Guns, Germs & Steel

Jarred Diamond

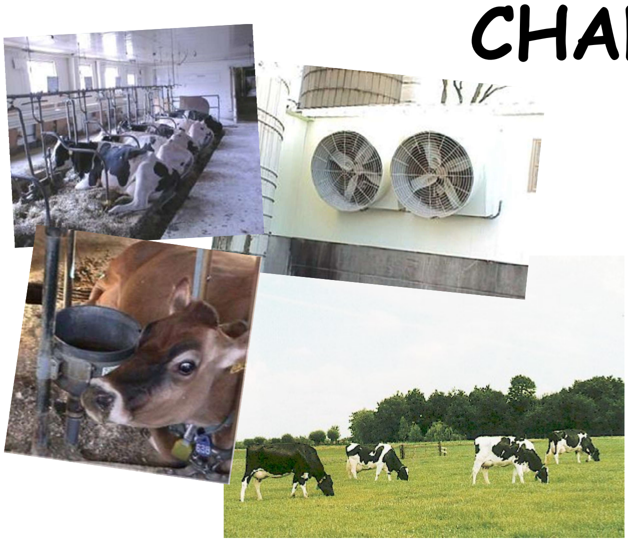
Vaccine

- First vaccine....
- Small Pox
- Cow Pox
- Latin   Vacca = Cow
- Vaccinate

Cow-inate!!!!

Trends in the Dairy Industry over the last 25 years can be best described by the term:

CHANGE



PM Fricke, Ph.D.

Most Dairy Farmers will double herd size 4 times.

- Pretty easy when 25 cows
- Become 50-100-200 cows
- But as we get to 200 cows
- Becomes 400-800-1,600 cows
- Now we are at 1,600 becoming 3,200 cows
- 3,200 cows and now dairymen are just
- Building more 3,000 milk cow dairies

Dairy Sectors (who's dairying?)

- Sunset dairies
  - Small dairies that will shut down when the current owner retires or leaves for economic, age, or lifestyle reasons
- Niche dairies
  - Production for a specific market or with a specialized system (organic, grazing, Amish, etc.)
- Lifestyle dairies
  - Operate with considerable off farm income for personal lifestyle reasons
- Large dairies
  - This is the principal sector in terms of current and future milk production in the United States and quickly across the world.
  - Large is a semi-load of milk at least every other day (400 cows)

Four Major Forces Shaping US Dairing

- Industrialization / consolidation of production
  - The dairy industry is in a phase of rapid structural change
  - Large dairy production technology has irreversibly dominated the industry
- Globalization of markets
  - No beef moves to Japan from North America
- Food safety issues
  - BSE, E. coli 0157, organic markets, fear based food marketing, No GMO's
- Consumerism
  - Low fat, Low carb, "Happy cows" Natural,

Challenges & Opportunities

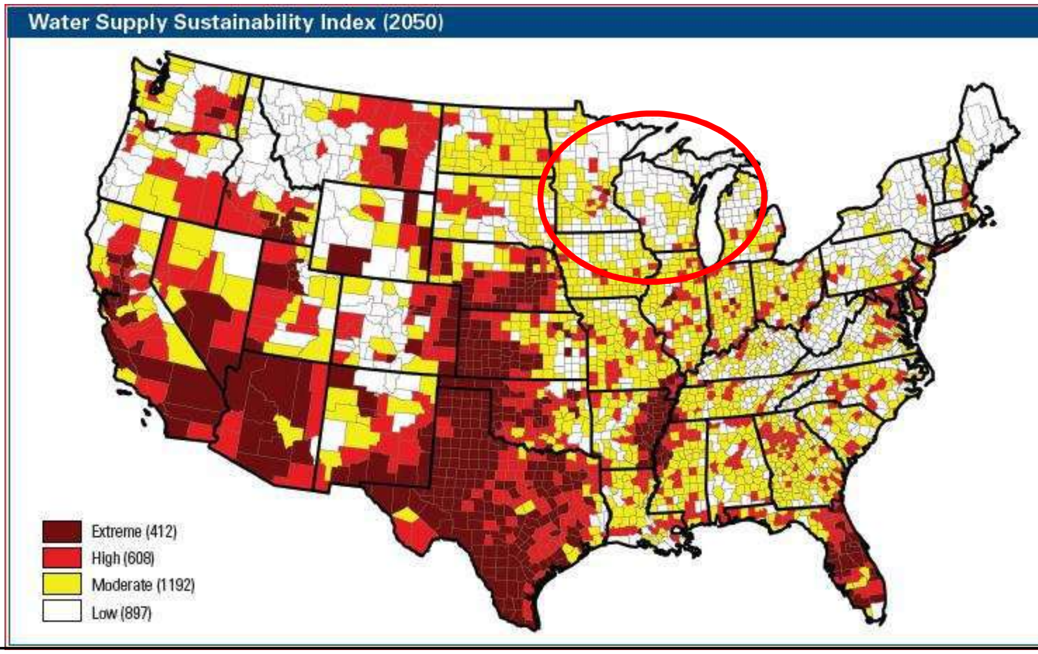
Dairy Farming

- Run as a business, is a Great Way of Life
- Run as a Way of Life, is a poor Business

Water

- Climate Change
- Current Demands NOT sustainable
- Opportunity
- Midwest

Water, The Midwest is favored



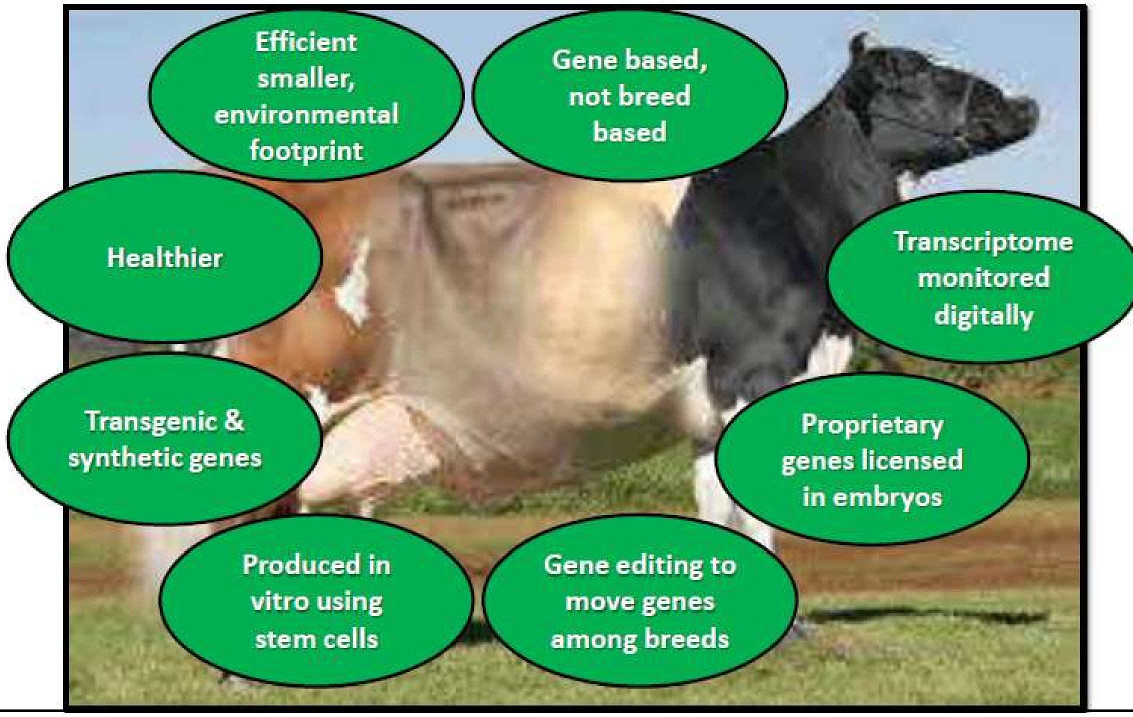
Welfare

- Tail Docking? Gone
- Polled Cows
- No overcrowding
- All cows must go outside for part of day

