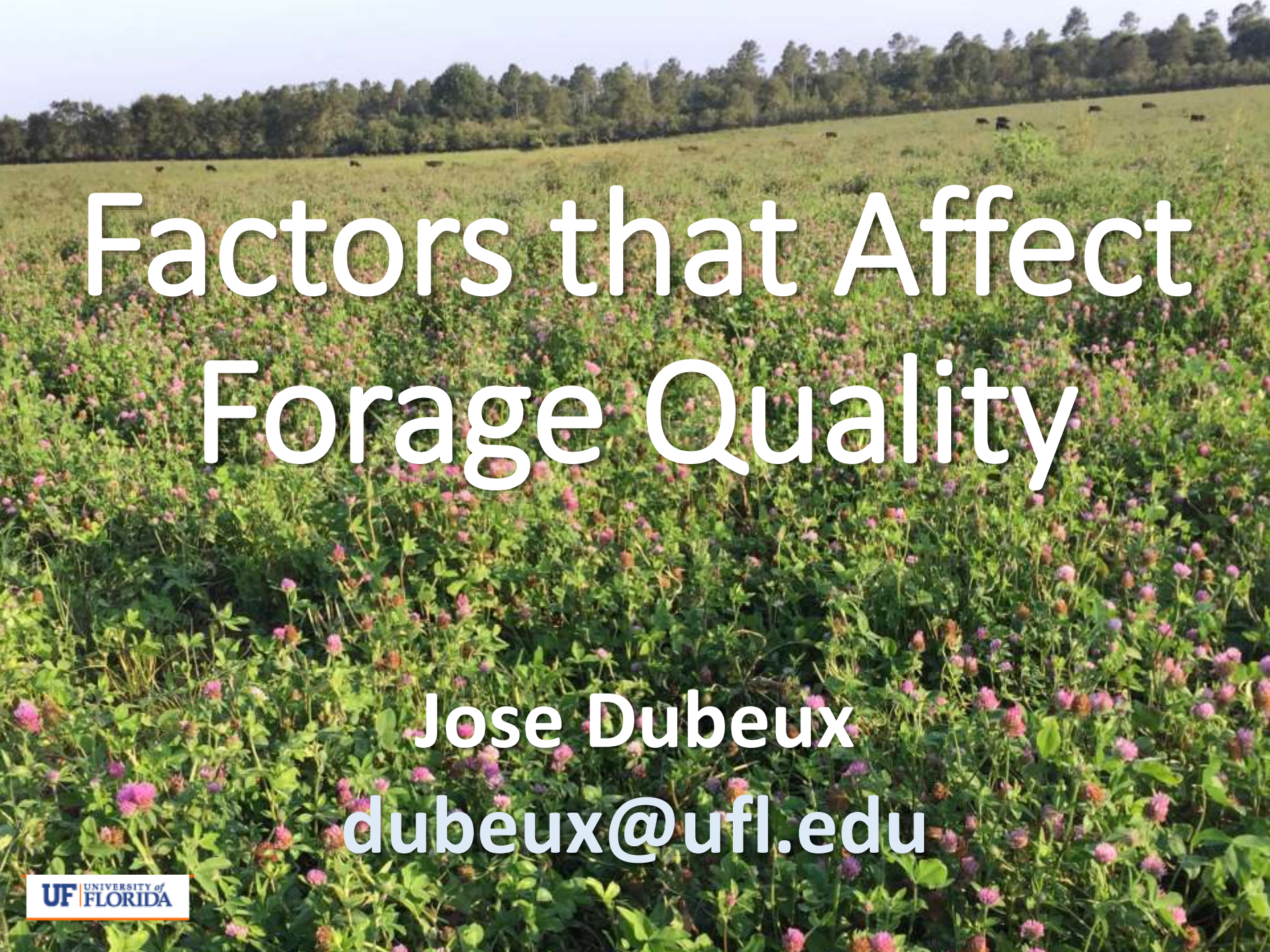

Factors that Affect Forage Quality

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What is forage quality?

High-quality forage

"Forage that contains large concentrations of digestible energy and is capable of being consumed in large amounts"

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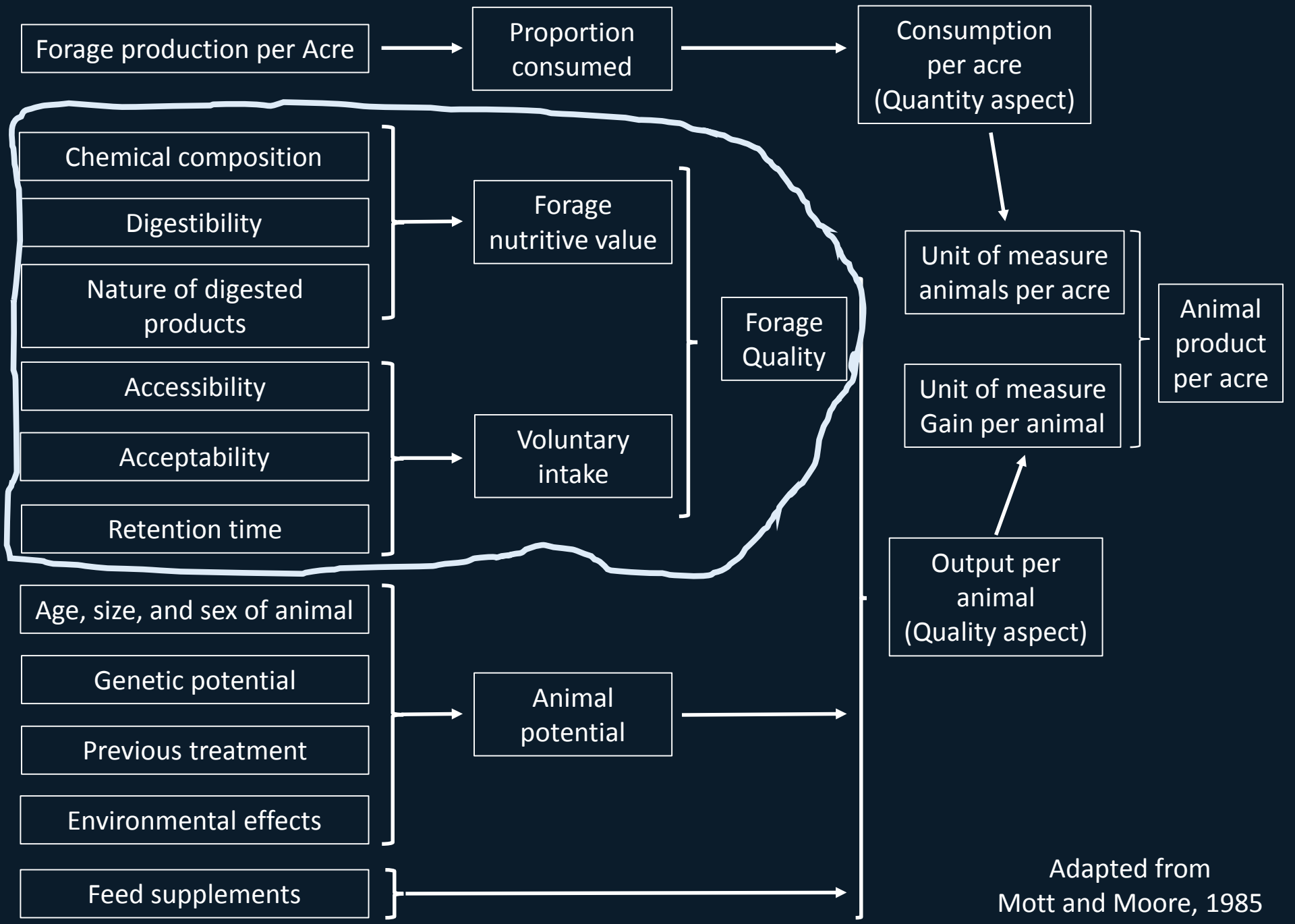
Hancock et al., 2014

What is forage quality?

- Forage nutritive value
  - Forage digestibility
  - Forage chemical composition
  - Nature of digested products/ efficiency of nutrient utilization
- Voluntary feed intake

Forage Quality


Forage production per Acre
Proportion consumed
Consumption per acre (Quantity aspect)
Chemical composition
Digestibility
Nature of digested products
Forage nutritive value
Accessibility
Acceptability
Retention time
Voluntary intake
Forage Quality
Unit of measure animals per acre
Unit of measure Gain per animal
Animal product per acre
Output per animal (Quality aspect)
Age, size, and sex of animal
Genetic potential
Previous treatment
Environmental effects
Animal potential
Feed supplements
Adapted from Mott and Moore, 1985

