Understanding Heterosis and the Value of Hereford Cattle

D. A. Daley
California State University, Chico

World Hereford Congress – Calgary, Canada
July 14, 2012
Genetic Improvement

- Selection - within breed (use of genetic predictors (EPD’s) and indices, genomics)

- Crossbreeding - heterosis / breed complementarity
Breed Complementarity

The degree to which two breeds complement one another.....

MORE EFFICIENT MEANS MORE HEREFORD.

For efficiency and profitability, nothing gets you there faster than Hereford. Hereford characteristics, such as gain and feed conversion, show a $78 advantage per head over Angus-sired calves from start to finish. Ideal for your herd and for the future of your business, adding Hereford gives you the power to become more profitable.
Heterosis - the superiority of the crossbred progeny compared to the average of the parental breeds.

Maternal Heterosis - the increase in calf performance due to the maternal effect of a crossbred cow.
Heterosis – what should we expect?

- Primary advantage in the “lowly heritable” traits --- “the non-additive genetic portion”
- Small, net positive effects in many traits
- Fitness traits---often difficult to measure and difficult to “visualize” success

LARGE NET POSITIVE CUMULATIVE EFFECT.
Direct (individual) vs. maternal heterosis

----Heterosis of the calf = 8.5%  
(individual)

----Heterosis of the F1 = 14.5%  
(maternal)
Heterosis Effects – individual (crossbred calves)

- Calving rate 4.4%
- Survival to weaning 1.9%
- Weaning weight 3.9%
- Postweaning ADG 2.6%
- Yearling weight 3.8%
- Feed conversion 2.2%.
Heterosis effects – maternal Crossbred cows

- Calving rate 3.7%
- Survival to weaning 1.5%
- Weaning weight 3.9%
- LONGEVITY 38%
- NUMBER OF CALVES 17.0%
- CUMULATIVE WEANING WT. 25.3%.
Lifetime Membership in
“The Breed of the Month
Club”
The Perception of Crossbreeding

- increase variability
- lack of consistency
- “mongerelize” the nation’s cow herd
- “too many breeds”
- lack of predictability.
The lack of implementation of well planned crossbreeding systems is the result of……

- Early failures because of the wrong genetic inputs……
- Purebred breeders………..
- Culture………………
- We measure the wrong traits!
Planned Crossbreeding Programs

- Systematic – utilize resource base
- Retain HETEROSIS
- Breed complementarity
- SIMPLE
- Marketability
- MATCH COWS TO THEIR ENVIRONMENT
- MEASURE PROFIT.
Why not planned crossbreeding?

1. A cultural bias that clearly reflects “purebreds are better!”
Why not crossbreeding?

3. We have decided that measuring outputs is more meaningful than measuring inputs---and easier!

- Average daily gain
- Ribeye area
- Quality grade
- Weaning weight
- Milk
- ....and the list goes on.........
Why not crossbreeding?

5. Heterosis is very difficult to visualize and even more difficult to measure.

- longevity
- morbidity
- livability
- age at puberty
- lifetime productivity
Why not crossbreeding?

10. Our industry and academics have focused on individual animal measurements for over 50 years.
The impact of crossbreeding on vertically coordinated beef systems
Objective

- Conduct a controlled crossbreeding field trial under “real world conditions”, comparing Angus and Hereford bulls on an Angus based cow herd.
- Measure traits that may have potential to impact overall profitability.
Materials & Methods

- 600 Angus based cows randomly mated to 15 Angus or 15 Hereford bulls
- Project conducted for 3 years
- Records maintained on all calves born into the project through production cycle
- Sire verification through calf DNA samples
Hypothesis

- Slight advantage in direct heterosis (weaning, feedlot, carcass)
- Large return for maternal heterosis (small incremental advantage in fitness traits, longevity, # of calves weaned per cow exposed)
Results

Weaning – slight advantage in “pre-conditioning”, 12 pounds + for crossbred calves.
## Results – primary differences

<table>
<thead>
<tr>
<th>Trait</th>
<th>Angus x</th>
<th>Hereford X</th>
</tr>
</thead>
<tbody>
<tr>
<td># of hd</td>
<td>297</td>
<td>284</td>
</tr>
<tr>
<td>ADG</td>
<td>3.45</td>
<td>3.48</td>
</tr>
<tr>
<td>FE – as fed</td>
<td>7.44</td>
<td>7.05</td>
</tr>
<tr>
<td>FE – DM</td>
<td>5.52</td>
<td>5.25</td>
</tr>
<tr>
<td>Cost of gain</td>
<td>79.77</td>
<td>75.98</td>
</tr>
<tr>
<td>Hospital cost/hd</td>
<td>14.52</td>
<td>12.68</td>
</tr>
<tr>
<td>Carcass - strs.</td>
<td>+15 % Choice</td>
<td></td>
</tr>
<tr>
<td>cullt hfrs.</td>
<td>+5% Choice</td>
<td></td>
</tr>
</tbody>
</table>
Summary of Results-Direct heterosis

- Slight increase in weaning performance
- Increase in average daily gain
- Increase in feed efficiency
- Decrease in cost of gain
- Decrease in quality grade
- Increase in net return - + $20 per head
Crossbreeding (maternal heterosis)

- 7 percent increase in pregnancy rates of “F1” yearling heifers compared to “straightbred…….”
- Similar to “Circle A” data
- Modeled to be about $50 per cow advantage
The application......

There is still an advantage to a black hide (read Angus)...depending on your market. Creating replacement females that have maternal heterosis—yet are still black and bred back to Angus bulls.
We have focused on sexy traits – not profit traits.....

👩‍⚕️ Our industry has focused on maximums, rather than on maximum return.

👩‍⚕️ When are we going to focus on maximum sustained profit per acre, per hectare or per unit—not maximum dollars per head.
The basic premise of seedstock production......

- All breeds can do all things! Just ask the breeders...........
- We have not capitalized on maternal and paternal lines...we have spent far too much time trying to blur those lines rather than utilize the differences.
Cattle breeding

Rather than making the complex simple (the mark of a great teacher), we seem bent on making the simple complex.....

Selection within breeds using EPD’s
Planned crossbreeding to capitalize on heterosis.....
Cattle breeding – so what have we done...

- Increased growth rate and mature size
- Focused on carcass merit (improved)
- Increased milk
- Increased maintenance cost
- Decreased functionality/adaptability
- Decreased longevity
- Made cattle phenotypically “better”
- Developed “trait leader” lists emphasizing maximums
- Selected for fertility with a feed truck
- Decreased emphasis on the ability of the cow to harvest low quality forages
Cattle Breeding – progress report

- We have lots of measurement of “horsepower”...
  - What about miles per gallon?
  - Warranty on the engine or powertrain?
  - Years of service?
  - Is it “buyer beware”? 