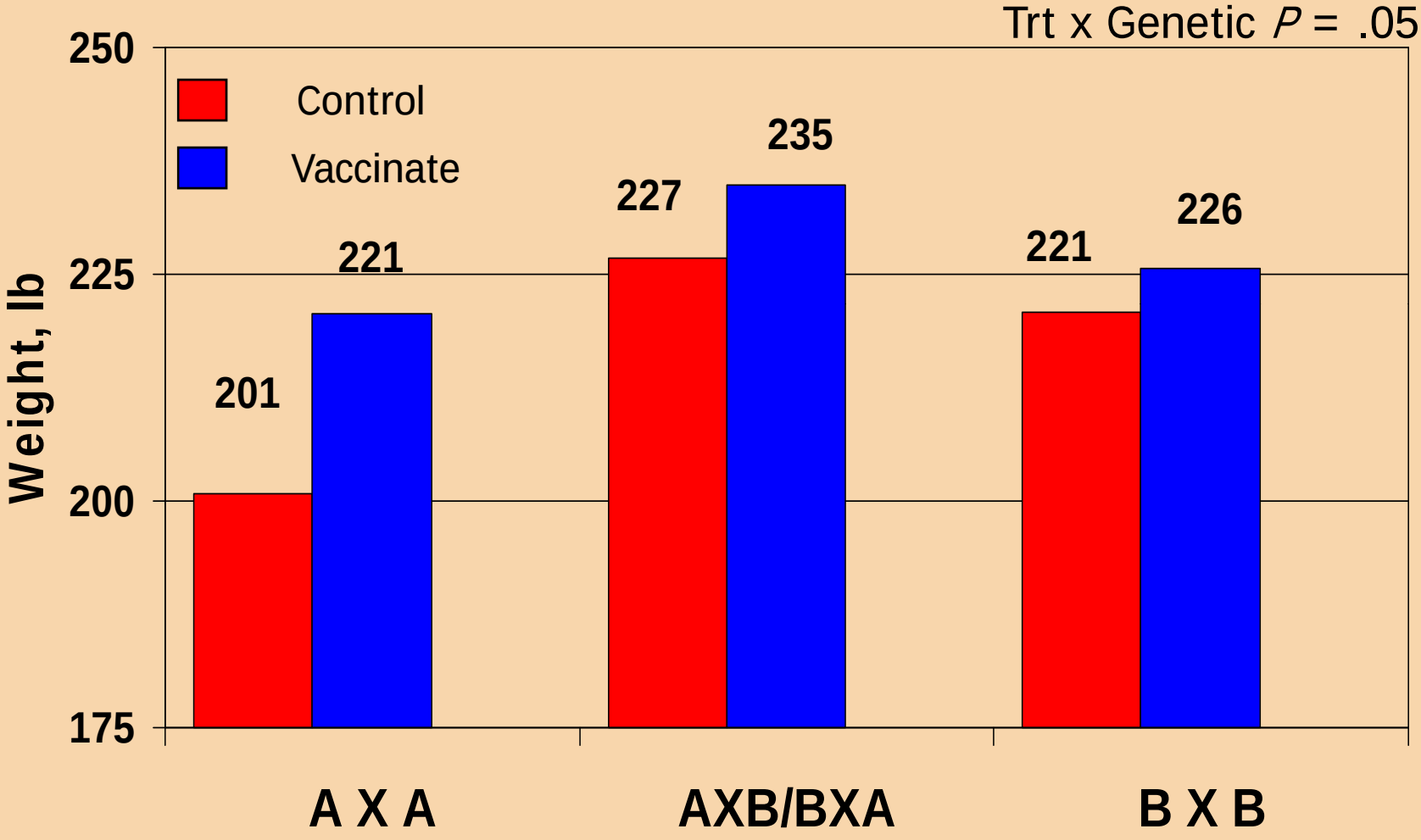
Effect of PCV_2 Vaccination and Genetic Line on Off Test Weight



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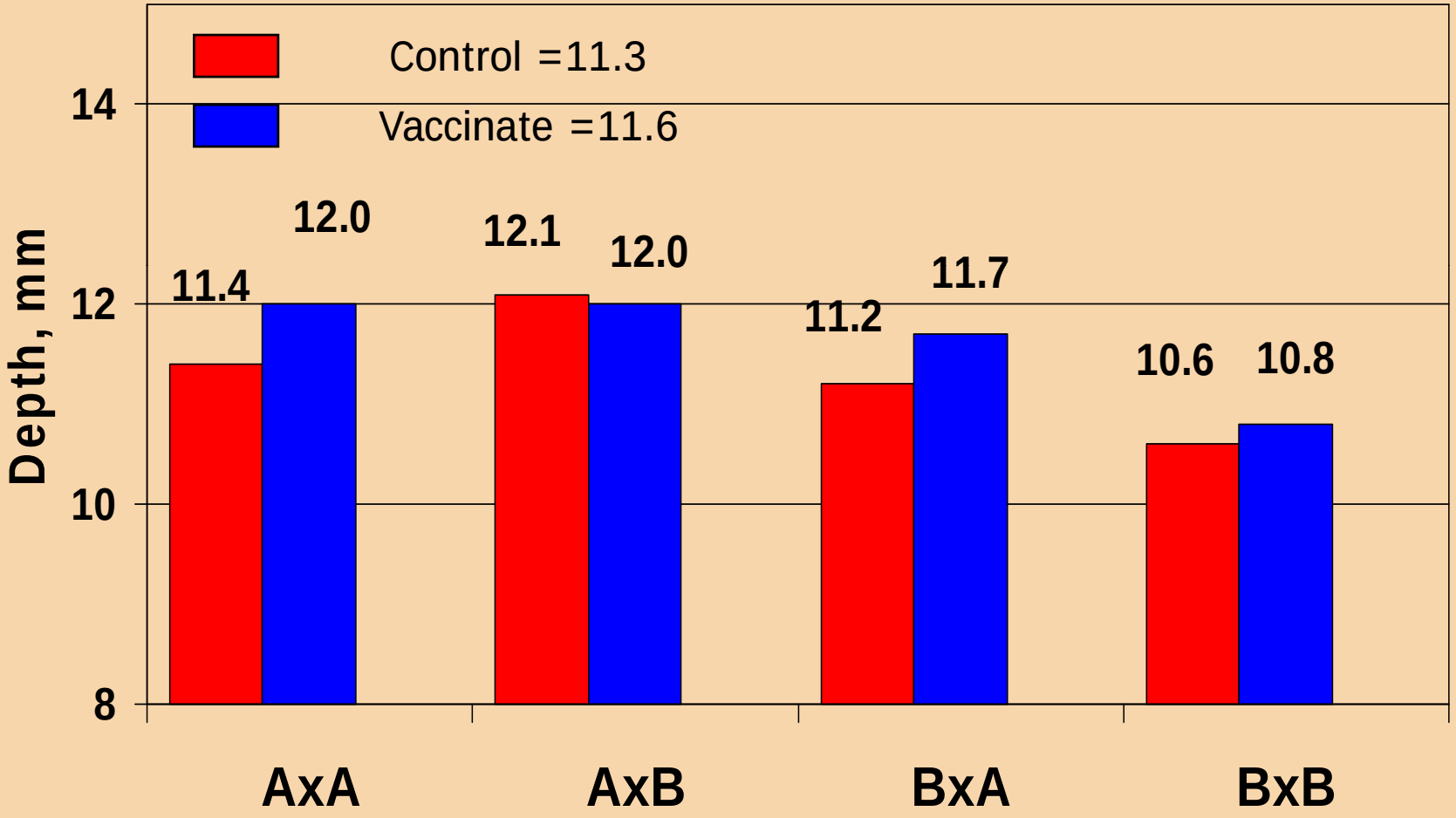
Effect of PCV_2 Vaccination and Genetic Line on Fat Depth at Off Test