Factors affecting forage nutritive value

Forage species

Summer annuals (Pearl Millet, Sudangrass): 1 to 1.5 lb/d

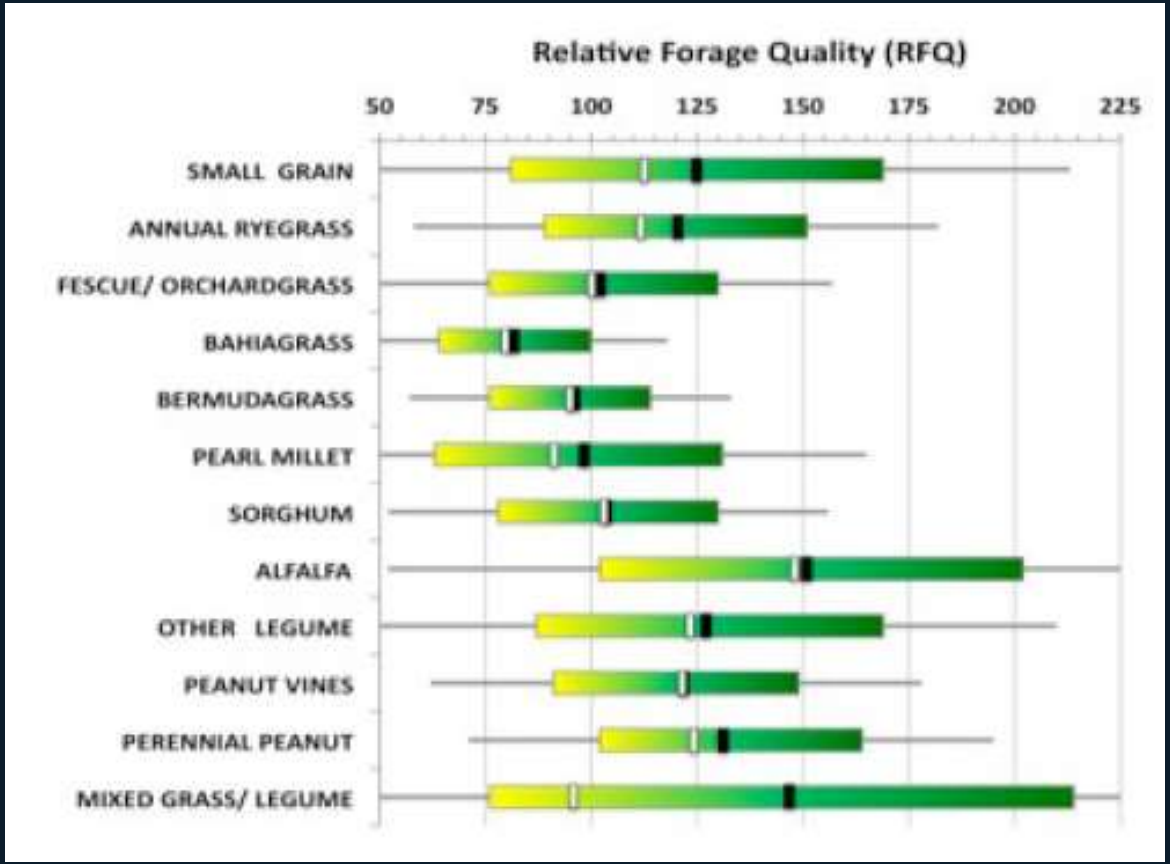
Bahiagrass: 0.5 to 1 lb/d

Bermudagrass: 1 to 1.5 lb/d

Cool-season grasses: 1.5 to 2 lb/d

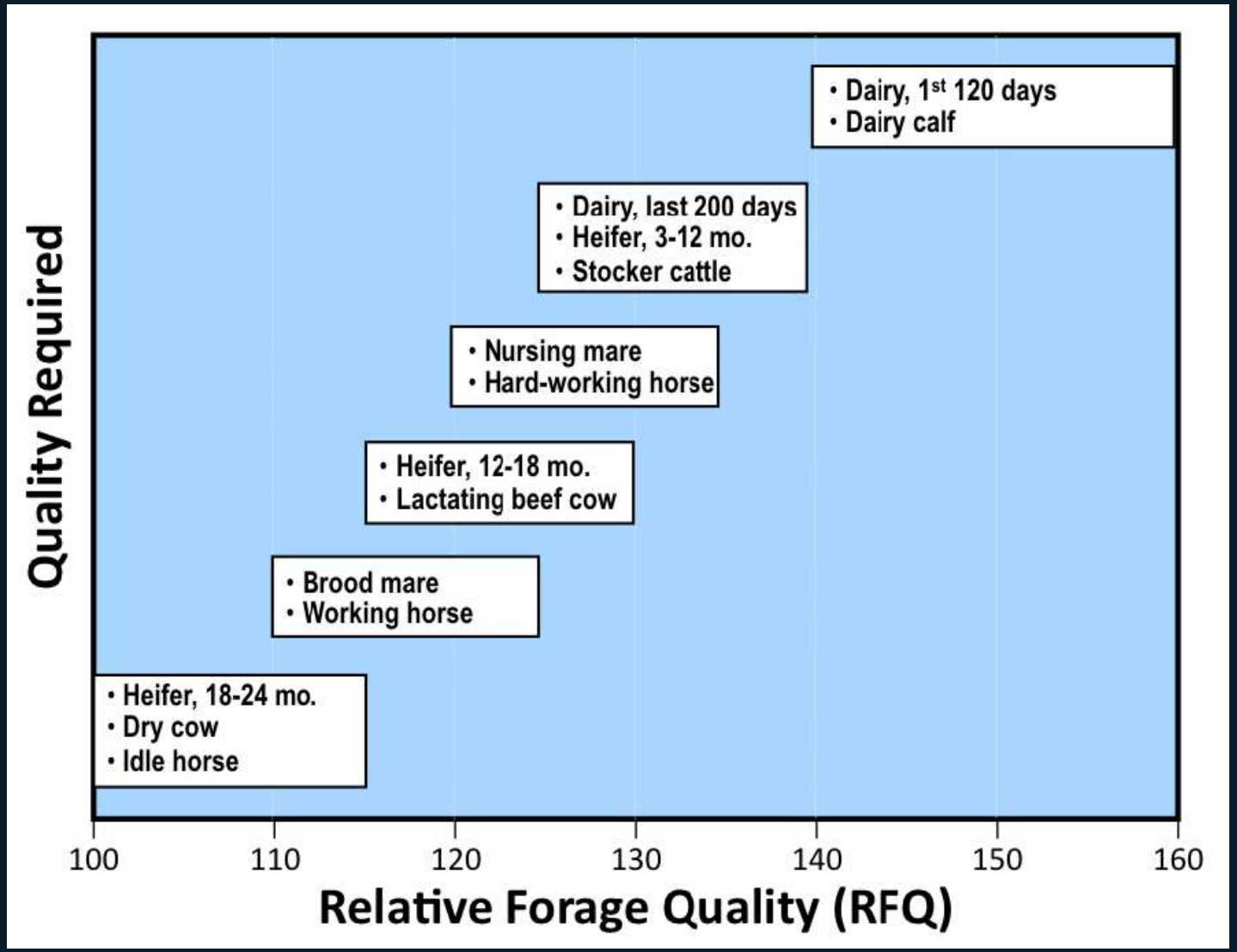
Grass/legume mixtures: 1.5 to 2.5 lb/d

Forage species



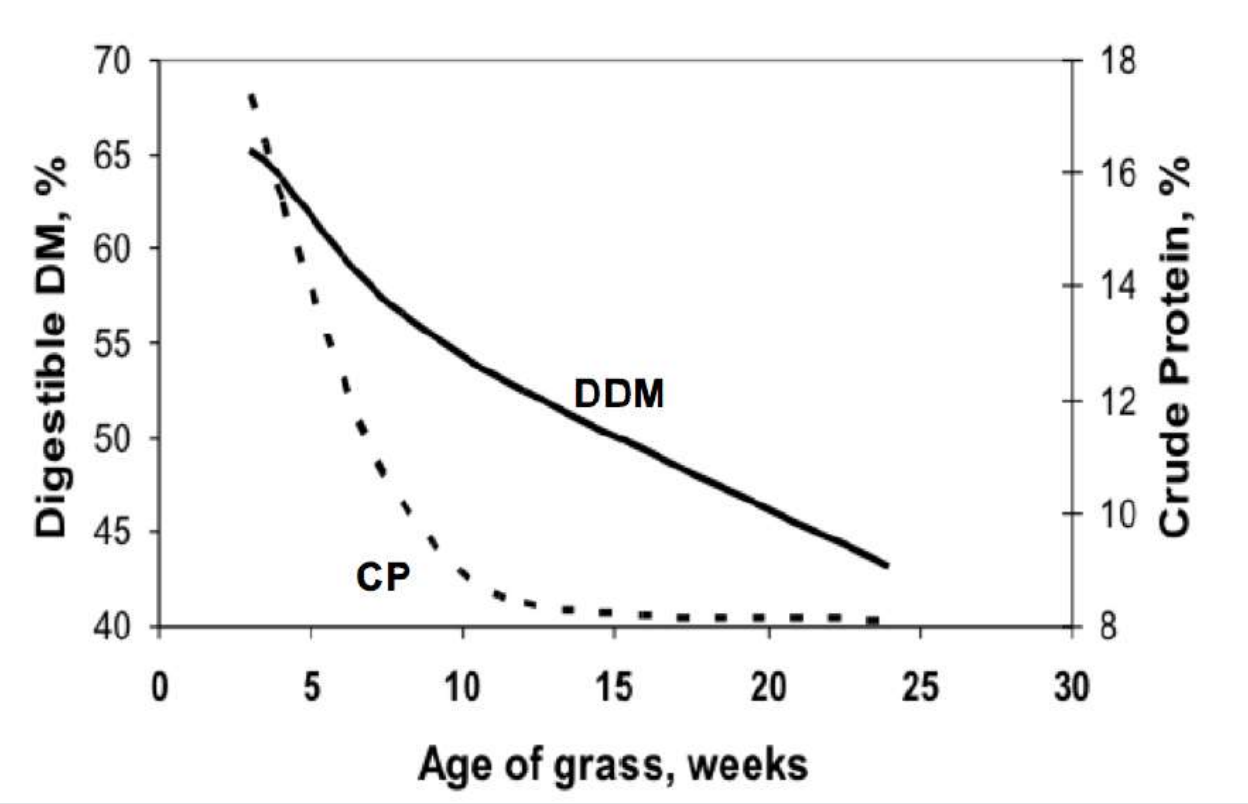
Hancock et al. (2014)

Livestock requirement and RFQ



Hancock et al. (2014)

Digestible dry matter (DDM) and crude protein (CP) of Coastal bermudagrass



Burton et al. (1963)

Animal performance and forage quality of Coastal bermudagrass hay with different maturity

Cutting interval (weeks)	Dry Matter intake (lb/day)	Forage digestibility (%)	Average daily gain (lb)
4	11.8	55	1.2
8	9.3	53	0.9
12	9.5	45	0.0

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Source: Circular 557, University of Florida Cooperative Extension Service. Wright et al.

