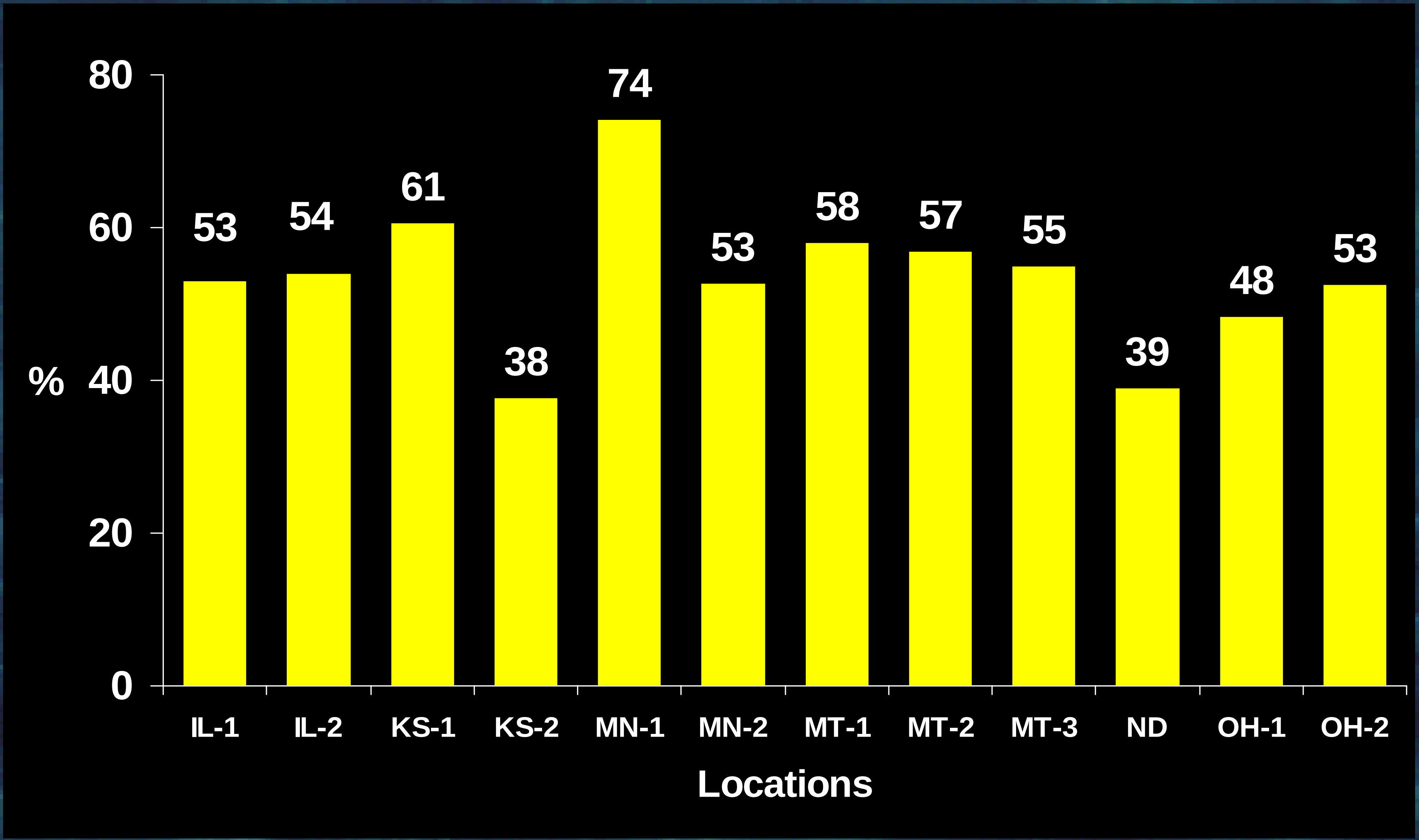
Reproductive Management

Rick Funston
Reproductive Physiologist
University of Nebraska

IANR

Reproduction is the single most important factor for profitable beef production.

Effect of Location on Pregnancy Rates

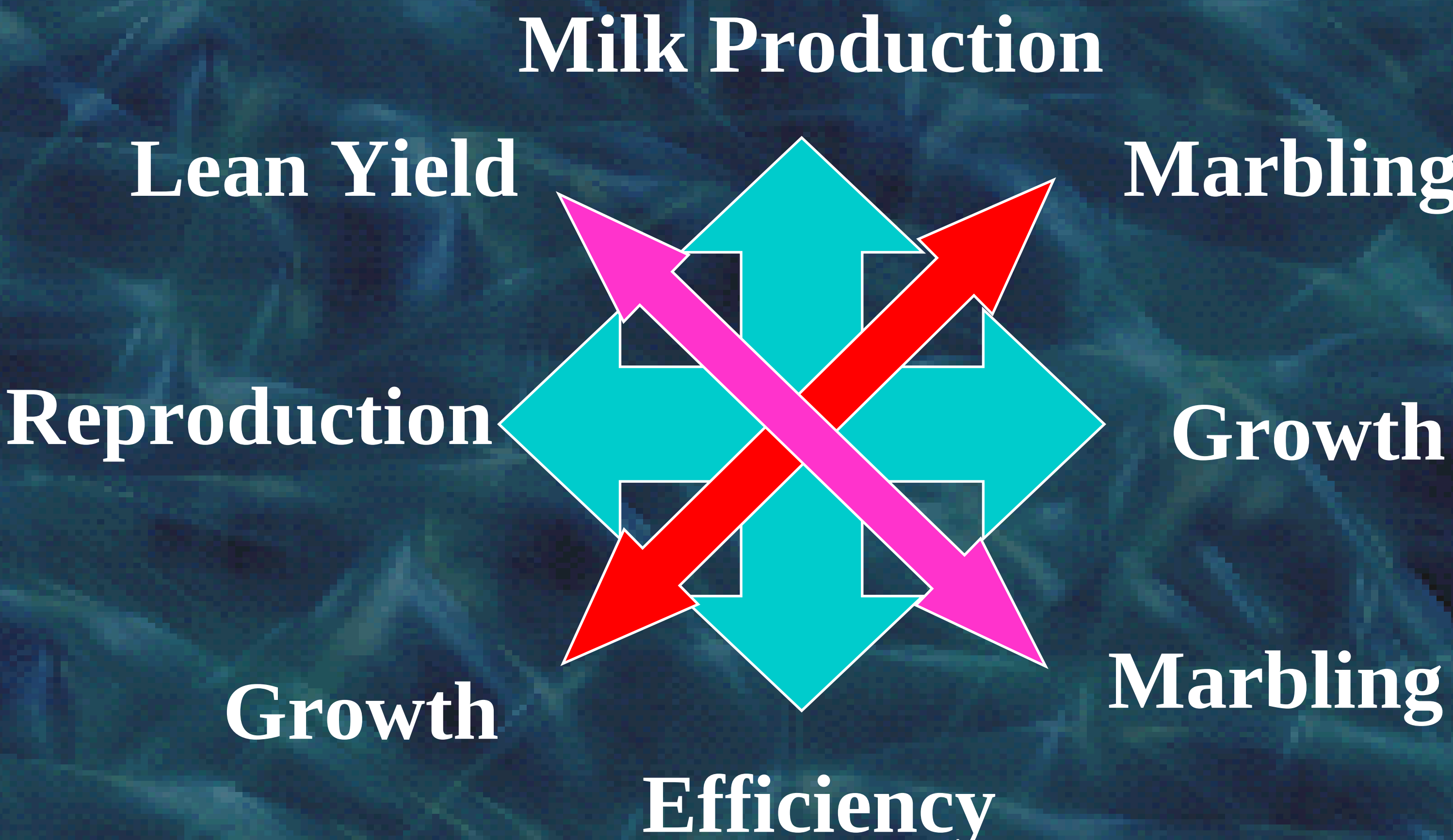


Can you cull a cow based on one year's progeny carcass data when you don't know who the sire is?

