



# Disease Resistant Genetics



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Almost 100 research papers  
in referred journals on  
immune response

Several thousand animals  
tested in research, beta test  
& commercial herds



Genetic regulation of the  
immune system of  
livestock

22-YR RESEARCH PROGRAM  
SEMEX SUPPORTED



# Semex Exclusive Patented Technology



**Immunity+**™

All Dairy Producers Want More Healthy Cows



# The Problem

Difficult to  
improve

Poor data quality  
& inconsistency

Selection for one  
disease can have  
negative effects on  
other diseases

# Traditional Selection for Health



**No “true” direct health traits**



**Hope it achieves better health**



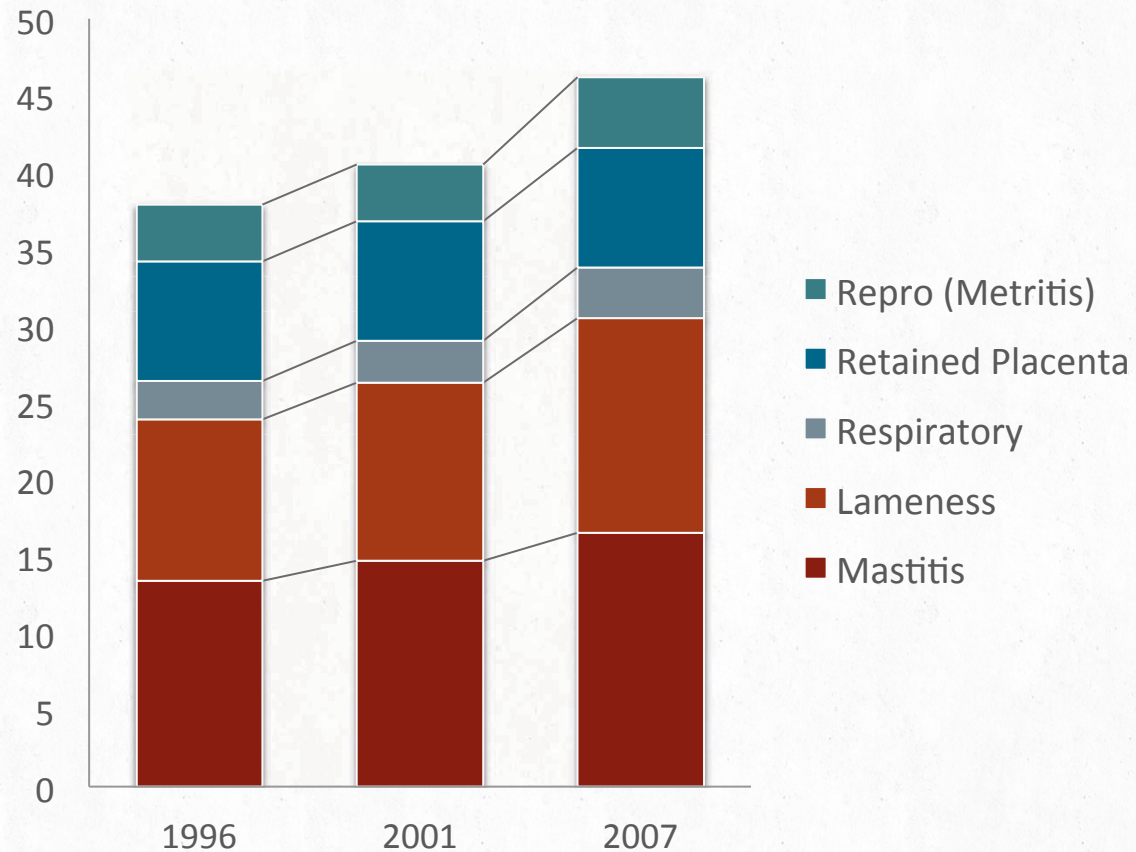
**Selecting an end result**

Productive Life  
Daughter Pregnancy Rate  
Daughter Calving Ease  
SCS



**Low heritability traits**

# Disease Trends



NAHMS Dairy 2007 Part II: Changes in the Dairy Cattle Industry 1991-2007

# Need a Better Approach



## Selection for Higher Immunity

It is the ultimate goal.

Even better than direct selection for health traits.



## A starting point for a healthier dairy



## Changes the way dairies will select for health

# Immunity Genetics

Emerging technology.

At least one competitor is pursuing a patent in this technology.

Research programs are being initiated at institutions around the world.





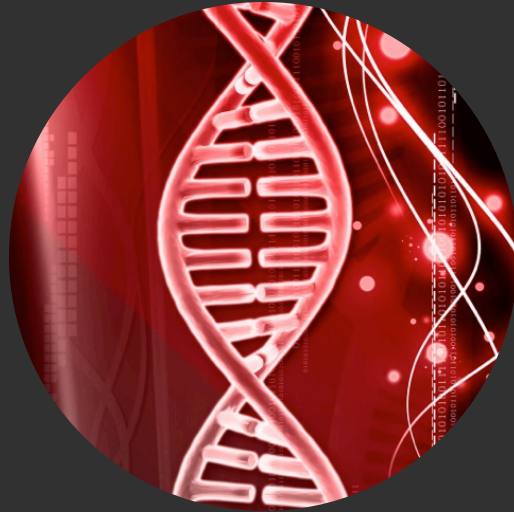
# Immunity Genetics

It is the future of health genetic selection

Semex is the first to bring it to market (2-3 year advantage)