Trt *P*=.13 Genetic *P*=.02 Trt x Genetic *P* = .46



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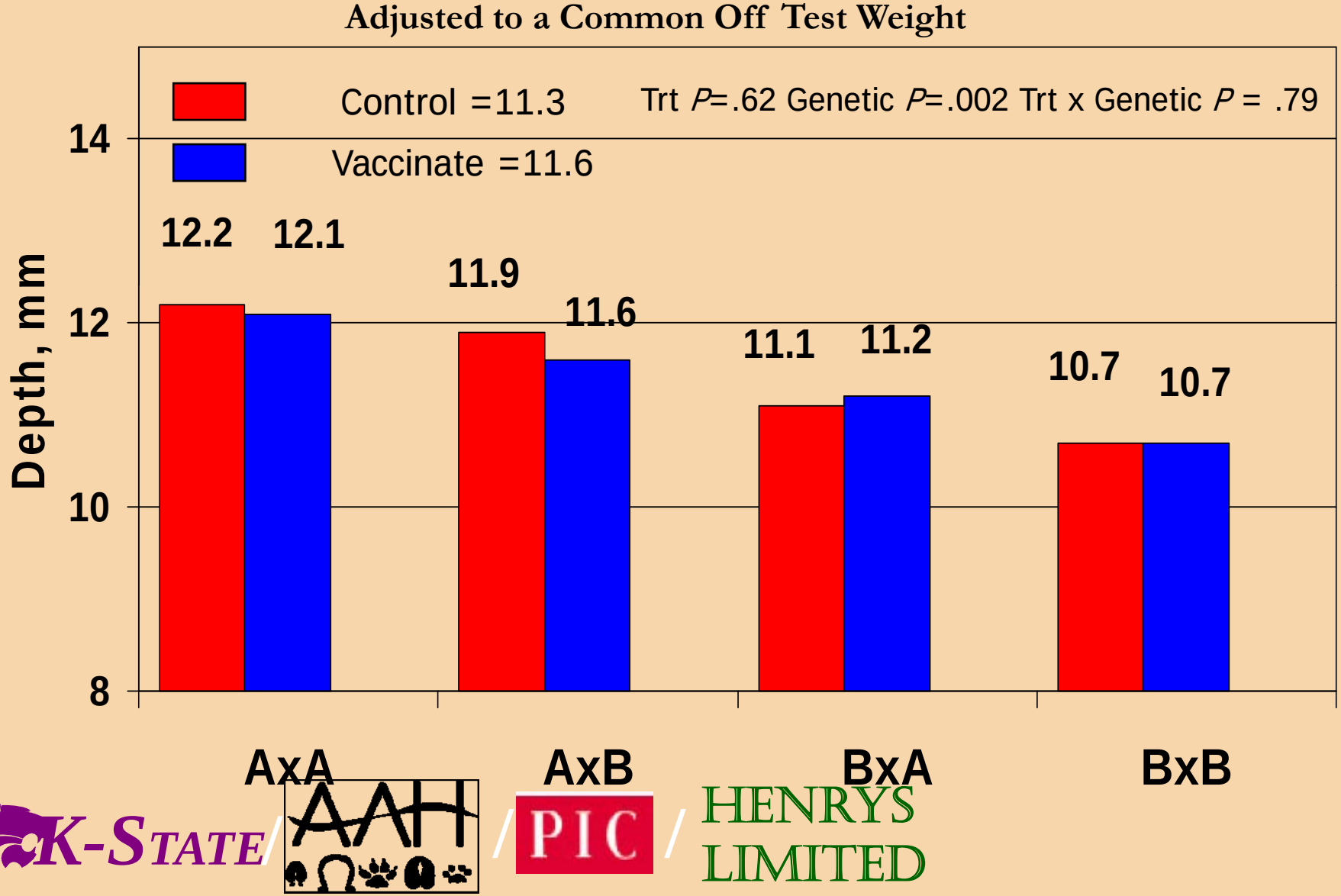
Effect of PCV_2 Vaccination and Genetic Line on Fat Depth at Off Test



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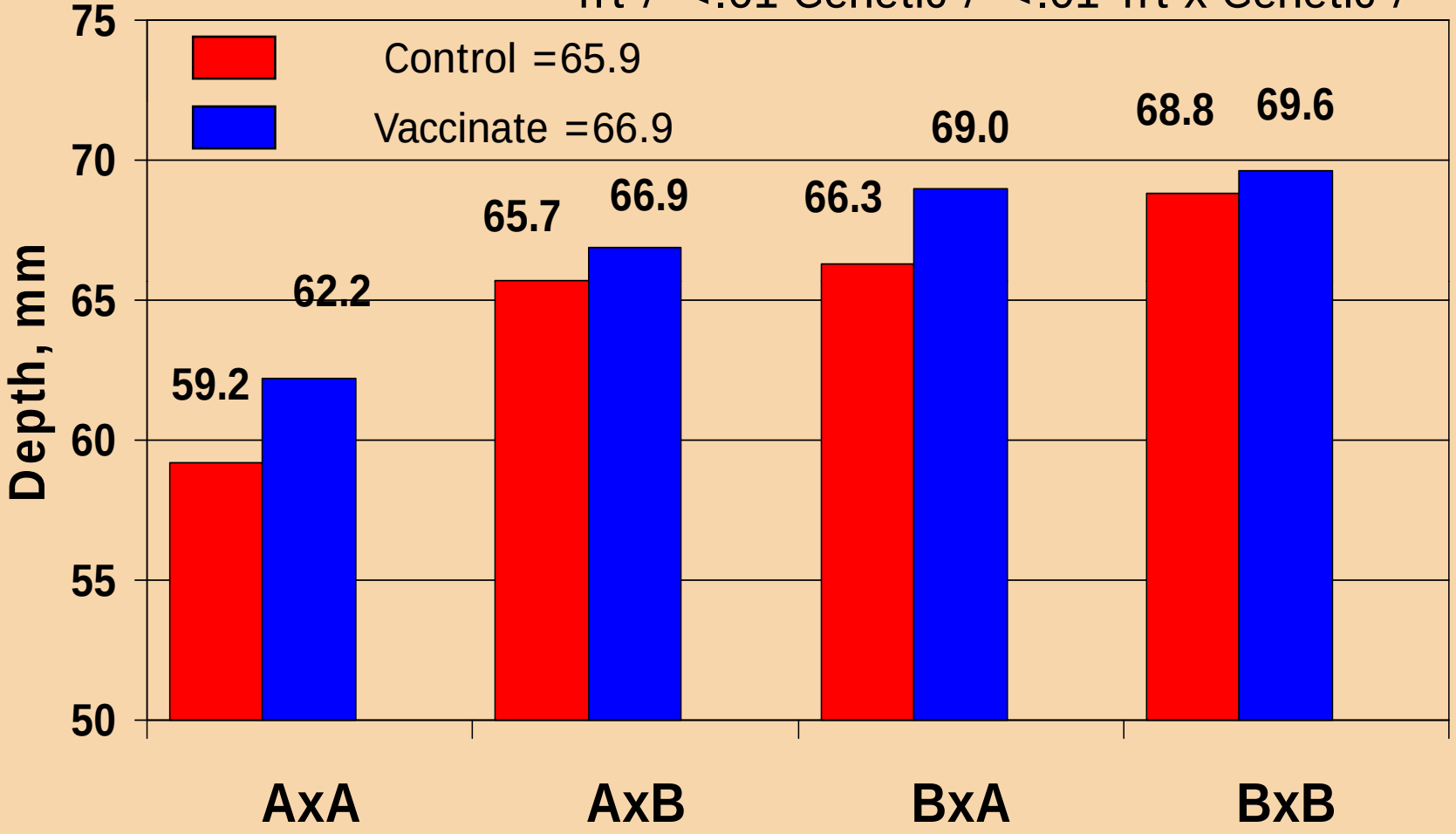
Effect of PCV_2 Vaccination and Genetic Line on Loin Depth at Off Test