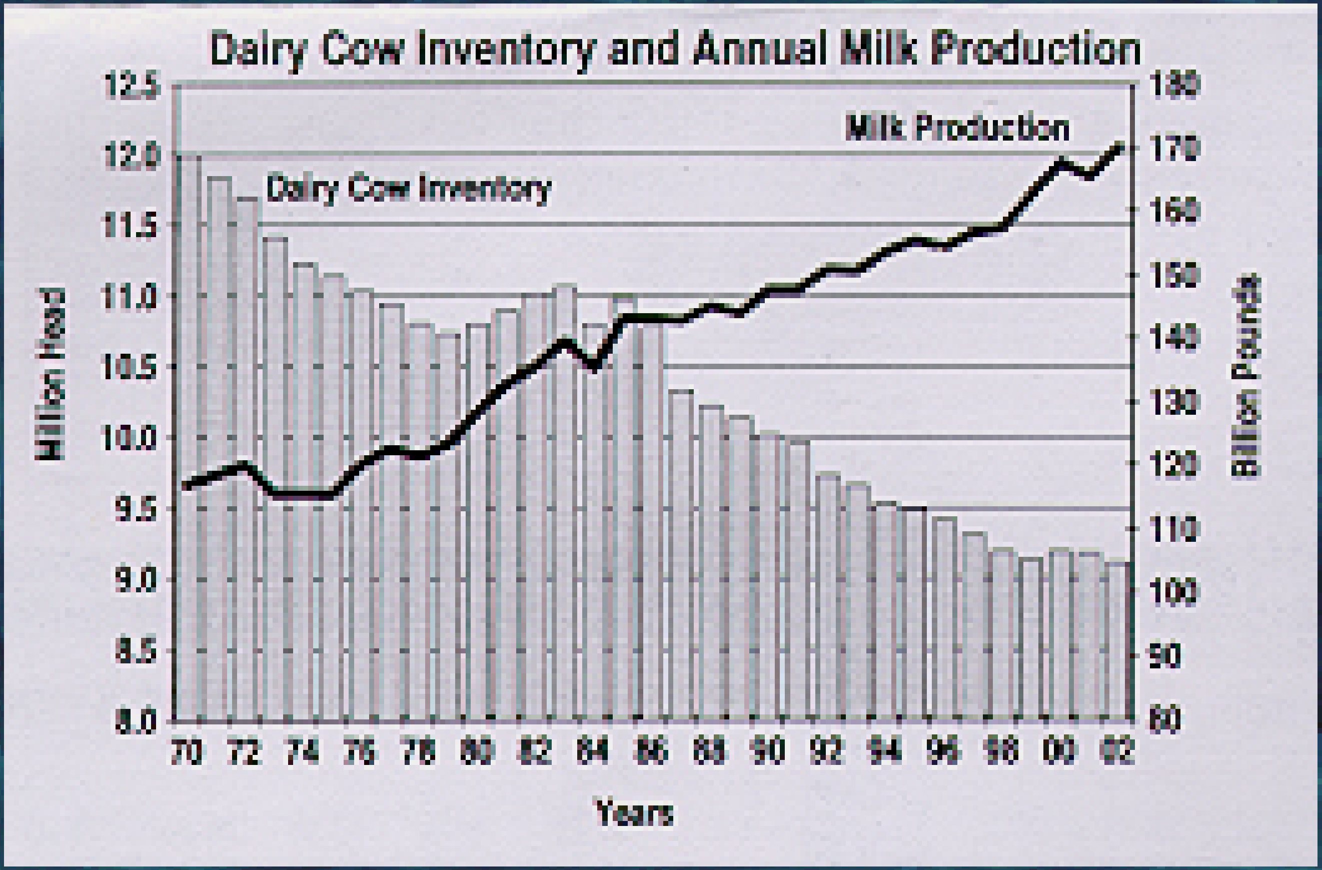
Sire Selection

- Determines more than 85% of the total improvement made in a herd

Which Direction to Go?



What happens when you practice single trait selection??



The effective population size of the US Holstein breed is 36 head

Our marbling push may be taking a toll on fertility

The premiums paid for high-grading cattle have almost led to a situation of single-trait selection for intra-muscular fat (IMF), or marbling, in the U.S. beef industry. While history teaches us the folly of single-trait selection, the current rush for marbling poses significant potential for lowered fertility in U.S. beef cattle.

If we accept the premise that androgens (testosterone) have a demeaning effect on IMF, then the ultra-sounding of bulls to determine IMF from a sire group could certainly lead to lower fertility and later puberty.

"We may be ignoring great variables in testerone levels." – Jim Bradford

Consider this scenario: You have 100 bulls to ultrasound that are of varied frame sizes of 5 through 7. Age at scanning is 11 1/2 to 12 1/2 months.

The 5-frame bulls have probably reached puberty and are at high testosterone levels. The 6- and 7-frame bulls are perhaps at a lower level of testosterone and thereby show more IMF (if of equal genetic predisposition).

The early puberty bulls would show more activity because they are burning more energy. Testosterone, acting as a repartitioning agent, allocates more nutrients to muscle and less to IMF.

As a result, the later-puberty bulls — with lower testosterone levels — would show an advantage on ultrasound readings for IMF.

Even if all the bulls were of the same frame size and equal puberty, we still have a strong chance of bias. If some of the bulls are of a high libido nature, they may burn twice the energy as average or lower libido bulls. This would turn a buyer away from such bulls if he were looking for balanced traits.

The industry needs some basic research to determine:

- When is an appropriate time to read IMF in relation to testosterone levels?
- What happens to IMF at high testosterone levels?
- How do low-fertility bulls read on IMF?
- Would the use of heifers in determining a sire's progeny reading for IMF be less antagonistic to fertility?

What it boils down to is that while we are measuring variables in IMF, we may also be ignoring great variables in testosterone levels. Thus, we're putting ourselves at great risk of unconsciously avoiding high-fertility bulls.

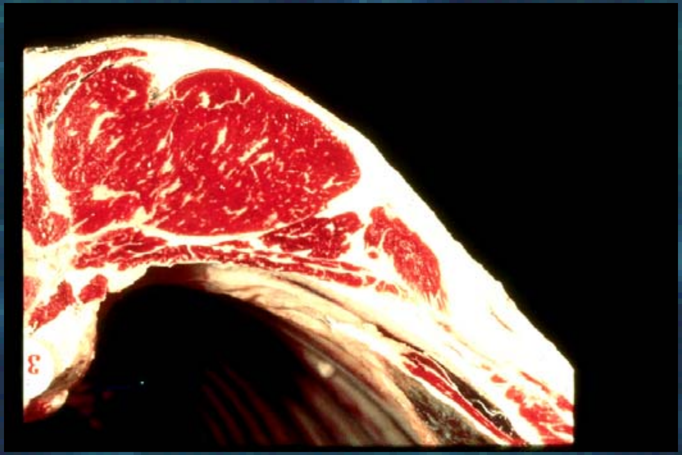
I have found little research that tests the correlation between IMF and testosterone. It should be an industry research priority as there's no production trait with greater economic consequences for beef producers than fertility. ◆

Jim Bradford owns and operates the Brad Z Ranch, a purebred Angus and purebred Gelbvieh operation in Guthrie Center, IA. The current chairman of the National Cattlemen's Beef Association Research Committee, Bradford has been a producer leader of national beef research efforts for the past decade.

Delayed Implanting in Steer Calves

	Re-Implant Weight	HCWT	Yield Grade	Choice (%)
Delay	914	797	3.18	92
Not	930	802	3.26	68

Common MYTH

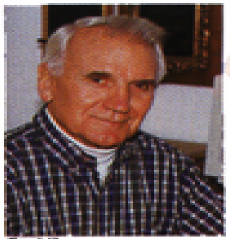


All we need to do is find the __________ gene and all of our problems will be solved…..

Genetic testing has me excited all over again

Tests show what's behind EPDs.

I haven't felt this much excitement for 15 years. Fifteen years ago, seedstock breeders began waking anew to the value potential of their product—in particular, to the carcass traits valued by consumers. Because of this awakening, we now have EPDs for marbling, EPDs for leanness, EPDs for ribeye size, EPDs for fat, EPDs for carcass size, and EPDs for retail yield. Today, these 15-year-old visions are paying big dividends through value-based marketing. But we may have just "scratched the surface."


Fred Knop

I'm excited again because we seem to be at the base of a whole new wave of technology—genetic tests that show why EPDs are what they are. This is technology that may lift our breeding programs and our product to even greater heights.

I'm excited, for example, because of the excitement of John and Mary Ellen Wozney of Coolville, Ohio, who are figuratively seeing double these days. John and Mary Ellen are Murray Grey breeders and they're excited about a bull named Katuna Courageous. Corey, as the bull is popularly known, was imported from Australia in 2001. Corey turned out to be a special bovine. In technical terms, Corey was found earlier this year to be double homozygous for the carcass traits of marbling and tenderness. This means that Corey carries two copies of the favorable form of the marbling gene plus two copies of the favorable form of the tenderness gene. It is estimated that fewer than 5 percent of all cattle on earth are double-double for these traits.

This double-double characteristic means that each of Corey's sons or daughters is guaranteed to inherit one copy of the marbling gene and one copy of the tenderness gene. If mated to a double-double female, Corey's offspring, too, will be double-double for these traits.

I'm excited because of the excitement of Jim Gibb, an old hand in this country's performance breeding program. Dr. Gibb, who once headed the performance program of the American Polled Hereford Association, is now managing partner of Frontier Beef Systems of Lafayette, Colo. Frontier recently announced the marketing of *Tender*GENE, a new tenderness test developed by scientists at the U.S. Meat Animal Research Center (MARC) in Nebraska.

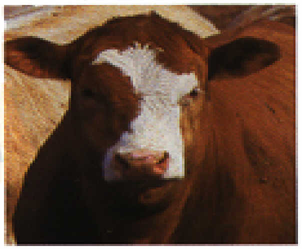
*Tender*GENE is a Calpain tenderness test. Calpain is a naturally occurring enzyme that plays a major role in beef tenderness by weakening muscle fibers. This weakening increases tenderization during the post-mortem aging process. The *Tender*GENE test can be conducted on hair, blood or semen to find breeding bulls, cows and replacement heifers that possess favorable tenderness genes. Two Calpain SNPs (Single Nucleotide Polymorphisms) have been identified. Animals carrying genes for both SNPs have been found to be 20 percent more tender in populations of Simmental and Angus-cross fed cattle.

I am excited, too, about the discovery of a DNA test for marbling that is awaiting a marketing arrangement.

