A Historic View of the Germplasm Evaluation Program's Influence on the U.S. Beef Industry

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2014 Beef Improvement Federation
Research Symposium and Convention
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Lincoln, Nebraska


G.E. Dickerson


L. V. Cundiff R. M. Koch K. E. Gregory


L.D. Van Vleck

U. S. Meat Animal Research Center

Authorized by Congress on June 16, 1964 with the mission to conduct research using large populations of livestock.

K. E. Gregory, Center Director (1965-1977)

30,000 acres seeded to warm and cool season grasses and 300 miles of fencing

5,000 acres developed for irrigated corn & alfalfa

Planned and Constructed Physical Plant
Phase I: Headquarters (1968-1971)
Feedlot , Animal and Service Bldgs (1971-1975)
Phase II: Meats and Livestock Engineering (1975-1977)

Established experimental populations
7000 cows, 5,000 ewes, and 500 litters of swine

Planned and Developed Research Organization

Recruited Scientists (~25 scientists by 1977)

Initiated Cattle Germplasm Evaluation Program in 1969

- Planning Meetings 1967-1969
- US MARC Advisory Committee (Appointed by Sec Agriculture)
- Ag Canada - Fredeen, Newman, Lawson, Rahnefeld
- AI industry Representatives-
- Breed Associations Leaders and Representatives
- Technical Committees (NC-1, S-10, W-1)
- Kansas State University Cooperators (Tuma, Dikeman)


G.E. Dickerson

Design of Experiments

Germplasm Evaluation - Breed Characterization
and
Germplasm Utilization - Crossbreeding Systems and Composite Populations

Dickerson, G. E. 1969. Experimental approaches to utilizing breed resources. Anim. Breed. Abstr. 37:191.

Dickerson, G. E. 1973. Inbreeding and heterosis in animals. Proc. Symp. Honoring J. L. Lush. ASAS pp 54-77.

(ASAP Monograph. 1959, 228 pp)
G. E. Dickerson - Techniques for research in quantitative animal genetics , pp, 57-105

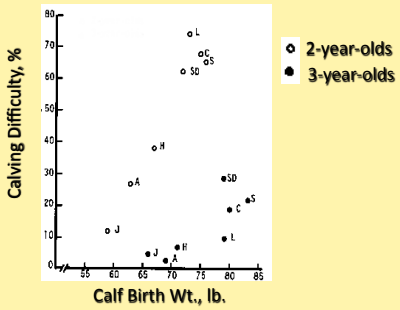
(ASAS Monograph . 1969, 274 pp)
G. E. Dickerson - Techniques for research in quantitative animal genetics , pp, 36-79

Sire Breeds Used in the Germplasm Evaluation Program at the USMARC

Cycle I 70-72	Cycle II 73-74	Cycle III 75-76	Cycle IV 86-90	Cycle V 92-94	Cycle VI 97-98	Cycle VII 99-00	Cycle VIII 01-02
			F_1 Crosses (Hereford or Angus dams)[a]				
Hereford	Hereford	Hereford	Hereford	Hereford	Hereford	Hereford	Hereford
Angus	Angus	Angus	Angus	Angus	Angus	Angus	Angus
Jersey	Red Poll	Brahman	Longhorn	Tuli	Wagyu	Red Angus	Beefmaster
S. Devon	Braunvieh	Sahiwal	Salers	Boran	Norweg. Red	Limousin	Brangus
Limousin	Gelbvieh	Pinzgauer	Galloway	Belg. Blue	Sw. Red&Wh.	Charolais	Bonsmara
Simmental	Maine Anj.	Tarentaise	Nellore	Brahman	Friesian	Simmental	Romosinuano
Charolais	Chianina		Shorthorn	Piedmontese		Gelbvieh	
			Piedmontese				
3-way crosses			Charolais				
Hereford	Hereford		Gelbvieh				
Angus	Angus		Pinzgauer				
Brahman	Brangus						
Devon	Santa Gertrudis						
Holstein							

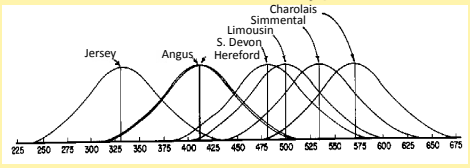
[a]Sire breeds mated to Angus and Hereford females, Composite MARC III (1/4 Angus, Hereford, Red Poll and Pinzgauer) cows were also included in Cycles V, VI, and VII.