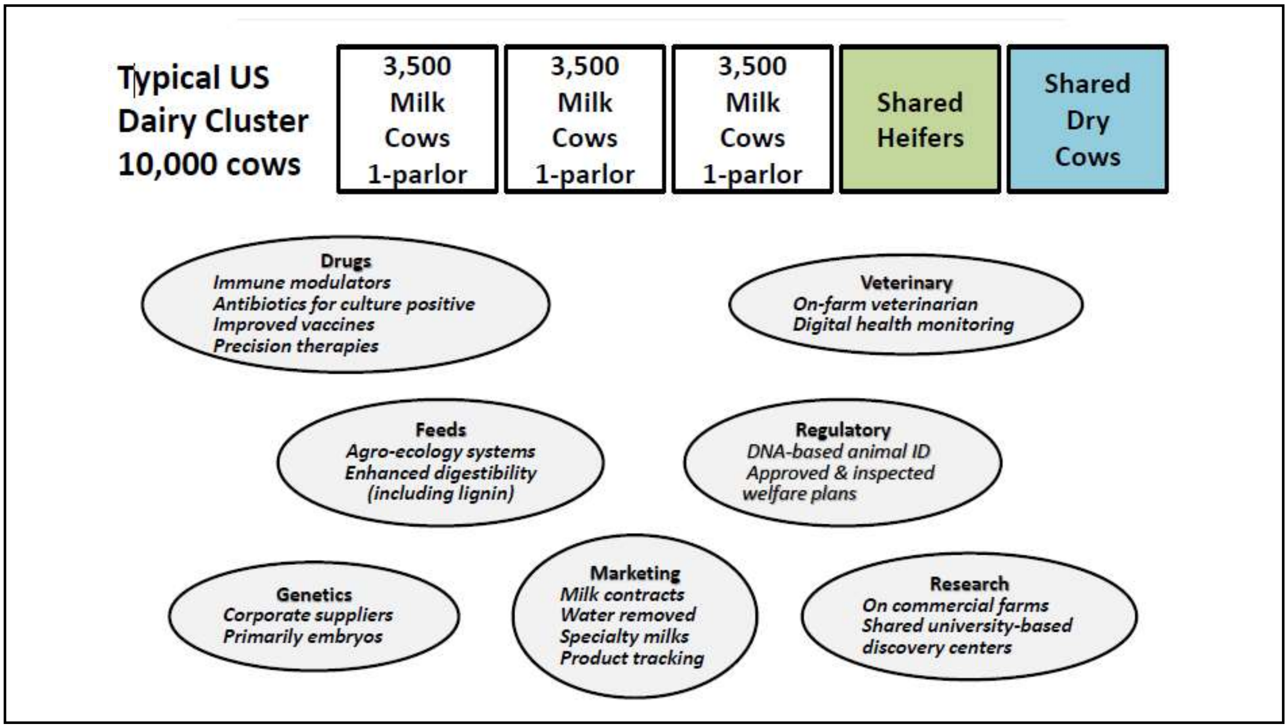
Hormones

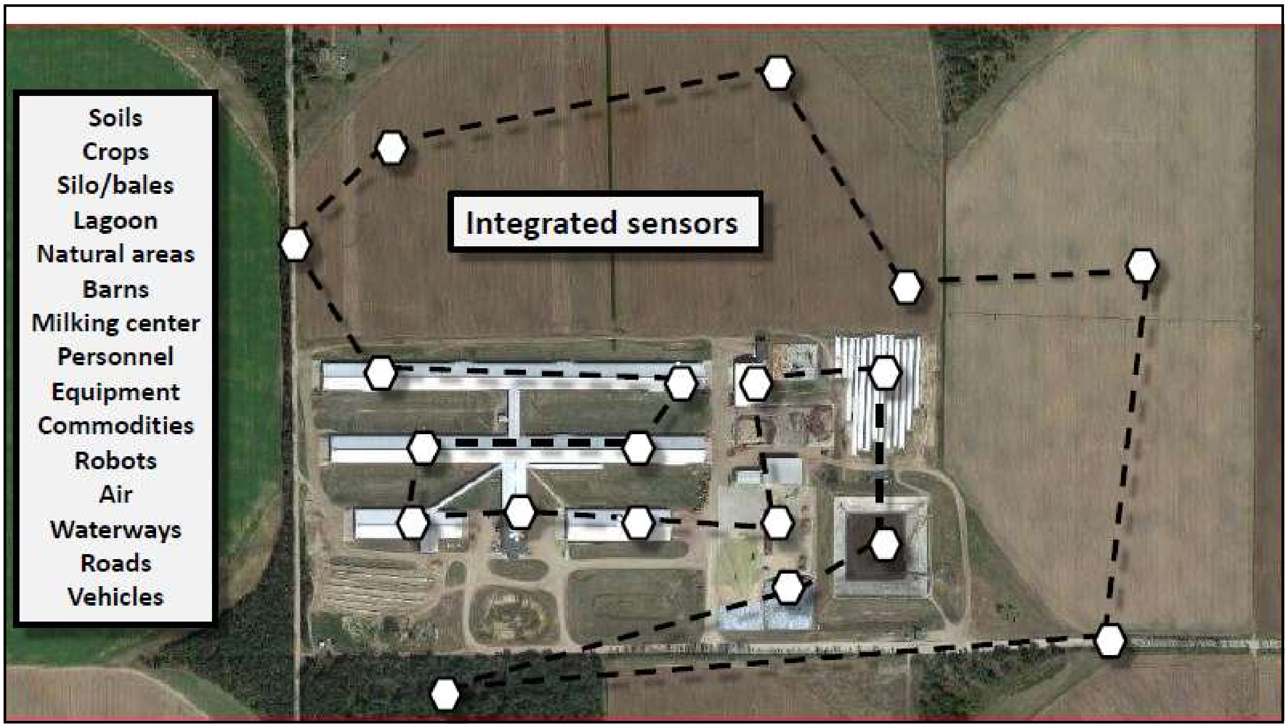
- Hormones Gone
- No OvSync, Co Sync, Double Whatever Sync