The big question now is whether it will take us 15 years again to weave new technology into our breeding programs. How long will it be before we see offerings of double-double bulls, or even single-single bulls? How long will it be before pedigrees of breeding stock will carry both EPDs and carcass genes?

There is already considerable activity afoot. I understand that DNA testing is being conducted by major seedstock producers in this country and abroad. Scientists at MARC are busily recharacterizing the numerous breeds in their decades-old germplasm evaluation program, including their genetic makeup. A three-day workshop on DNA technology will be held at the Embassy Suites hotel in Kansas City beginning Dec. 4 (check the Beef Improvement Association's Web site for details).

READY FOR THE RAIL TEST



Genetic testing of parent stock will greatly increase the chances of progeny to grade at high rates for important carcass traits.

I felt both excitement and confidence back in 1988 when, as editor of this publication, I saw the convergence of elements and attitudes that led us into the EPD era and the era of value-based marketing. I see this convergence occurring again and I feel the same excitement and confidence that this new wave will carry our breeding programs and our product to even more exciting levels.

To contact Fred Knop, write Drovers *or send e-mail to fredlyn@aol.com.*

NEW DESIGN 9150

29AN1593

B/R **NEW DESIGN** 323-**9150** AAA 13286230 CAA 1218074 TATTOO #9150

- B/R NEW DESIGN 323
  - B/R NEW DESIGN 036
  - B/R RUBY OF TIFFANY 155
- B/R RUBY OF TIFFANY 4117
  - RITO 9M9 OF 2036 SCOTCH CAP
  - B/R RUBY OF TIFFANY

The Breed's #1 All Time Marbling Sire

- ✔ The 2000 Angus Sire Alliance winner due to his outstanding combination of calving ease and overall carcass merit
- ✔ $46.89 Sire Alliance profitability value and top 10% feed efficiency rank
- ✔ Ranks in the top 2% of the breed for BW EPD
- ✔ #1 for Beef Value among bulls with a -1.0 BW EPD or less

AMERICAN ANGUS SIRE SUMMARY FALL 2004 ❍ TOP 25%

TRAIT	BW	WW	MILK	DTS	YW	SC	IMF	uRE	uFAT	u%RP	GRP/PRG
EPD	-1.3	+33	+26	0	+58	+.57	+.19	+.36	-.017	+.74	11
ACC	.73	.73	.28		.61	.28	.54	.54	.55	.55	.20

BORN 02/13/99

TRAIT	CW	MARB	REA	FAT	%RP	GRP/PRG
EPD	+7	+.99	+.44	-.001	+.43	6
ACC	.83	.85	.82	.81	.81	23

INDEXES	$F	+5.26	$G	+38.12	$B	+46.21

Angus Sire Alliance	
Profitability Value	$46.89
Feed Efficiency Rank	Top 10%

Calving Ease: ★ ★ ★ ★

Carcass Merit:

Owned By: Circle A Ranch, MO

Angus Sire Alliance, MO; Rishel Angus, NE

EXT

29AN1413

N BAR EMULATION EXT AAA 10776479 CAA 849773 TATTOO #U23

Owned By: Sinclair Cattle Co., Warfordsburg, PA

Green Garden Angus, Ellsworth, KS

- EMULATION N BAR 5522
  - EMULATION 31
  - ANKONY 8F78 LASS 8F275
- N BAR PRIMROSE 2424
  - EMULATION 31
  - PRIMROSE N BAR 9962

The Original Curve Bender

- Still one of the breed's best for transmitting moderate birth weight, high growth and reduced mature size
- Outstanding functional phenotype and longevity
- His daughters are the most complete and productive mature cows in most herds today
- Many breeders are taking this last opportunity to make one more crop of foundation EXT daughters

TRAIT	BW	WW	MILK	DTS	YW	CW	MARB	REA	FAT	%RP	PROG./HERDS	SC
EPD	+2.0	+43	+21	10561	+81	+21	+.01	+.21	+.028	-.33	1091	-.49
ACC	.99	.99	.99		.99	.99	.99	.99	.98	.98	250	.99

❍ TOP 25% AMERICAN ANGUS SIRE SUMMARY FALL 2002

TRAIT	%IMF	RE	FAT	%RP	PROG/HDS
EPD	+.08	+.33	+.041	-.08	4494
ACC	.94	.94	.94	.94	1767

ANGUS ULTRASOUND BODY COMPOSITION FALL 2002

2002 GTS Data	STA	#HEAD
Stature	-0.6	1221
Capacity	+0.8	1221
Body Length	+0.7	1221
Muscling	+0.9	1221
Rear Legs	-0.2	1221
Feet & Pasterns	+0.8	1221
Femininity	+1.1	760
Udder Attachment	+3.1	243
Udder Depth	+2.2	243
Teat Size	+3.9	243

Comment: Added capacity, body length, muscling;Feminine daughters;Outstanding teat & udder quality

Calving Ease: ★★★

Carcass Merit:

ROCK SOLID ACCURACY: BIRTH WEIGHT, PERFORMANCE, MATERNAL, CARCASS

	GeneSTAR®			Frontier Beef Systems		
	Marbling	Tenderness One	Tenderness Two	TenderGENE SNP 316	TenderGENE SNP 530	TenderGENE Score
ANGUS						
29AN1413 EXT	★★	0	★★	CC	GG	5
29AN1458 PFRED	★	★★		GC	GG	3
29AN1478 SAUGAHATCHEE				GC	GG	3
29AN1501 602C				GC	GG	3
29AN1510 ADVANTAGE				GC	GG	3
29AN1520 N BAR PRIME TIME				CC	GG	5
29AN1523 NEW DESIGN 878	0	★★		GC	GA	3
29AN1524 TRAVELER 234D				GC	GG	3
29AN1530 POWER DESIGN	0	★★	0	GG	GG	3
29AN1531 ROCKN D AMBUSH	0	★★	★★	CC	GG	5
29AN1532 EXT 4137				GC	GA	3
29AN1543 STRATEGY	★	★		GG	GA	2
29AN1549 BUSHWACKER 944				GG	GG	3
29AN1551 DESTINATION 928	0	★★	★★	CC	GG	5
29AN1552 SEVEN PLUS				GC	GG	3
29AN1556 LEAD ON	0	★★	★	GC	GG	3
29AN1564 TRAVELER 8T4				GC	GG	3
29AN1567 MODERN DESIGN				GC	GA	3
29AN1569 BANDWIDTH				GC	GA	3
29AN1570 FORECAST				GC	GG	3
29AN1574 OBJECTIVE				GG	GA	2
29AN1577 EXTRA H6	★	★		GC	GG	3
29AN1578 CLASSIC ROCK	0	★★		GC	GG	3
29AN1582 FACTOR				GC	GA	3
29AN1583 SOUTHERN ROCK				CC	GG	5
29AN1585 SOMETHING SPECIAL				GC	GA	3
29AN1587 EXACTLY	★	★		GG	GG	3
29AN1589 FORESIGHT				GC	GG	3
29AN1591 KING KAHN	0	★	★			
29AN1593 NEW DESIGN 9150	0	★★	★	GC	GG	3
29AN1594 LEVERAGE	0	★	★	GC	GG	3
29AN1596 IDEAL 7451				GC	GG	3
29AN1597 RITO PRIME				GC	GA	3
29AN1598 ACCURATE	0			GC	GA	3
29AN1586 HIGHMARK				CC		
29AN1603 EDITION	★					
29AN1606 EXCEED				GC	GG	3
29AN1609 NEW STANDARD				GC	GG	3
29AN1610 MAJOR DESIGN				GC	GG	3
29AN1616 NEW LEVEL				GG	GG	3
29AN1617 SANDY				GG	GA	2
54AN2157 HIGH PRIME				CC	GA	4
54AN3361 BOOM TIME	★	★	★	GC	GG	3
90AN4738 FOCUS	★	★★		GG	GA	2
90AN5797 CONNECTION				GG	GA	2

INDUSTRY COMMENTARY

Not a silver bullet

Expectations for the future of DNA testing

R. Mark Thallman

Beef cattle breeders have heard for years that DNA testing is coming and that it will change the way they breed cattle. At long last, the time is here when DNA testing for economic traits is available, albeit in a very immature form. Breeders must decide whether to use the technology, and if so, how to use it. DNA testing has a number of potential applications in cattle breeding, including parentage testing, tests for genetic diseases or defects, and tests for qualitatively inherited traits such as color or horns. However, most economically important production and end-product traits are influenced by several or many genes and are known as "quantitative traits."

Several DNA tests for quantitative traits have become commercially available recently and the number of such tests is expected to increase rapidly over the next few years. Considerable information about a DNA test is required in order to decide whether to use it. The National Beef Cattle Evaluation Consortium is developing a process for the independent validation of DNA tests to help cattle breeders decide which DNA tests will be most effective for them. Several tests have already been through the process.

DNA testing can make evaluations available anytime after birth, which is important for traits that can only be measured late in life or postmortem. Although some continued collection of phenotypes will always be required, DNA testing should allow greater information to be extracted from each phenotype that is measured. This is especially important for traits that are expensive to measure or sex-limited.

The availability of DNA testing will bring, along with all of the advantages, misuse of information, especially in the early years when only a few DNA tests are available. We have heard much discussion of the evils of "single-trait selection." Breeders must now face the temptation of "single-gene selection," which may have far greater consequences.