Relationship Between Calf Birth Weight and Calving Difficulty (Laster et al., 1983)



CARCASS DATA OBTAINED IN COOPERATION WITH KANSAS STATE UNIVERSITY (Dikeman et al.)

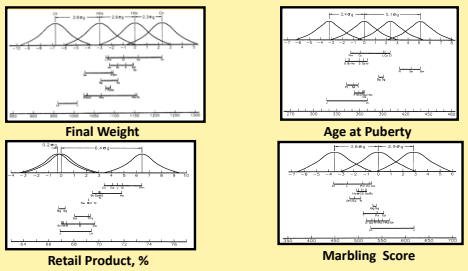
Retail Product at 457 Days, lbs.



Distributions for Breeds in Retail Product Growth to 457 Days

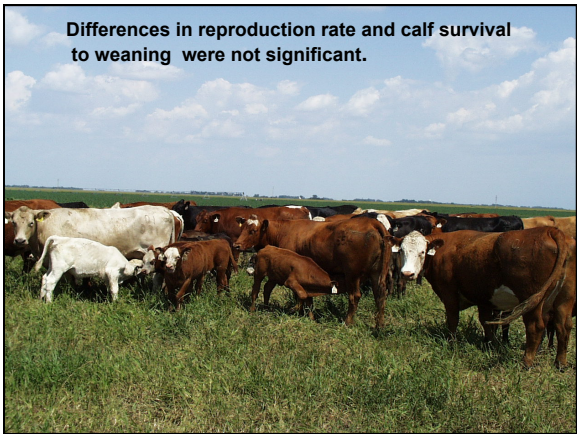
Cundiff (1983 BIF Meeting - Adapted from Koch et al., 1983)

Variation between and within breeds



- Significant variation was found among and within breeds.
- Differences between breeds were often as great as differences within breeds.
- No one breed excelled in all important beef traits.
- Performance was often optimized in crosses.
  - e.g., Yield Grade and Quality Grade optimized in steers with 50:50 ratios of Continental to British inheritance.

Differences in reproduction rate and calf survival to weaning were not significant.



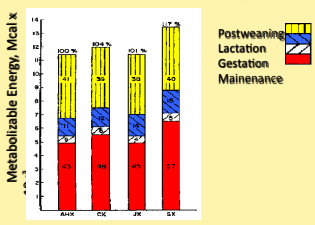
BREEDS GROUPED INTO BIOLOGICAL TYPES FOR FOUR CRITERIA[a] (Gregory, Cundiff, and Koch, 1982)

Breed group	Growth rate mature size	Lean to fat ratio	Age at puberty	Milk production
Jersey (J)	X	X	X	XXXXX
Hereford-Angus (Hax)	XX	XX	XXX	XX
Red Poll (R)	XX	XX	XX	XXX
South Devon (Sd)	XXX	XXX	XX	XXX
Tarentaise (T)	XXX	XXX	XX	XXX
Pinzgauer (P)	XXX	XXX	XX	XXX
Sahiwal (Sw)	XX	XXX	XXXXX	XXX
Brahman (Bm)	XXXX	XXX	XXXXX	XXX
Braunvieh (B)	XXXX	XXXX	XX	XXXX
Gelbvieh (G)	XXXX	XXXX	XX	XXXX
Simmental (S)	XXXXX	XXXX	XXX	XXXX
Maine Anjou (M)	XXXXX	XXXX	XXX	XXX
Limousin (L)	XXX	XXXXX	XXXX	X
Charolais (C)	XXXXX	XXXXX	XXXX	X
Chianina (Ci)	XXXXX	XXXXX	XXXX	X