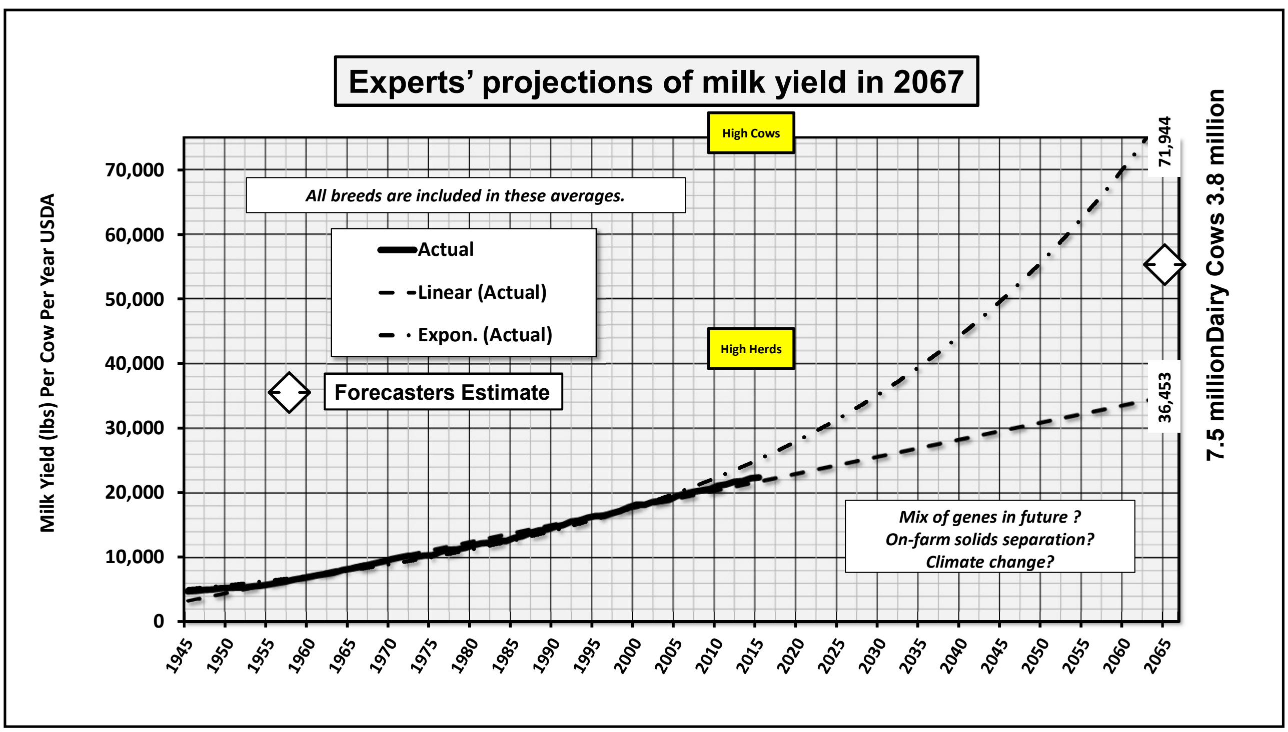
Genetics

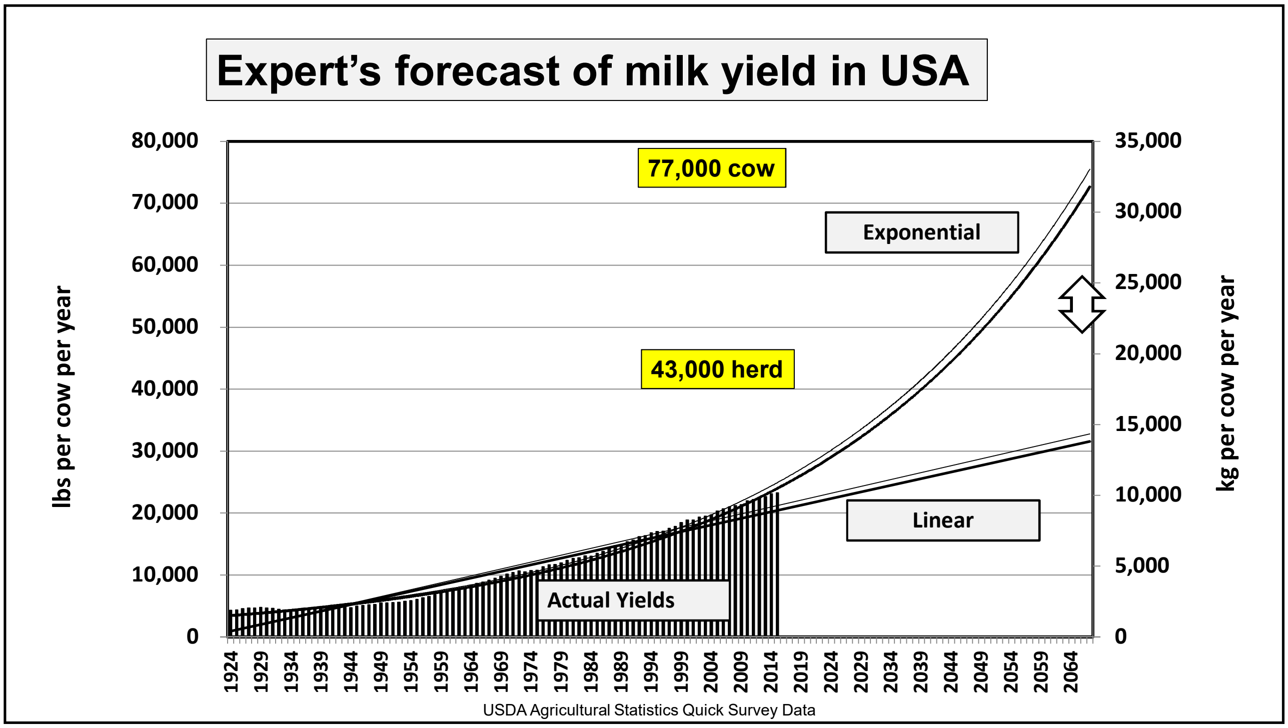


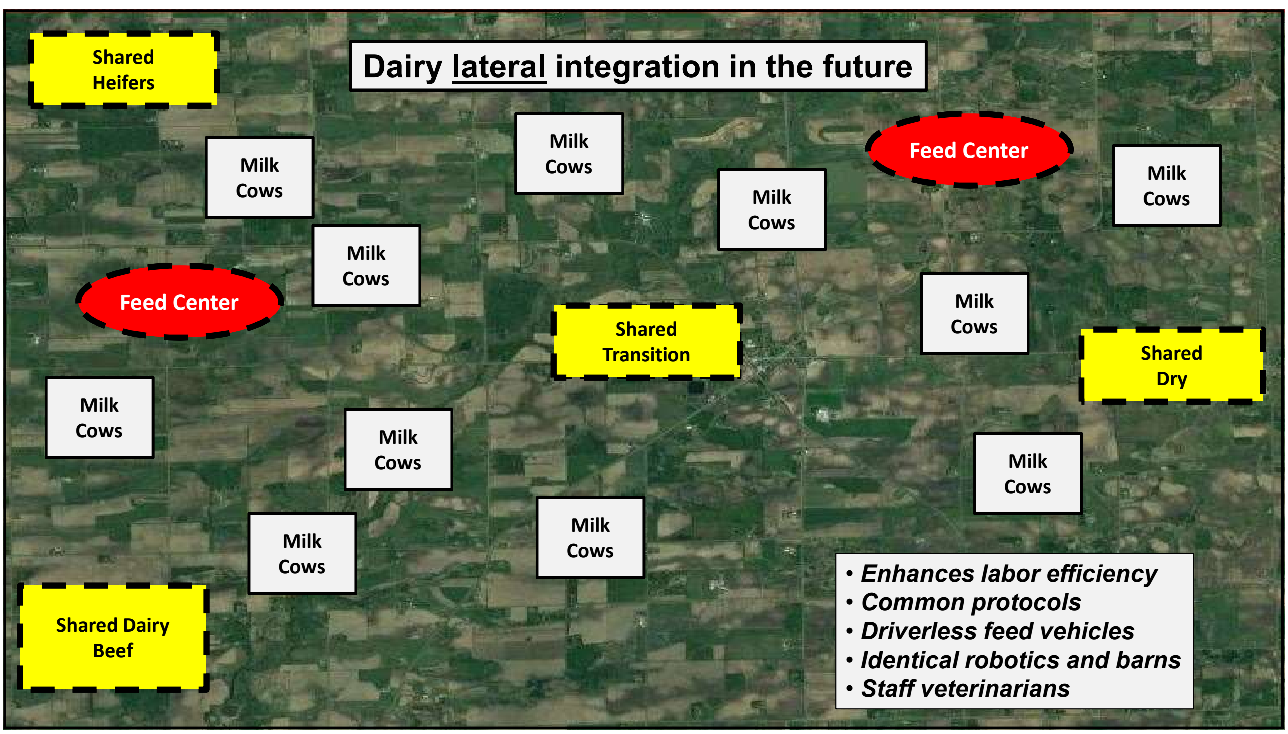
Future Farms


Typical US
Dairy Cluster
10,000 cows
3,500 Milk Cows 1-parlor
3,500 Milk Cows 1-parlor
3,500 Milk Cows 1-parlor
Shared Heifers
Shared Dry Cows
Drugs
Immune modulators
Antibiotics for culture positive
Improved vaccines
Precision therapies
Veterinary
On-farm veterinarian
Digital health monitoring
Feeds
Agro-ecology systems
Enhanced digestibility
(including lignin)
Regulatory
DNA-based animal ID
Approved & inspected
welfare plans
Genetics
Corporate suppliers
Primarily embryos
Marketing
Milk contracts
Water removed
Specialty milks
Product tracking
Research
On commercial farms
Shared university-based
discovery centers


Soils
Crops
Silo/bales
Lagoon
Natural areas
Barns
Milking center
Personnel
Equipment
Commodities
Robots
Air
Waterways
Roads
Vehicles
Integrated sensors

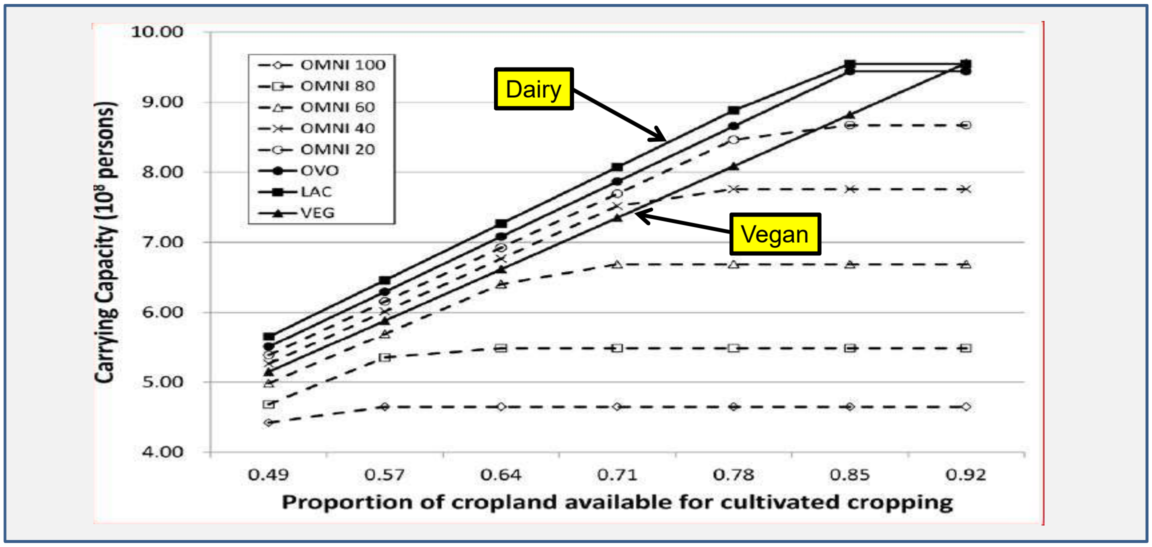

Experts' projections of milk yield in 2067
High Cows
High Herds
All breeds are included in these averages.
Actual
Linear (Actual)
Expon. (Actual)
Forecasters Estimate
Mix of genes in future ?
On-farm solids separation?
Climate change?
71,944
36,453
Milk Yield (lbs) Per Cow Per Year USDA
7.5 millionDairy Cows 3.8 million
70,000
60,000
50,000
40,000
30,000
20,000
10,000
0
1945
1950
1955
1960
1965
1970
1975
1980
1985
1990
1995
2000
2005
2010
2015
2020
2025
2030
2035
2040
2045
2050
2055
2060
2065


Expert's forecast of milk yield in USA
80,000
70,000
60,000
50,000
40,000
30,000
20,000
10,000
0
lbs per cow per year
35,000
30,000
25,000
20,000
15,000
10,000
5,000
0
kg per cow per year
77,000 cow
Exponential
43,000 herd
Linear
Actual Yields
1924 1929 1934 1939 1944 1949 1954 1959 1964 1969 1974 1979 1984 1989 1994 1999 2004 2009 2014 2019 2024 2029 2034 2039 2044 2049 2054 2059 2064
USDA Agricultural Statistics Quick Survey Data


Shared Heifers
Dairy lateral integration in the future
Milk Cows
Milk Cows
Feed Center
Milk Cows
Milk Cows
Milk Cows
Feed Center
Shared Transition
Milk Cows
Shared Dry
Milk Cows
Milk Cows
Milk Cows
Milk Cows
Milk Cows
Shared Dairy Beef
• Enhances labor efficiency
• Common protocols
• Driverless feed vehicles
• Identical robotics and barns
• Staff veterinarians

Which farms will survive?

Carrying capacity of USA agriculture is greatest with dairy!



Peters, Christian J., Jamie Picardy, Amelia F. Darrouzet-Nardi, Jennifer L. Wilkins, Timothy S. Griffin, Gary W. Fick. 2016. Carrying capacity of U.S. agricultural land: Ten diet scenarios. Elementa: Science of the Anthropocene • 4: 000116 • doi: 10.12952/journal.elementa.000116