Forage quality and cost of supplementation using bermudagrass hay

Maturity (weeks)	Crude Protein (%)	TDN (%)	Supplement required for a lactating beef cow (lb/hd/d)	Cost to supplement ($/hd/d)
4	11.8	55	1.2	$0
6	9.3	53	0.9	$0.23-0.48
8	9.5	45	0.0	$0.53-0.75

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Source: Circular 557, University of Florida Cooperative Extension Service. Wright et al.

Environment and management

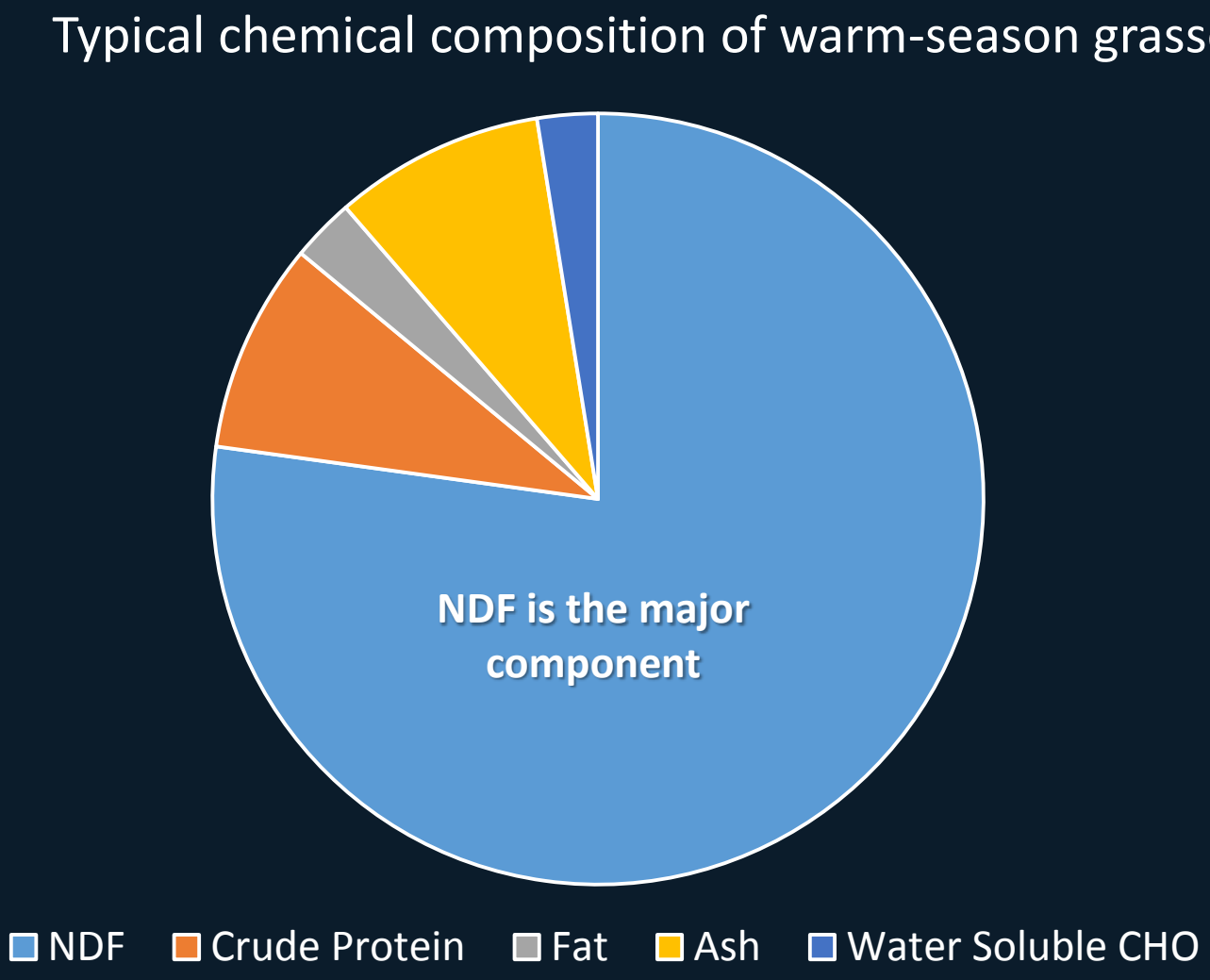
- Soil fertility
- Rainfall regime/irrigation
- Temperature, light
- Fertilization program

N fertilization and crude protein in bermudagrass hay

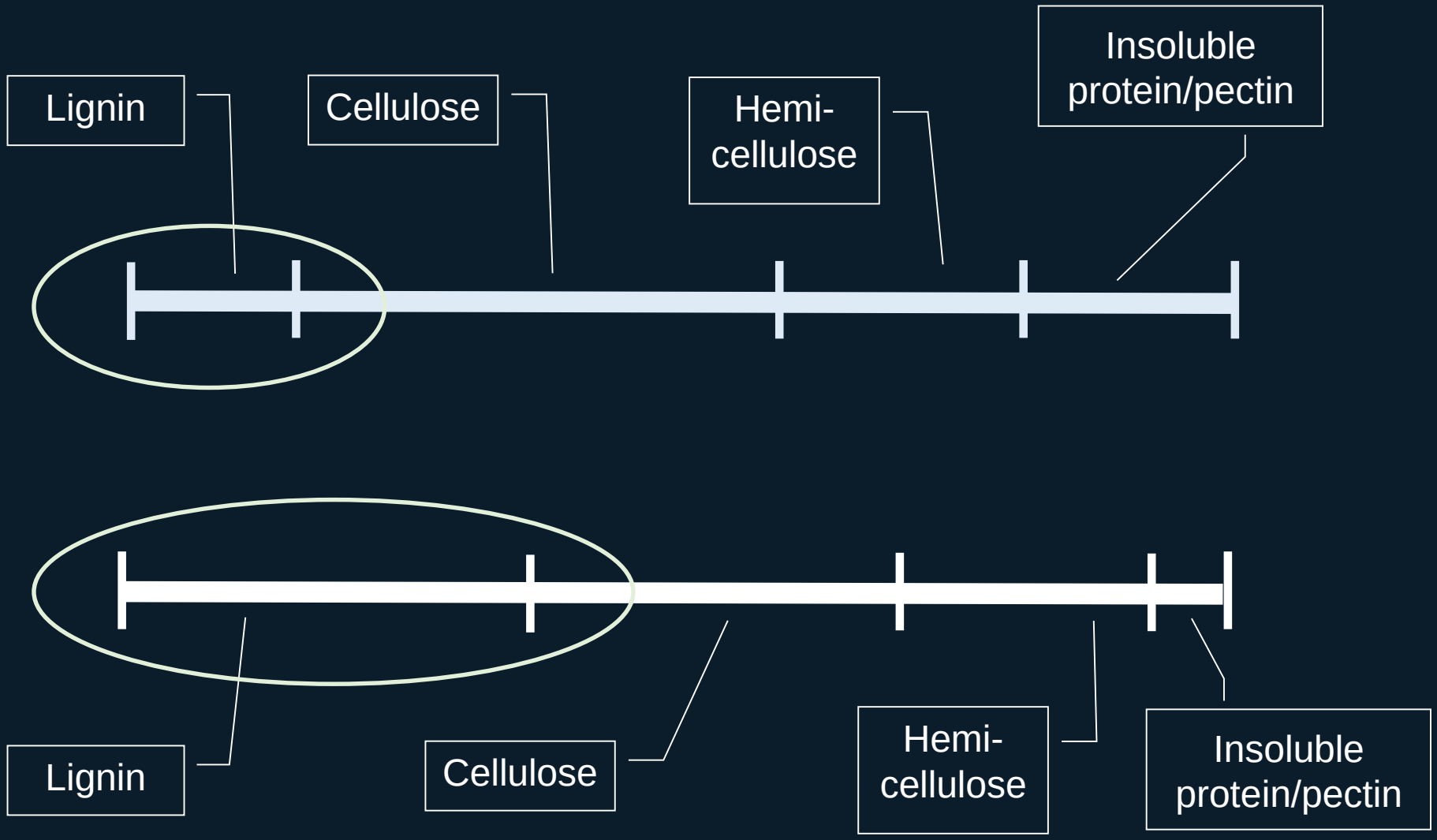
Applied N (lb/Acre)	Crude protein (%)
100	9.2
200	11.0
300	12.2
400	13.1
500	13.8

Source: Circular 938, University of Florida Cooperative Extension Service. Overman et al.