Trt *P* <.01 Genetic *P* <.01 Trt x Genetic *P* = .32

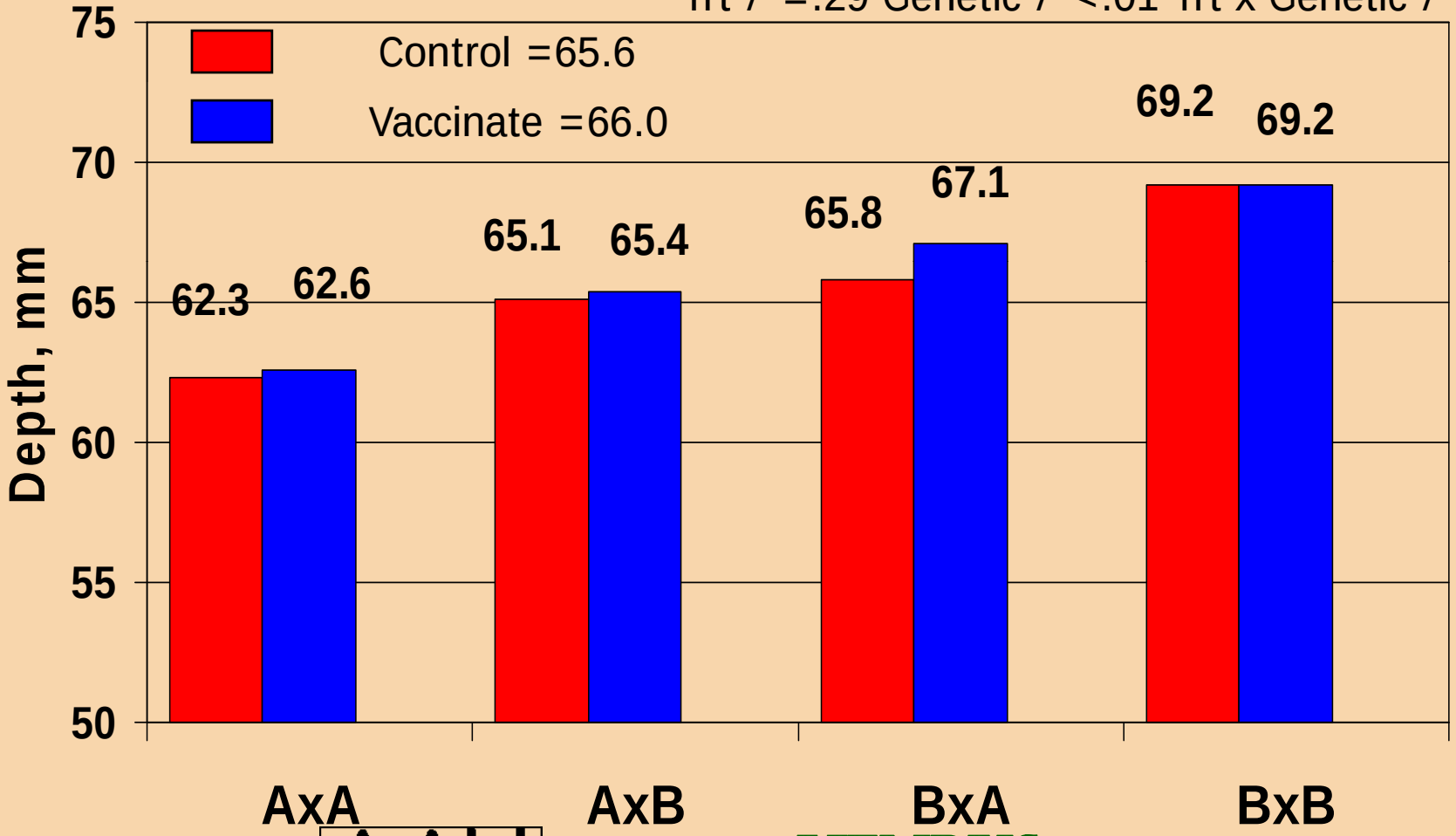


K-State / AAH / PIC / HENRYS LIMITED

Effect of PCV_2 Vaccination and Genetic Line on Loin Depth at Off Test

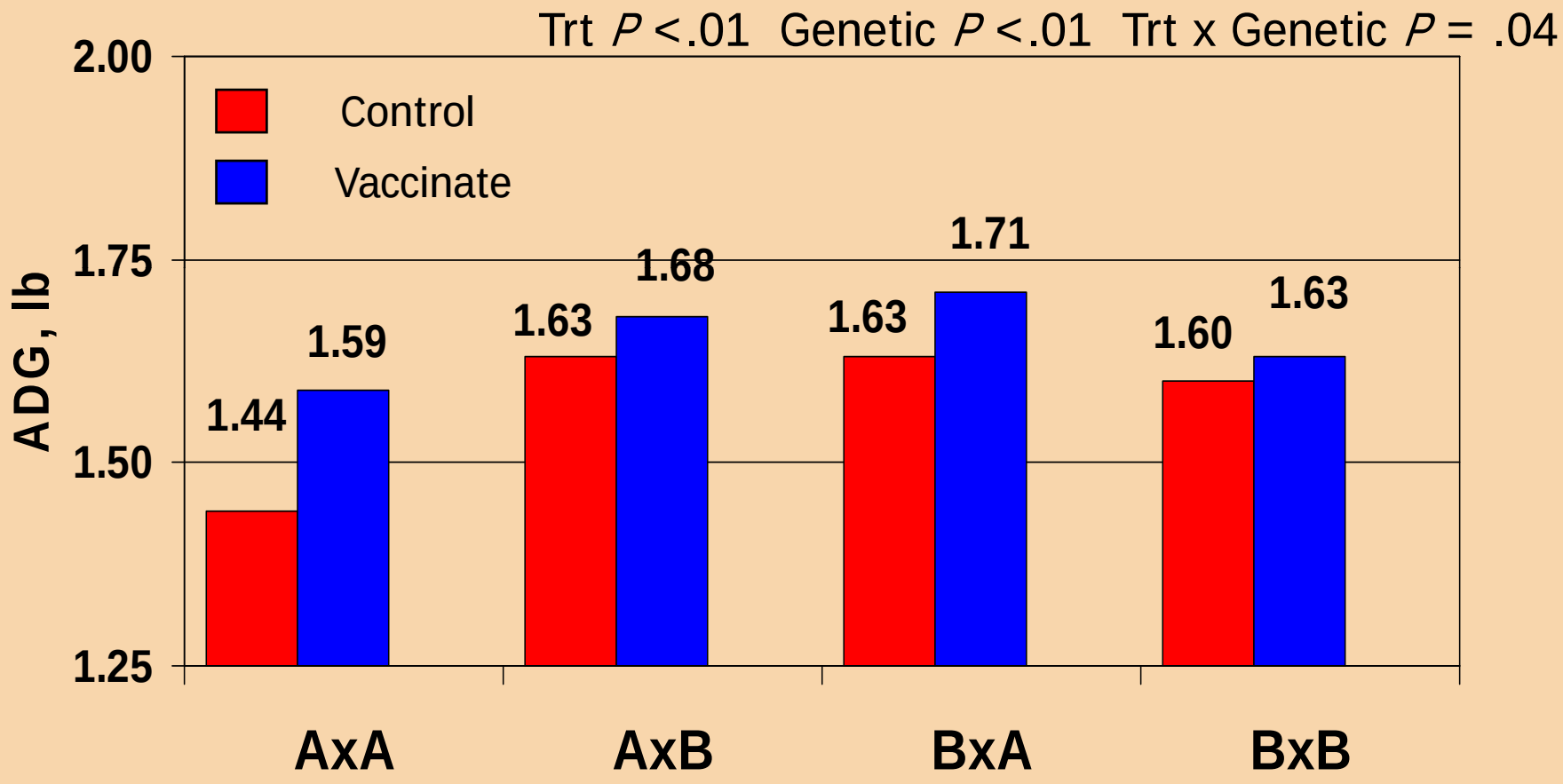
Adjusted to a Common Off Test Weight

Trt *P* =.29 Genetic *P* <.01 Trt x Genetic *P* = .82



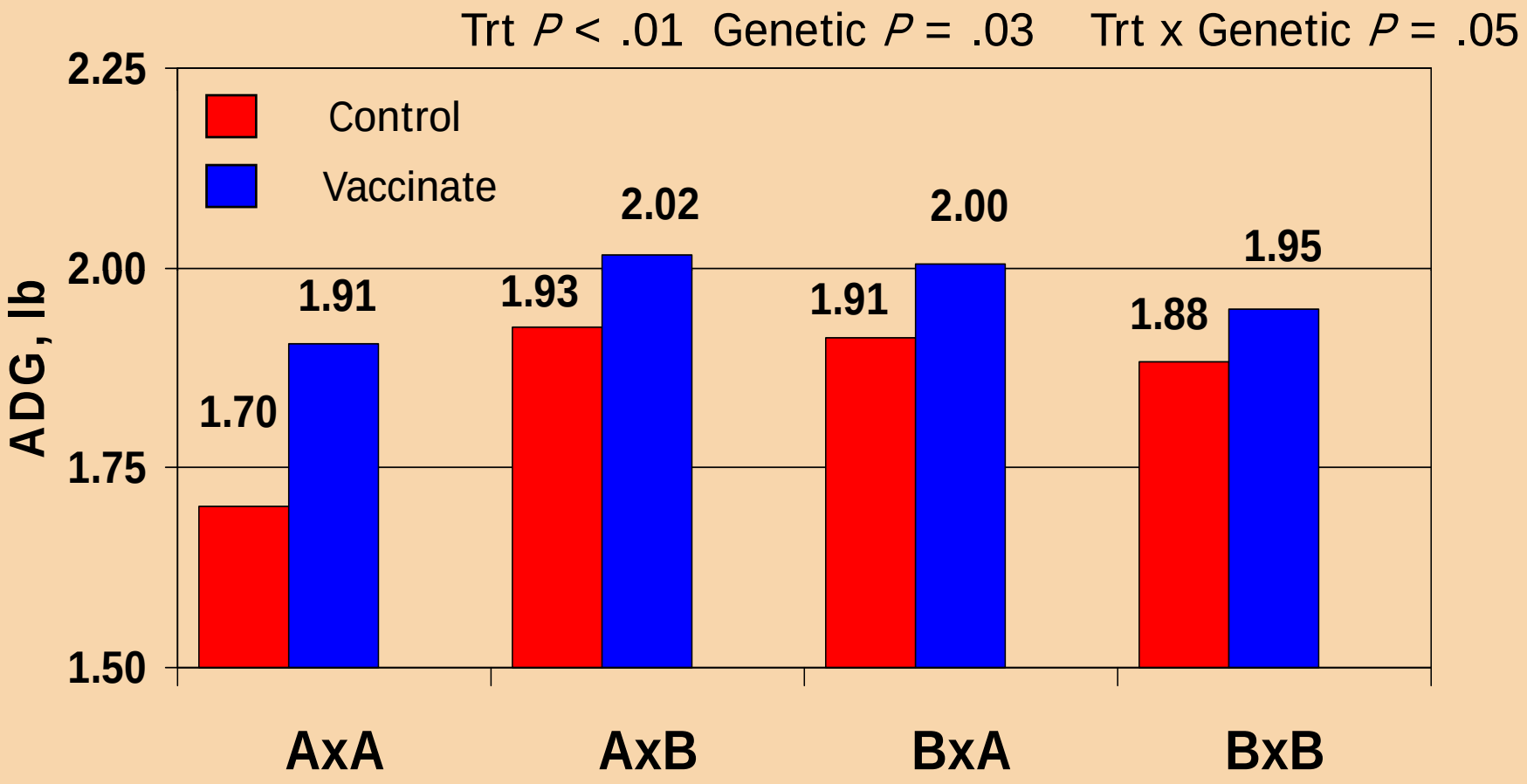
K-State / AAH / PIC / HENRYS LIMITED

Effect of PCV_2 Vaccination and Genetic Line on Wean to Finish ADG