For example, a bull with one of the top (high accuracy) EPDs in his breed for a trait had the least desirable, but most common, genotype (test result) for a DNA test for one of the genes affecting the trait. Semen sales on this bull dropped off sharply following the release of the test result. Apparently, breeders decided that they could not use bulls with the less favorable allele (form) of this gene, a prime example of "single-gene selection."

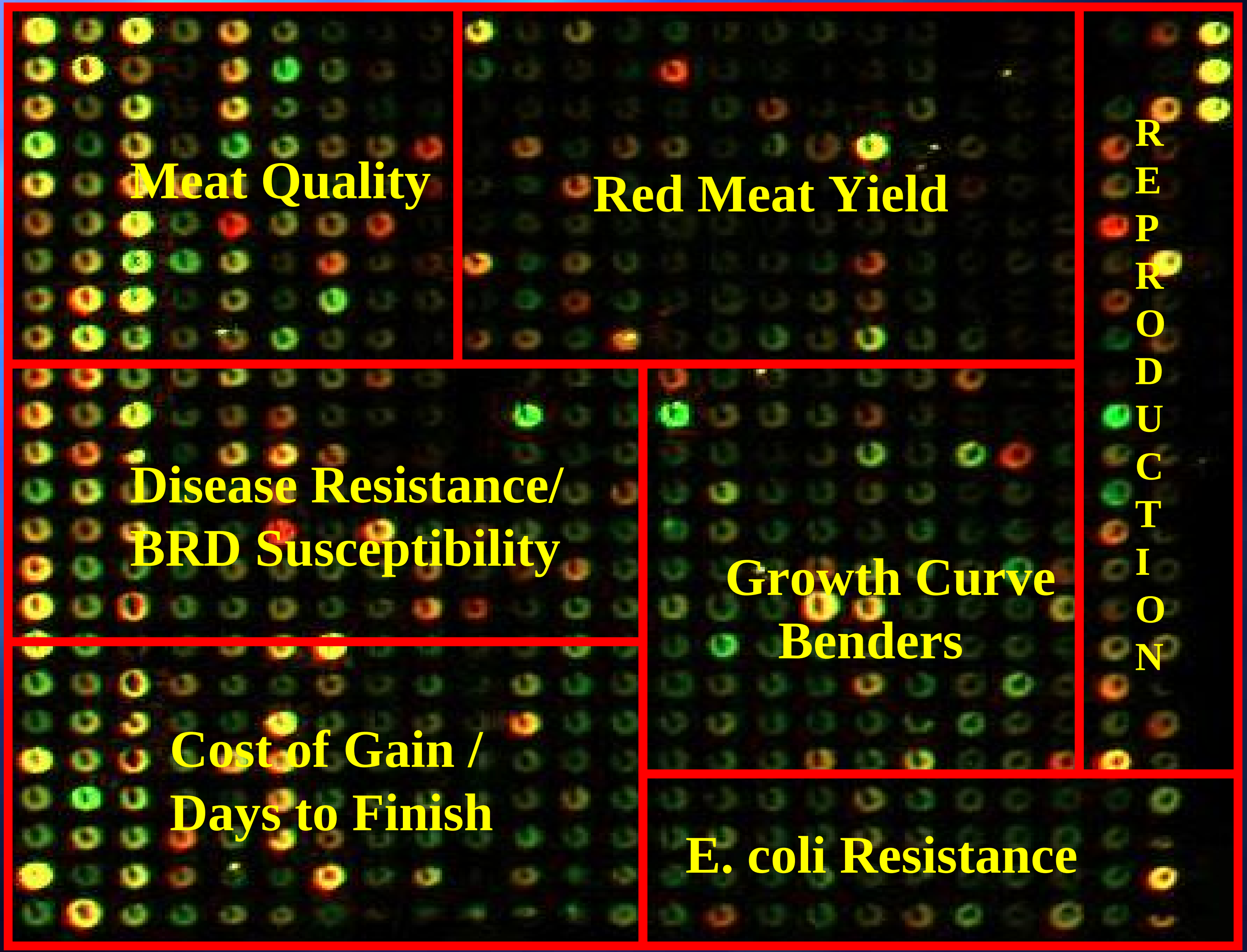
This is understandable, but it is not good use of DNA test information because the DNA test provides information about only one of the genes influencing the trait, whereas the EPD provides an estimate of his total genetic merit at all genes that influence the trait. DNA test results should not greatly influence our estimate of the overall genetic merit of individuals with high-accuracy EPDs. However, DNA testing can contribute substantial information about individuals that would otherwise have low-accuracy genetic evaluations, and this is where it is most useful. Education on the effective use of DNA testing is becoming a priority.

In the short run, DNA testing should not be expected to simplify cattle breeding. Selection decisions will be based on more pieces and types of information and breeders will have to decide which tests to run and which animals to test. It is a real challenge to integrate DNA test results with EPDs to make the most effective selection decisions.

In the longer run, the goal is to integrate DNA test results into the existing national cattle-evaluation process so that selection can be based on the resulting DNA-adjusted EPDs, which will weight the information from each DNA test result, the phenotypes and the pedigree appropriately, to provide the best estimate of genetic merit from the information available. The National Beef Cattle Evaluation Consortium and the Beef Improvement Federation are developing the basic framework for this process. Successful implementation will require the joint cooperation of DNA testing companies, breeders and breed associations. There are challenges in using DNA testing effectively in beef cattle. Nonetheless, cattle breeders are making strides in implementing DNA testing and are making changes in traits, such as tenderness, that have been difficult to select for in the past. Undoubtedly, the way in which DNA testing is used by the beef industry will change over time, but the early adopters of the technology are likely to be in a better position to capitalize on that change.

R. Mark Thallman is a research geneticist, U.S. Meat Animal Research Center ARS-USDA

Breeding on a Chip



Heritability Estimates (%)

Heifer Pregnancy ………..27

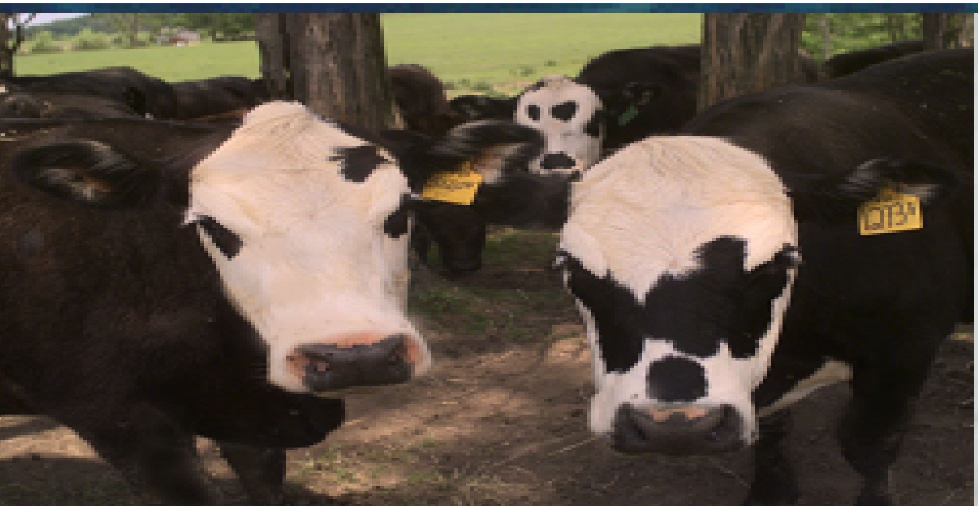
Stayability……………………10

Response to selecton is slow,

Heterosis is more important

Advantage of Crossbred Cows

Trait	Maternal Heterosis
Longevity	1.2 yrs (44%)
Calf Weight/Cow Exposed	74 lb (25%)
Net Profit/Cow Exposed	$70




"If you are looking for additional fertility and production from your cowherd, Sim x Angus or Sim x Red Angus females are the way to go. In over 48,000 comparisons from our heifer development program, we routinely observe an 8 to 10% increase in fertility from these hybrid-line females when compared to straightbreds. This combined with superior milk and maternal traits, make these females hard to beat in any production system."

Dr. Patsy Houghton, General Manager, Heartland Cattle Company, McCook, NE

Longevity of Crossbred Dams Varying in Size and Milk Prod.

