Southern Pasture and Forage Crop Improvement Conference
Aiken, South Carolina
May 17-18, 2011

<u>Tuesday, May 17, 2011</u>
7:00 – 8:30 AM Registration (Newberry Hall)

South Carolina/Georgia Program

8:30 AM Welcome
8:45 AM Forage in the Northern Areas of South Carolina and Georgia, John Andrae, Extension Forage Specialist, Clemson University, Clemson, SC
9:15 AM Forage in the Coastal Plains Areas of Georgia and South Carolina, Dennis Hancock, Extension Forage Specialist, University of Georgia, Athens, GA
9:45 AM Break

General Program

10:15 AM Sustaining Long-Term Extension Programs: 10, 20, 30 years. Ray Smith, University of Kentucky
11:00 AM Discussion. Daren Redfearn, Oklahoma State University
11:15 AM Business Meeting. Daren Redfearn, SPFCIC Chair, Oklahoma State University, Stillwater, OK
11:45 AM Lunch

<u>Tuesday, May 17, 2011</u>

Workgroups

Forage Breeding
Moderator: Ann Blount, University of Florida

1:00 -2:45 Presentations on new forage releases and discussion concerning evaluating genetic material

Joint Session Forage Ecology / Physiology & Forage Utilization
Moderators
Yoana Newman, Univ. of Florida, Gainesville, FL &
Rocky Lemus, Mississippi State University

1:00 Adapting Forages to the Target Animal Species, Jim Muir, Texas A&M University

1:30 Challenges vs. Benefits of Legume in Forage Systems for the South. John Andrae, Clemson University & Yoana Newman, University of Florida

2:00 Summer Annual Update Opportunities and Challenges, Chris Teutsch, Virginia Tech University

2:30 Discussion

2:45 Break

3:15 N Use Efficiency in Ryegrass Production, Rocky Lemus, Mississippi State University

3:45 Outcome of switchgrass forage studies in Tennessee. Gary Bates, Univ. of Tennessee

4:15 Effects of hay preservatives on hay quality, intake, and digestion. Dirk Phillips, University of Arkansas

4:45 Discussion

Forage Extension

3:15 Introduction, Daren Redfearn, Oklahoma State University

3:30 Alternatives to Ammonium Nitrate and Controlling N Loss. Dennis Hancock, University of Georgia

4:00-5:00 Discussion

Wednesday, May 18, 2011:

TOUR

Meet and depart from

Hampton Inn (100 Tamil Drive, Aiken, SC)

8:00 Welcome and Introductions

Outside the Hampton Inn

8:15 Load Buses and Depart for Dairy #1 (To be confirmed)

10:00 Arrive at Dairy #1

Learning Objectives at Dairy #1

1. Manipulating grazing behavior and forage intake
2. Tracking forage growth rates and availability
3. Feed wedge budgeting
4. Incorporating wildlife habitat into the farm plan

12:30 Load Buses and Depart for Burke Co. Extension Office (Waynesboro, GA)

1:00 Lunch at Burke Co. Extension Office

Special Thanks to Burke Co. Extension Faculty and Staff

1:45 Load Buses and Depart for Pineland Dairy, Inc. (Waynesboro, GA)

2:30 Arrive at Pineland Dairy, Inc.

Beryl Landis, Owner

Pineland Dairy and Milky Way Dairy

Learning Objectives at Pineland Dairy

1. Conversions to pasture
2. Hybridization of pasture-based and TMR-based models
3. Minimizing labor
4. Utilizing winter annual legumes for grazing and N fixation

5:00 Load Buses and Return to Aiken, SC

6:30 Adjourn – Southern Pasture and Forage Crop Improvement Conference

65th Southern Pasture & Forage Crop Improvement Conference

May 17 – 18, 2011

Newberry Hall

Aiken, SC

Conference Hotel: Hampton Inn, Aiken, SC

Effects of Hay Preservatives on Hay Quality, Intake, and Digestion

Dirk Philipp, Kenneth Coffey, and Anne Bass*
*All authors are affiliated with the University of Arkansas, Animal Science Department

Southern Pasture & Forage Crop Improvement Conference
Aiken, SC
May 2011

Overview

Preservatives have been historically used in forage production, mainly so for silage with the purpose of lowering the pH to provide near-optimum conditions for desirable microbial populations. More recently, producers started to use preservatives during the hay-making process, with the presumption to reduce losses during storage and maintaining nutritive value, similar to silage.