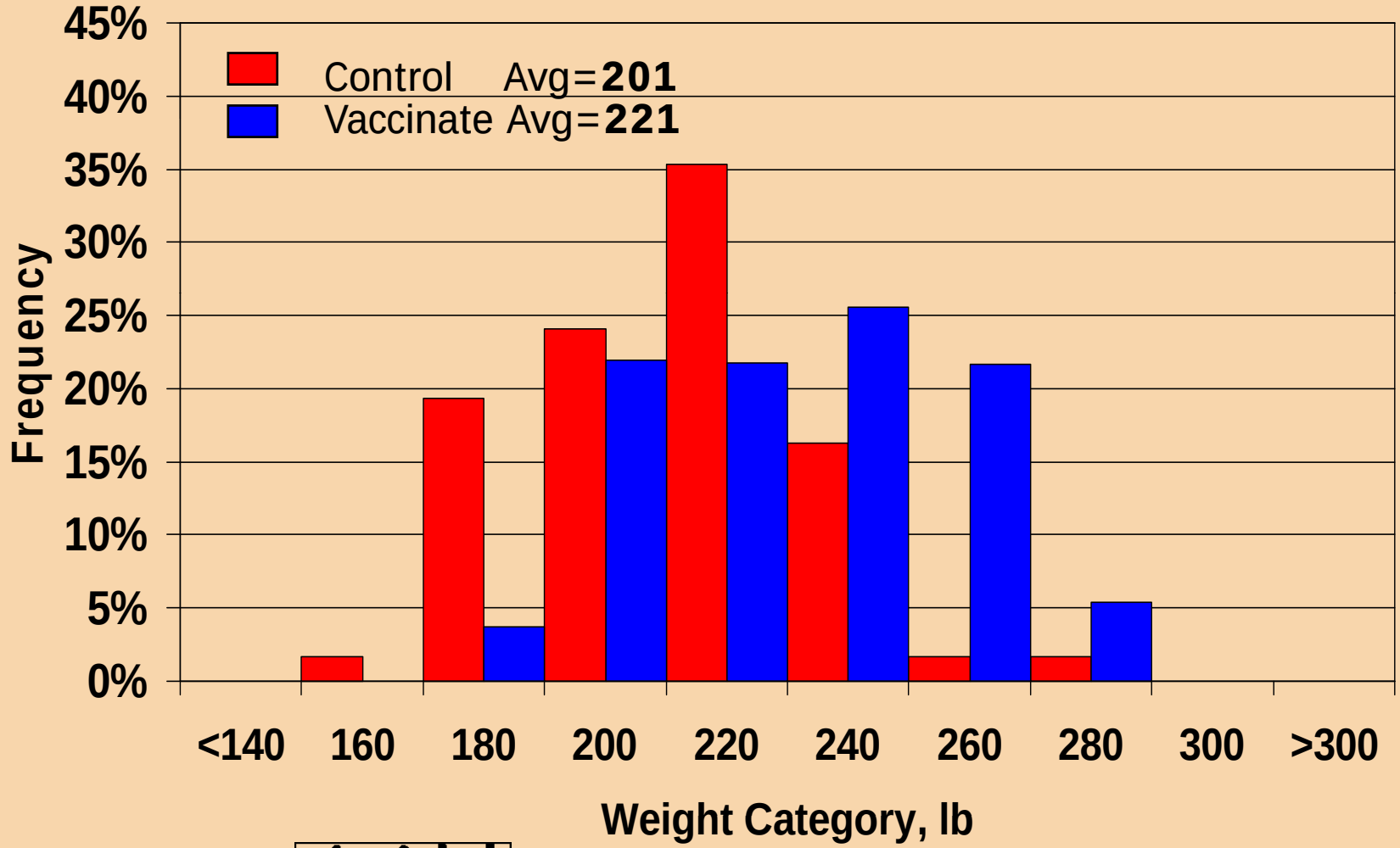
K-State / AAH / PIC / HENRYS LIMITED

Effect of PCV_2 Vaccination and Genetic Line on Finisher ADG



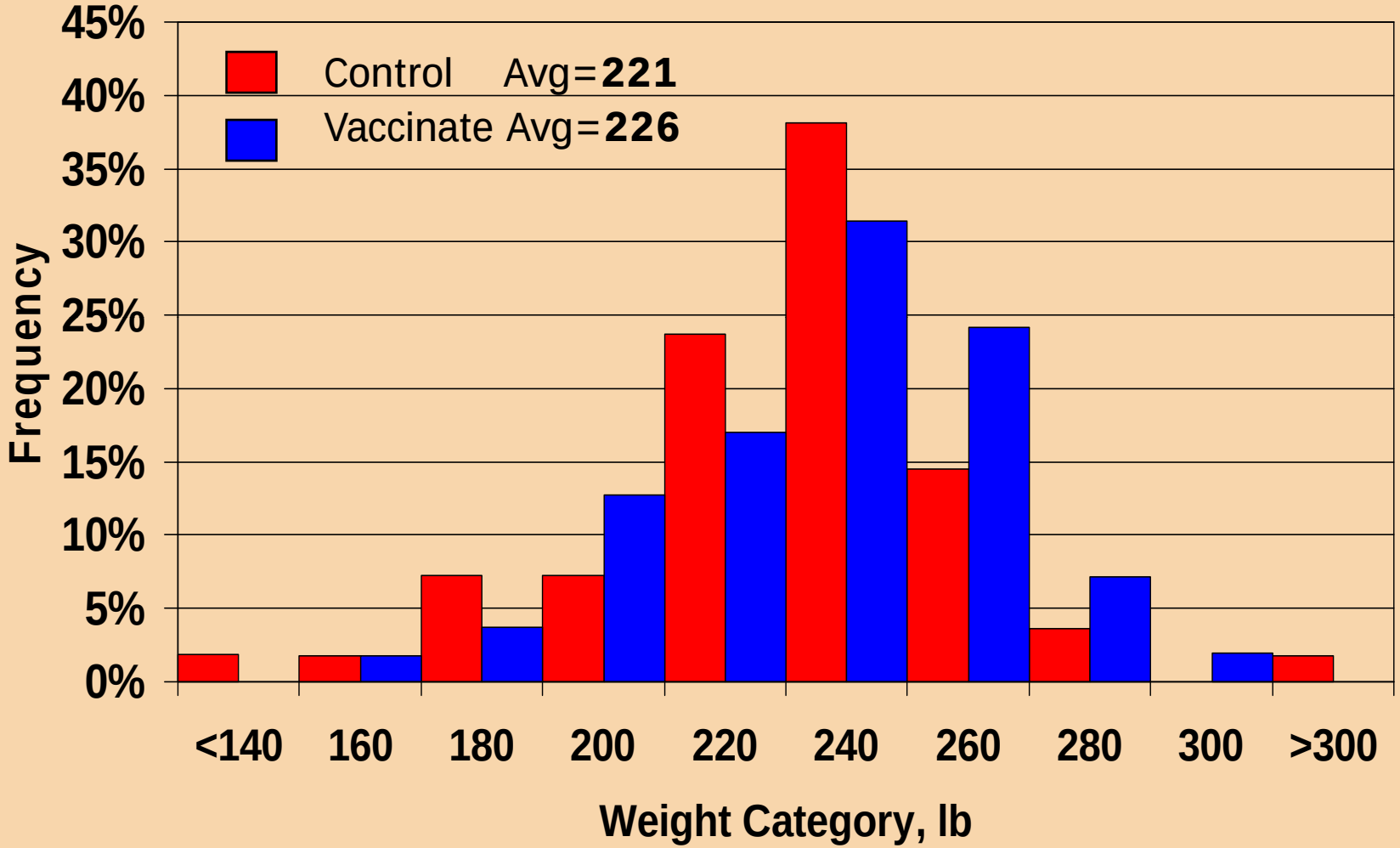
K-State / AAH / PIC / HENRYS LIMITED

Off Test Weight Histogram – AxA



K-STATE / AAH / PIC / HENRYS LIMITED

Off Test Weight Histogram – BxB



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Maternal Immunity

"*What role does maternal immunity play in the vaccination of the young pig?*"