Development stage and chemical composition



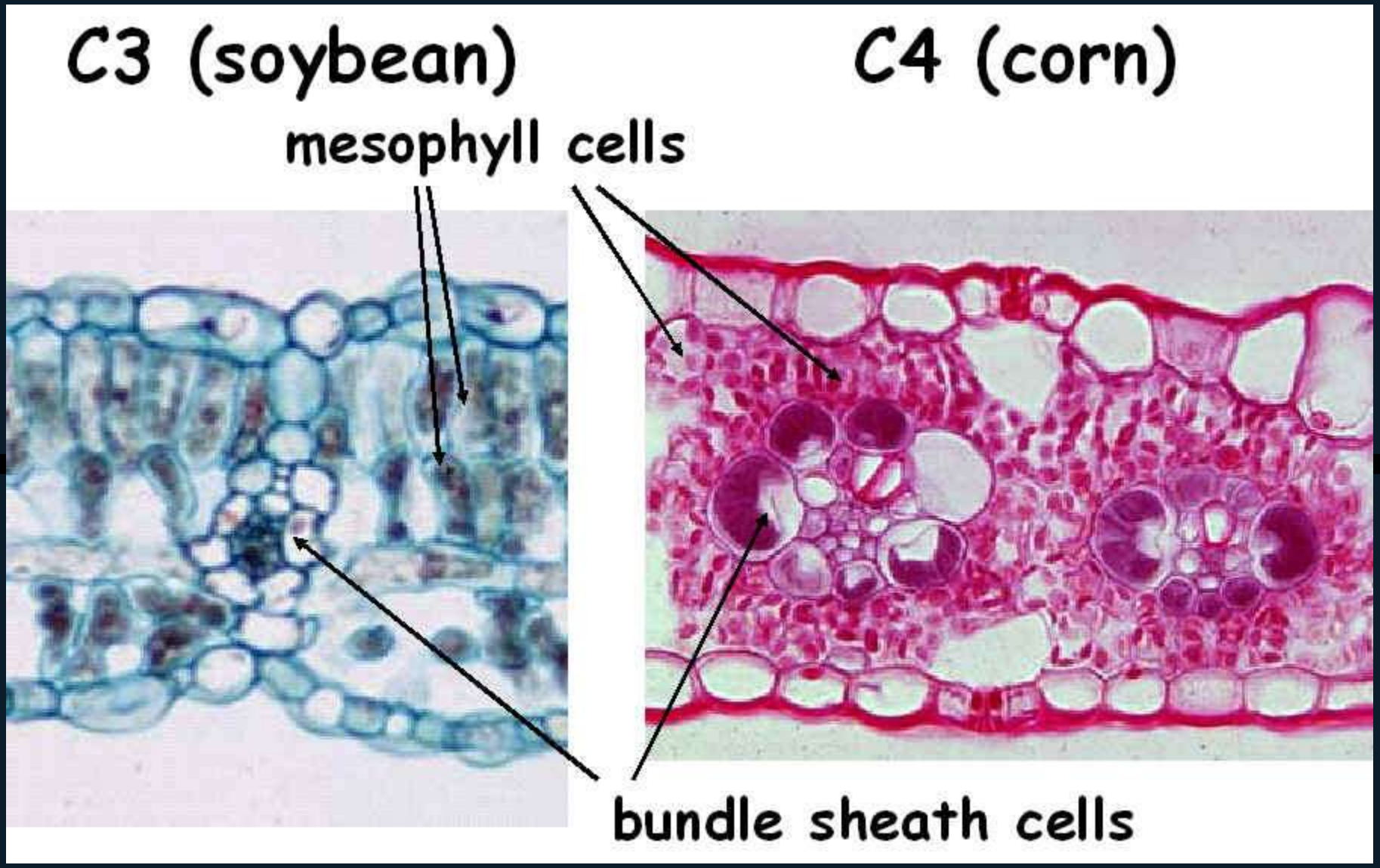
NDF composition and digestibility varies



NDF composition and digestibility of bermudagrass varieties at 3 weeks of regrowth

Variety	NDF (%)	DM Digestibility at 48 h (%)	NDF digestibility at 48 h (%)
Coastal	66.9	51.4	42.6
Tifton 85	68.6	61.7	60.6

Adapted from Mandebvu et al. (1999). J. Ani. Sci. 77:1572-1586


C3 (soybean)
C4 (corn)
mesophyll cells
bundle sheath cells

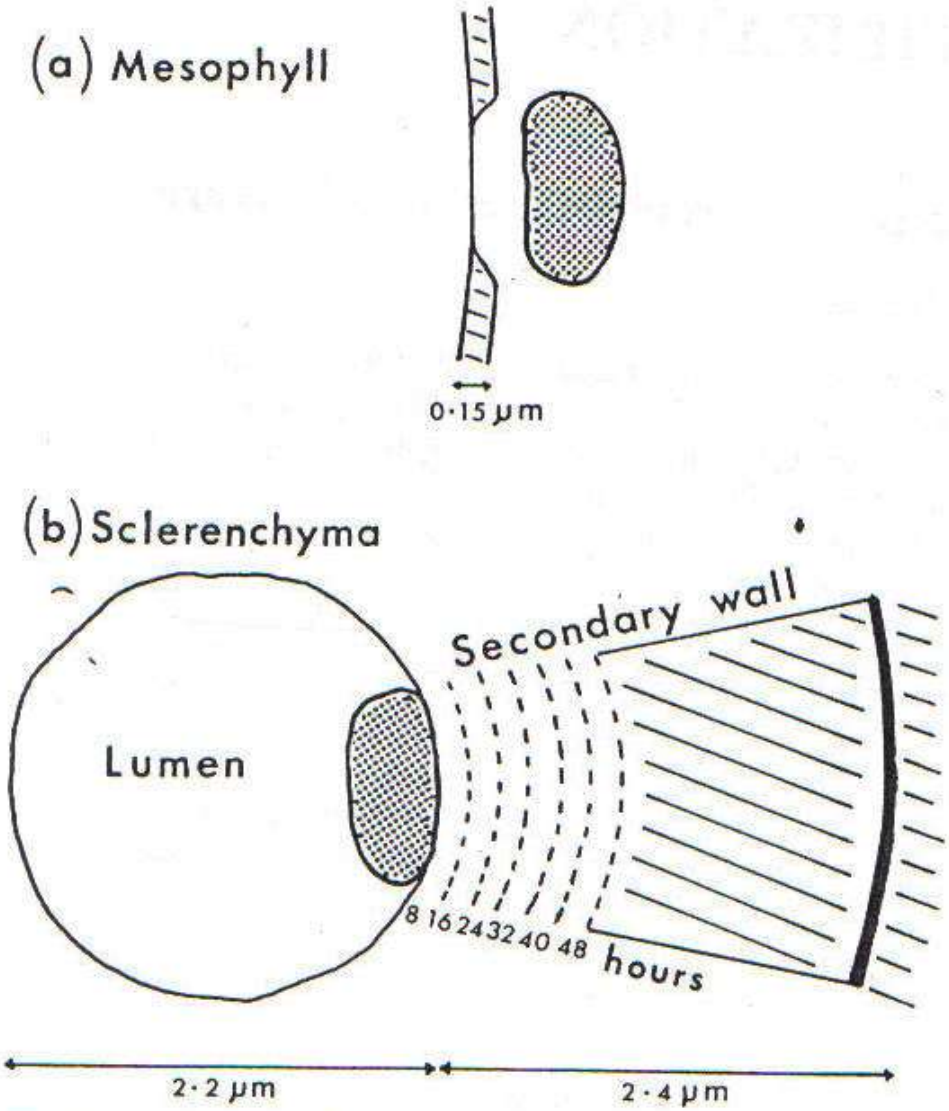


Fig. 1. Cross section of digestion by a bacterium (stippled) of (a) a mesophyll cell primary wall from the outer surface, compared with (b) a sclerenchyma cell secondary wall from the inner lumen surface (primary wall–middle lamella contiguous with the adjoining cell depicted as a thick line), showing progressive digestion fronts during 8 to 48 h based on the same digestion rate of 0.15 µm 8 h^{-1} as for the mesophyll cell (see text). Cells and bacteria (1 by 0.5 µm) drawn to scale.