Biological Type of F1 Dams		% in Herd
Sire Breed	Milk Prod.	> 6yrs
Medium	Medium	64
Medium	High	55
Large	Medium	41
Large	High	38

Heifer Management Practices Prior to Weaning

- Implants
- Creep Feeding
- Cow Productivity
- Freemartins

Replacement Heifer Selection

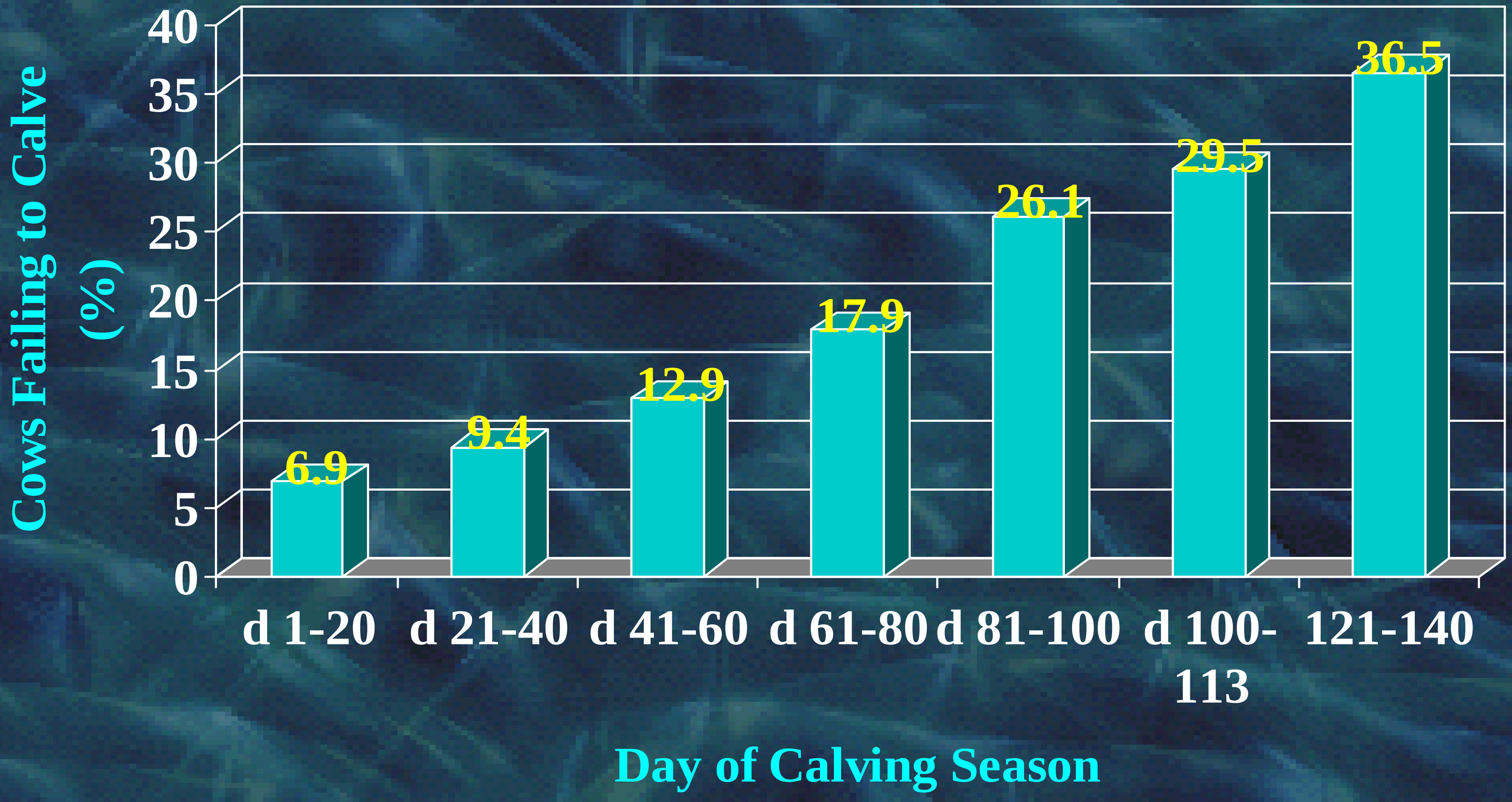
1. Cull daughters of “bad mark” cows
2.
3.
4.
5.
6.

What are“Bad Mark”Cows* ?

1. Cows that need help calving
2. Cows that calve late (+42 days)
3. Cows that fail to wean a calf
4. Cows that have big teats/need help
5. Cows that wean a light wt. calf
6. Cows that have “attitude” problems

* assume opens are culled

Effect of Calving Date on the Number of Cows Calving the Following Year



(Patterson et al., 1992)

Replacement Heifer Selection

1. Cull daughters of “bad mark” cows
2. Cull light wts., big birth wt & 6 frame
3. Cull youngest (born +45 d. calving)
4. Select daughters of oldest cows
5. Optimum (not maximum) preg. rate
6. Pigmented eyes & udder
7. Form = depth rib, chest width, guts

What about before birth?

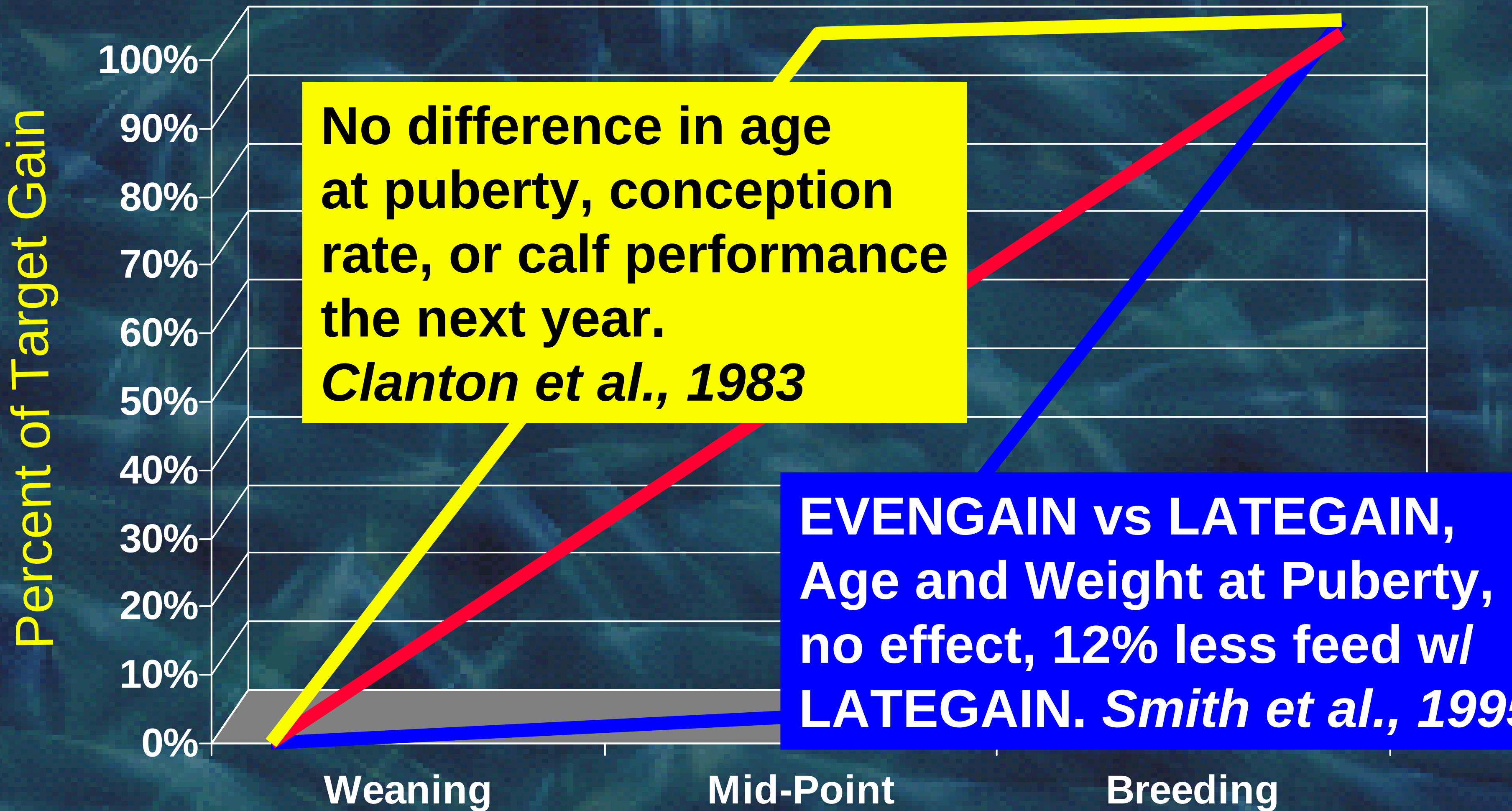
What about before birth?

N = 170	No Supplement	Supplement
BW	77	79
WW	455	469
ADJ 205d Wt	480	499
Weaning Age	192	190

What about before birth?

n = 39	No Supplement	Supplement
Preg Check, Wt.	787	807
BCS	5.68	5.88
Preg, %	73	94
1st Service Preg, %	63	94

Effect of Time of Gain From Weaning to Breeding on Heifer Performance



What is the appropriate Target Weight??

% Mature Weight	53	58
Pregnancy Rate – 1st	92	88
-2nd	91	91
-3rd	94	92
-4th	96	96

What is the appropriate Target Weight??