Semex will be the first with immune genomics





# What is Immunity?

## Attacks from Air



## Response: Air Defense

Experience & training



All actions controlled by central government defense system

## Attacks from Water

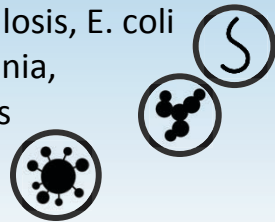


Experience & training

## Response: Naval Defense

### Bacterial infections

- mastitis, listeriosis, brucellosis, E. coli scours, bacterial pneumonia, metritis, digital dermatitis



MEMORY

### Others diseases

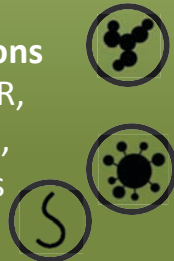
- Parasitic, prion & fungal diseases



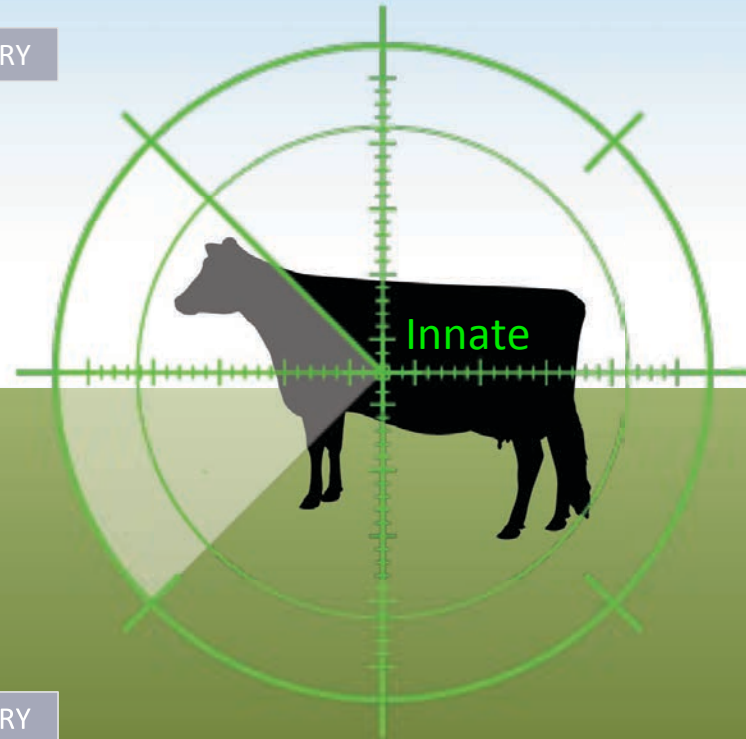
MEMORY

### Viral & mycobacterial infections

- -viral pneumonia, BVD, IBR, leucosis, foot & mouth, tb, retained placenta, Johne's



Antibody-mediated adaptive immune response



Immune response is controlled & directed by 2000+ genes

Cell-mediated adaptive immune response

# Defense Against Infections

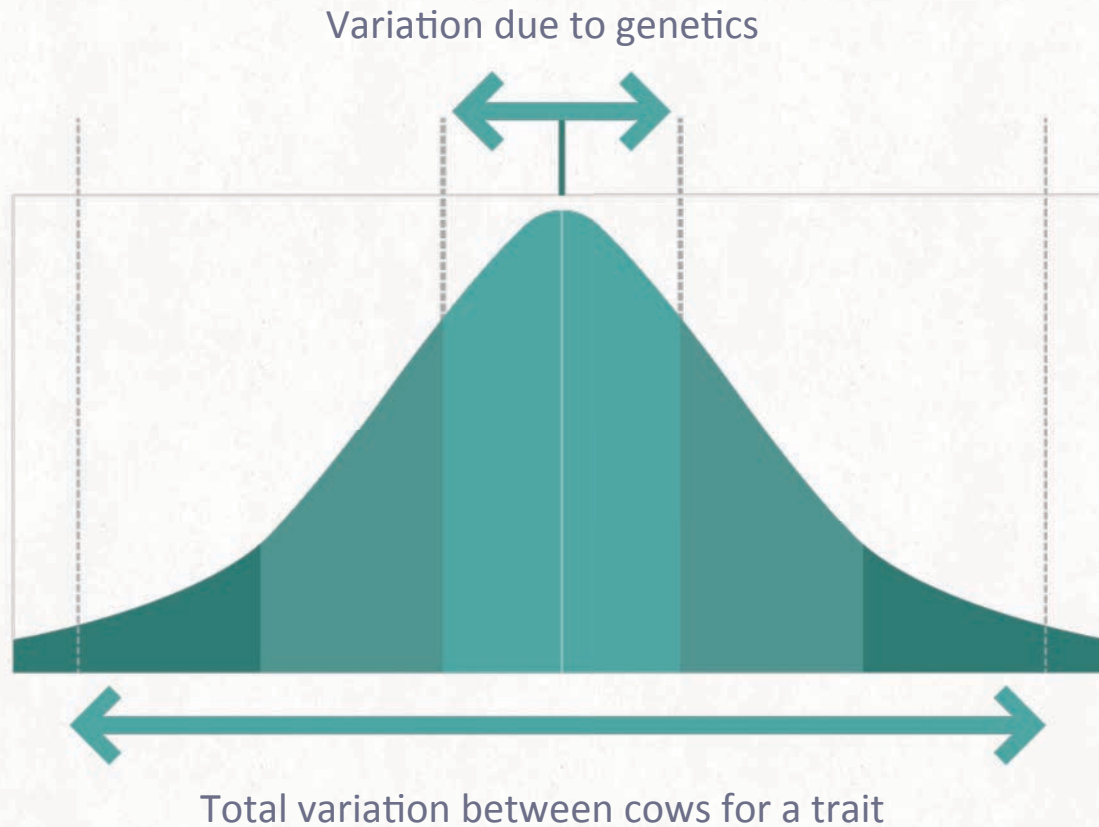
Overall broad-based defense against most viral & bacterial infections