K-STATE / AAH / PIC / HENRYS LIMITED

Maternal antibody impact on vaccine response

- IFA antibody titers compared over time
  - Pre-vaccination at 21 days of age
  - 60 day sample (~3 weeks after second vaccination)
  - 150 day sample at off-test
- Field virus infections occurred early in controls in this farm
- Work is ongoing to relate QPCR to antibody to growth response

K-STATE / AAH / PIC / HENRYS LIMITED

Trial Tag	Group	IFA Titer (3/15/07) (Bleed 1)	IFA Titer (4/23/07) (Bleed 2)	IFA Titer (7/23/07) (Bleed 3)
		21 doa	**60 doa**	**150 doa**
492	Control	<20	<20	>2560
499	Control	<20	2560	>2560
502	Control	<20	no	1280
148	Control	80	>2560	>2560
612	Control	80	>2560	>2560
615	Control	80	80	>2560
643	Control	80	<20	>2560
336	Control	160	>2560	>2560
478	Control	160	640	2560
567	Control	160	no	>2560
640	Control	160	>2560	>2560
GMT		**70**	**502**	**2404**

Trial Tag	Group	IFA Titer (3/15/07) (Bleed 1)	IFA Titer (4/23/07) (Bleed 2)	IFA Titer (7/23/07) (Bleed 3)
		21 doa	**60 doa**	**150 doa**
129	Control	1280	320	>2560
168	Control	1280	640	2560
220	Control	1280	320	>2560
282	Control	1280	640	>2560
283	Control	1280	320	>2560
293	Control	1280	640	>2560
548	Control	1280	160	>2560
262	Control	2560	640	>2560
292	Control	2560	640	2560
324	Control	2560	1280	>2560
261	Control	>2560	640	>2560
264	Control	>2560	640	>2560
563	Control	>2560	2561	>2560
		1763	**575**	**2561**

Trial Tag	Group	IFA Titer (3/15/07) (Bleed 1)	IFA Titer (4/23/07) (Bleed 2)	IFA Titer (7/23/07) (Bleed 3)
		21 doa	**60 doa**	**150 doa**
498	Vaccinate	<20	>2560	320
500	Vaccinate	<20	>2560	320
501	Vaccinate	<20	>2560	1280
614	Vaccinate	80	>2560	2560
566	Vaccinate	160	2560	1280
613	Vaccinate	160	2560	1280
644	Vaccinate	160	>2560	640
		58	**>2560**	**861**

Now I am reduced to guessing – until PCR is complete

Trial Tag	Group	IFA Titer (3/15/07) (Bleed 1)	IFA Titer (4/23/07) (Bleed 2)	IFA Titer (7/23/07) (Bleed 3)
		21 doa	**60 doa**	**150 doa**
167	Vaccinate	1280	>2560	>2560
285	Vaccinate	1280	>2560	>2560
286	Vaccinate	1280	>2560	>2560
295	Vaccinate	1280	1280	>2560
320	Vaccinate	1280	2560	2560
325	Vaccinate	1280	>2560	2560
328	Vaccinate	1280	>2560	1280
551	Vaccinate	1280	1280	1280
588	Vaccinate	1280	160	320
166	Vaccinate	2560	2560	1280
553	Vaccinate	2560	>2560	>2560
554	Vaccinate	2560	1280	2560
265	Vaccinate	>2560	640	2560
552	Vaccinate	>2560	320	1280
		1640	**1413**	**1810**

Maternal antibody study- the RIGHT (aka Dritz) way

- Study begins next week
- "Does maternal antibody block benefits of vaccine for growth AND antibody production?"
- K-State & Arizona Pork Producers

K-STATE / AAH / 

The B&K Livestock comparative vaccine & antibody trial

K-State / AAH / Kansas Swine Alliance / B&K Livestock Farms Inc. Clay Center, KS

Comparative trial, vaccine and dose

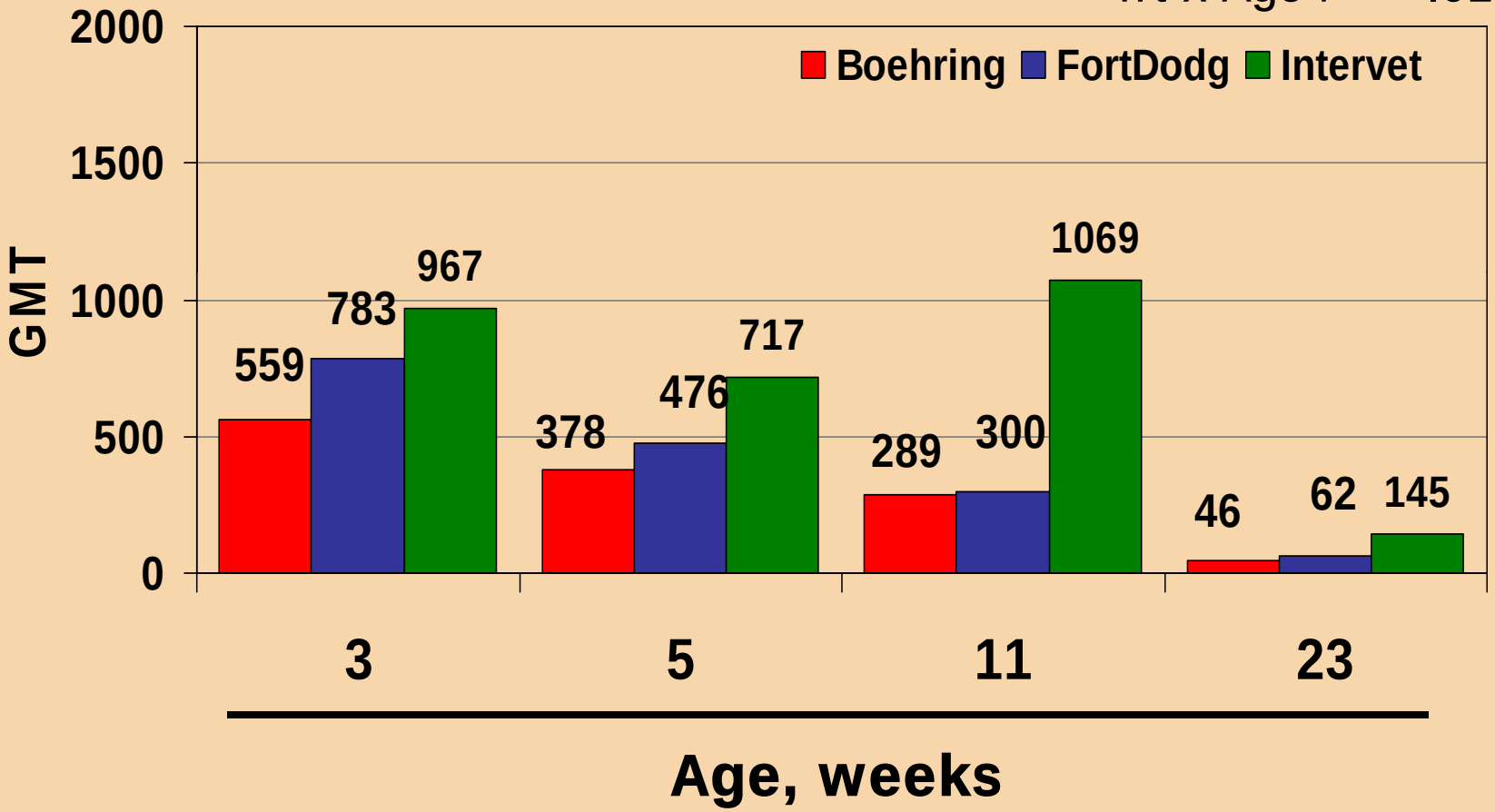
- 620 weaned pigs from sow farm to off-site nursery finisher
- History of severe PCV losses in previous groups
- 6 groups of 15 pigs each selected at random for treatment, no non-vaccinated controls (welfare)
  - BI full dose, BI half dose groups
  - Intervet full dose, Intervet half dose groups
  - Ft Dodge full dose, half dose groups
- Sampled at 3, 5, 11 and 18 weeks of age
- Little wild-type virus present in this study