% Mature Weight	50	55
Breeding Season	60 d	45 d
Pregnancy Rate	87	90
Calve Date	3/15	3/9
Birth Weight	75	75
PG Wt. 2nd Calf	903	926
2nd Preg. Rate	91	92

Heifers developed to 50% mature weight

	MGA	No MGA
April 24 Cycling, %	577 83	577 78
45 d preg, %	90	90
1st cycle, %	83	78
Wt. Preg check, lb	795	785

Feeding to a "Target Weight"

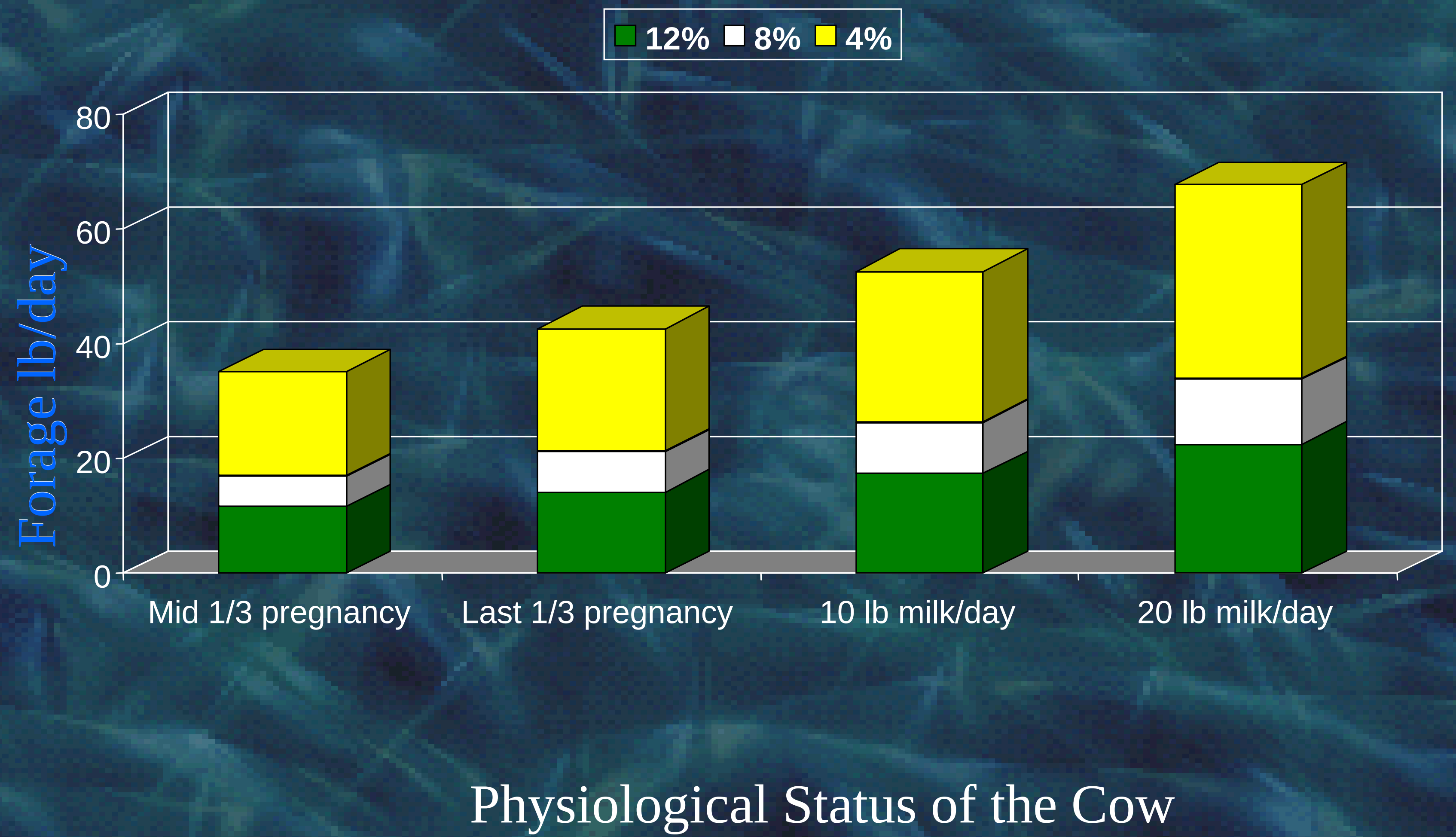
Item	% of Mature Wt @ breeding	
	55%	65%
Pre-breeding wt	600	683
Conception (21d)	30	62
Calving wt.	834	897
Calf birth wt.	71	73
Calving difficulty,%	52	29
Calf death loss,%	6	5

BALANCED NUTRITION: KEY TO OPTIMIZING PRODUCTION

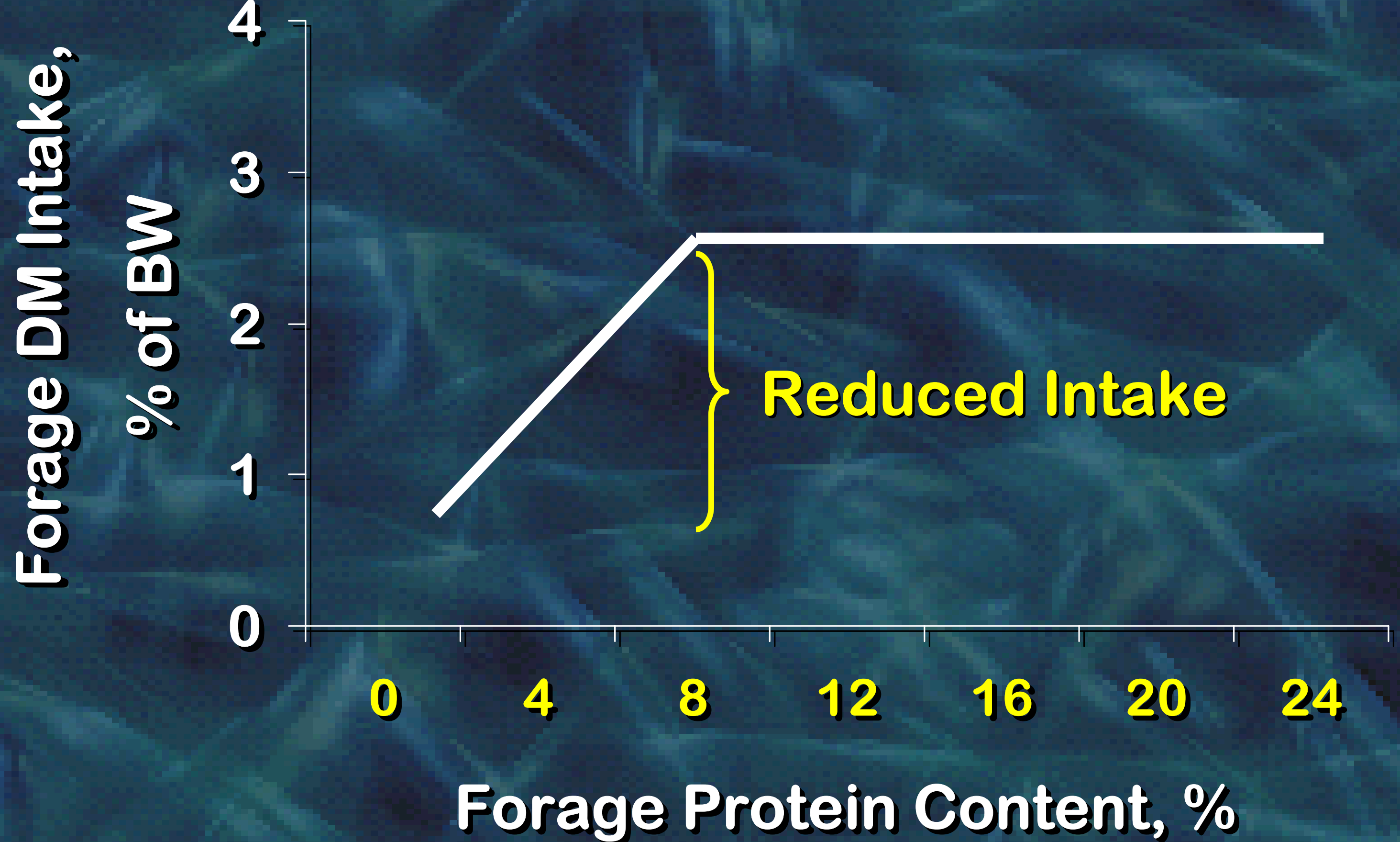
- ✓ Protein
- ✓ Energy
- ✓ Minerals
- ✓ Vitamins
- ✓ Water

FORAGE INTAKE NEEDED TO PROVIDE PROTEIN REQUIRED

FOR PREGNANCY AND MILK (1200 POUND COW)