High Immune Response Technology

# Heritability

% of total variation that's explained by genetics



# Immune Response



Production Traits 25-35%

Conformation Traits 15-40%

**Immune Response 25%**

Longevity 8-10%

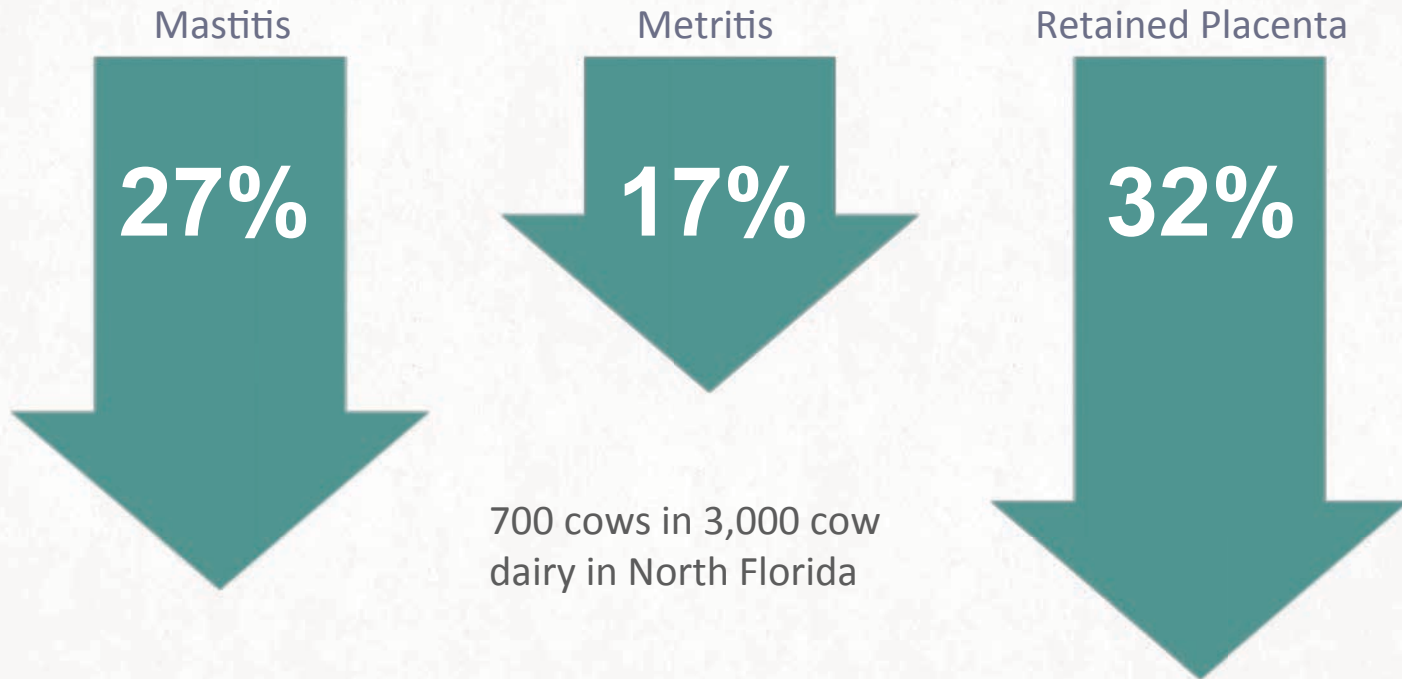
Calving Ease Traits 6-7%

Daughter Fertility 4-7%

Disease Incidence 2-10%

# Less Disease

High Immune Responders have Less Disease



700 cows in 3,000 cow dairy in North Florida