- Mesophyll cells are easily digested and they are present in greater proportion in legumes and cool-season grasses (C3)
- Sclerenchyma and bundle sheath cells are slowly digested and they are present in greater proportion in warm-season grasses

Wilson and Mertens (1995)

Proteins are mostly present in thick-walled cells in warm-season grasses

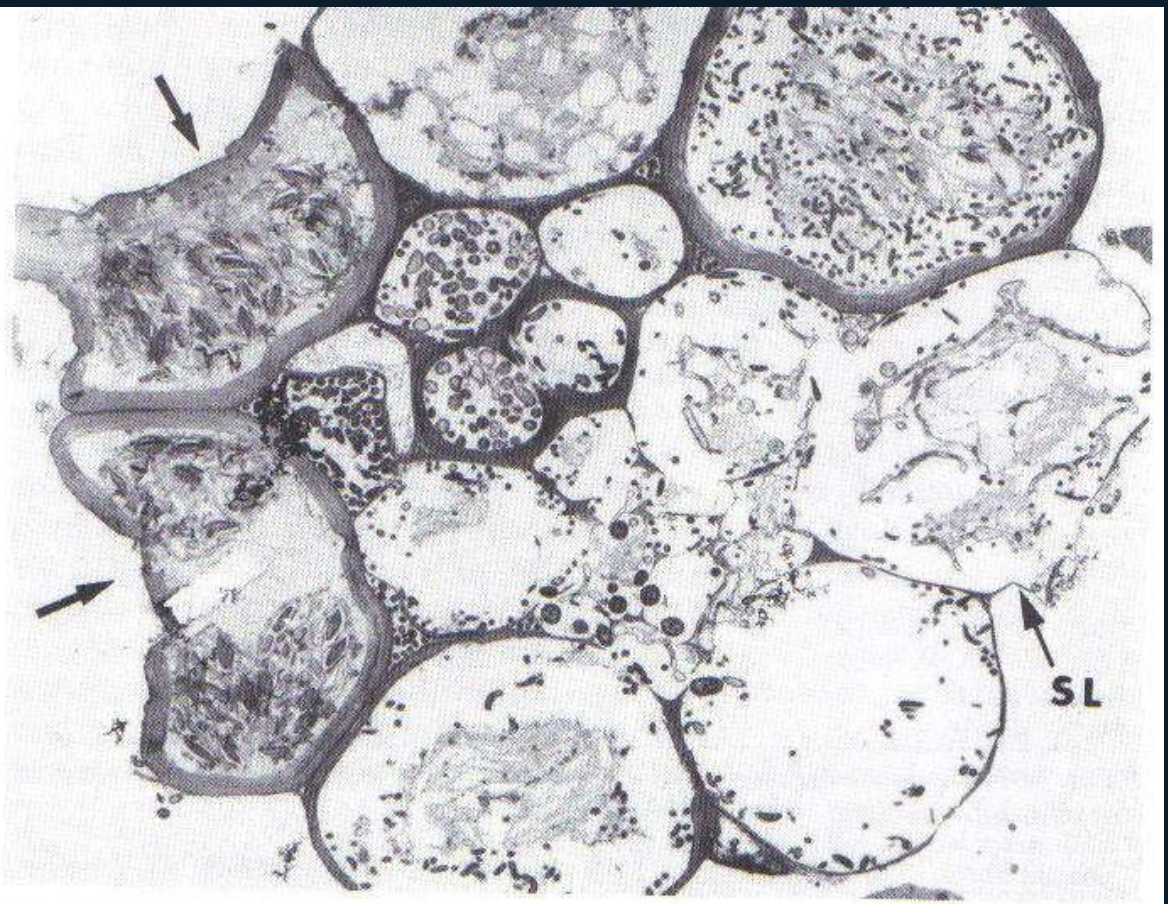
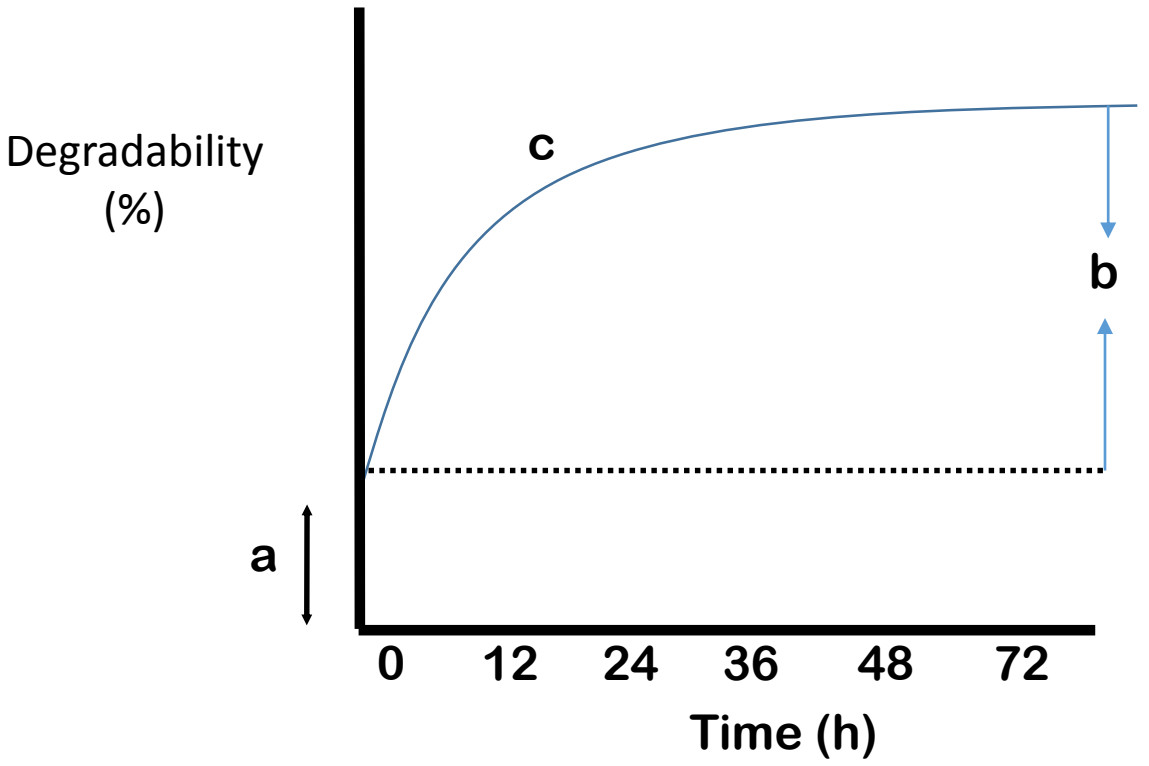


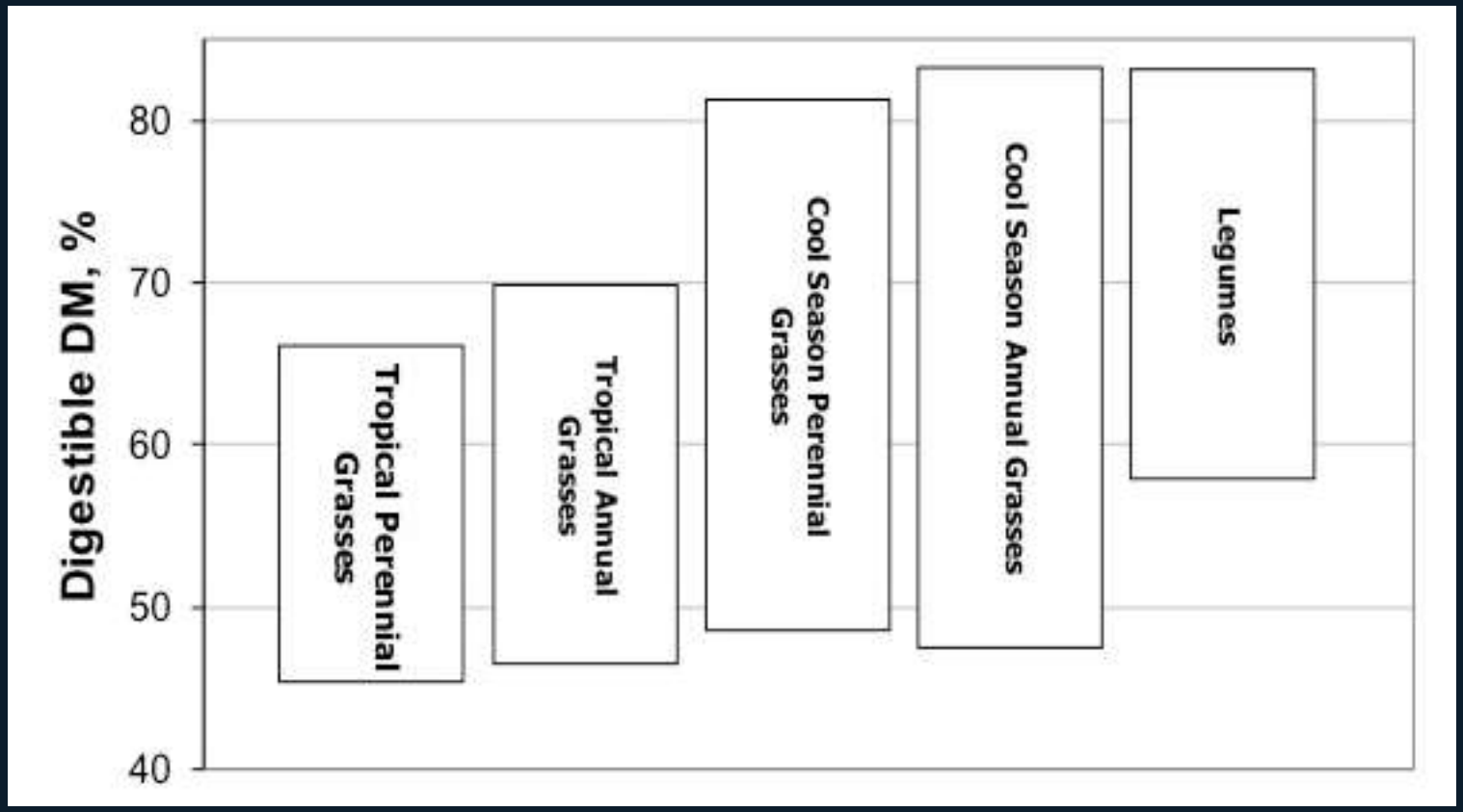
Fig. 1-3. Electron micrograph of a vascular bundle of a tropical grass (*Panicum antidotale* Retz.-NADP-ME type of C_4 grass) digested for 24 h in rumen fluid showing some parenchyma bundle sheath cells with no digestion of contents (↓) and other cells with only the thin suberized lamella (SL) remaining. Note absence of mestome sheath in this C_4 photosynthetic type.