This talk sought to give some answers and insight into three questions that are being addressed below in text format. In addition, research was presented on the subject that was conducted at the University of Arkansas.

What are the challenges of making hay in humid areas?

Climatic factors: Frequent rainfall during spring and early summer are the major challenges for hay curing in the southeastern US. In addition, rainfall intensity is higher that contributes to higher nutrient losses during a storm event. Solar radiation is higher as well, but in many instances windows of sunny days are narrow which is compounded by a generally high relative humidity.

Technical issues: The question whether hay can be moved off the field with the recommended moisture concentration of 18% and stored safely depends also on bale type and size. The minimum requirement for moisture concentration decreases as bale density and volume increase. Large bales contain material from a relatively large area and thus contain hay with varying degrees of moisture, more so than in smaller square bales (Muck and Shinners, 2001). Elevated moisture concentrations can result in growth of fungi (*Aspergillus, Fusarium*) which produce toxic compounds that reduce palatability. From a human health perspective, actynobacteria (*Actinomycetes*) provide the causative agent for Farmer's Lung Disease (Rankin, 2000)

Which types of hay preservatives are being used commercially?

***Chemical Preservatives*:**

- Propionic acid, acetic acid, formic acid
- Organic acid mixtures (propionic acid the major component) most common hay preservative
- Anhydrous ammonia

Effects, organic acids:

- Reduce mold growth
- Reduce bale heating

- Higher moisture still present, but microbial growth is reduced
- Reduction in short term DM loss
- Reduction in long term storage (> 4 months) less certain
- Application rates 0.5-1.0% of mass of hay

Effects, anhydrous ammonia:
- Applied at 1% reduced mold, maintained hay color, reduced heating in small square and large round bales
- Reduction of DM losses when bales were wrapped in plastic
- Can increase *in vitro* fiber fraction digestion
- Ammonia to be "the most economic hay preservative system," because of these effects and relatively low costs

Problems, anhydrous ammonia:
- Not widely used as preservative; animal and human safety concers
- Can be toxic to ruminants (when applied to high-quality legumes forages greater than 3% by mass)
- In humans anhydrous ammonia can cause burns, blindness, even death when directly exposed
- Small square bales are difficult to handle when treated with ammonia
- Large bales are probably best suited: large amount of forage (economics), odor less of a problem

Biological Preservatives
- Often silage products transferred to use in hay
- Either bacteria-based, enzyme-based, combination of both
- Thought to enhance fermentation and minimize aerobic spoilage

Bacterial Inoculants:
- Lactic acid producing bacteria; adding more of already existing bacteria population located on hay
- Enhance competition for substrate against mold forming organisms

Enzymatic Inoculants:
- Taken from bacteria cells
- Promote cell break-down (cellulases, amylases) to make substrate more available to desirable bacteria (e.g., *Lactobacillus*)

Chemical composition, intake by sheep, and *in situ* disappearance in cannulated cows of bermudagrass hayed at two moisture concentrations and treated with a non-viable *Lactobacillus*-lactic acid preservative