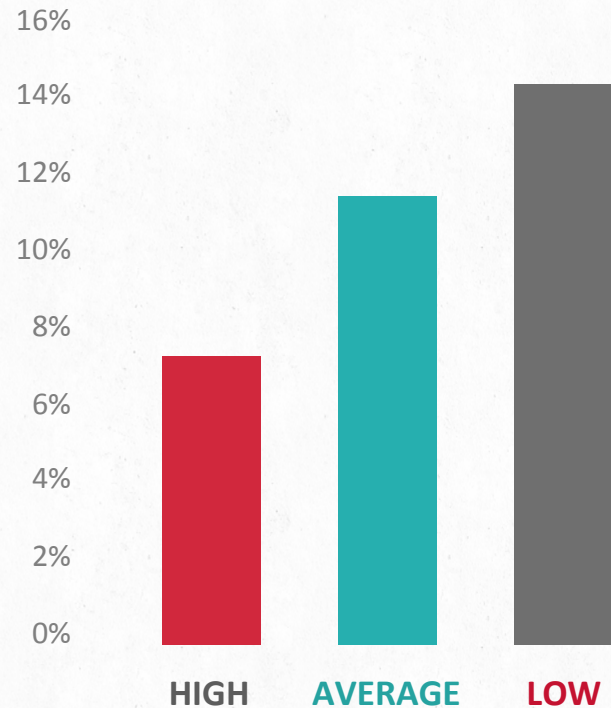
Range in all herds was 19–30% less incidence of disease  
(High responders vs. herd average)



# Average Disease Incidence

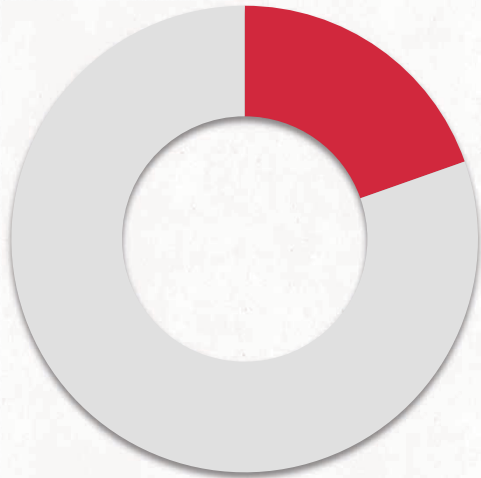
Disease incidence (average for all diseases) for each immune response category.

64 herds

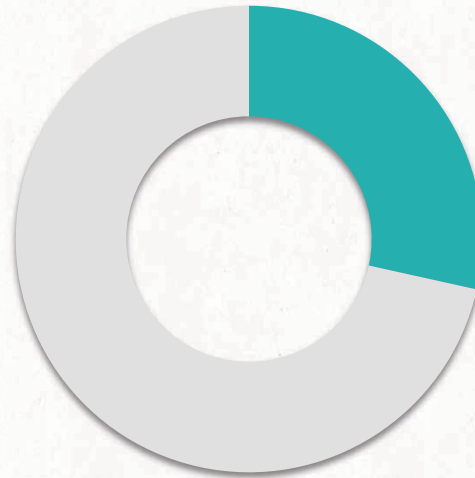


# Disease Incidence

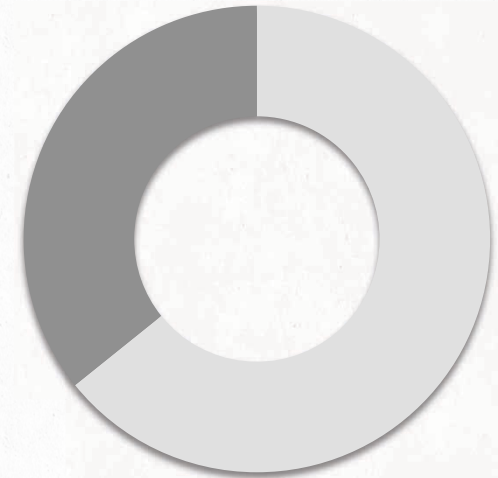
Incidence Rate of Clinical Mastitis in Cows Across Canada