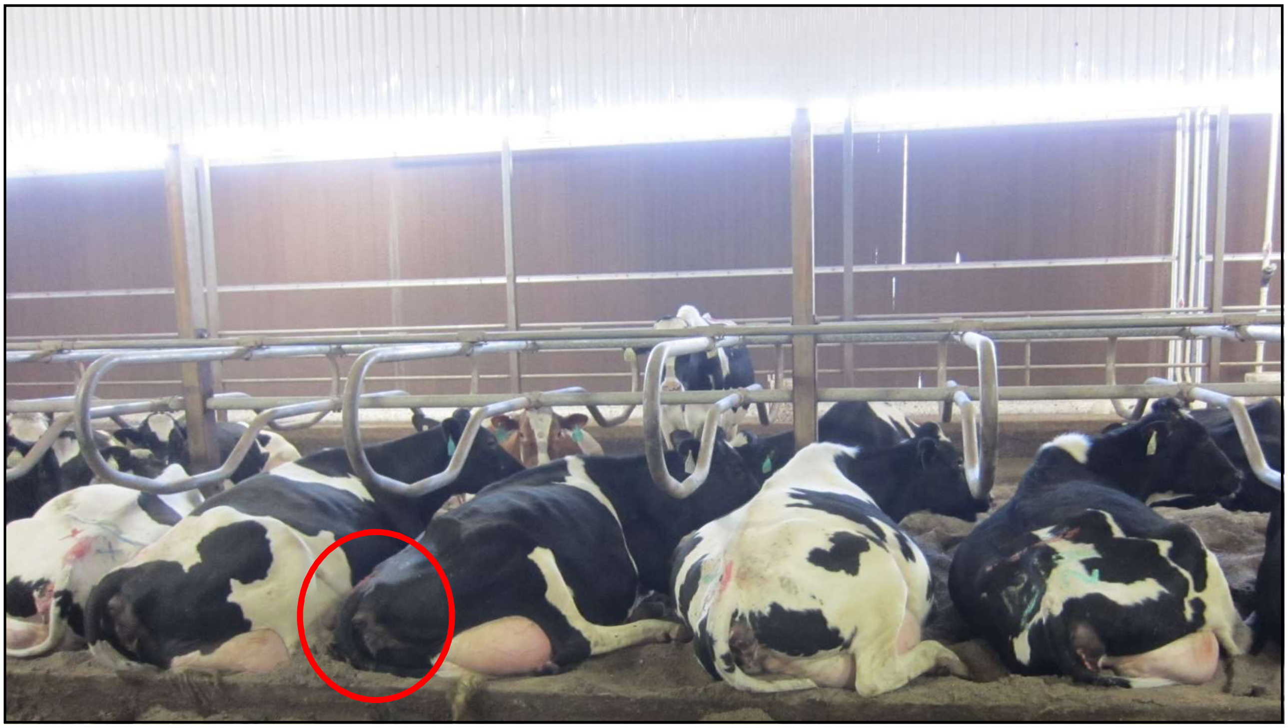
Dairy Companies & Consultants

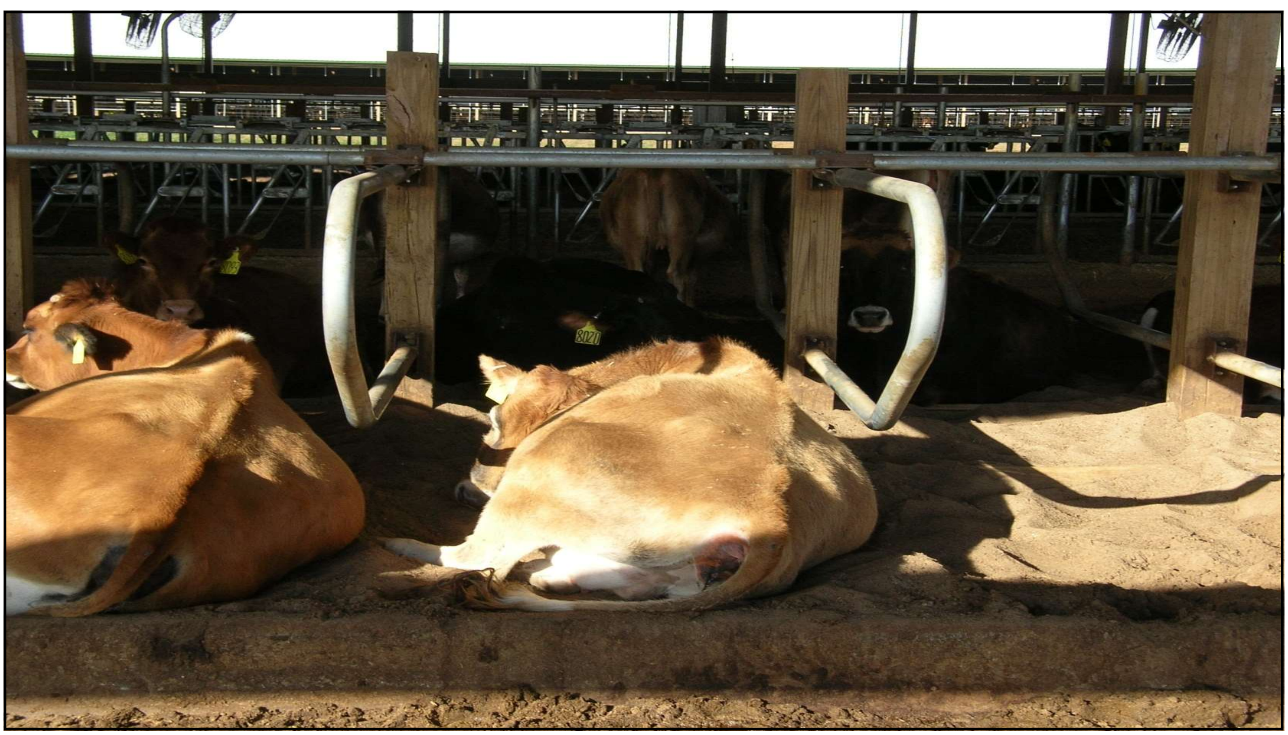
- Everyone wants to "Value Add" to my business
- First I do not care "what" you know
- Until I know that you care!
- And I need you to have "ownership"
- What ever solutions you have for my problems
- You need to have a belief that they work
- And that they fit my dairy or problem.

Cow Comfort is Universal

- Cow Comfort is independent of size


Freestall Pen
Head to Tail



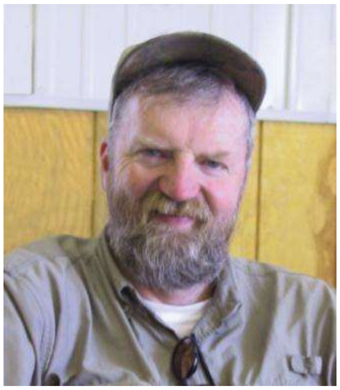


3 things a Cow Should Do!

- Stand to MILK
- Stand to EAT & DRINK
- LAY DOWN

" Milk is the Absence of stress!!!"

Questions? Thoughts?



Dr. Gordie Jones
Partner
Central Sands Dairy, LLC.

gordon.a.jones@att.net

Questions? Thoughts?

NOTES

The role of the modern dairy cow in improving the profitability of dairy production

GREG ANDERSEN

SEAGULL BAY DAIRY, INC. AMERICAN FALLS, IDAHO

Seagull Bay Dairy: American Falls, Idaho
Andersen Dairy: Declo, Idaho

One Herd on Two Sites

300 Holsteins 2,000 Crossbreds

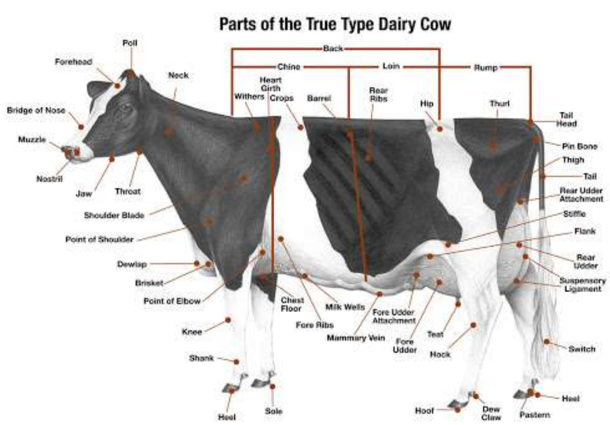
Some Elite Holsteins (Sell 50 bulls annually to AI)

Seagull Bay Dairy
- 600 milk cow (Fresh – 90 days)
- 160 close up cows/springers
- Baby calves up to 180 days

Andersen Dairy
- 1500 milk cows
- Far off dry cows
- Heifers 7 months and older

Seagull-Bay Supersire 7H11351
Ammon-Peachey Shauna “Global Cow”

How we used to do it



Corrective Matings based on "type" evaluations

Evaluation
- Classification by breed organizations
- Mating programs by AI companies

Results?
- Great improvement in Mammary System
- More attractive cows
- Taller cows
- TPI index gives heavy weight to PTAT
- TPI has been widely used as a selection tool for sires

Downside?
- Tall cows score higher
- Economic traits not necessarily correlated to Type traits

Dairy Shows Champions–
"Incredible- but not always practical"

What do dairy producers want?

Moderate Size

Healthy Cows

Athletic

High Components

Calving Ability

Fertility

Hardiness

High Production

Udder Health

7H6417 OMAN

Health and Wellness
Direct Selection > Indirect Selection

Health Traits in US: 1990's

Included in TPI and NM formulas

Daughter Pregnancy Rate etc.

Calving Ease

Somatic Cell Score

Productive Life

Livability *New*

Wellness Traits in US: 2015

Not yet included in TPI and NM

Zoetis, ABS, Genex, etc…

Metabolic Disease Resistence

Mastitis Resistance

Lameness

Metritis

Ketosis

DA

"Type is not the limiting factor…"

Lloyd Holtermann – Rosylane Holsteins WI

1000 Holsteins Watertown, Wisconsin

All Holsteins

Does not Classify

Type not used in selection criteria

Health is main component of Feed Efficiency

PL and Protein main traits for selection

1.68 Feed Efficiency in 2016

0 Milk Fever

0 Ketosis

36 Preg Rate

4% DOA

What does the "modern cow" look like?

Will color matter? Performance only?

Points to consider

How is your milk check calculated?

Management & Nutrition First

Use a selection index

Custom indexes are highly encouraged based on your own breeding needs

Focus on 4-5 key traits and avoid high negatives

Gender-sorted semen technology is improving

Consider choosing which cows and heifer will provide replacements

Every pregnancy has a purpose

Semen purchases are an investment and not an expense

Use the best sires for your plan from any breed you are using

Holstein Herds that have selected for PL and DPR have very good fertility and longevity

Body condition is very important to cow health and fertility

Modern dairy cows can achieve high production and maintain body condition

Hybrid vigor is real

Interim results from Procross study

Comparison of Montbeliarde × Holstein and Viking Red × Holstein crossbreds with pure Holstein cows during first lactation in 8 commercial dairies in Minnesota

https://www.ansci.umn.edu/sites/ansci.umn.edu/files/procross_final_f1_first_lactation-lb.pdf

Amy Hazel, Brad Heins, and Les Hansen University of Minnesota – Jan 2016

Table 1. Production (*actual* and not mature equivalent) during the first 305 days of first lactation for M×H and V×H crossbreds compared to pure HO cows.

Trait	Holstein	Montbeliarde × Holstein	Viking Red × Holstein
Number of cows	978	513	540
Age at calving (months)	23.9	23.8	23.7
Milk (lb)	24,185	24,150	23,229**
Fat (lb)	900	920	910
% Fat	3.74	3.83	3.93**
Protein (lb)	733	756**	740
% Protein	3.05	3.14**	3.19**
Fat + Protein (lb)	1,633	1,676*	1,651
Somatic cell score	2.1	2.2	2.1

* Significant difference ($P < 0.05$) from pure Holsteins.
** Significant difference ($P < 0.01$) from pure Holsteins.

Table 4. Fertility during first lactation for M×H and V×H crossbred cows compared to pure HO cows.

	Holstein		Montbeliarde × Holstein		Viking Red × Holstein	
Trait	n	Estimate	n	Estimate	n	Estimate
Days to first breeding	970	71	507	69*	539	70
First service conception rate (%)	948	38	499	43	528	47**
Overall conception rate (%)	950	38	499	46**	528	43†
Times bred (up to 5)	959	2.30	506	2.07**	537	2.15
Days open	901	125	480	113**	514	117*

n = Number of cows.
† Tendency for significant difference ($P < 0.10$) from pure Holsteins.
* Significant difference ($P < 0.05$) from pure Holsteins.
** Significant difference ($P < 0.01$) from pure Holsteins.

More results

Table 2. Twinning rate, gestation length, calving difficulty score (1-5 scale), and stillbirth rate during first lactation for M×H and V×H crossbreds compared to pure HO cows.

Trait	Holstein (HO service sire)	Montbeliarde × Holstein (VR service sire)	Viking Red × Holstein (MO service sire)
Number of cows	971	496	508
Twinning rate (%)	1.0	0.6	0.8
Number of cows	961	493	504
Gestation length (days)	276	279**	280**
Calving difficulty-All	1.5	1.6	1.7*
Calving difficulty-Females	1.4	1.4	1.3
Calving difficulty-Males	1.6	1.7	2.1**
Stillbirth rate-All (%)	9	4*	5†
Stillbirth rate-Females (%)	6	2*	3
Stillbirth rate-Males (%)	11	7	8

† Tendency for significant difference ($P < 0.10$) from pure Holsteins.
* Significant difference ($P < 0.05$) from pure Holsteins.
** Significant difference ($P < 0.01$) from pure Holsteins.

Table 5. Survival during first lactation for M×H and V×H crossbred cows compared to the pure HO cows.

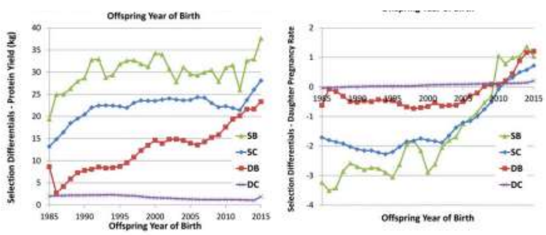
	Holstein		Montbeliarde × Holstein		Viking Red × Holstein	
Trait	n	Estimate	n	Estimate	n	Estimate
Survival to 60 DIM (%)	1033	96	536	96	560	97
2nd calving within 14 months (%)	1021	63	530	72**	552	70*
2nd calving within 17 months (%)	1021	76	529	83**	551	81†
Survival to 2nd calving (%)	1014	80	529	84	551	83

n = Number of cows.
† Tendency for significant difference ($P < 0.10$) from pure Holsteins.
* Significant difference ($P < 0.05$) from pure Holsteins.
** Significant difference ($P < 0.01$) from pure Holsteins.