[a] Increasing number of X's indicate relatively higher values

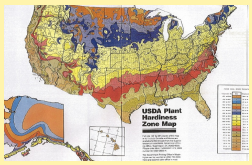
Important to match genetic potential to feed resources

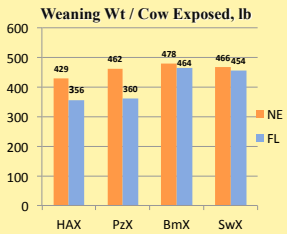
Estimated Total Metabolizable Energy Required For The Production of Calves to 455 Days of Age



Ferrell and Jenkins, 1985

Matching Genetic Potential to the Climatic Environment (Olson et al., 1991)





TRADEOFFS

***Bos indicus* x *Bos taurus* crosses excel in**

- **Weaning weight per cow exposed**
- **Cow efficiency**

but even in subtropical and tropical regions these advantages are tempered by:

- **Older age at puberty**
- **Reduced meat tenderness**

and in temperate regions in cold seasons

- **increased calf mortality**
- **reduced rate and efficiency of gain**

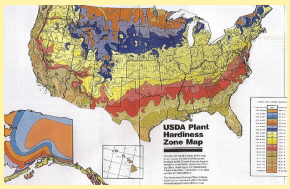
	USMARC NE	Brooksville FL	El Reno OK	Uvalde TX	McGregor TX	Tifton GA	LSU LA
Luli	X	X	X	X	X	X	
Boran	X		X		X		
Senepole		X		X			
Romosinuano	X	X					X
Bonsmara	X	X	X				X

A COMPILATION OF RESEARCH RESULTS INVOLVING TROPICALLY ADAPTED BEEF CATTLE BREEDS

Regional Project S-1013
S-243 and S-277 Multi-state Research Projects
Southern Cooperative Series Bulletin 405

Proceedings: Tropically Adapted Breeds
Southern Section ASAS
February 8, 2005
Little Rock, Arkansas

www.lsuagcenter.com/en/crops livestock/
livestock/beef cattle/breeding genetics/trpoical+breeds.htm



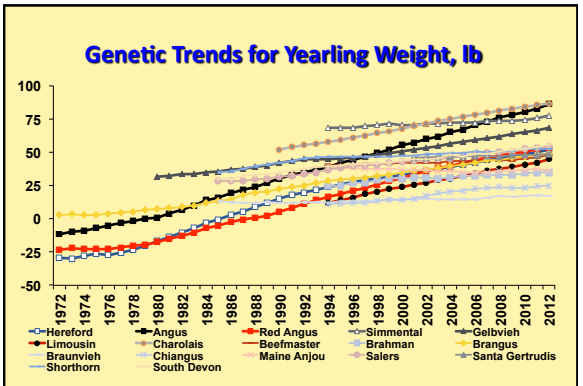
Matching Genetic Potential to the Climatic Environment

- In hotter more humid climates of the gulf coast cattle with ~ 50% tropical adapted germplasm are more optimal.
- In more intermediate subtropics, cattle with ~25% tropically adapted germplasm are more optimal.

ORIGIN of ACROSS BREED EPDs (AB-EPDs)

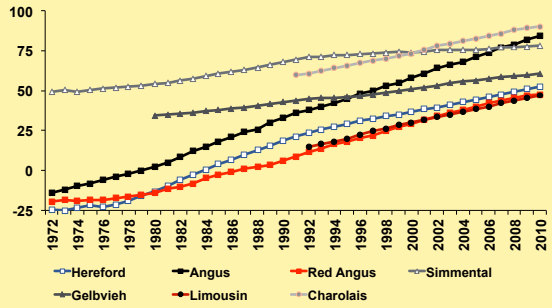
BIF Meetings and Workshops

1988 BIF Mtg. Why can't EPDs be estimated across breeds? (Keith Vander Velde)
1989 BIF Mtg. EPDs for use across breeds. (Notter)
1991 J. Anim. Sci. 69:4763 (Notter and Cundiff)
1993 J. Anim. Sci. 71:1419. (Nunez-Dominquez, Van Vleck, and Cundiff) BIF Mtg.
1993 BIF Mtg. Accuracy of inter-breed comparisons. (Van Vleck)
1994 4th Genetic Prediction Workshop – Procedures and first factors published
1994 – Present. AB-EPD factors published annually in BIF Proceedings for BW, WW, YW and Milk (Van Vleck, Cundiff, Thallman, Kuehn)
2008 – Present. AB-EPD factors published annually for REA, FAT, MARB (Kuehn and Thallman)