High Antibody  
Immune Responders  
17.1%



Average Antibody  
Immune Responders  
27.9%

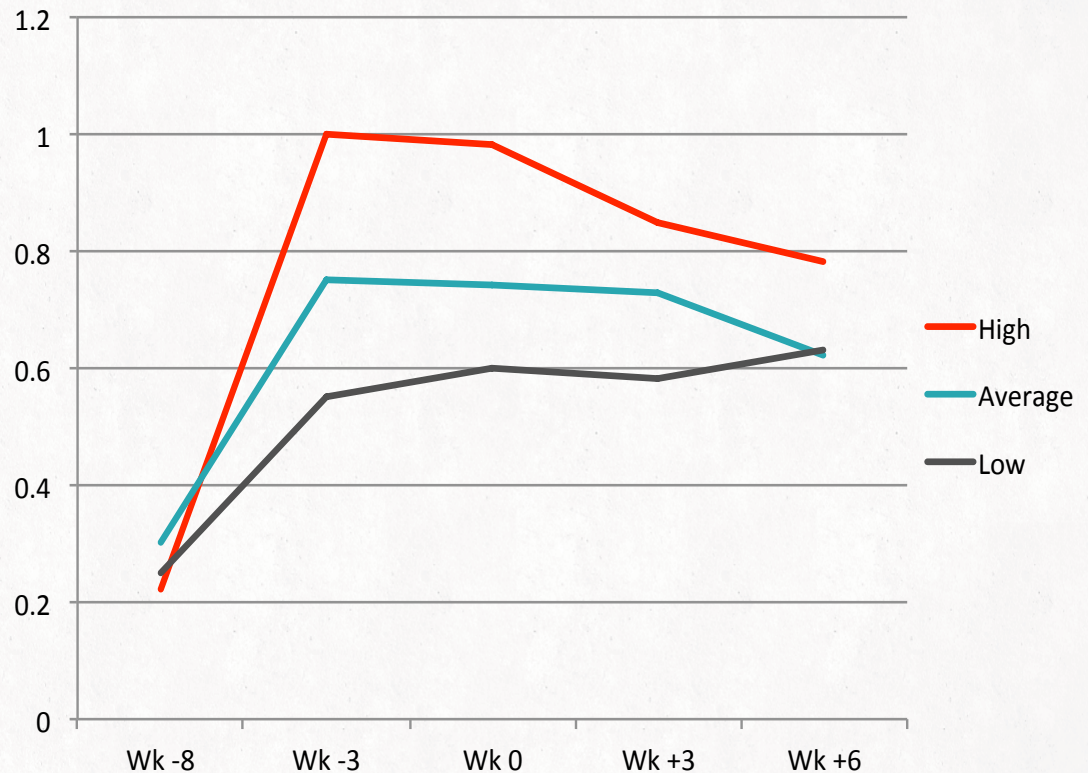


Low Antibody  
Immune Responders  
30.7%

Reference: Thompson-Crispi et al Clin  
Vaccine Immunol 2012

# Vaccine Response

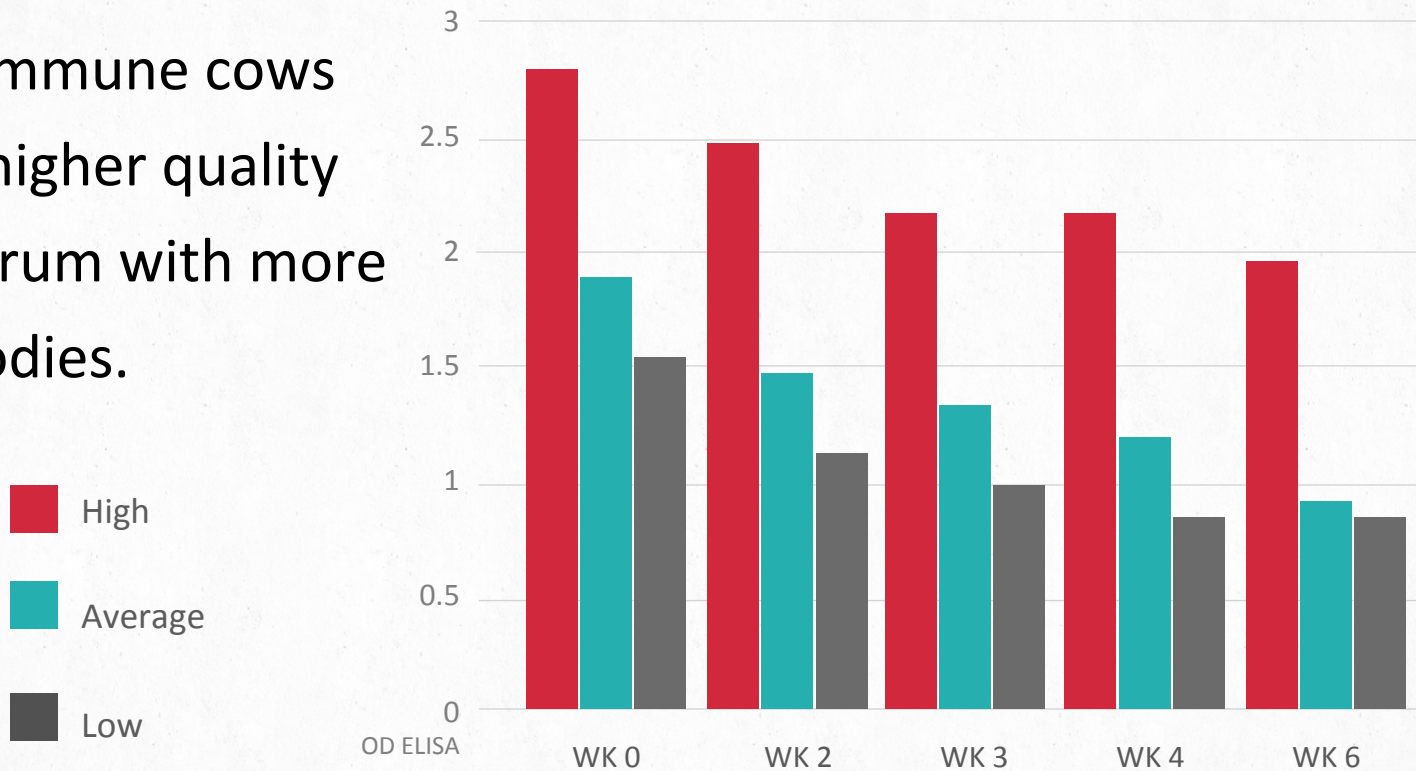
High immune cows respond better to commercial vaccines.



Reference: Wagter & Mallard et al 2000 JDS 83:488

# Quality Colostrum

High immune cows have higher quality colostrum with more antibodies.



Reference: Wagter & Mallard et al 2000 JDS 83:488

# Economic Value of High Response Cows



## Lower incidence of disease

Mastitis, metritis, retained placenta, milk fever, Johne's, etc.