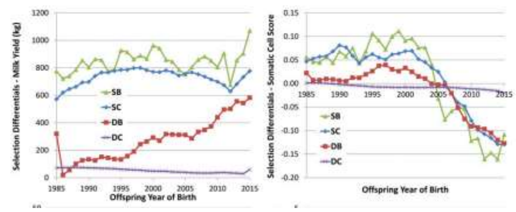
Holsteins improving in profitable traits

Changes in genetic selection differentials and generation intervals in US Holstein dairy cattle as a result of genomic selection 2016
http://www.pnas.org/content/113/28/E3995.full.pdf
Adriana García-Ruiza,b, John B. Coleb , Paul M. VanRadenb , George R. Wiggansb , Felipe J. Ruiz-Lópeza , and Curtis P. Van Tassellb

Protein Yield increasing and DPR increasing



Milk yield increasing SCS decreasing



Concluding thoughts

There is an impressive pool of sires from various dairy breeds

Holsteins have the largest pool

Disciplined selection within the Holstein breed has worked very well for many herds

Genomic selection has increased the rate of genetic advancement

Choose specifically and intensely for traits of most economic importance to your business

Consider selecting for Wellness Traits

WINSTAR GENETICS

"WinStar breeding will be primarily focused on high total merit index breed improvement. Cows with innate ability for high production coupled with adequate fitness and wellness traits are proven to outperform their peers of lesser genetic merit. Improved performance will lead to increased profit potential in well managed herds of all sizes."

NOTES

Thinking Outside the Box: One Panhandle Farm's Quest for Sustainability

Meghan E. Austin, DVM

People that make this work…

People that make this work…

Our Location

- Jackson County
  - Marianna, FL
- #1 county for row crop production
- Currently 3 dairies in county
- Population: 49,746
- Close proximity to Tallahassee & Gulf Coast

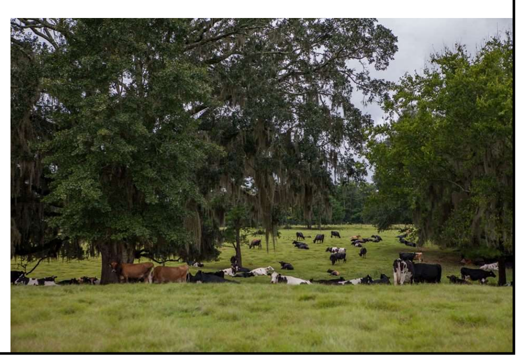
Background

- Cindale Farms: The beginning
  - Parents (Dale & Cindy Eade) have been in the dairy business for 37 years
  - Parents are ‘first-generation’ farmers
  - 1994 ‘A New Beginning’
    - Parents were minority owners in large dairy operation until 1994
    - Leased small facility in Cottondale
    - Initially all work done by family

cindale farms
MARIANNA , FLORIDA

Cindale Farms

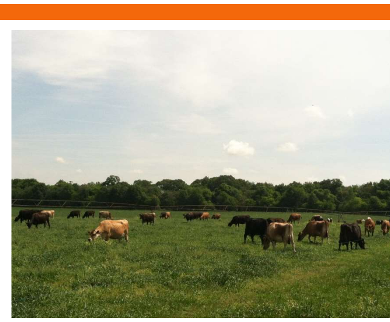
- The beginning
  - 1996
    - Moved to leased farm in Marianna
    - Grew herd & increased labor force
  - 2003
    - Purchased land and built current facility
    - 467 acres of pasture, hardwood forest, timber & wetlands



Cindale Farms

Cindale Farms

- The last 7 years
  - Brad and I returned in late 2009
    - Spent many good years at UF
  - Reinvigoration/fresh ideas
    - Focus more on grazing
    - Change genetic base of herd
    - Seasonal calving
    - Assist with goals of becoming more involved with local community
  - Management transition
    - 2009-2014: management responsibilities shared w/Dale & Cindy
    - August 2014: management responsibilities transitioned to Brad & I



Cindale Farms

- Farm Basics
  - 467 acres
    - Hybrid rotational grazing operation
    - 75 acres under center pivot
  - 550+ cattle
    - 300 milk cows (Jersey & Jersey-holstein crosses)
    - 250 youngstock

Cindale Farms

Cindale Farms

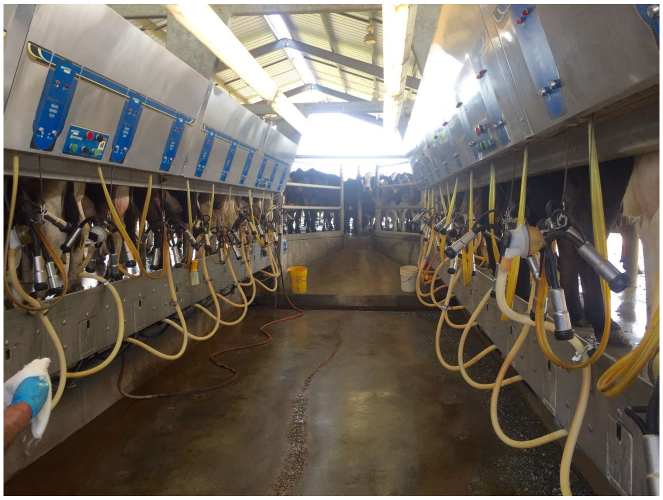
- Main barn
  - Double 12 parallel rapid exit parlor
  - Break room, storage, milk room & working facility
- Feed/cooling barn
  - External feed alleys
- Six bay commodity barn
- Two stage waste water management system
  - Partitioned concrete lined solid separator
  - Effluent lagoon

Cindale Farms

Cindale Farms

Cindale Farms

Cindale Farms



Cindale Farms

Cindale Farms

- Hybrid grazer
  - Feed a TMR
  - Able to rotationally graze the majority of the year to offset some purchased forage inputs
  - Purchase additional forages

Cindale Farms

- 75 acres under center pivot surrounding barns
  - Managed intensive rotational grazing
  - Perennial & annual pastures
  - Conservation tillage employed across farm
  - External fencing high tensile electric, cross fenced with polywire
  - Paddock sizes are varied depending upon forage availability

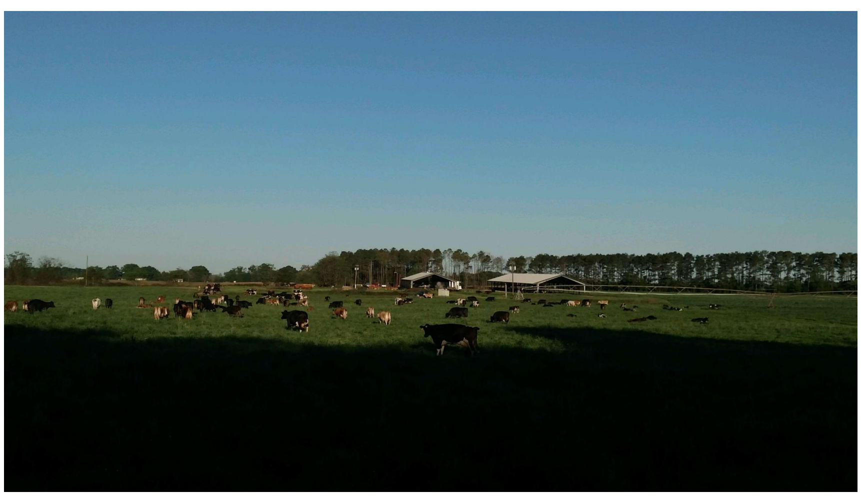
Cindale Farms

Cindale Farms

Cindale Farms

Cindale Farms

Cindale Farms



Cindale Farms

Cindale Farms

- Reproduction
  - Utilize both A.I. and natural service
    - A.I. on natural heats for month of January
    - Bulls in February-March
  - Seasonal
    - Main breeding season from January 1st to April 1st (calves kept)
    - Second season July 1st to Sept 1st (all calves sold)

Cindale Farms

- Calf raising
  - Seasonal (End of Sept-beginning January)
  - Housed in groups on grass paddocks based on age
  - Start in a 'training pen'
    - Tattooed and paste dehorned
    - 2-3 days
  - Constant access acidified milk
    - Receive 1.5-2 gallons milk/day
    - Acidify to pH 4.2-4.8
  - Wean at 8 weeks
    - Gradual weaning beginning at 6 weeks

Cindale Farms

Cindale Farms

Cindale Farms

Cindale Farms

- A vision for the future
  - Enhancing sustainability
    - Ability to support additional family units
    - Optimizing land use while enhancing environment
    - Establishing connection to local consumers/economy
  - Diversification
    - Preferred over linear expansion of dairy
    - Fit our goals/ideas for the future

- The birth of a new business: 'Thinking outside the box'

SOUTHERN
CRAFT
Creamery
Handcrafted ICE CREAM

Southern Craft Creamery

- The beginning
  - 2010-2011
    - Early brainstorming began
  - 2012
    - Lauren began perfecting our 'base' recipe
    - Marketing ideas came to fruition
    - Construction
  - 2013
    - First sales began in February

Southern Craft Creamery

- The last 4 years
  - 2013
    - Establishing a viable market
      - Building relationships
      - Wholesale to independent grocers & chef-owned restaurants
    - Selected as Overall Winner for Garden & Gun magazine's 'Fourth Annual Made in the South Awards'
    - Shipping headaches

GARDEN&GUN

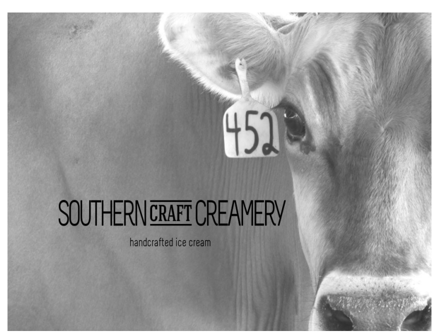
Southern Craft Creamery

- The last 4 years
  - 2014
    - Expand market
    - Expand production facility (twice)
    - Management transition
    - Recognized by the Florida Cabinet
    - Jackson County Agricultural Innovators
    - Featured in Food & Wine's blog
      - Top 7 holiday ice creams

Southern Craft Creamery

- The last 4 years
  - 2015-2016
    - Continued to expand market while maintaining quality
    - Purposeful slow growth
    - Featured in Southern Living Magazine
      - 2015 Food Award Winner
      - 2016 Food Award Winner

Southern Living



Southern Craft Creamery

- What's in store for 2017…
  - Doubling production capacity
  - Continued expansion of market
  - Expansion into retail

Southern Craft Creamery

- Creamery basics
  - Handcrafted, artisanal ice cream
  - Small batch
  - Non-homogenized
  - Local sourced ingredients from producers
  - Sales in over 38 locations

Handcrafted ICE CREAM
Marianna, FL

Southern Craft Creamery

Southern Craft Creamery

Southern Craft Creamery

Southern Craft Creamery

Southern Craft Creamery

Southern Craft Creamery

Cindale Farms & Southern Craft Creamery

- A vision for the future
  - Cindale Farms
    - Continued diversification
    - Enhanced utilization of fresh, local milk
  - Southern Craft Creamery
    - Continued market expansion while staying true to vision
    - Product diversification
    - Venture into retail

Cindale Farms & Southern Craft Creamery

- A vision for the future
  - Enhancing sustainability
    - Continue to support additional family units
    - Optimize land use while enhancing/preserving environment
    - Enhancing connection to local consumers/economy

Dairy Industry: Opportunities & Challenges

- Looking back to when we were looking ahead
  - Six years ago our family had a serious conversation about our future
  - Agreed that 'small farms' would be obsolete in 10 years
    - This seems to have been fast-forwarded
  - Our vision had to fit our goals and desires as both a family unit and profitable business enterprise

Dairy Industry: Opportunities & Challenges

- We must all challenge ourselves to think 'outside the box' if we want to continue to dairy
  - We are obviously all very good at producing high volumes of milk, but if we continue to do so in the face of decreasing demand, where will the majority of us be in 20, 10 or even 5 years?