Wilson (1993)

How about digestibility?



Typical range of digestibility among different forages



Hancock et al. (2014)

Particle size and passage rate plays a role in digestibility

	Intake g DM/kg$^{0.75}$.day	DM Digestibility (%)
Chopped	44.1 ± 2.0	51.7 ± 0.6
Pelleted	58.4 ± 1.9	45.3 ± 1.0
Difference	+14.3**	-6.4**

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Adapted from Minson (1967)

Factors affecting voluntary feed intake

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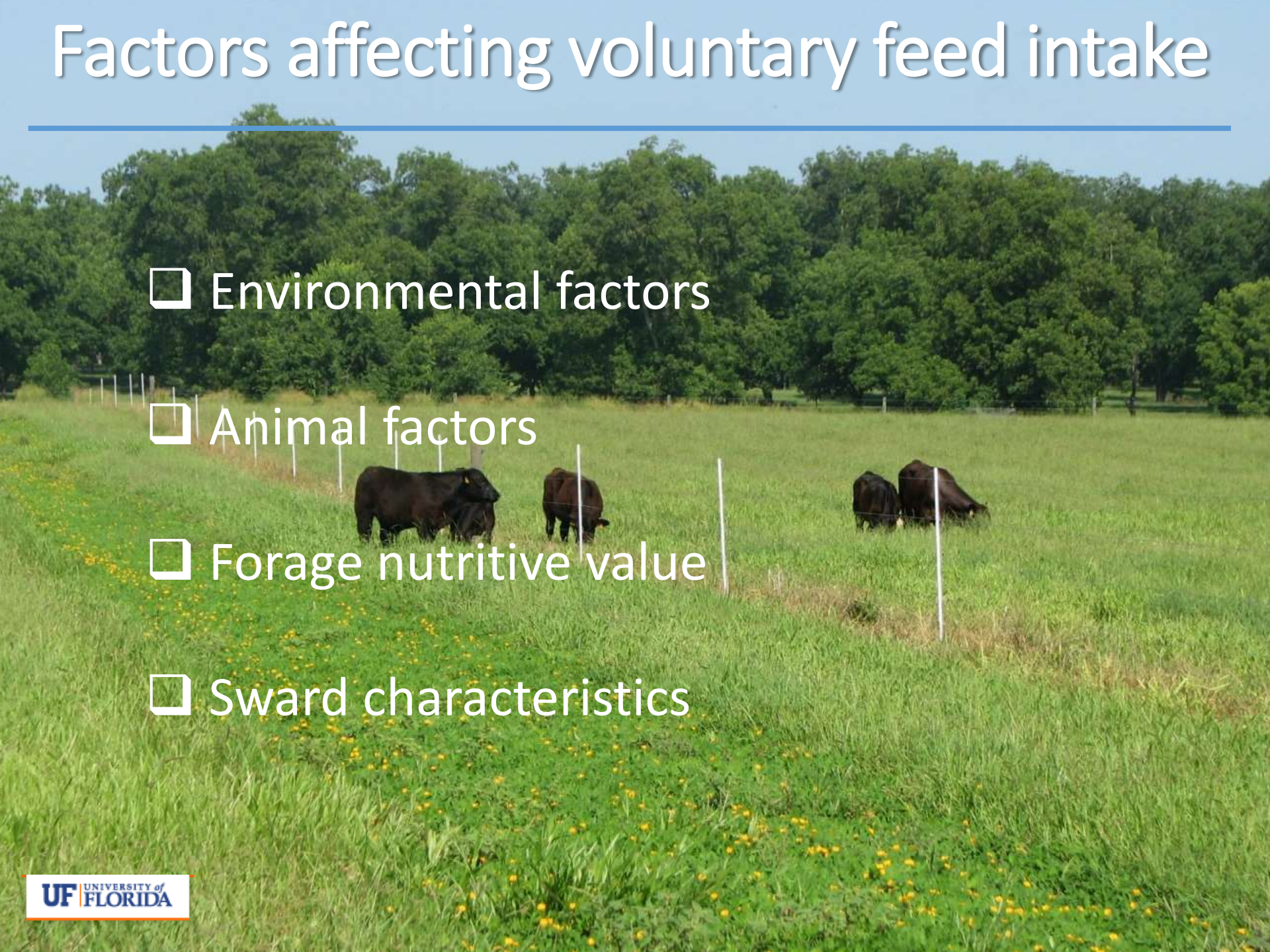
Factors affecting voluntary feed intake



- Environmental factors
- Animal factors
- Forage nutritive value
- Sward characteristics

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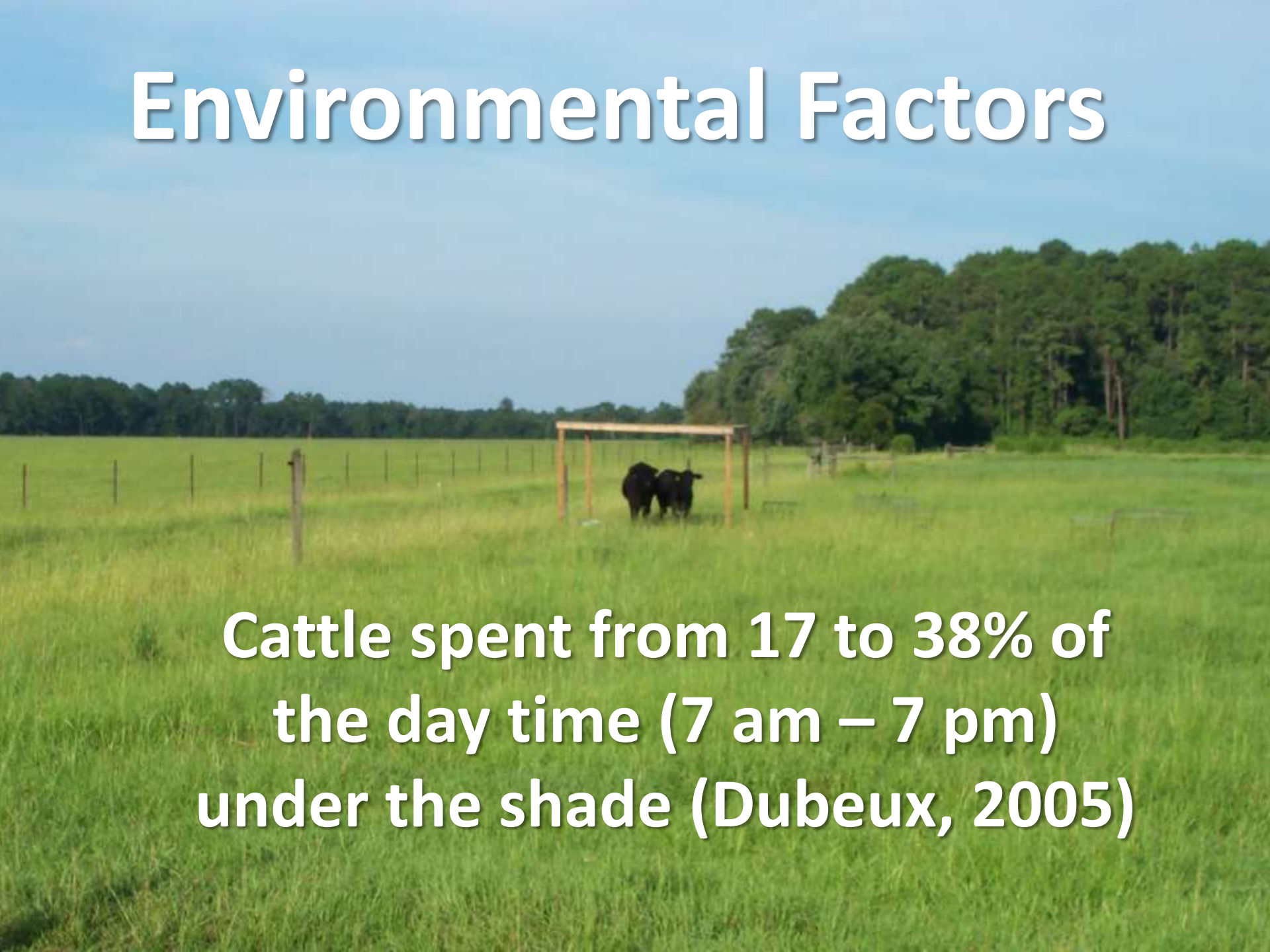
Environmental Factors



Cattle spent from 17 to 38% of the day time (7 am – 7 pm) under the shade (Dubeux, 2005)

Animal factors

Age, weight, sex, genetic potential, physiological status, previous treatment –
All affect voluntary intake