Adapted from Spring 2014 Genetic Trends from Breed Associations and 2014 AB-EPD factors (Kuehn and Thallman, 2014)

Genetic Trends for Yearling Weight, lb

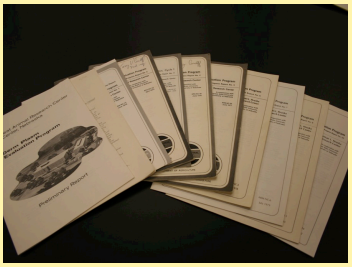


Adapted from Spring 2012 Genetic Trends from Breed Associations and 2012 AB-EPD factors (Keuhn et al., 2012)

BREEDS GROUPED INTO BIOLOGICAL TYPES FOR SEVEN CRITERIA[a]

Breed	Growth rate and Mature size	Lean to fat ratio	Marbling	Tender-ness	Age at puberty	Milk pro-duction	Tropical Adaptation
Jersey	X	X	XXXX	XXX	X	XXXXX	XX
Longhorn	X	XXX	XX	XX	XXX	XX	XX
Wagyu	X	XXX	XXXX	XXX	XX	XX	XX
Angus	XXXXX	XX	XXXXX	XXX	XX	XXXx	X
Red Angus	XXXX	XX	XXXX	XXX	XX	XXX	X
Hereford	XXXX	XX	XXX	XXX	XXX	XX	X
Red Poll	XX	XX	XXX	XXX	XX	XXXX	X
Devon	XX	XX	XXX	XXX	XXX	XX	X
Shorthorn	XXXX	XX	XXXX	XXX	XX	XXXx	X
Galloway	XX	XXX	XXX	XXX	XXX	XX	X
Braunvieh	XXX	XXXX	XX	XX	XXXX	XX	XX
Gelbvieh	XXXX	XXXXX	X	XX	XX	XXXX	X
Holstein	XXXXX	XXXX	XXX	XX	XX	XXXXXX	X
Maine Anjou	XXXX	XXXX	XX	XX	XXX	XXX	X
Salers	XXXX	XXXX	XXXX	XX	XXX	XXXx	X
Norwegian Red	XXXX	XXXX	XXX	XX	XX	XXXX	X
Swedish Red & White	XXXX	XXXX	XXX	XX	XX	XXXX	X
Friesian	XXXX	XXXX	XXX	XX	XX	XXXX	X
Simmental	XXXXX	XXXX	XX	XX	XXX	XXXx	X
Limousin	XXXX	XXXXX	X	XX	XXXX	X	X
Charolais	XXXXX	XXXXX	XX	XX	XXXX	XX	X
Piedmontese	XX	XXXXXX	X	XXX	XX	XX	XX
Belgian Blue	XXX	XXXXXX	X	XXX	XX	XX	X
Romosinuano	X	XXX	XX	XX	XXX	XXX	XXX
Tuli	XX	XXX	XXX	XX	XXX	XXX	XXX
Brangus	XXXX	XXX	XXX	XX	XXX	XXX	XXX
Beefmaster	XXXX	XXX	XX	XX	XXX	XXX	XXX
Santa Gertrudis	XXXX	XXX	XX	XXX	XXX	XXX	XXX
Bonsmara	XXX	XXX	XX	XX	XXX	XXX	XXX
Brahman	XXXX	XXXX	XX	x	XXXXX	XXXX	XXXX
Nellore	XXXX	XXXX	XX	x	XXXXX	XXX	XXXX
Boran	XXX	XXX	XX	x	XXX	XXX	XXXX
Sahiwal	XX	XXXX	XX	x	XXXX	XXXX	XXXX

[a] Increasing numbers of X's indicate higher values with lower case x's indicating intermediate values.