## Improved vaccine response



## Higher quality colostrum



## Lower cull rates

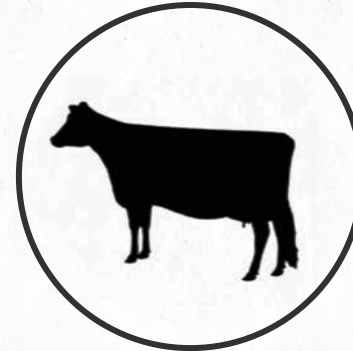
# Economic Value of High Response Cows

High Immune Cow



VS.

Herd Average Cow



Additional **\$124** per cow per year

# Semex's Approach

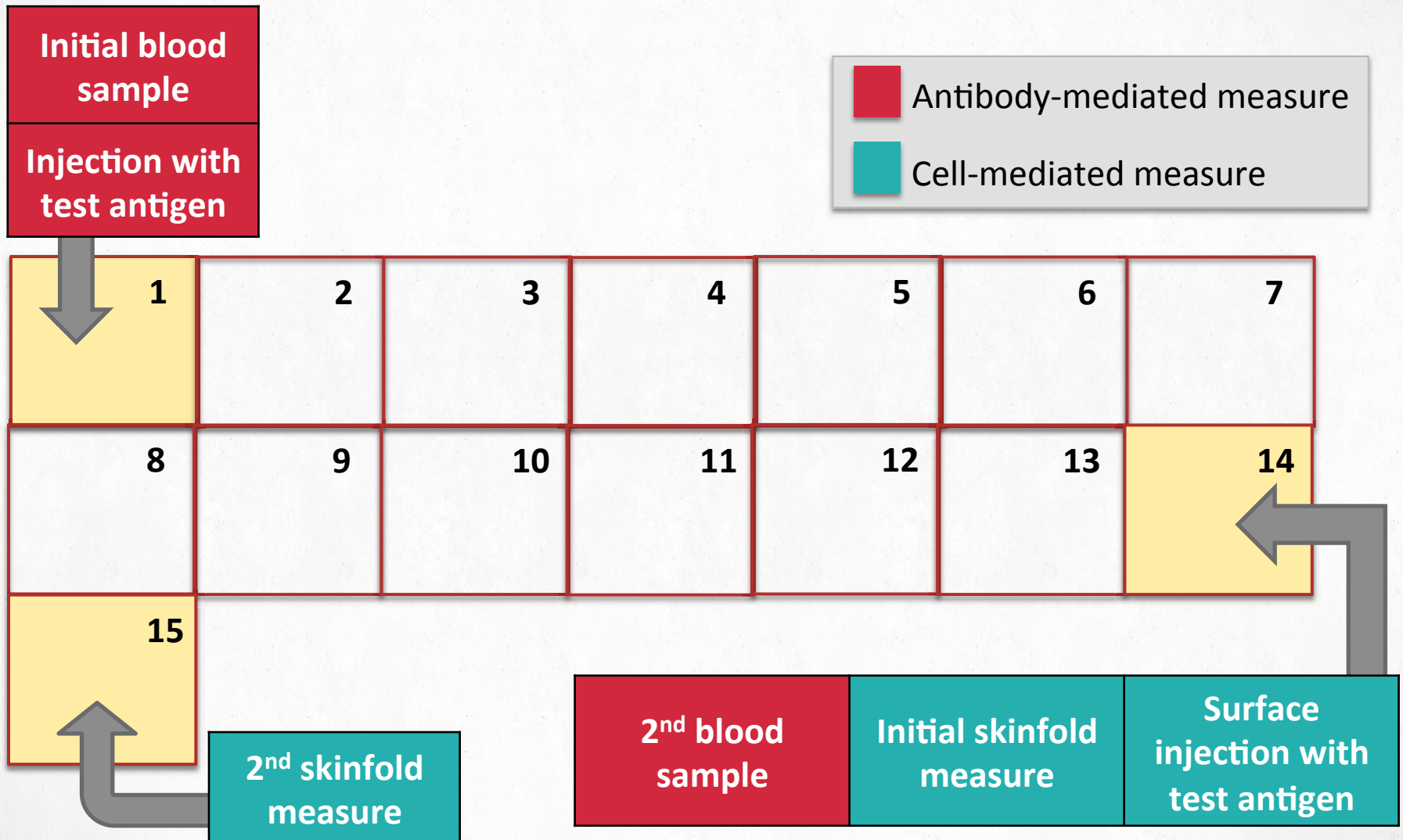
Test all marketable proven bulls & the latest genomic bulls