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Summary

Bermudagrass [*Cynodondactylon*(L.) Pers.] is commonly used for grazing and haying in the southern USA, but hay curing can be challenging due to frequent rainfall events during spring and early summer. An existing stand of ‘Greenfield’ bermudagrass was divided into 12 plots using a randomized complete block design with a 2×2 factorial treatment arrangement to evaluate the influence of a non-viable *Lactobacillus*-lactic acid preservative and moisture concentration at baling on chemical composition, intake by sheep, and in-situ disappearance in cattle. At time of mowing, half of the plots in each block were either spray-treated (T) or not treated (U) with 81 mL/t forage dry matter (DM) of the preservative solution. Hay was then baled at target moisture concentrations of either 174 g/kg DM (L) or 267 g/kg DM (H). Maximum temperature and heating degree days were greater ($P<0.05$) from H compared with L during the 42-d storage period. An interaction between spray and moisture treatments tended ($P<0.10$) to affect recovery of DM; recoveries for LT (0.992) differed ($P<0.10$) from HT (0.913), but LU and HU were intermediate between the spray-treated hays, and did not differ from either ($P>0.10$). Post-storage nutritive value was largely influenced by moisture treatments only. Intake and digestibility, and in situ DM disappearance of these same hays were determined using 16 wether lambs (43±3.7 kg initial BW), or six ruminallycannulated cows (617±3.5 kg initial BW), respectively. Dry matter intake by sheep was not affected by either treatment factor ($P>0.05$), but DM digestibility and digestible DM intake were greater ($P<0.05$) from U compared with T. The *in situ* immediately soluble DM portion was greater from ($P<0.05$) L compared with H, but the reverse was true for the potentially-degradable DM fraction. The lag time tended ($P<0.10$) to be greater from H compared with L. Treating bermudagrass with a non-viable *Lactobacillus acidophilus*-lactic acid spray product at time of baling may not offset the negative effects on forage quality and digestibility of baling bermudagrass hay at excessive moisture concentrations.

Table 1
Concentrations of moisture, bale weight, and heating characteristics of bermudagrass hay baled at two concentrations of moisture and treated or not treated at mowing with a non-viable *Lactobacillus*-lactic acid preservative and stored in small stacks for 42 days.

	Treatments[a]					
	LU	LT	HU	HT	SED[b]	Effects[c]
Pre Storage						
Moisture concentration, g/kg	171	177	293	265	21.3	M
Bale weight (as is), kg	23.9	24.6	31.1	31.0	2.27	M
Bale weight (DM basis), kg	19.8	19.1	21.9	22.7	1.29	M
Post-storage						
Moisture concentration, g/kg	106	102	128	128	6.71	M
Bale weight (as is), kg	21.0	21.1	24.2	23.8	1.12	M
Bale weight (DM basis), kg	18.7	18.9	21.1	20.7	0.95	M
DM recovery	0.947ab	0.992a	0.961ab	0.913b	0.098	m×t
Maximum temperature, ºC	41.4	39.3	56.2	48.9	8.57	M
Heating degree days[d]	5	22	69	64	41.5	M
Days above 35ºC	3	6	7	10	4.0	ns

Means within a row without a common superscript letter differ ($P<0.1$).

[a] Treatments, bermudagrass hay was baled at 174 g/kg (L) or 267 g/kg (H) moisture concentrations and spray-treated (T) or not treated (U) at time of mowing with a non-viable *Lactobacillus*-lactic acid preservative.

[b] SED, standard error of the difference of the means.

[c] M, moisture effect ($P<0.05$); m×t, tendency of moisture by spray treatment interaction effect ($P<0.1$); ns, no significant difference.

[d] Heating-degree days were calculated as the summations of the increment each day by which the internal bale temperature was >35°C during the 42-d storage period.

Table 2
Pre- and post-storage chemical composition (g/kg dry matter, DM, unless otherwise noted) of bermudagrass baled at two concentrations of moisture and treated or not treated at mowing with a non-viable *Lactobacillus*-lactic acid preservative and stored in small stacks for 42 days. There were no differences between treatments pre-storage; thus, means were combined.

Component (pre-storage)					SED[a]	Effects[b]
N	24				3.3	ns
Neutral detergent fiber (NDF)	672				22.8	ns
Acid detergent fiber (ADF)	329				9.6	ns
Hemicellulose	343				2.0	ns
Lignin (sa)	44				6.8	ns
Acid detergent insoluble N (ADIN)	2.4				0.2	ns
ADIN, g/kg N	95.1				10.2	ns
Component (post-storage)	Treatments[c]					
	LU	LT	HU	HT	SED	Effects
N	24	24	24	22	2.2	ns
NDF	718	712	743	747	16.2	M
ADF	337	342	353	352	9.0	M
Hemicellulose	381b	370c	390a	395a	16.8	M, M×T
Lignin (sa)	38.0	43.5	51.2	49.2	7.8	M
ADIN	2.4	2.5	2.8	2.8	0.30	m
ADIN, g/kg N	99.5	104.4	116.8	122.2	9.30	M

Means within a row without a common letter differ ($P<0.05$).