Dairy Industry: Opportunities & Challenges

- We don't farm like we did 30 years ago, so why do we continue to sell milk the same way?
  - "The art of life is a constant readjustment to our surroundings." –Kakuzo Okakaura
  - "The price of doing the same old thing is far higher than the price of change." –Bill Clinton
  - "Adapt or perish, now as ever, is nature's inexorable imperative." –H.G. Wells

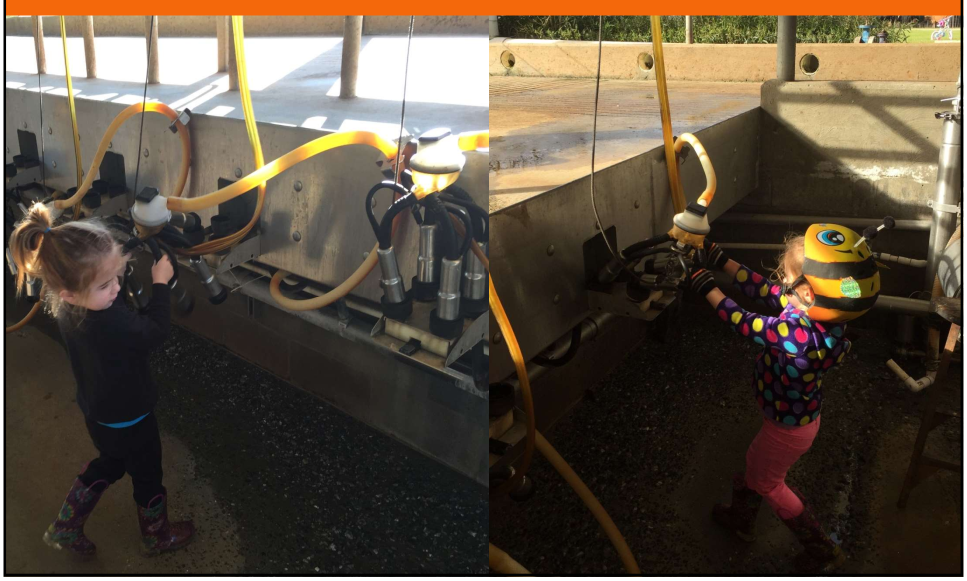
Dairy Industry: Opportunities & Challenges

- We have to be innovative and continue to challenge the 'norm' on the dairy aisle and on the dairy farm
  - Beginning to see progress in this area…need more
  - Opportunity for farms of all sizes
- We need to get out of our 'comfort' zone
- How do we accomplish?
  - By thinking 'outside the box'
  - By having meaningful, open, transparent conversations with consumers

Dairy Industry: Opportunities & Challenges

- Today’s consumer (for the most part) wants to know where their food comes from, how it is produced & why ‘we’ do what ‘we’ do.
  - Let’s use this to our advantage!

Don’t be afraid to try something new…



Thank You!

NOTES

PRODUCER PANEL

SUMMARIES OF SOUTHEAST MILK CHECK-OFF PROJECTS FUNDED IN 2015

Improving calving rates in dairy cows by infusion of seminal proteins at AI

John J. Bromfield, Laila Ibrahim, Peter J. Hansen and Cliff Lamb
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Seminal plasma is the cell free fluid that transports sperm cells into the female reproductive tract at insemination. However, during AI seminal plasma is either removed or significantly diluted to facilitate an increased number of insemination from a single ejaculate, one ejaculate is enough to provide for 300 breedings. Previous work in our laboratory has shown the benefits of uterine seminal plasma exposure in promoting healthy pregnancy outcomes by increasing embryo development and changing the maternal immune system during early pregnancy. We hypothesize that exposure of uterine tissues to seminal plasma at the time of AI in cows promotes cellular changes that increase pregnancy success. In addition, we aim to identify the active proteins in seminal plasma that induce these changes and supplement them back into semen for AI.

Using an explant model of isolated endometrium (the lining of the uterus) we have demonstrated that seminal plasma does indeed drive acute changes in the expression of key molecules important in early embryo development. We observed significant time and dose dependent increases in the expression of *CSF2*, *PTGS* and *IFNε* in response to seminal plasma (15-, 5- and 10-fold, respectively). Upregulation of these molecules in the uterus at the time of AI may help establish healthy embryonic development, and subsequently improve pregnancy outcomes.

Investigations in women, pigs and mice suggest that the seminal plasma protein TGFβ is integral in initiating the changes in uterine protein expression that may assist in embryo development. As such we profiled semen for TGFβ content in 33 bulls. Interestingly we identified two isoforms of TGFβ in bovine seminal plasma. Seminal plasma TGFβ-1 was measured at very high concentrations with an average concertation of 7108 ±1553 pg/ml (range of 156 - 33,311 pg/ml). Seminal plasma TGFβ-2 was measured at an average concertation of 6067 ± 1157 pg/ml (range of 0 - 27,358 pg/ml). The wide variation of both TGFβ isoforms between bulls may be a source of variable pregnancy rates observed in bulls at different locations or different times of year. It has been suggested that diet, environment and stress can all modulate TGFβ expression in biological fluids.

The preliminary studies discussed here are the first to describe the presence of TGFβ in bull semen and the role in which it can modulate the uterine environment at the time of insemination to potentially improve embryo quality. We have recently completed an experiment where we have infused seminal plasma into cows at the time of AI to identify specific changes in the uterus in a whole animal model. The fact that seminal plasma proteins are lacking, or significantly diluted during AI provides a unique opportunity to improve AI pregnancy success.

Improving efficiency of microbial growth in order to reduce protein feed costs for cows

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Objectives: The majority of protein metabolized by the cow comes from microbes growing in the rumen, but microbes use as little as 1/3 cellular energy (ATP) on growth. If we could elucidate why microbes grow so wastefully, we could increase microbial protein supply to the cow and decrease need for expensive feed protein. We know that microbes waste energy on storing energy inefficiently (synthesizing reserve carbohydrate) and burning off excess energy as heat (energy spilling), but we do not know the relative importance of these energy sinks. The objective of this study was to compare how protozoa and bacteria, two major microbial groups in the rumen, waste energy on reserve carbohydrate synthesis vs. energy spilling when given excess energy (glucose).

Methods: Rumen fluid was collected from one of two cows, and bacteria and protozoa were prepared by filtration and centrifugation. Microbial groups were resuspended in nitrogen-free buffer (to limit growth), transferred to anaerobic flasks, and then given a large dose of glucose (5 mM). Glucose, reserve carbohydrate, and total heat production were monitored after dosing glucose. Energy spilling was calculated as heat not accounted by synthesis of reserve carbohydrate or endogenous metabolism (heat production prior to dosing glucose). Experiments were repeated six times per microbial group.

Results: Protozoa consumed glucose rapidly (within 50 min) and synthesized large amounts of reserve carbohydrate, with over half of glucose carbon (53%) being directed towards this carbohydrate. They did not spill energy, as all heat production (104%) was accounted by reserve carbohydrate and endogenous metabolism. Bacteria, by contrast, consumed glucose more slowly (¼ the rate of protozoa). They synthesized only half as much reserve carbohydrate as protozoa. Instead, bacteria spilled large amounts of energy, with spilling accounting for >50% of heat production once glucose was exhausted.

Conclusions: Both protozoa and bacteria can waste energy from excess glucose, with protozoa doing so by synthesizing reserve carbohydrate and bacteria largely by spilling energy.

Implications: These results could guide feeding strategies that decrease energy waste by microbes, increase microbial protein supply, and decrease feed protein. Specifically, results could improve prediction of microbial protein supply by diet formulation software, which in turn would guide those strategies. Diet formulation software, such as the Cornell Net Carbohydrate and Protein System (CNCPS), predicts microbial protein supply but imperfectly, owing to poor representation for how microbes waste energy on reserve carbohydrate and energy spilling. Our results will improve this representation, improve prediction of microbial protein supply, enable software to formulate diets that maximize microbial protein, and reduce expensive feed protein.

GENETIC AND NON-GENETIC EFFECTS ON MATERNAL ABILITY TO SUPPORT EMBRYONIC SURVIVAL AND MODIFY SUBSEQUENT PERFORMANCE OF THE OFFSPRING

Peter J. Hansen, Serdal Dikmen, Raluca Mateescu, and John B. Cole

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Objectives

We analyzed a unique dataset of embryo transfer recipients and their calves from a local dairy in north Florida to achieve two goals:

1) Identify genetic markers for ability of cows to produce embryos, of cows to become pregnant after embryo transfer, and of the embryos to establish pregnancy after transfer to recipients
2) Determine whether embryo transfer and parity have effects on the offspring that affect its subsequent production when it becomes an adult.

Genetic markers for embryo transfer. Reproductive technologies such as superovulation and embryo transfer allow superior females to produce many more offspring than in traditional breeding programs. In addition to high cost, these technologies are also associated with variable animal response. Heritability of number of structures recovered and number of good embryos for superovulation were moderate (0.27 and 0.15, respectively). Values for number of good embryos from in vitro fertilization (IVF) were 0.21. Thus, there is genetic variation in embryo production in both systems. In contrast, the heritability of recipient (0.03) and embryo (0.02) pregnancy success after transfer were low. A genome wide association study was performed to identify regions of the genome associated with embryo production traits. Several regions were identified including several similar to regions previously associated with other fertility traits. These regions might be useful in increasing accuracy of genetic selection for reproduction.