Intake and nutritive value

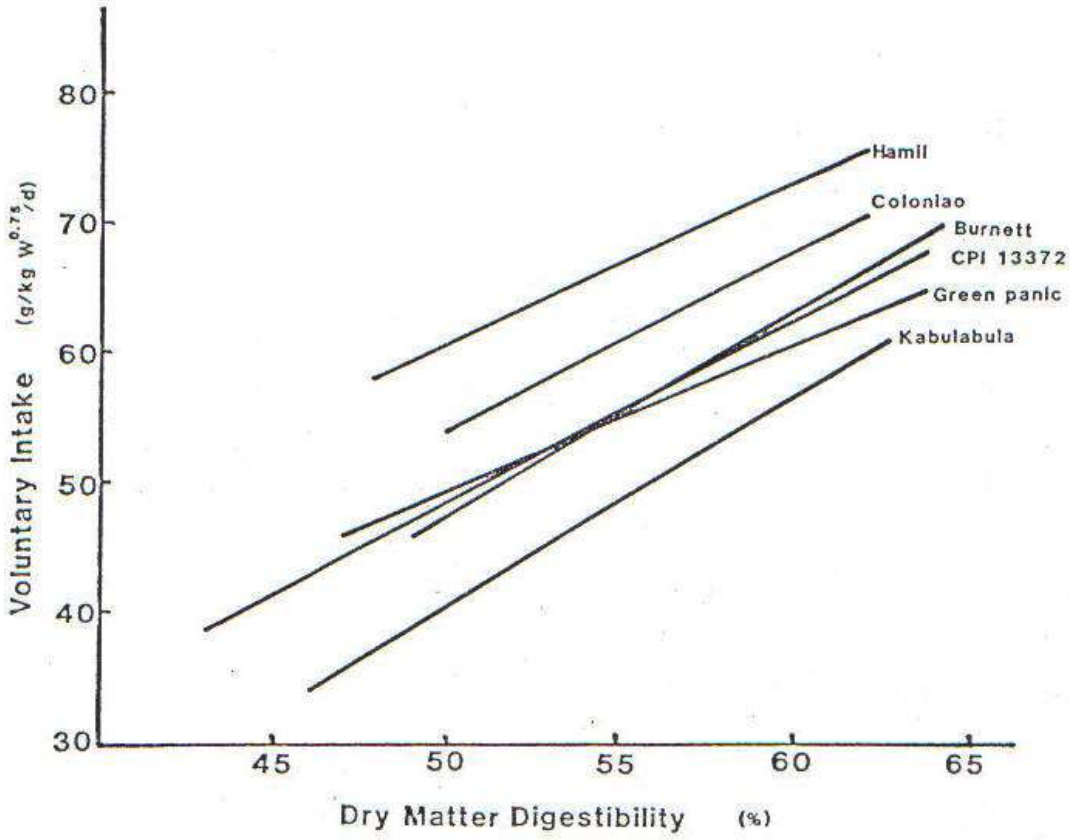


Fig. 5. Relation between intake and digestibility for six varieties of Panicum (Data from Minson 1971). from MINSON, 1982

Intake and Herbage Allowance

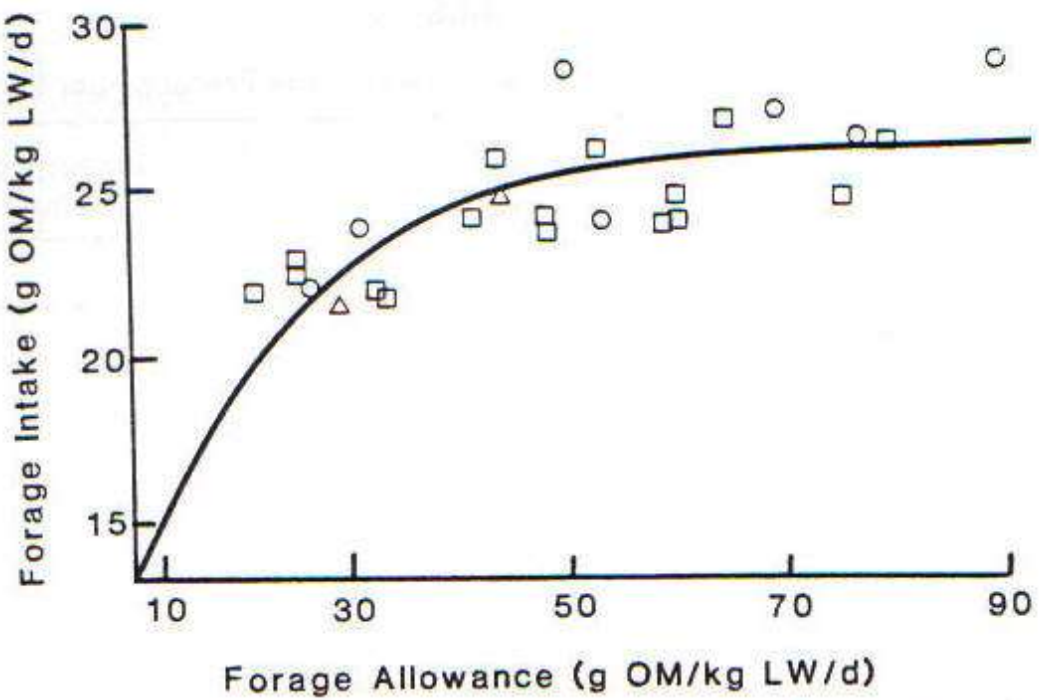


Fig. 3.2. The effect of forage allowance on intake by calves (○), beef (△), and dairy (□) cows. Data from Ernst *et al.* (1980).

Minson, 1990

Intake and Herbage Allowance

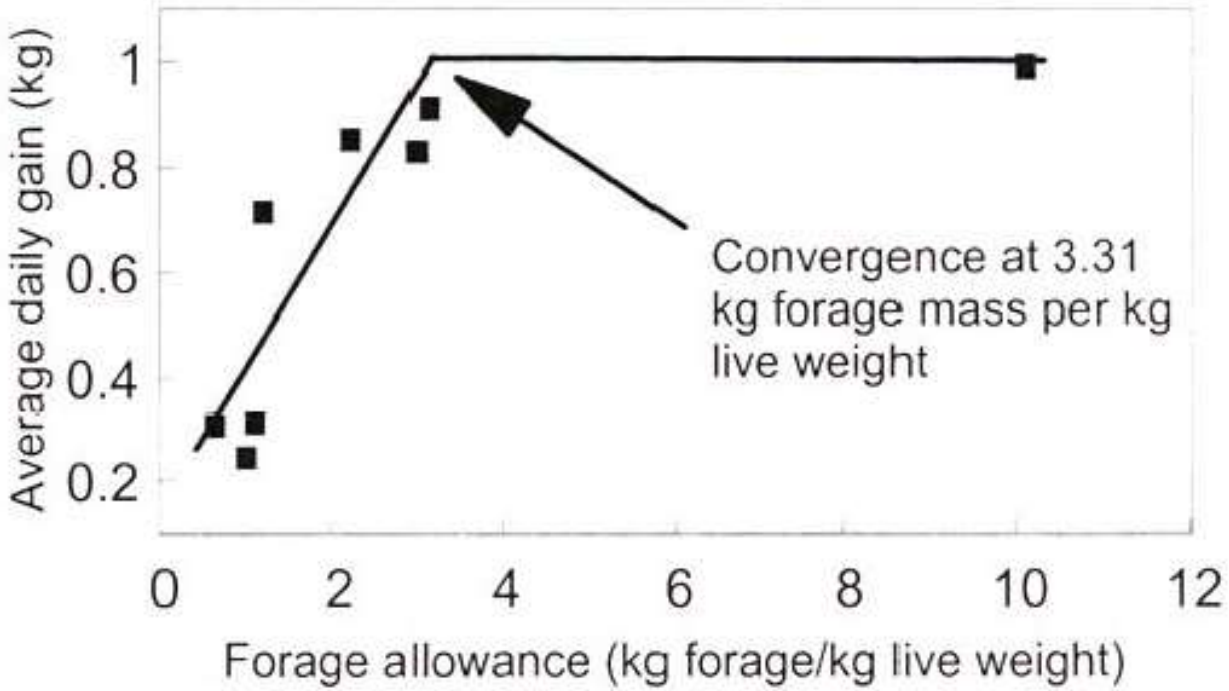
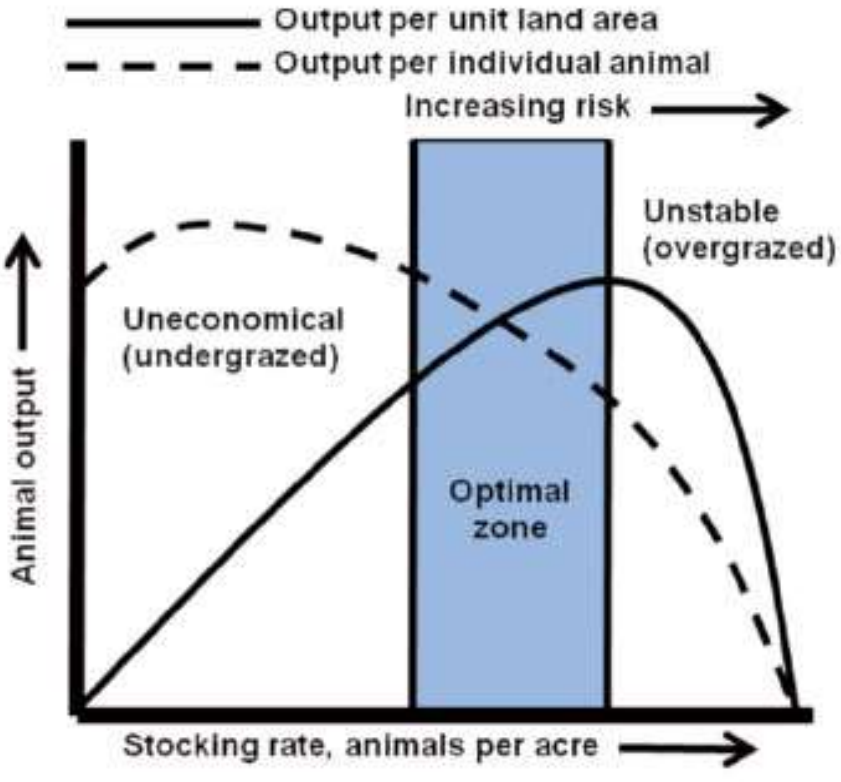


Fig. 2. Relationship of average daily gain and forage allowance (kg of forage per kg of animal live weight) for continuously stocked pearl millet [*Pennisetum glaucum* (L.) R. Br.] pastures. Adapted from McCartor and Rouquette (1977).