[a]SED, standard error of the difference of the means.

[b]M, moisture effect ($P<0.05$); M×T, moisture by spray treatment interaction effect ($P<0.05$); m, tendency of moisture effect ($P<0.1$); ns, no significant difference.

[c]Treatments, bermudagrass hay was baled at 174 g/kg (L) or 267 g/kg (H) moisture concentrations and spray-treated (T) or not treated (U) at mowing with a non-viable *Lactobacillus*-lactic acid preservative.

Table 3
Dry matter intake and digestibility by sheep of bermudagrass hay baled at high or low moisture concentrations and treated or untreated with a nonviable lactic acid-*lactobacillus* preservative at time of mowing.

	Treatments[a]					
	LU	LT	HU	HT	SED[b]	Effects[c]
Dry matter (DM) intake, g/d	730	634	762	658	140.7	ns
DM intake, g/kg bodyweight (BW)	16.9	14.9	18.1	16.1	4.50	ns
DM digestibility	0.541	0.487	0.544	0.513	0.0162	T, m
Digestible DM intake, g/d	394	308	415	337	72.1	T
Digestible DM intake, g/kg BW	9.15	7.23	9.8	8.23	2.241	ns

[a] Treatments, bermudagrass hay was baled at 174 g/kg (L) or 267 g/kg (H) moisture concentrations and spray-treated (T) or not treated (U) at mowing with a non-viable *Lactobacillus*-lactic acid preservative.

[b] SED, standard error of the difference of the means.

[c] T, spray treatment effect ($P<0.05$); m, tendency of moisture effect ($P<0.1$); ns, no significant difference.

Table 4
In situ DM disappearance in cannulated cows of bermudagrass hay baled at high or low moisture concentrations and treated or untreated with a nonviable lactic acid-*lactobacillus* preservative at time of mowing.

	Treatments[a]					
Item[b]	LU	LT	HU	HT	SED[c]	Effects[d]
A	0.177	0.169	148	0.143	0.0152	M
B	0.529	0.546	0.573	0.571	0.0249	M
U	0.294	0.285	0.280	0.285	0.0331	ns
Lag time, h	1.03	1.43	2.05	2.32	1.106	m
k_d/h	0.039	0.039	0.037	0.040	0.0063	ns
ED	0.450	0.438	0.457	0.444	0.0228	ns

[a] Treatments, bermudagrass hay was baled at 174 g/kg (L) or 267 g/kg (H) moisture concentrations and spray-treated (T) or not treated (U) at mowing with a non-viable *Lactobacillus*-lactic acid preservative.

[b] A, immediately soluble fraction; B, fraction that disappeared at a measurable rate; U, undegraded fraction in the rumen; k_d, disappearance rate; ED, effective ruminal disappearance.

[c] SED, standard error of the difference of the means.

[d] M, moisture effect ($P<0.05$); m, tendency of moisture effect ($P<0.1$); ns, no significant difference.

References

Muck, R.E.; Shinners, K.J. Conserved forage (silage an hay): progress an priorities. In: International Grassland Congress, 19., São Pedro, 2001. *Proceedings.* Piracicaba: FEALQ, 2001. p.753.

Rankin, M. 2000. Preserving bales hay with organic acids. Focus on forage, Vol 2, #5. University of Wisconsin.

The Potential for Utilizing Native Grasses for Forage Production

Gary Bates, Joe Beeler, Fred Allen, Plant Science
Matt Backus, John Waller, Animal Science
Pat Keyser, Craig Harper, Forestry, Wildlife and Fisheries and Center for Native Grasslands Management
The University of Tennessee

There has been much interest in native warm-season grasses (NWSG), especially switchgrass, as a biofuel crop. Agricultural economists have forecast as much as 55 million acres may be utilized for switchgrass feedstock production nationwide. If this forecast is realized, considerable acreage currently used for forage production will be converted, with significant impact on the cattle industry, particularly in the Southeast.