K-State / AAH / Kansas Swine Alliance / B&K Livestock Farms Inc. Clay Center, KS

Effect of PCV_2 Vaccine and Time on IFA GMT (Bleed x Treatment)

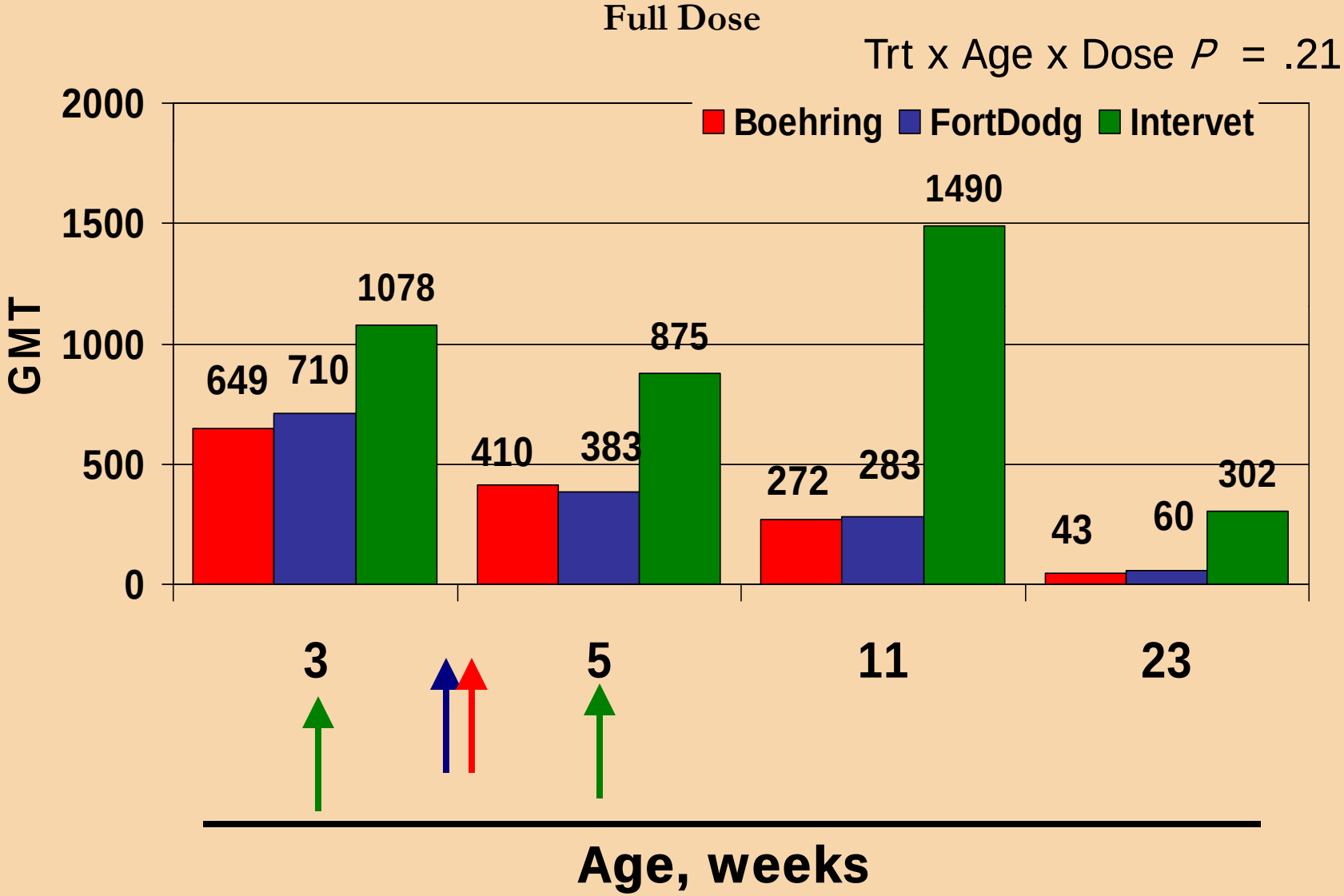
Full and Half Dose Combined

Trt x Age $P < .01$



K-State / AAH / Kansas Swine Alliance / B&K Livestock Farms Inc. Clay Center, KS

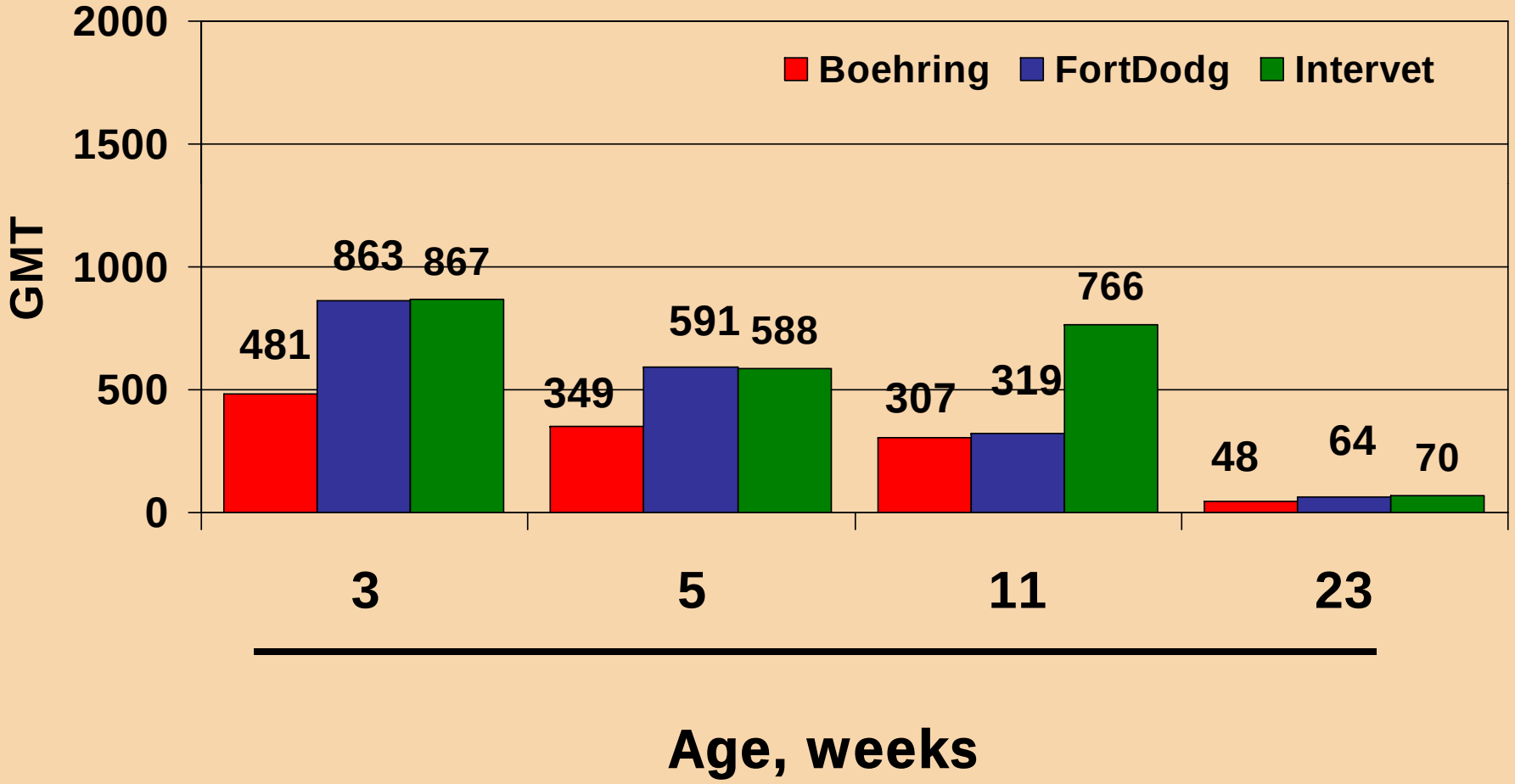
Effect of PCV_2 Vaccine and Time on IFA GMT (Bleed x Treatment)