Postnatal function as affected by embryo technology and maternal parity during gestation. This study tested the hypothesis that postnatal function of cattle is influenced by the environment experienced by the developing embryo and fetus during gestation. Accordingly, we evaluated survival, growth, and production traits of offspring derived by IVF, multiple ovulation and embryo transfer (MOET), and artificial insemination (AI). IVF calves were born heavier and had an altered growth trajectory compared to AI calves, in addition to having higher mortality rates during the first six months of age. Traits of MOET offspring were intermediate and not different from AI or IVF. Moreover, the altered phenotype of IVF offspring extended to adult milk production. Cows derived by IVF produced less milk and fat in their first lactation compared with dairy cows derived by AI. Additionally, females born to heifers had a distinct postnatal phenotype compared with offspring from cows. In conclusion, we provide evidence that the microenvironment of the embryo and fetus can affect development in ways that have an impact on adult performance. Some benefits of IVF in livestock for genetic improvement could be offset in certain circumstances by adverse programming events.

Promoting testing and surveillance for bovine viral diarrhea virus in Florida and Georgia Dairy herds using bulk tank milk samples

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Funding to support this research was provided through the Florida Milk Checkoff program**,** May 1, 2015

Disease caused by bovine viral diarrhea virus (BVD) produces significant economic loss to the dairy industry. Studies have shown a BVD outbreak in a lactating herd can cost $35 to $410 per lactating cow depending on the severity of the disease. Diseases observed in infected herds include: reproductive failure (failure to conceive, embryonic loss, abortion, congenital defects and stillborn or weak, unthrifty calves) and respiratory disease and diarrhea in young calves. The effect of BVD infection on the developing fetus varies depending on the stage of pregnancy. Exposure of the fetus to the non-cytopathic BVD biotype prior to 125 days of gestation can result in the development of a persistently infected (PI) calf. PI calves shed large numbers of the virus throughout their lifetime and continually expose other cattle to the virus. Management practices to control the disease include vaccination of all members of the herd, biosecurity procedures to prevent introduction, bio-containment to interrupt the spread of the virus and laboratory testing of samples for the presence of the virus in a herd, with the final goal of identifying and removing PI animals from the herd.

A polymerase chain reaction (PCR) assay to detect BVD antigen has been validated for use in bulk milk samples (Idexx VetMAX™ Gold BVDv Detection Kit). This test has been shown to be highly sensitive and can consistently detect a single PI cow in a group of up to 800 lactating dairy cows. Samples from each truckload of milk from 39 dairies in GA and 39 in FL delivered to Southeast Milk, Inc. laboratories in Belleview or Okeechobee, FL were collected by SMI employees and shipped to the TVDIL for testing over a 6 month period. Somatic cells were collected from the milk samples and BVD RNA was extracted.

The cumulative incidence of BVD 38.4% [14/39 (35.9%) farms in FL and 16/39 (41%) farms in GA had at least one positive test during the 6 month period]. A follow up survey asking dairy owners or managers about their management practices was sent to all the dairies tested. Twenty one surveys were returned (13 from BVD negative herds and 8 from positive herds). Surveys included questions about replacement management or source, vaccination practices, degree of veterinary involvement and owner knowledge about BVD. Responses from positive and negative dairies were compared using Fisher's Exact statistical test. Overall, 95% of farmers had some knowledge about BVD. Management activities such as purchasing or raising replacement heifers, vaccination programs and vaccines used, BVD testing, etc. were not significantly different between farms with a positive or negative BVD test. However, negative BVD farms were more likely to have consulted a veterinarian on a weekly or monthly basis than BVD positive farms (81.8% vs 14.3% respectively; $P=0.033$).

These results indicate a whole herd BVD testing plan may be warranted in some herds. BVD is likely causing health and reproductive problems.

Evaluating new sensor technologies and breeding lines for mitigating forage yield decline

Cheryl Mackowiak and Ann Blount: NFREC, Quincy Florida

Field and crop surveying (sensor-based) technologies are being developed to better assess crop health from plant- to field-scale. The Veris® on-the-go sensor technology provides a platform to collect real-time soil electrical conductivity (EC), pH, and organic matter measurements comprised of hundreds or more samples per acre (significantly greater than is typically performed with grid sampling). Additionally, spectral imaging sensors can detect canopy visible and near visible radiation to calculate a Normalized Difference Vegetation Index (NDVI for estimating crop productivity) or thermal radiation, used to detect crop development and stress. Canopy sensors can be used on the ground or via drones. The NDVI can also be calculated from satellite imagery. The potential production benefits derived from these technologies have yet to be realized or demonstrated across many commodities or production systems. We soil mapped sections of fields at three different dairies across Florida. The question was: Can we use soil mapping and other data collections, such as canopy sensing via hand-held or aerial methods, to aid in forecasting crop productivity in cool-season forages?

Our project began in late fall, 2015, with cool-season forage plantings at three Florida dairies. We tested commercial varieties and experimental lines of triticale, oat, wheat, rye and ryegrass. We included N calibration test strips (56 kg N ha^{-1} in a 6 m wide band across the forage types), used for the canopy sensing. Additionally, a quinine-based, bird-repellent seed treatment (Avipel, Arkion Life Sciences, LLC., New Castle, DE), was demonstrated. Bird damage, particularly on central and southern Florida dairy operations, remains a serious problem to silage seed plantings.

The Veris MSP3 EC mapping helped forecast crop response, where greater relative yields tended to correspond to higher EC values. It is interesting to note that the lowest EC values also coincided well with lighter colored areas depicted in online Google Earth maps. These lighter colored swaths were likely derived from spatial variability in pivot emitter performance over time. Soil pH helped to identify where alkalinity was increasing. The soil organic matter was not as well understood, as it tended to be greater in areas with greater EC, but not always.

Aerial thermal imagery coincided with the NDVI results in that cooler temps were found with forages that were less mature or having greater coverage and growth. Cooler canopy temperatures were likely due to increased canopy transpiration. However, high transpiration rates might also be a sign that a plant is less water efficient and therefore one might consider thermal imagery as a useful field screening tool in drought tolerance research and breeding. A combination of imaging and mapping tools, along with strategic sampling, can be used towards developing productivity indices, but much further research and testing is required in this area.

Our on-dairy mapping and surveying efforts coincided with the testing of different cool-season grass forages over the past few years. Recent releases include rust resistant forage oat varieties, “Legend 567” and “FL 0720” that is under commercial production contract (available Fall, 2017). We are anticipating the release of a new forage triticale, FL08128 for cool-season silage production and excellent disease resistance. The on-farm testing has served also as sentinel plots to indicate new disease or insect outbreaks, like sorghum and oat aphids, crown rust on oat, and gray leaf spot on ryegrass.

Title: A High Manure Uptake Bermudagrass/Stargrass for Dairy Production

Authors: P.R. Munoz, J. Dubeux, and L. Sollenberger

Agronomy Department - IFAS - University of Florida

Objectives

In the process of developing new forage cultivars, selection is carried out under recommended or reduced fertilizer rates to produce nutrient efficient cultivars. However, in dairy operations, each cow generates significant amounts of manure every day that must be used or disposed. Usually dairy producers apply this manure in bermudagrass and stargrass pastures. This takes advantage of manure as a fertilizer but is also a way to dispose of this large amount of "waste." The amount applied is restricted by the Nutrient Management Plan (NMP) to the amount of nutrients, especially nitrogen, removed by the pasture. The objective of this work was to develop a new variety of bermudagrass aimed at the problem of nutrient uptake, thus the new variety should not only yield well, but also be able to remove more nutrients than the current varieties. With this new variety the dairy producer could increase the manure applications per acre per year in their NMP.

Methods

Starting in early summer 2014, we established a large collection of 287 bermudagrass and stargrass lines in three Florida sites: Ona, Citra, and Marianna. This collection was evaluated for yield, diseases, pest and nitrogen content. We calculated the amount of nitrogen needed for unit of biomass produced and selected the four with the higher nutrient uptake per unit of mass and three with the lowest, with the addition of two controls (Florida 44 and Tifton 85). A greenhouse experiment with increased levels of nutrients was established. Once the response of the selections was confirmed we established a field experiment, summer 2015, under four nutrient fertilization rates: 1/2X, 1X, 2X, and 6X, where X=recommended fertilization for hay production of bermudagrass. Yield was evaluated six times during in 2016, the first year of evaluation.

Results and Implications

Out of the seven selections six produced more biomass than the controls. Response to nutrient fertilization was observed in four of the selections, with higher biomass production usually achieved when fertilized with 2X. Three of the selections showed good efficiency potential with production of a similar amount of biomass with1/2X as with higher nutrient rates. One selection performed the best under low and high nutrient fertilization rates, reaching over 22,000 lb/acre during the season. As a reference, the control Tifton 85 produced an average of 15,000 lb/acre and did not respond significantly to nitrogen fertilization. These experimental lines will be established at three Florida sites during 2017, evaluated under low and high nutrient fertilization for two years to collect the data needed for release to Florida producers as cultivars. Additionally, one or two collaborators would be needed to evaluate their performance under manure applications. With this procedure we expect to have an improved cultivar for Florida dairy producers in the near future.