Prior to its emergence as a bioenergy crop, switchgrass was primarily considered a forage crop, as were the other NWSG species. Several University of Tennessee faculty are investigating the potential to "double-crop" switchgrass. Biofuel production involves a single harvest in November. In a two-harvest system, early growth is removed for forage and regrowth removed in November for biofuel production, creating an opportunity for increased income from a stand and diversified markets.

We still need to determine the impact of early harvests on fall biofuel yields in such double-cropping systems. Several studies are currently investigating this question in the context of grazing and hay production.

Hay harvest system

The objective of this research is to determine if a one-time forage harvest is possible at either the vegetative or the boot stage without reducing the yield of a fall biomass harvest. A small plot study was conducted during 2009 – 2010 at Knoxville, TN with Alamo switchgrass. A randomized complete block design was employed. Harvest treatments consisted of either a vegetative (May) or boot-stage (June) forage harvest, each followed by a November biomass harvest, or a single November biomass harvest. All plots also received a fertilization treatment that consisted of either 30 or 60 lb of N/acre at green-up. The plots harvested for forage received an additional 0, 30 or 60 lb of N/acre after the early harvest. In 2009, the single-harvest treatment yielded 8.8 tons of biomass/acre, while the biomass from the two-cut systems produced an average of 8.9 tons/acre. In addition, the two-cut systems yielded an average of 1.2 (May) or 3.0 tons/acre (June). In 2010, the forage harvests averaged 4.3 tons/acre for May and 5.5 tons/acre for June. The fall biomass harvest from the two-cut systems produced an average of 5.0 tons/acre, while the single-harvest treatment yielded 12.2 tons of biomass/acre. The reduction in biomass yield for the forage harvest systems in 2010 was most likely due to the difference in summer rainfall between 2009 and 2010. During 2009, June to October rainfall was over 18 inches above normal (25.9 vs 17.3) while 2010 rainfall was equal to the long-term average for June to October.

Grazing system

The objective of this grazing study was to use cattle to harvest high quality early-season growth of NWSG and harvesting the regrowth for biofuels. Grazing was conducted at Research and Education Centers near Grand Junction, Springfield, and Greeneville, TN in late spring 2010. Weaned beef steers (594 ± 27.6 lb) were used in a completely randomized design with three forage treatments: 1) switchgrass (SG); 2) a combination of big bluestem and indiangrass (BB/IG); and 3) eastern gamagrass (EG). Treatments were replicated three times at each location. A put-and-take system with four steers (testers) allotted to each 3-acre paddock was used to manage grazing pressure. Additional steers (grazers) were used to keep forage in a vegetative state. Steers had free choice access to pasture, water, mineral, and shade. A high-fiber equilibration ration was fed 5 d before and after the 30 days grazing period to adjust for gut fill of the steers. Average daily gain (ADG) of steers grazing BB/IG differed from EG and SG ($P < 0.05$). There was no difference between steers grazing SG and EG. The ADG of steers grazing BB/IG, SG, and EG was 2.64, 2.21 and 1.69 lb/d, respectively. Our results demonstrate the ability of NWSG to provide summer forage and acceptable animal performance for beef stocker cattle.

FORAGE AGRONOMY: INNOVATE OR PERISH.

THE CASE FOR NEW GERMPLASM

James P. Muir
Texas AgriLife Research & Texas A&M University

INTRODUCTION

As we contemplate the prospect of disbanding the Southern Pastures and Forage Conference after 60 years, forage agronomists, like all agronomists throughout the southeastern USA, face a similar choice: innovate or become irrelevant as a discipline. Why is agronomy in general and forage science in particular irrelevant to a world that values research and education more each day? With population densities climbing and land available to agriculture shrinking, the study of agriculture (agronomy) should be thriving. Our knowledge and insights should be leading, providing guidance, offering solutions to a land-poor, water-thirsty, and food-hungry world. Instead we are bewildered defenders of a discipline few value and hardly anyone, even the initiated, believes has a future.