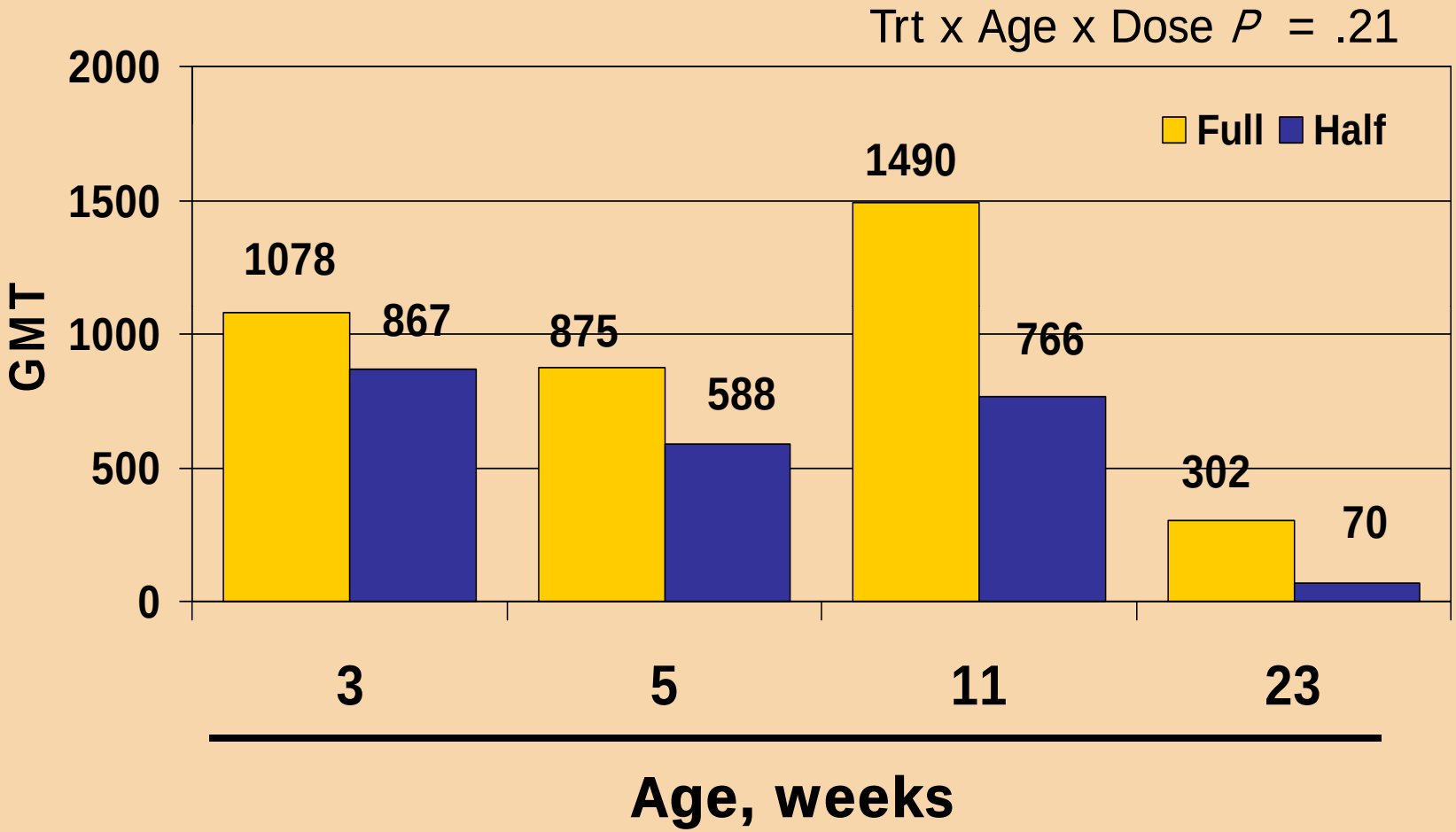
Effect of PCV_2 Vaccine and Time on IFA GMT (Bleed x Treatment)

Half Dose

Trt x Age x Dose *P* = .21

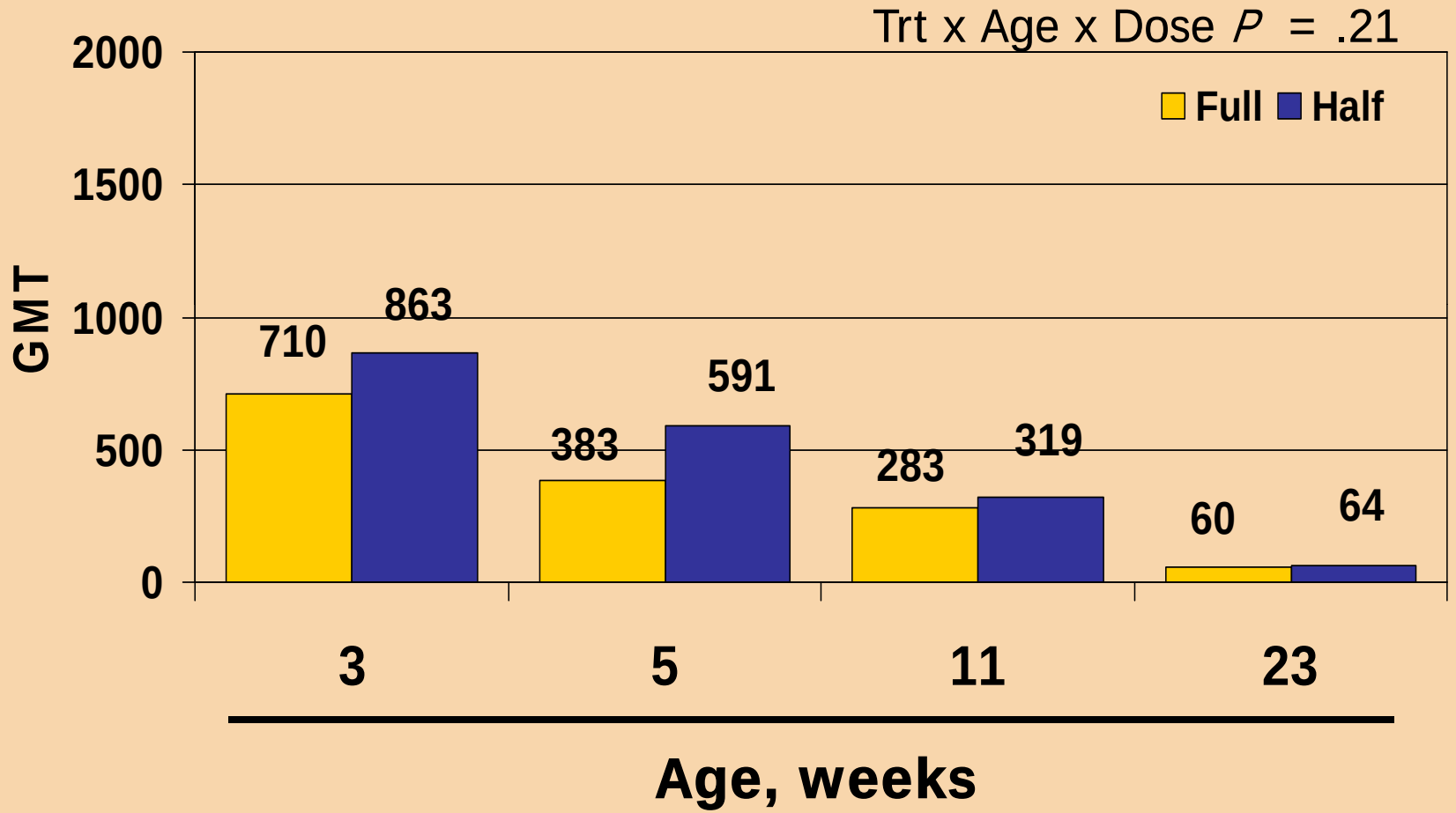


Intervet Vaccine - Effect of PCV_2 Vaccine and Time on IFA GMT (Bleed x Treatment)



K-State / AAH / Kansas Swine Alliance / B&K Livestock Farms Inc. Clay Center, KS

Fort Dodge Vaccine - Effect of PCV_2 Vaccine and Time on IFA GMT (Bleed x Treatment)