Effects of dietary 25-hydroxyvitamin D on activation of antimicrobial defenses of dairy cattle

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Previous research funded by the Milk Check-Off showed that intramammary administration of the active vitamin D metabolite, 1,25-dihydroxyvitamin D_3, enhanced expression of antimicrobial genes in immune cells of the udder. Objectives in this experiment were to determine the effects of feeding supplemental 25-hydroxyvitamin D_3, the precursor to 1,25-dihydroxyvitamin D_3, compared with conventional vitamin D_3 on concentrations of 25-hydroxyvitamin D and minerals in serum, mammary immunity, and mastitis resistance in dairy cows. Sixty Holstein cows (multiparous, pregnant, lactating, SCC < 165,000/mL) were blocked by milk yield and, within each block, randomly assigned to receive a daily dietary supplement containing 1 mg vitamin D_3 (**1mgD,** equivalent to 40,000 IU), 3 mg vitamin D_3 (**3mgD**), 1 mg 25-hydroxyvitamin D_3 (**1mg25D**), or 3 mg 25-hydroxyvitamin D_3 (**3mg25D**) for 28 days (n = 15/group). Blood and milk were sampled at 0, 7, 14, and 21 d for measurement of vitamin D metabolites, minerals, and energy metabolites in serum. At 21 d, cows fed 1mgD and 3mg25D received an intramammary *Streptococcus uberis* challenge. Data were analyzed by analysis of variance. Significance was declared at $P < 0.05$. The cows fed the 1mg25D and 3mg25D treatments had greater concentrations of 25-hydroxyvitamin D in serum at 7, 14 and 21 d compared with cows fed 1mgD and 3mgD treatments (62 ± 7, 66 ± 8 ng/mL, 135 ± 15, and 232 ± 26 ng/mL for 1mgD, 3mgD, 1mg25D, and 3mg25D, respectively, at 21 d). The 3mg25D cows had greater concentrations of calcium and phosphorous at 21 d compared with other treatments (Ca = 2.38, 2.4, 2.37, 2.48 ± 0.02 m*M*; P = 1.69, 1.87, 1.88 and 2.10 ± 0.08 m*M* for 1mgD, 3mgD, 1mg25D and 3mg25D, respectively). Milk yield, dry matter intake, bodyweight, and energy metabolites (NEFA, BHBA, glucose) did not differ between treatments. Expression of inducible nitric oxide synthase and beta-defensin 7 antimicrobial protein genes in milk somatic cells sampled from 0 to 21 d was positively correlated with concentrations of 25-hydroxyvitamin D in serum. For the mastitis challenge, the 3mg25D cows had less severe mastitis at 60 and 72 h after challenge with *Streptococcus uberis* compared with 1mgD cows. The 3mg25D cows also had slightly lower ($P = 0.06$) rectal temperature compared with 1mgD cows during the challenge period (38.9 vs. 39.1 ^{o}C). Inducible nitric oxide synthase gene expression, when adjusted for vitamin D 1α-hydroxylase gene expression, was greater in 3mg25D cows compared with 1mgD cows during mastitis. In conclusion, feeding 25-hydroxyvitmain D_3 increased serum 25-hydroxyvitamin D more effectively than supplemental vitamin D_3, resulting in increased serum calcium and phosphorous concentrations and less severe mastitis in lactating dairy cows.

Effect of Level of Dietary Cation-Anion Difference and Duration of Prepartum Feeding on Calcium and Energy Metabolism in Transition Cows

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The objectives were to evaluate the effects of two levels of negative dietary cation anion difference (**DCAD**), -70 vs. -180 mEq/kg, and two durations of feeding, 21 vs. 42 days, on performance and metabolism in parous Holstein cows. One-hundred and fourteen (n = 114) Holstein cows at 230 d of gestation were randomly assigned to one of four treatments with two levels of negative DCAD (-70 vs. -180 mEq/kg) and two durations (**Dur**) of feeding the negative DCAD, short (**S**; 21 days) or long (**L**; 42 days). Cows in S received a diet for the first 21 days of dry period that was similar in nutrient content to the negative DCAD diets, but had a positive DCAD of +110 mEq/kg. Therefore, during the first 21 d of the experiment, cows were fed one of three DCAD diets, +110, -70, or -180 mEq/kg, whereas during the last 21 d of gestation they were fed either -70 or -180 mEq/kg. Measurements included intake of dry matter, yields of milk and milk components, body weight, body condition, and blood samples analyzed for minerals, metabolites and measures of acid-base status. Reducing the level of negative DCAD induced a more exacerbated compensated metabolic acidosis that increased concentrations of ionized calcium (**iCa**) during the prepartum period (1.26 vs. 1.29 ± 0.01 m*M*). Prepartum dry matter intake decreased (P=0.02) approximately 1.2 kg/d in the first 21 days of the dry period in L compared with S. Also, reducing the level of negative DCAD reduced (P<0.01) dry matter intake approximately 1 kg/d in the last 21 days of gestation. Yield and composition of colostrum was not influenced by treatments (means of 4.2 kg, 4.60% fat, and 12.4% true protein). Extending the period of feeding the negative DCAD, particularly the -70 mEq/kg, reduced milk yield in the first 42 DIM (**Table 1**); however, yields of 3.5% fat-corrected milk (**FCM**), energy-corrected milk (**ECM**), fat and true protein were unaffected by treatments.

Table 1. Effect of level of DCAD and duration of feeding on lactation performance in Holstein cows

	Treatment							
	-70 mEq/kg		-180 mEq/kg			P-value		
Item	Short	Long	Short	Long	SEM	DCAD	Dur	DCAD x Dur
Milk, kg/d	43.1[a]	39.1[b]	41.7	41.1	1.1	0.79	0.04	0.13
3.5% FCM, kg/d	46.7	43.9	46.0	45.8	1.3	0.63	0.23	0.31
ECM, kg/d	45.2	42.4	44.5	44.3	1.2	0.62	0.21	0.30
Yield, kg/d								
Fat	1.73	1.66	1.73	1.73	0.06	0.57	0.52	0.51
Protein	1.27	1.18	1.25	1.24	0.04	0.64	0.18	0.30
Lactose	2.00[a]	1.82[b]	1.94	1.91	0.06	0.78	0.05	0.19
Solids not fat	3.64[A]	3.34[B]	3.55	3.50	0.10	0.72	0.08	0.22
Net energy, Mcal/kg	0.731[A]	0.757[B]	0.748	0.753	0.009	0.50	0.10	0.26

[a,b] Values with different superscripts differed ($P \leq 0.05$); [A,B] Values with different superscripts

Initial results suggest that reducing the negative DCAD from -70 to -180 and extending the period of feeding from 21 to 42 days had minor effects on cows during the postpartum period. In fact, yields of 3.5% FCM, ECM and milk components were unaffected by treatment.

Title: Jiggs Bermudagrass and Mulato II Brachiariagrass: Are They Viable Options for Use on North Florida/South Georgia Dairies?

Authors: Lynn Sollenberger (Agronomy Dept.), Joe Vendramini (Range Cattle REC), Marta Kohmann (Agronomy Dept.), Leonardo Moreno (Agronomy Dept.), and Jose Dubeux (North Florida REC)

Abstract:

Productive and high quality forages are critical to the success of dairy operations, but the combination of high yield and excellent quality has been difficult to find among warm-season perennial grasses adapted to the Gulf Coast region. Mulato II brachiariagrass and Jiggs bermudagrass have characteristics that make them attractive to dairy enterprises, but additional research station and on-farm evaluation is needed before they can be recommended to producers. Jiggs bermudagrass establishes rapidly, has fine stems for rapid wilting/drying, is persistent under frequent defoliation, and tolerates poorly drained soils. Mulato II is a productive grass with high nutritive value, but persistence in cooler climates is not documented. For both grasses, it is important to know if they provide advantages over currently used hybrid bermudagrasses in North Florida/South Georgia, environments that are cooler than where they have been most widely tested and used.

The objective of this project was to assess the potential of Jiggs and Mulato II for use as warm-season forages on dairies by measuring yield, persistence, and nutritive value in research station experiments and on-farm demonstrations carried out at three dairies. At each dairy, Jiggs and Tifton 85 bermudagrasses and Mulato II brachiariagrass were planted in side-by-side 0.5-acre strips between July 24 and August 6, 2014. Establishment was monitored during the 2014 growing season. On-station, one experiment compared Jiggs and Tifton 85 bermuda-grasses, harvested every 28 days during summer at two stubble heights (3 and 6 inches) and fertilized at three levels of K_2O (0, 20, and 40 lb/acre/harvest). The second experiment compared Jiggs and Mulato II harvested every 28 days and fertilized at two nitrogen rates.

The on-farm demonstrations showed that under producer conditions Jiggs bermudagrass consistently established easier and faster than Tifton 85 or Mulato II. Through two years, on-station experiments showed no evidence that Jiggs is less cold tolerant than Tifton 85 in North Florida, but Jiggs forage is less digestible than Tifton 85 and Mulato II. Mulato II stands survived the first winter after planting with virtually no stand loss and produced higher yields than Tifton 85 in the year after planting due to strong late-season production. However, an average to slightly colder than average second winter killed most of the Mulato II stand indicating that it will not function as a long-lived perennial in North Florida. Based on these studies, we conclude that Jiggs provides rapid establishment and earlier spring growth than most bermudagrasses. Additionally, it has persisted under frequent cutting in North Florida for at least two years, but its forage is less digestible than Tifton 85. Mulato II is not well suited to systems requiring a long-lived perennial, but because it is a seeded forage, it may have some potential as a high digestibility, short rotation forage crop. It could be seeded in spring of one year and produce high yields of high quality forage that growing season and the next.

Inoculant Effects on Mycotoxins, Fermentation Characteristics, and Nutritive Value of Bermudagrass Silage – Year 2

Joe Vendramini[1], Lynn Sollenberger[2], and Jose C. Dubeux Jr. [3]

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Year Funded: 2015

The objective of this research project was to evaluate the effects of commercial silage inoculants on mycotoxins, fermentation characteristics, and nutritive value of bermudagrass silage. The data is referent to the second year of this research project. The experimental area was located at the Range Cattle Research and Education Center, Ona, FL. A Jiggs bermudagrass hayfiled was subdivided in 36 plots of 10 x 10 ft each plot. The plots were staged on September 15 2015 at 3 inches stubble height and fertilized with 80 lbs N/ac. The harvest occurred on October 15 2015 with target regrowth interval of 4 weeks. Treatments were 7 commercial inoculants and control (untreated treatment) in a randomized complete block design with 6 replicates. The inoculants tested were B500, Biotal Plus II, Early Sile Advance, Promote HQ, Promote VS-3, AS, and XC. The mini-silos (PVC pipes with rubber caps with capacity of 2 lb of green forage) were filled immediately after harvest with the target 20-30% forage dry mater concentration. The inoculants were applied with a hand sprayer before ensiling. The silos were opened on February 19 2015. There were no effects ($P > 0.05$) of the inoculants on silage nutritive value. The mean values of nutritive value measurements were: DM = 25%, DM recovery = 91%, CP = 12.1%, NDF = 68.1%, ADF = 39.7%, IVTD = 49%, and NDFD = 25%. In addition, there were no effects ($P > 0.05$) of inoculant on fermentation characteristics. The mean values for the fermentation characteristics were: pH = 5.0, Lactic acid = 2.0%, Acetic acid = 1.4%, Propionic acid = 0.5%, Butyric acid = 0.3%, and Ammonia = 19.3% CP. Aerobic stability (120 h) and mold and yeast counts pre- and post-aerobic stability measurements were similar among treatments. In addition, there was no presence of aflatoxin (< 5 ppb), zearalenone (< 500 ppb) and T2 (< 500 ppb) on the silage in any of the treatments tested. Commercial inoculants were not effective to improve nutritive value, fermentation characteristics, and aerobic stability of Jiggs bermudagrass silage. The results differed from the first year of the research trial (2014) despite of similar forage characteristics in 2014 and 2015. There is a need to develop management practices to make the use of inoculants in warm-season grass silage more consistent and predictable.