The objective of this paper is to discuss a few (among many) reasons for our communal short-comings. Forage science in the southeastern USA has fulfilled the mandates Land-Grant Universities, Agricultural Experiment Stations and Extension Services were originally designed to address. Today, however, we falter as a discipline. My thesis is that we are not too late to change, not too late to retake a leadership role, and not too late for relevance. The case for new germplasm is presented as an example of how we can break out of our somnambulant lethargy.

OUR HISTORY

One of the primary goals of the 1862 Morrill Land-Grant Act that gave breath to our Land Grant Universities was to make knowledge available to all citizens, not just the wealthy (Campbell, 1995). Practical education that stayed several steps ahead of agricultural technology and production methods was primary among these. These were not meant to be technical colleges teaching trades where "management" or "production" dominated classroom curricula. Rather, these were to be true universities that instilled the analytical tools future scientists needed to solve future problems. Land Grant University agricultural colleges were created to prepare scientists and critical thinkers rather than technicians or rote producers.

The Hatch Act of 1887 created Agricultural Experiment Stations in our southeastern states (Campbell, 1995). These were to be centers of innovation that would complement the education component at land grant universities. The goal was to facilitate scientific experimentation and practical application of agricultural advances that would lead US farmers and ranchers into a promising future. The key was to take risks with experimentation, new ideas, new species, and new technologies which land managers could not themselves afford to take. Experiment Station scientists were contracted to help farmers and ranchers break out of established molds and stretch their technological envelopes into a new age of more efficient and productive agriculture guided by scientific methodology.

The Smith-Lever Act that followed in 1914 was designed to facilitate the flow of Experiment Station innovations to an isolated and barely literate agricultural community (Campbell, 1995). What later evolved into State Extension Services were conceived as communication facilitating systems aimed at fomenting improvements for all land managers, not just the rich and powerful. Farm and ranch visits, field days, town hall lectures and printed pamphlets divulged new ideas that would otherwise have remained unattainable to most farmers and ranchers.

Through most of the twentieth century, US agriculture was the envy of the world. A confluence of diverse North American climates, rich soils, democratic land tenure, laissez faire economy and a burgeoning national and international market came together in a fortuitous era in which agriculture could not help but flourish. Fewer farmers produced more at lower cost. Land Grant Universities, along with their associated Agricultural Experiment Stations and Extension Services, nurtured this blossoming. They created new technologies and identified germplasm that would have taken risk-averse and isolated farmers and ranchers centuries to create on their own.

THE PRESENT: FORAGING FOR A RUDDER

That was yesteryear. If we look at forage education, research and extension programs in the southeastern USA today, what do we see? I suggest that at least part of our perceived irrelevance as a discipline arises from a reluctance to adapt to a new reality. Today's land managers are no longer the uneducated, provincial ranchers and farmers of the past century. They have university degrees, travel outside their counties and can surf the internet. When in doubt they can hire consultants, tap into industry services, or innovate on their own.

So where does that leave the forage agronomist in the southern Land Grant University systems? We are certainly able to think outside the box, but we appear to have succumbed to a communal reluctance to step beyond our intellectual comfort zones. Caught between scientific inertia and the all-pressing need to survive tenure and promotion in a bean-counter's world, perhaps we fail to lift our gaze above the canopy, choosing instead to safely patch-graze where others have already delved down to the stubble. The first two issues of this year's Agronomy Journal (ASA, 2011a 2011b) tell the story: forage research published on bermudagrass, bahiagrass, oats, alfalfa and orchardgrass. In other words, same old same old. Even when we do innovate, we take so many years to study, publish and divulge that our clients have surpassed us by the time we get the technology out (McClinton, 2011).

Have we lost strong forage academic programs at land grant universities because we teach history rather than science? Do the few programs that remain in the southeast run the risk of disappearing if, as a discipline, we continue to instruct what the majority already espouse, thereby courting irrelevance? For example, as forage agronomy lecturers, we may at times be guilty of intellectual reductionism. Forage ecosystems and their management are eminently complex, an intricate dance of climate, soil, plant, insect, animal and the market (manager) they support. Which of us were taught or currently teach that **critical analytical thought** are vastly more important than the Mott Scheme, the trade-off between quantity and quality, or, science forbid, the deity of $P \leq 0.05$?