543 HO, 98 JE, 30 AY bulls tested - all Semex bulls will be tested over time

Top 10% for overall immune response qualify for Immunity+

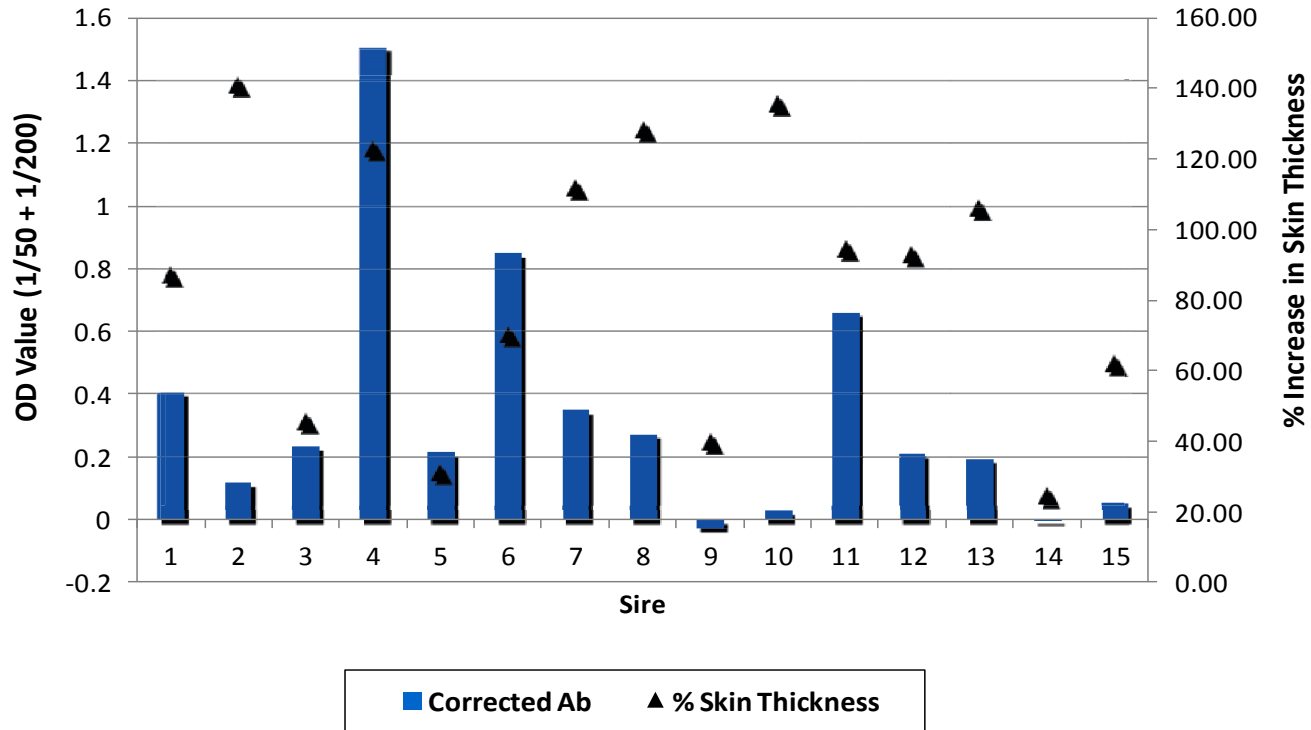


# Testing for Immune Response



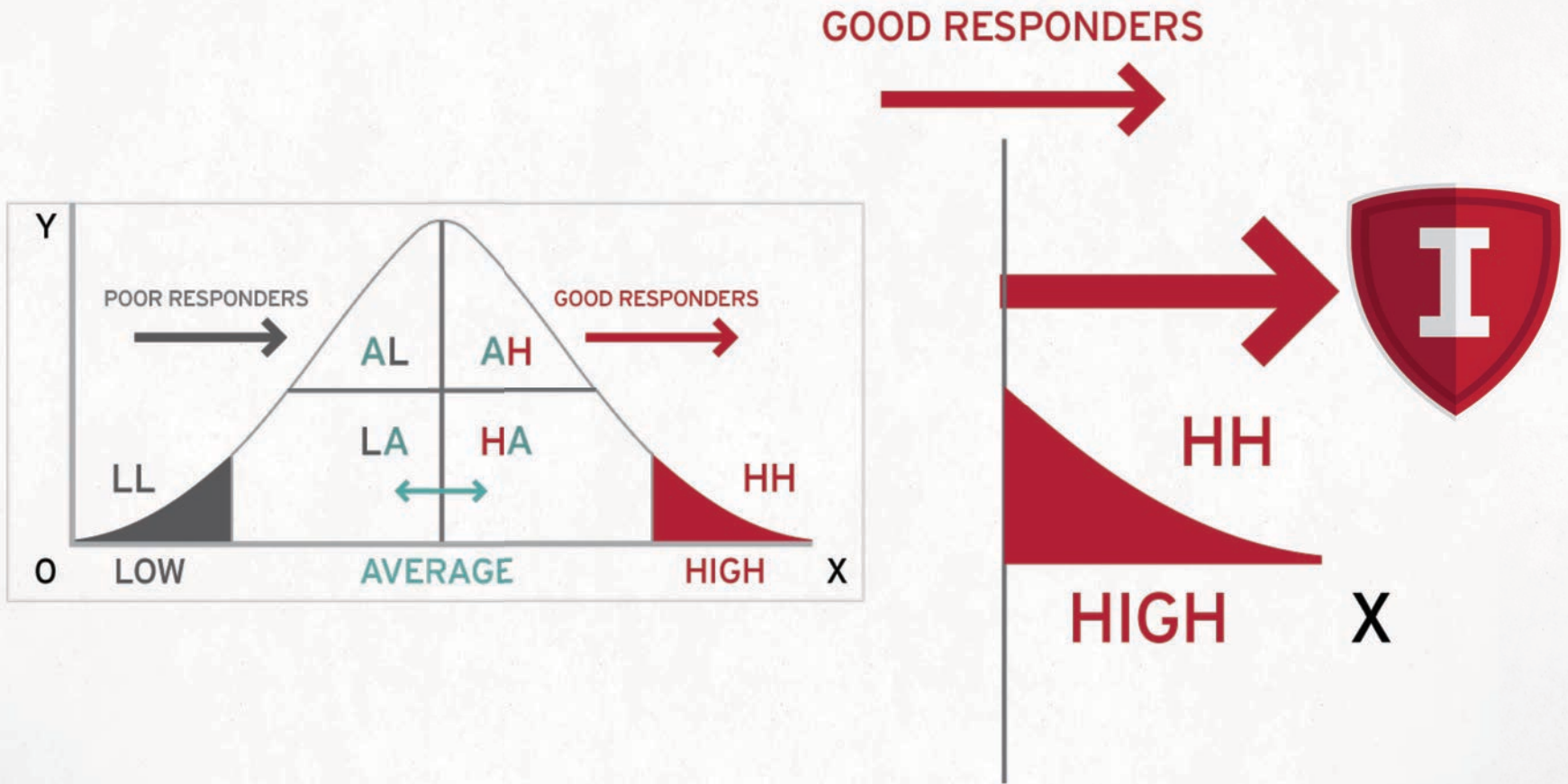


# Sample of Test Results



# Bulls Designated as Immunity+

Approximately 10% of sires



# Transmission to Daughters



**25%**

Heritability of immune response



**50%**

Proportion of genes that sire passes on to his daughters

# Building a Stronger Herd

DAUGHTERS OF IMMUNITY+™ SIRES ARE EXPECTED TO HAVE



*Including mastitis, metritis,  
ketosis and retained placenta.  
Early indications show a desired  
response to Johnes as well.*

*In addition to the \$ value  
of the genetics for  
other traits.*

Dr Chesnais, Senior Geneticist, Semex

# Dairies Using Immunity+



Compare disease incidence of daughters of Immunity+ bulls vs. daughters of other bulls

## Herd: Dairy Test 1

1509 milking  
cows

1267 heifers

# Disease Incidence DT1 Cows

Comparison of all 1<sup>st</sup> lactation cows at DT1 Dairy

## Immunity+ Daughters

Average rate of disease  
(for recorded  
diseases)

**16.7%**

Mastitis

**8.8%**

## Competitor & Semex (non-immunity+) Daughters

Average rate of disease  
(for recorded  
diseases)

**18.2%**

Mastitis

**15.8%**

### Improvement

Reduction in disease  
incidence by 8.5%

# Calf Pneumonia – DT1 Heifers

Comparison of all heifers at DT1 Dairy

## Immunity+ Daughters

Average rate of calf pneumonia

**6.8%**

## Competitor & Semex (non-immunity+) Daughters

Average rate of calf pneumonia

**9.1%**

### Improvement

Reduction in pneumonia incidence by 25%

# New Immunity+ Bulls

(36 HO bulls – August 2013)

| Sire Proof            | Average - Immunity+ Bulls | Difference vs. Average of All Bulls Tested (Aug'13) |