If protein content falls below requirements, then energy intake can be reduced



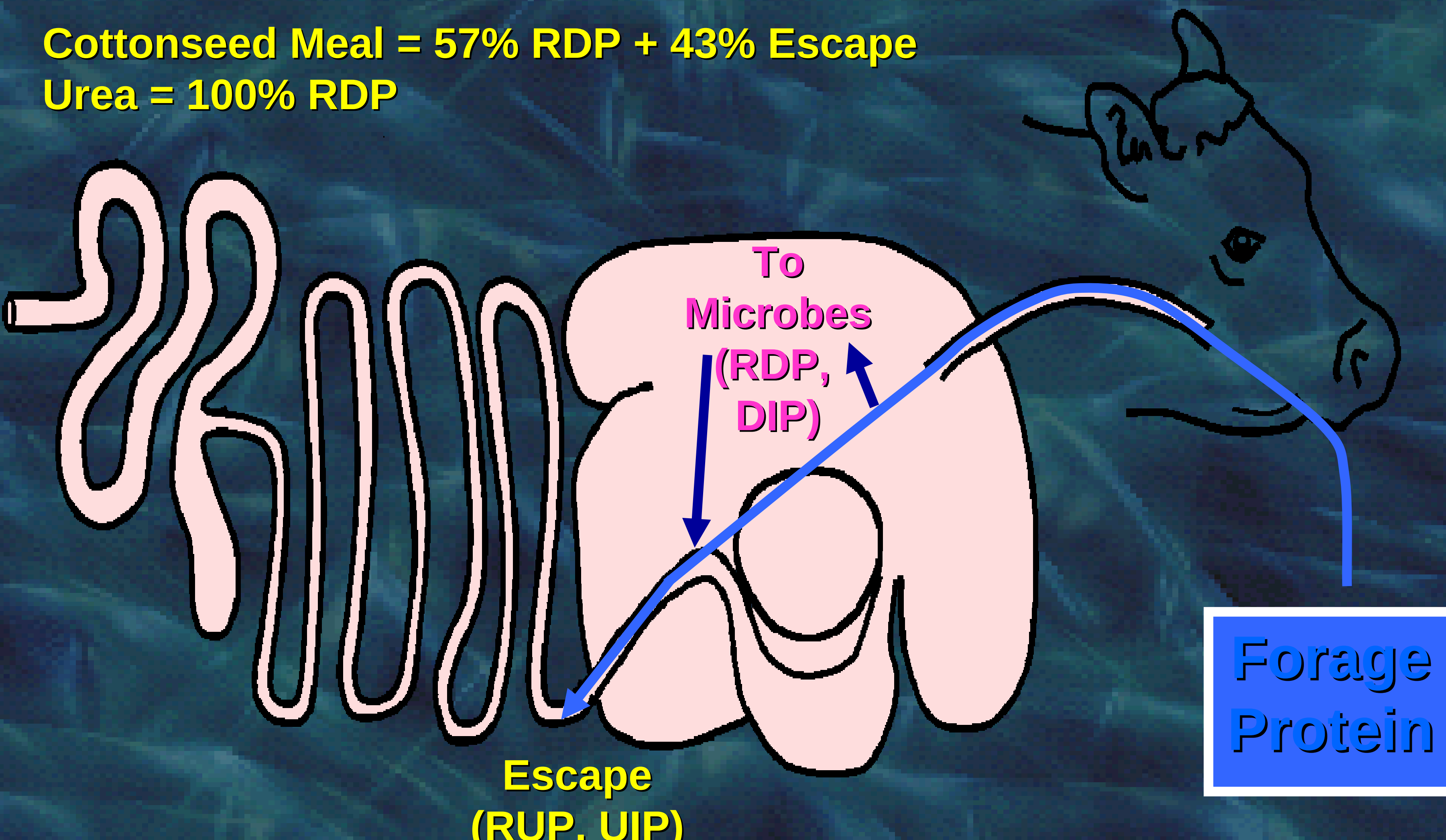
Mathis, 2000

Excess Protein

- Heifers fed excess protein had lower first service conception rates (82 vs 61%).
  - Beef heifers grazed pastures either N fertilized or not, and supplemented SBP or not.
  - Embryo survival not statistically different (68 and 74 % for high and low N, and 65 and 76 % for non supplemented and supplemented).

Rumen Function

Cottonseed Meal = 57% RDP + 43% Escape
Urea = 100% RDP



Excess UIP

- **Negative effects on several hormones that positively influence reproduction when fed at high level (.71, .55, .25 lb/d; Kane et al., 2000).**
- **Heifers fed additional UIP during development reached puberty at a later age and heavier weight, fewer serviced in 1st 21 d (.55 lb/d; Lalman et al., 1993).**

Gluten Feed

- 24% CP (75% DIP)
- .9% P
- 3.9% fat
- 80% TDN
- 36% NDF-little pH Δ
- <40% ration DM

Distillers Grains

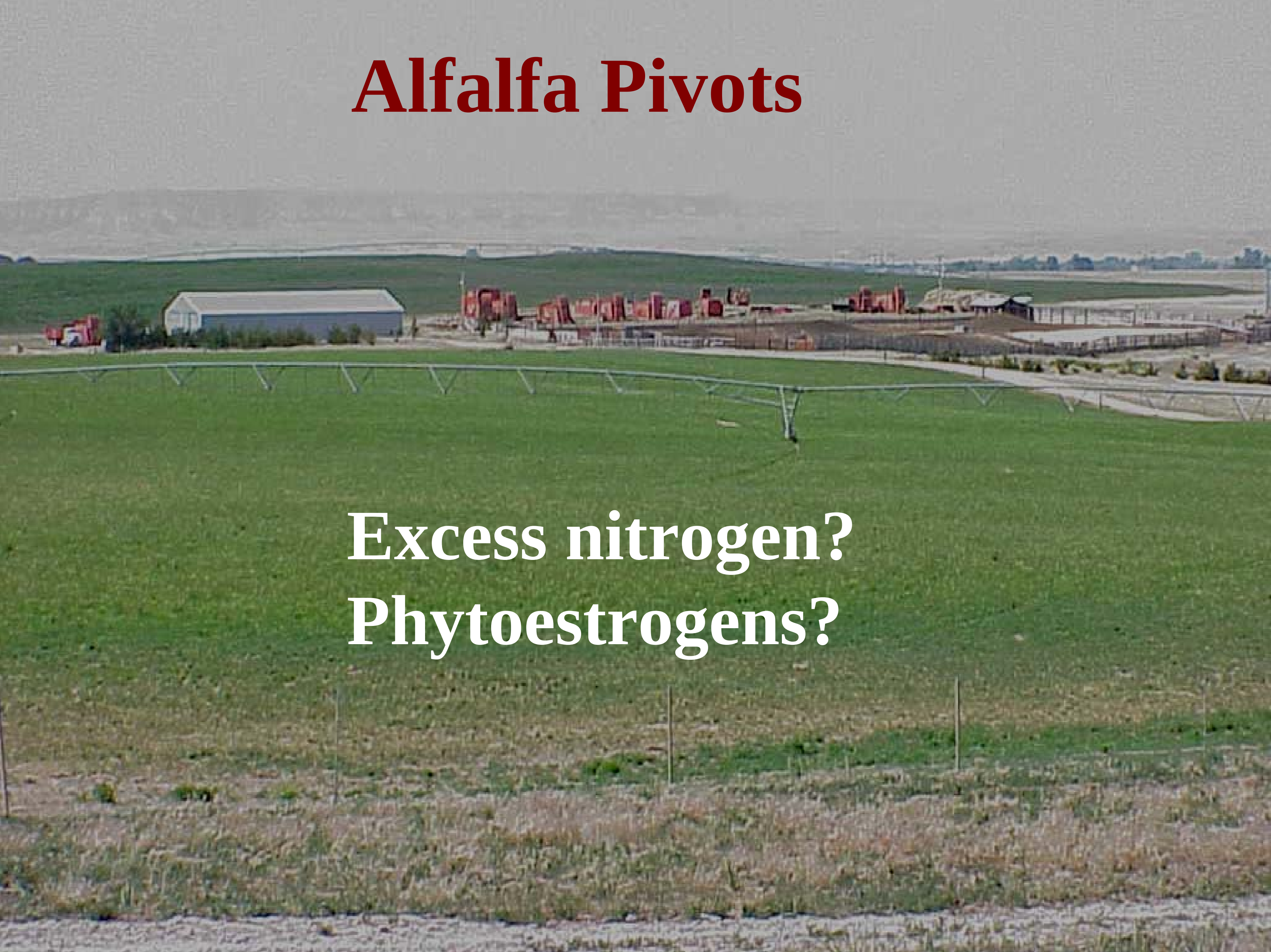
- 30% CP (35% DIP)
- .8% P
- 11% fat- limits use
- 88% TDN
- 40% NDF-little pH Δ
- <40% ration DM

University of Illinois

- 100 Simmental Cows
- Fed 13 lb Corn Gluten Feed + 10 lb alfalfa or 12.26 lb DDG + 10 lb alfalfa
- 60 % AI pregnancy rate
- 97.1 % (CGF) vs 90.7 % (DDG) after 45 d cleanup

University of NE

- 54 2-yr-old cows
- Fed 3 lb DDG or WCGF as a protein source in a total mixed diet for 60 d postpartum
- Blood samples collected every 14 d, no difference in cyclicity
- Synchronized with Hybrid Synch + CIDR
- 65 % (DDG) vs 64 % (WCGF) AI pregnancy rate