If we undertake research whose outcomes we can predict, the experiment station forage agronomists are likewise redundant. If we already have an expected outcome, we have failed to risk. How many of us break out from the shadow of our major professor who, in turn, never broke out from the shadow of her/his major professor, who was the first to address the issue that is still being worried to death today? What about our newly hired researcher, trained by the world's foremost expert on species A or method B, who plans on building a career in, no surprise, A or B? This despite the fact that these species or technologies were already well known to our land managers decades ago or have long since been proven to fit poorly into our natural ecosystems.

Likewise, if we provide services and out-reach that land managers, consultants and agro-industrial representatives can get elsewhere, we follow rather than lead. What happened to the concept of **land husbandry?** Today our extension specialists work with "producers" whose "production efficiency" gives us greater "product" per unit of input. Whatever happened to balancing short-term challenges with long-term concerns such as stability, sustainability, and equilibrium? Perhaps the southeast is not as antagonistic to international markets or environmental concerns as it once was. Perhaps there are, after all, opportunities in land fragmentation, multiple land-use priorities, secondary roles or the myriad other challenges of today for which our narrow land grant university educations or our graduate school mentors never prepared us.

IDEAS FOR A RELEVANT FUTURE

Flexibility and adaptability

Our world has changed since the first Southern Pastures and Forage Conference and would be barely recognizable to the signatories of the Morrill Land-Grant Act of 1862. Forage agronomy has invented and reinvented itself numerous times since those dates. It should be no surprise, then, that we are being asked today to go through equally drastic changes as a discipline.

The benefits of flexibility are clearly visible in once successful forage academic programs that have redefined themselves as turf, applied environmental, or bioenergy majors. If graduates from Land Grant Universities can no longer find jobs in forage science but can build careers in these new fields, universities have no choice but to retool. Same principles, same science, but different applications. Likewise if grant funding, the major driving force behind agricultural research in the past few decades, or private industry partnerships, the present and future direction of agronomy, take us away from bahiagrass for brangus cows to switchgrass for potential bioenergy, we can either accept the inevitable or be left in the dust of obscurity. The extension agent, the county talk or the printed fact sheet are all anachronisms whose time has come and gone. Specialists, now retooled as wildlife or bioenergy experts, can communicate through Facebook pages or phone apps. If they want to keep up with their clients' technology, they have no choice.

Rescinding the reductionist

The world is not a simple place (Aarssen, 2001). Yet as forage scientists, we attempt to reduce complexity down to a single factor so that we can unequivocally state that "if we change Y, then X will surely follow." The problem is that X, in the world outside our forage plot, is also dependent on myriad other factors that, each viewed in context, has its own effect not only on X, but on Y before it ever gets to X. Forage science has been so enamored with this approach that we often fail to see the big picture. We become so spellbound by the details that we are incapable of inserting our science into the "real world" that forage became while we were gazing transfixed at the neutral detergent fiber or in vitro organic matter digestibility in our lab crucibles.

The first place to start is in our undergraduate and graduate classrooms. Details such as biochemistry or statistics are needed, but they make sense only within the broader context. Ecosystems are where our plants thrive or dive: soil, climate, competition, pathogens, herbivores and scores of other factors come into play long before details become salient. If we take a further step back, the rancher, the ranch, the environment, the market or even world politics come into focus. How do we accommodate these in forage science? Do we turn our backs on them, pretending they are irrelevant to our laboratory or pen trial? Better to teach European Union agricultural policy, learn Mandarin, or take a sabbatical to Hyderabad University.

Reductionism is the favored child of our discipline such that we smother ourselves in irrelevant detail. We have lost the ability for critical, analytical thought. We revere basic research to the detriment of applied, systems analyses. We are so inbred that we consider a team composed of forage nutritionists, physiologists and geneticists to be multi-disciplinary! If we are truly progressive, we might consider a wide-ranging team to include animal science, agricultural economy, and soil science. This is the blind leading the blind, like-minded disciplines fascinated by a small sliver of reality rather than capable of seeing the larger, complex picture. If we are to stride with open eyes into the new century, better to team up with the anti-reductionists: sociologists, macro economists, political scientists, environmentalists and whoever else can drag us back into relevance.