|-----------------------|---------------------------|---|
| TPI                   | <b>2305</b>               | +186  |
| Net Merit             | <b>\$708</b>              | + \$165   |
| Productive Life       | <b>+4.7</b>               | +1.6  |
| SCS                   | <b>2.69</b>               | -0.11 (favourable)                                  |
| DPR                   | <b>+0.7</b>               | +0.9  |
| Daughter Calving Ease | <b>5.7</b>                | -0.7 (favourable)                                   |



# Breeding Strategy













Recommend prioritizing Immunity+ bulls for use on heifers.

If the dairy uses Sexxed on heifers, the next best option for Immunity+ is 1<sup>st</sup> lactation cows.



# Breeding Strategy

## Heifer Focus (example)

|                         | Heifers  | 1 <sup>st</sup> Lactation  | 2 <sup>nd</sup> Lactation   |
|-------------------------|--|--|---|
| 1 <sup>st</sup> Service |  <b>Immunity+</b> <sup>™</sup>  |  <b>Genomax</b> <sup>™</sup><br> <b>HealthSmart</b> <sup>™</sup> |  <b>HealthSmart</b> <sup>™</sup> |
| 2 <sup>nd</sup> Service |  <b>Immunity+</b> <sup>™</sup>  |  <b>Genomax</b> <sup>™</sup><br> <b>HealthSmart</b> <sup>™</sup> |  <b>HealthSmart</b> <sup>™</sup> |
| 3 <sup>rd</sup> Service |  <b>Genomax Plus</b> <sup>™</sup><br> <b>HealthSmart</b> <sup>™</sup> |  <b>Repromax</b> <sup>™</sup>  |  <b>Repromax</b> <sup>™</sup>   |



**Immunity+**<sup>TM</sup>  
*Disease Resistant Genetics*



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Genetics for Life<sup>®</sup>

Contact us at [Immunity@semex.com](mailto:Immunity@semex.com)

More technical information at [www.semex.com/immunity/technical](http://www.semex.com/immunity/technical)