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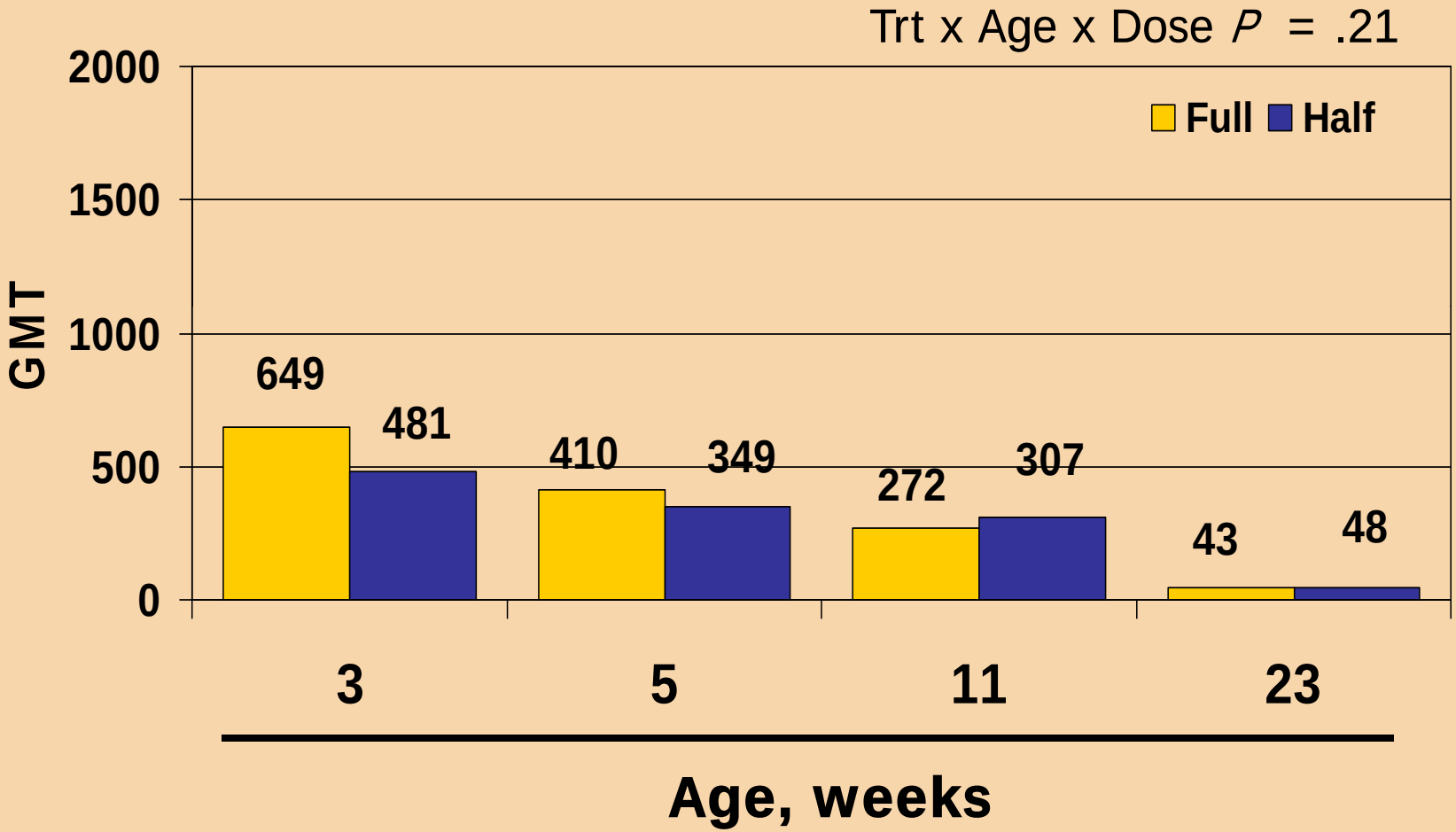
BI Vaccine - Effect of PCV_2 Vaccine and Time on IFA GMT (Bleed x Treatment)



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Full Dose vs. Half Dose and Timing Our Observations from the field

- Full doses are *absolutely* recommended if possible
  - Demonstrated antibody response is better
  - Clinically fewer lightweight pigs
  - Clinically fewer affected pigs than half dose
- Maternal passive immunity inhibits antibody response to vaccine
  - The younger the pig, higher the passive antibody and less likely to effectively immunize?
  - But must immunize before infected/viremic
  - Impact on performance trials to be done
- Two doses appear to produce a superior response over single dose

Summary: antibody results and questions for future research

- IFA has high correlation with SN
- Question of passive interference with immunization is not answered conclusively
  - Variation herd-to-herd and group-to-group
  - Why do some groups/pigs apparently fail?
  - Timing vaccinations, repeated doses?
- New antibody tests being developed
  - Quantitative DIVA, differential ELISA
- Essential for compliance, apparent failure and herd status/timing decisions

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NPB
The Mega Study

"This multi-institutional research will develop much needed tools and build towards next generation circo virus vaccines."

K-State, ISU, SDSU, NPB Collaboration

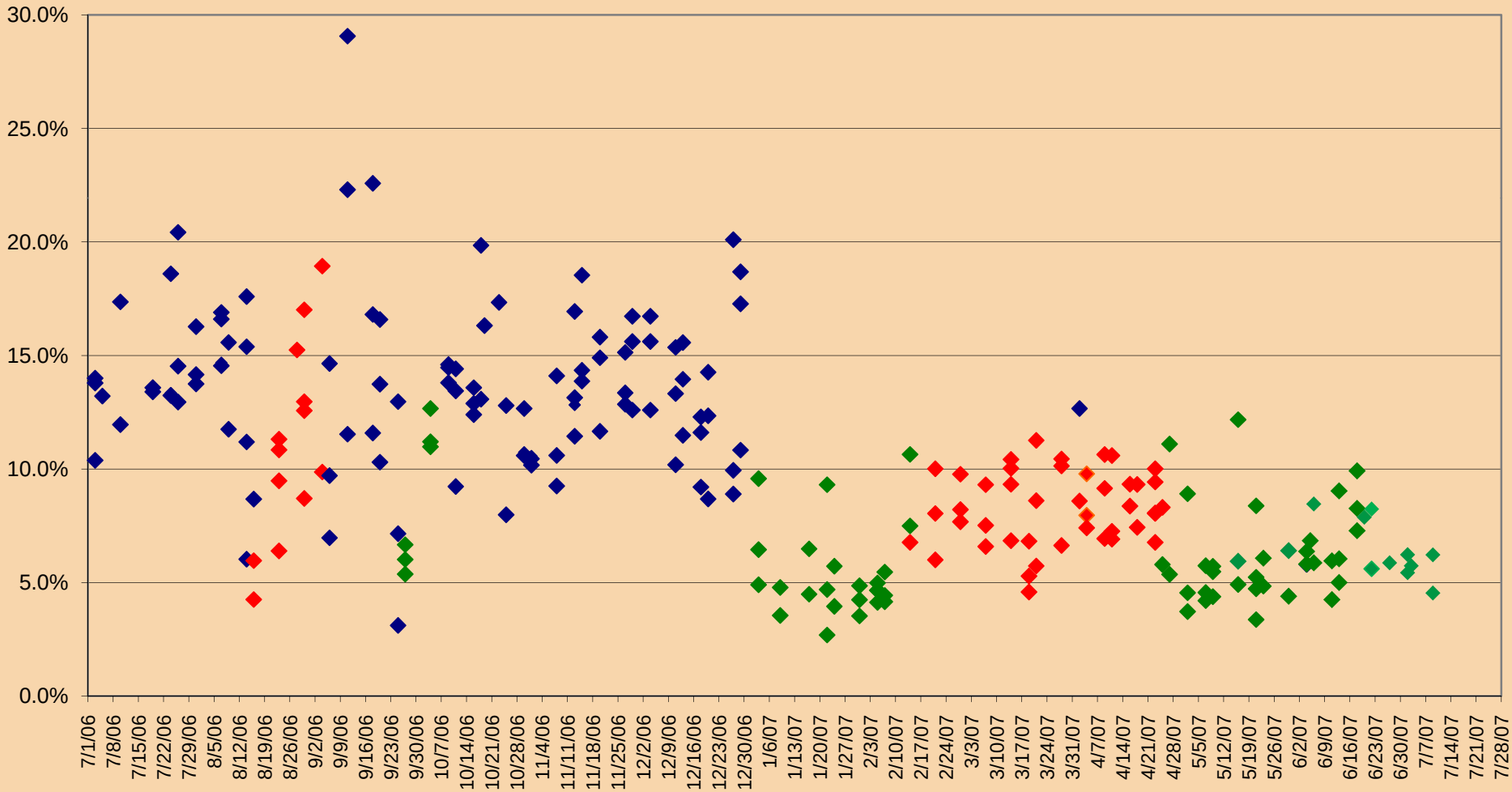
"PCVAD Induced Immune Dysfunction"

- To develop antibody tests that will differentiate viruses in an infection
- To discriminate vaccine responses from field viruses
- To quantitate the antibody response and define relevance

More Experience From the Field

Placed since 7/1/06 - Mortality + Light-weight Culls (<225#) by placement date

Red diamonds = "Single Dose Ft Dodge"
Green diamonds = "Two Dose Intervet"
Blue diamonds = Non-vaccinates



Conclusions:

- Circovirus disease, with the immunologic and growth impacts, has changed our view of population health
- Immunization success, and vaccine product diversity, is a wonderful beginning for disease management
- Many questions are yet to be addressed, including possibilities for elimination from populations
- Collaborative research efforts are critical to future progress

What lies ahead ?

- Vaccine
  - next generation vaccines?
  - Effect over time and the emergence of new "strains"?
- Maximizing benefit – the growth effect of PCV; can we immunize all animals?
- Sows and gilts – what to do and what not?
- Needed tools
  - KSU research, others

Thanks to our ever-growing team!

Suther Farms

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NEW HORIZON FARMS LLP

We've come a LONG way in a year!

It's nice to see healthy pigs again.

Thanks to everyone for all their support

Thanks to our team for a slam dunk!

Any questions?