Take risks

If we step out into the unknown, we might become relevant again. Maybe our administrators, state legislators or grant reviewers will once again believe in forage agronomy if we step away from what we know and begin to work with the unknown. There are worlds of ideas and innovations whose surface we have barely unearthed, many of these complex and multi-disciplinary (Janzen et al., 2011). If we go where no Florida or Texas landowner has ever gone before, we will have awakened the innovative scientific spirit that will breathe new life into our discipline.

An example among many: we need new germplasm. As forage scientists we invariably think of this as entailing larger collections or further crosses of the plant species that already work. If our systems are failing, or at least failing to gain us attention as a discipline, let us keep searching for solutions where our predecessors found them, right? Look to the alfalfas, tall fescues, bermudagrasses, and bahiagrasses that have "made" our discipline. Perhaps it is time to look beyond those species. We certainly need to move beyond monospecific pastures and learn from natural grasslands that diversity equals stability (Tilman et al., 1996; Whitbread et al., 2009). We need new plant germplasm, new paradigms that take us beyond a rehashing of Forages 101 as taught in 1963.

New germplasm goes well beyond the plant. It also includes diverse (but not necessarily new) animal breeds, species and complex systems (Hanley and Hanley, 1982). Our pasture research focuses, ad nausea, on well-established cattle breeds such as the Brahman or Friesian. Who among us has worked with the Corriente? And why not move beyond the bovine to other species? There are literally hundreds of animal species, both native (Fulbright and Alfonso-Ortega, 2006) and exotic (Popenoe, 1983) which we rarely, if ever, consider. We shrink from bringing these onto our experiment stations because our colleagues would consider them too far-fetched, too risky.

I would argue that society invests in us so that we take risks in its stead. Ranchers or farmers cannot take those same risks. Why? Because if they fail, they go hungry. We, on the other hand, can risk failure, teach society to avoid them, and then move on, eventually, to innovations that do work. Today's forage scientist has the resources but not the temerity to risk novel ideas in our pastures and grasslands. Take, for example, *Bubalus bubalis*, which was domesticated long before *Bos* spp. and is better adapted to large swaths of the southeastern USA (Popenoe, 1981). How many grazing trials studying water buffalo are published in the Agronomy Journal or how many forage agronomists regularly promulgate their use in hot, humid regions of North America? Or who among us is currently looking at forage systems for *Bison bison* (Hawley, 1987)?

There are myriad ideas that we can ride back into relevance. Multi-species pastures, looking beyond the ruminant for other herbivores, multi-species herds, non-traditional land uses, niche markets, multi-disciplinary teams that recruit outside agriculture, integrated education, research and extension led by land managers or foreign markets, or production systems that coexist with rather than constantly battle the climates and natural resources available to us. How about a graduate course titled "The Tao of forage science"? It may not be so bad to occasionally feel uncomfortable or at least challenged by new ideas. Recall how stimulating Savory's (1988) ideas were, despite originating on the distant savannahs of Africa to challenge "facts" our college professors taught us?

Innovate or perish

If we continue to shirk risk, if we insist on the simpleton's reductionism, forage agronomy will lose what little relevance to society it retains today. Some might argue that we have already reached that stage and are too ossified to adapt. I would disagree. Regardless of your position on the issue, the truth is that we no longer live in the agrarian culture that enacted the Morrill Land-Grant, Hatch or Smith-Lever Acts. Our clients are no longer "producers;" rather, they are **land managers** whose priorities go well beyond simple farming or ranching to

natural resource husbandry. As forage scientists we can also change, wrenching our tethered intellects away from a fading past and focusing our unfettered intellects on an unpredictable future. Become adaptable, analytical, team players. Take risks. Step outside our comfort zones. The alternative is to let forage science specifically and agronomy in general fade gently into the twilight of irrelevance to which we are already largely relegated. I would rather roar defiantly into a fascinating future that includes myriad new iterations of forage science.

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