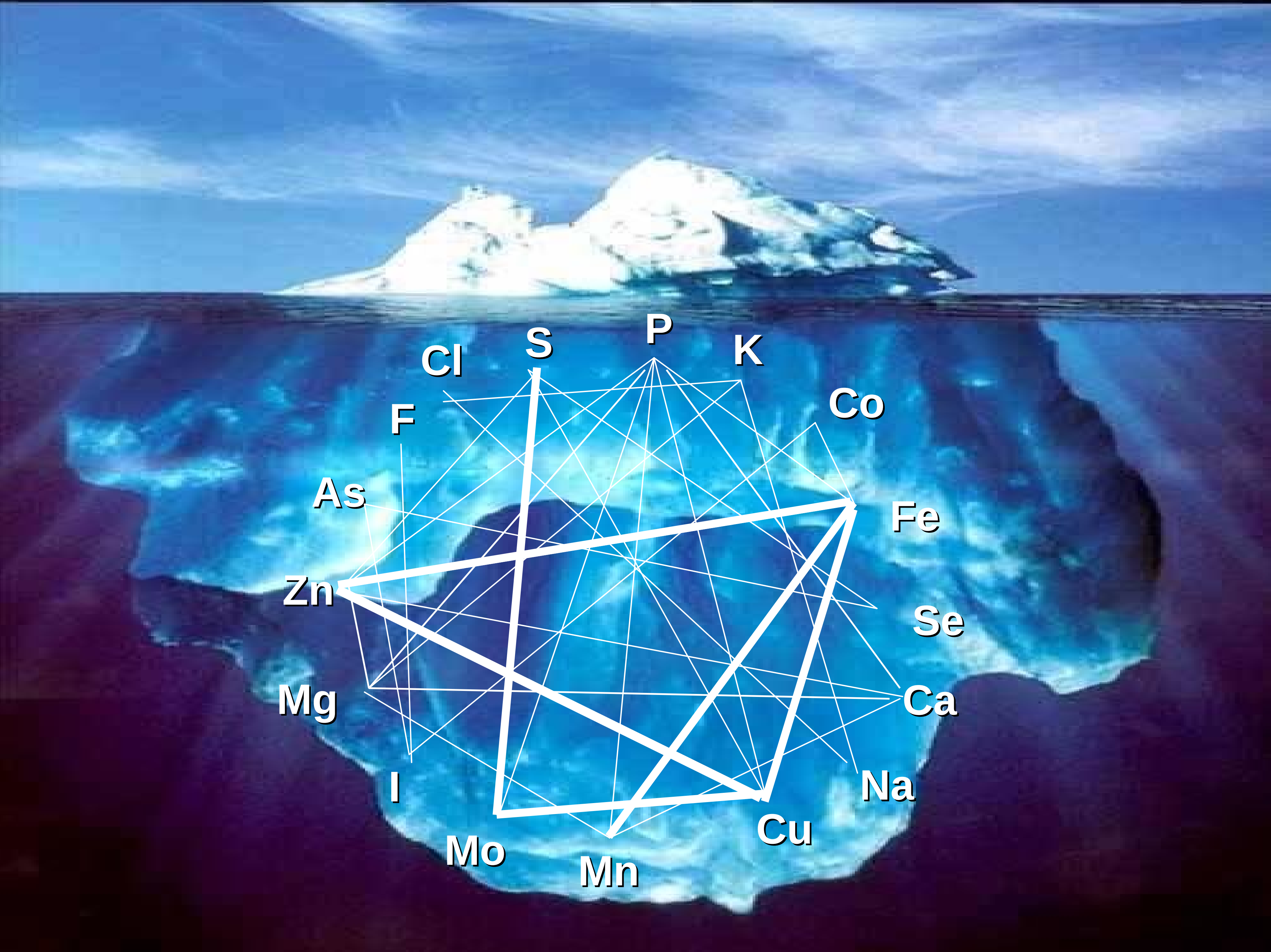

Alfalfa Pivots
Excess nitrogen?
Phytoestrogens?

Excess Protein Summary

Consumption of diets very high in crude protein have been implicated in negatively influencing reproduction

Probably more correctly, when available dietary energy is low for rumen microbes and excess ammonia is present, decreased fertility may occur

DIP vs UIP excess


P
S
K
Cl
Co
F
As
Fe
Zn
Se
Mg
Ca
I
Na
Cu
Mo
Mn

Heifers fed excess Mo had:

- Delayed puberty
- Lower ovulation
- Lower conception

Phillippo et al., 1984

Pre-calving Nutrition

Effect of Pre-Calving Nutrition on Birth Weight and Calving Difficulty

Energy level (TDN)	Birth Wt.	Dystocia
Low (11 lb)	58	26
Medium (14)	62	17
High (17)	64	18

Protein Level(%NRC)	Birth Wt.	Calving Ease
75	81.4	1.8
100	85.8	1.6
150	83.6	1.8
200	88.0	2.0

Calving Assistance

Item	Late	Stage II Early
Calf Vigor	1.1	1.2
PPI	51	49
% in heat	82	91*
Services/conception	1.24	1.15
Fall Pregnancy	78	92*
Calf ADG	1.63	1.74*
Calf WW	387	422*

Effect of Rumensin on Puberty and Conception Rates

Group	No. heifers	% Cycling	% Bred
Rumensin	24	92	55
Control	26	58	47

Treatment	Age @ Puberty	% Pregnant
High Roughage	383	83
Rumensin +90% HR	369	96
Rumensin +100% HR	369	96

Effect of sire on pregnancy

Sire	Pregnancy
A	70
B	43
C	65
D	60
E	71
F	50
G	68

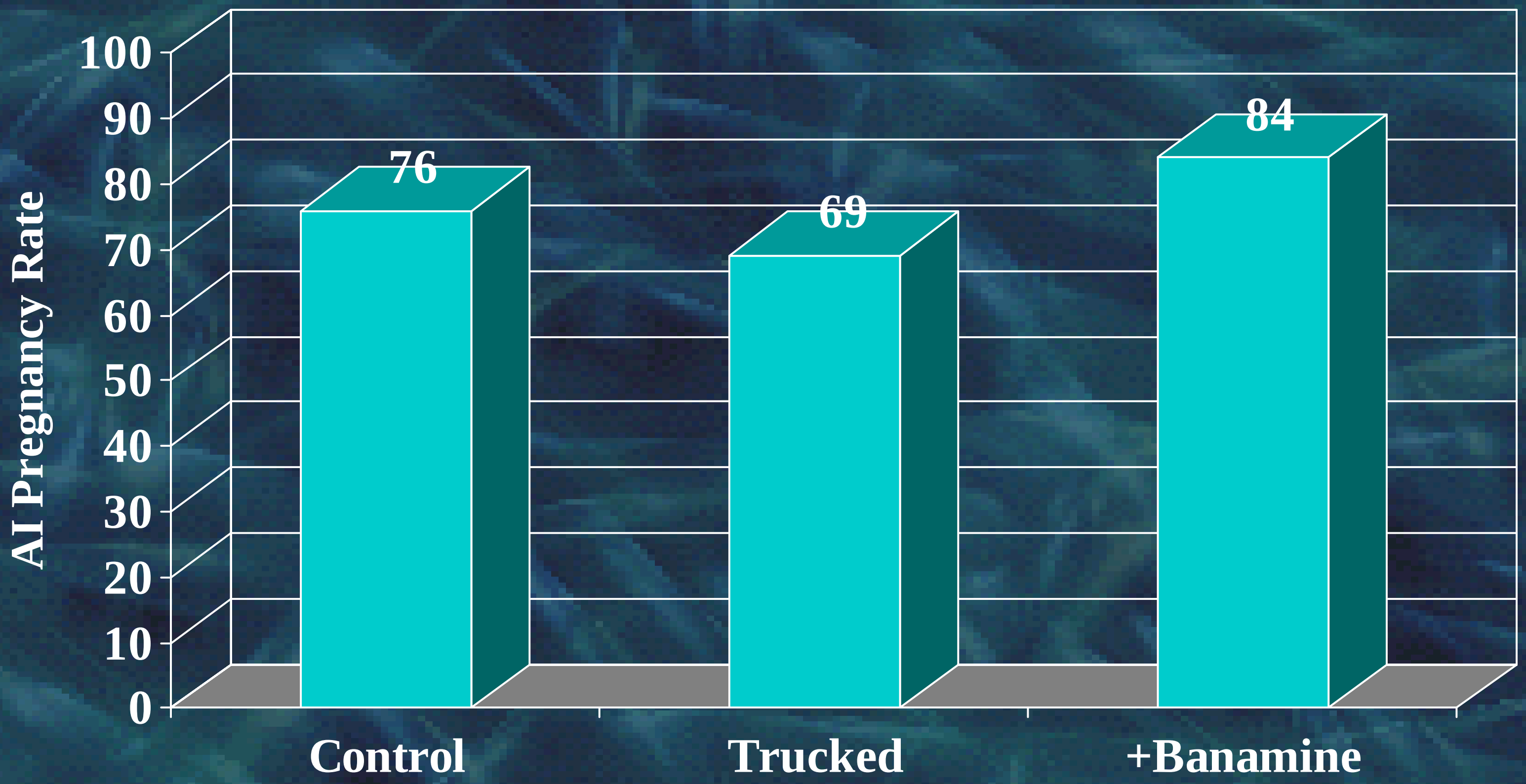
Technician Effects

Tech	Preg Rates
1	67
2	44
3	61
4	41
5	62
6	76
7	60

Handling Cattle after AI

	Day Transported after AI		
	1 - 4	8 - 12	29 - 33
Synchronized Pregnancy Rate	74%	62%	65%
Breeding Season Pregnancy Rate	95%	94%	94%
Mean Day of Conception	9.6	13.4	13.6

Effect of Banamine on Trucking Stress



32 cows/trt; trucked 4hr; d 12-15

Factors that Affect Estrous Response & Conception Rates

- ✓ Body Condition
- ✓ Age, Parity
- ✓ Postpartum Interval
- ✓ Percent Cycling in Herd
- ✓ Nutrition
- ✓ Weather
- ✓ Correct Application of Protocols

Questions???

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