Timely release of Progress Reports and scientific publications impacted choice of breeds used for beef production

Beef Breed Registrations

(National Pedigreed Livestock Council Bi-Annual Reports)

Year	British					Continental					American					Total 1000s
	A	H	Sh	RA	Total %	C	S	L	G	Total %	Bm	SG	Brg	Bf m	Total %	
1965	34.6	56.0	3.4	0.2	94.3	2.8				2.8	1.4	1.1	0.4		2.9	1,113
1970	40.0	45.0	4.0	0.6	89.9	5.1				5.1	2.1	2.2	0.7		5.0	882
1975	29.2	39.9	2.8	0.8	73.1	7.4	8.0		0.9	19.7	2.6	2.1	1.3	1.2	7.3	1,049
1980	28.1	38.5	2.1	1.1	70.2	2.9	7.4	4.3	0.5	17.1	4.0	2.8	2.7	3.3	12.7	917
1985	22.3	26.1	2.4	1.8	52.9	3.9	12.2	6.0	2.3	29.9	4.3	3.8	4.4	4.7	17.1	700
1990	21.5	23.1	2.4	2.1	49.4	6.3	10.6	9.8	3.1	36.2	1.8	2.0	4.3	6.3	14.4	738
1995	28.7	14.8	2.0	3.8	49.7	7.1	9.1	10.1	4.3	37.6	1.9	1.5	3.6	5.6	12.7	784
2000	37.5	12.2	2.7	5.7	58.0	6.1	6.2	7.0	3.8	29.3	2.6	1.5	3.9	4.6	12.7	696
2005	41.7	9.6	2.5	6.0	59.8	10.3	6.1	5.5	3.8	31.9	1.1	1.0	3.2	2.7	8.0	777
2007	44.1	8.8	2.5	6.0	61.3	9.5	6.6	4.8	4.6	30.8	1.1	1.0	3.2	2.3	7.5	789
2009	44.8	8.6	2.1	6.4	61.9	8.8	6.1	3.9	4.7	28.6	1.1	1.0	4.0	2.0	8.1	745

Breeds are an important genetic resource

SYSTEMATIC CROSSBREEDING OR COMPOSITE POPULATIONS USE:

Heterosis
Breed differences
Complementarity
among breeds to match genetic potential with:

- Market preferences
- Feed resources
- Climatic environment

Experimentation with populations directly tied to the beef industry has guided the beef industry for 50 years.

Experimental populations directly tied to the beef industry will be even more critical in the future than in the past.

Experimental populations in which comprehensive genotypes and phenotypes are recorded are needed to provide the data base necessary to guide the beef industry.

Partnerships

USDA –ARS
Land Grant Universities:
State Agr. Exp. Stations
Education
Extension

U.S. Congress
State Legislatures

Industry Organizations
Beef Improvement Federation
Breed Associations
State BCIAs
National Cattlemen's Beef Assoc.
AI Industry

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G.E. Dickerson
1967-1986

UNL Graduate Students
7 M.S.
12 Ph. D.
3 Post Doctorals
5 Visiting Scientists

Key roles:
Germplasm Evaulation
Germplasm Utilization
Twinning in Beef Cattle
Many publications

L. D. Van Vleck
1988-2008

Graduate Students
11 M.S
25 Ph.D.
6 Post Doctorals
47 Visiting Scientists

Key roles:
MTDFREML
EBVs Twinning Rate
AB-EPDs
Many publications

ACKNOWLEDGEMENTS

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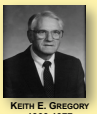
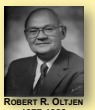
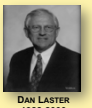


KEITH E. GREGORY
1966-1977



ROBERT R. OLTJEN
1977-1988



DAN LASTER
1988-2000

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2010-PRESENT

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