Sollenberger et al., 2006

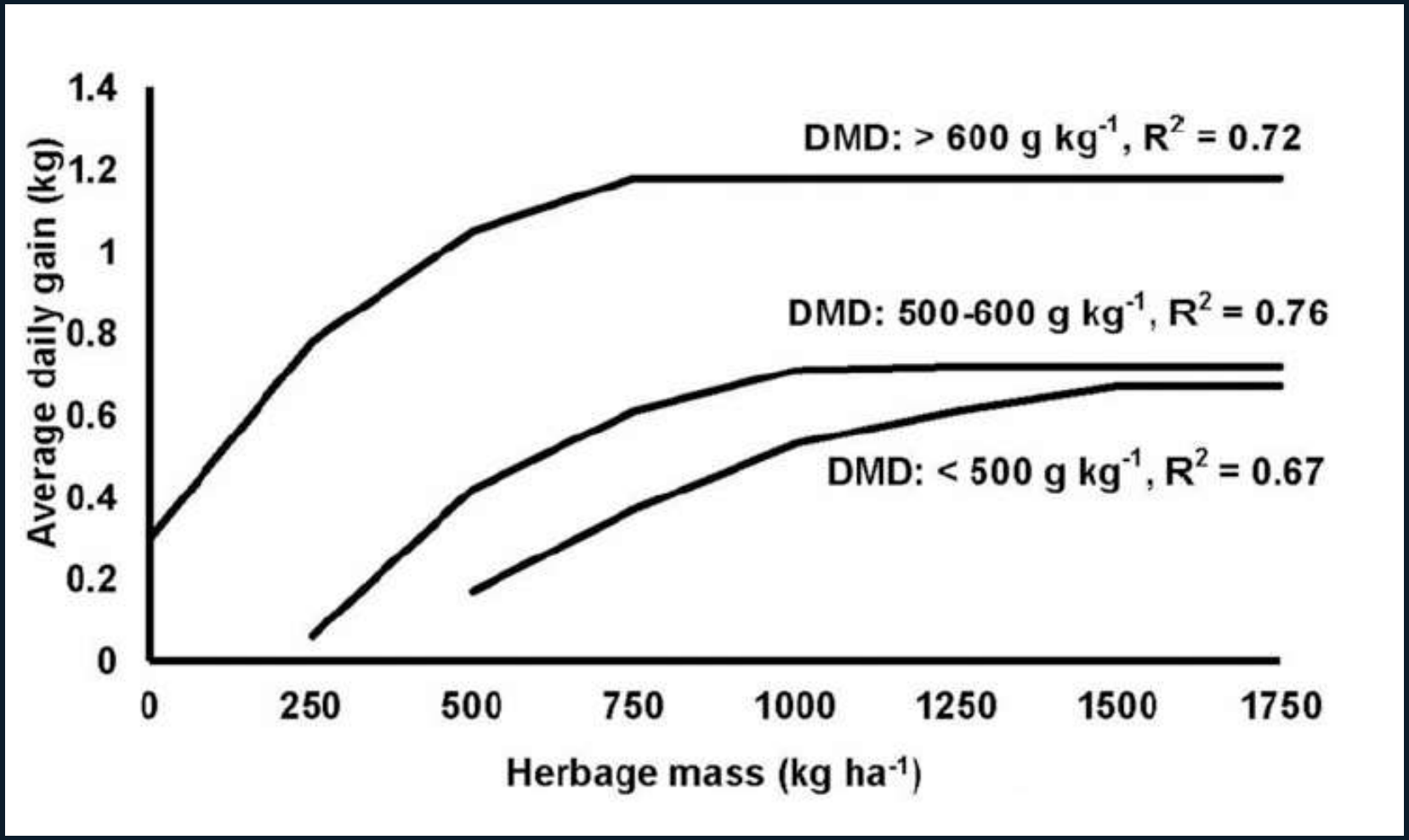
Grazing management makes a difference

Undergrazing



Overgrazing

Nutritive value and herbage mass combined set the limits



Source: Duble et al. (1971) adapted by Sollenberger and Vanzant (2011)

Quality of conserved forages

- Methods of conserving forages do not improve forage quality
- There are losses in quantity and quality
- Losses occur at the field and during storage

Losses

	Harvesting and Baling	Storage	Feeding	Total losses
Hay, no cover/on ground	7-15%	20-40%	5-25%	30-60%
Hay, under roof	7-15%	2-10%	5-15%	15-35%
Baleage	3-10%	3-10%	4-10%	10-25%

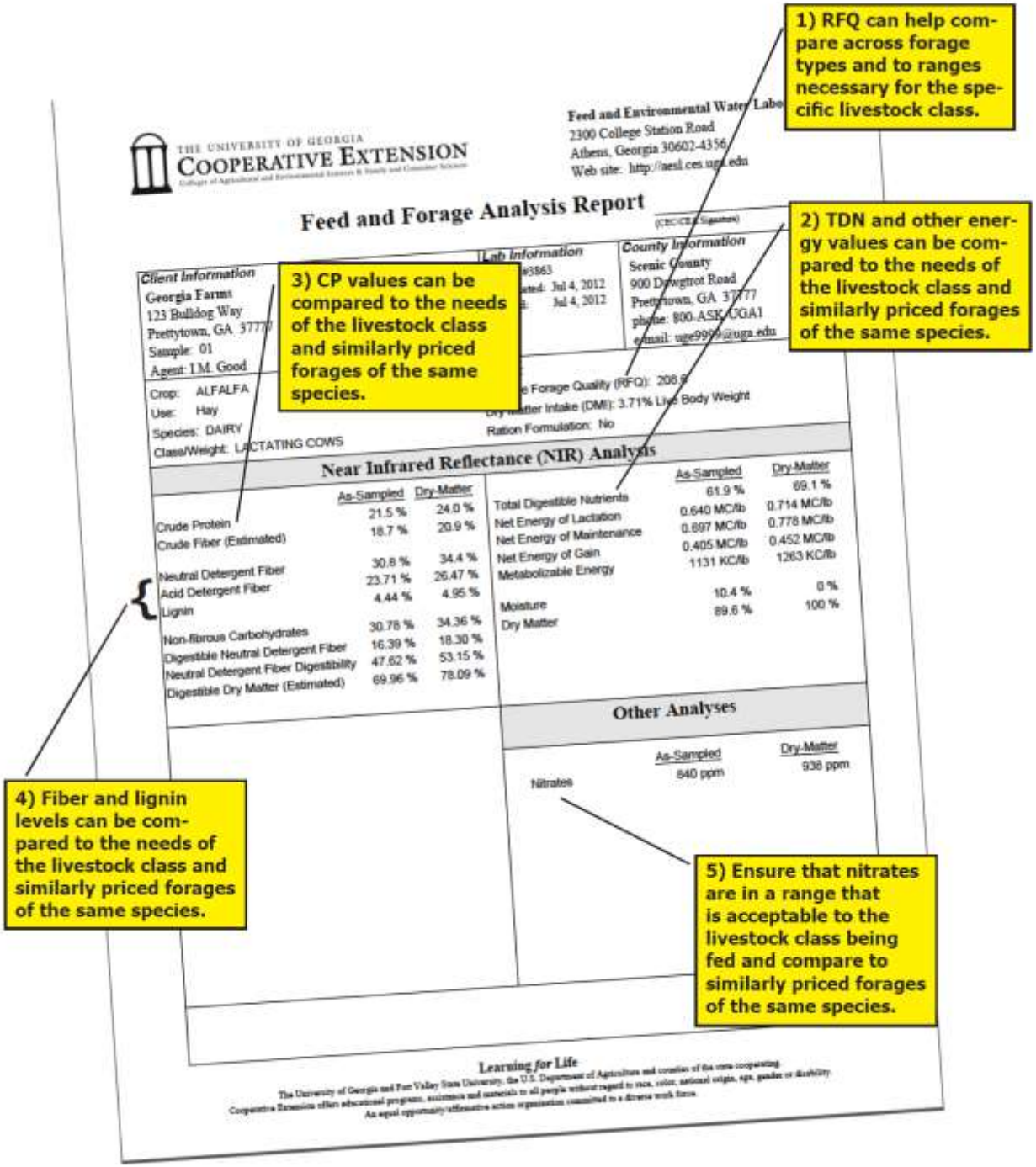
Source: Hancock, 2010

Losses

	Cost of production ($/ton)			
	$80	$100	$120	$140
	Value of losses in the system ($/ton)			
Hay, no cover/on ground 50% losses	$40	$50	$60	$70
Hay, under roof 25% losses	$20	$25	$30	$35
Baleage 15% losses	$12	$15	$18	$21

Source: Hancock, 2010

First things first…
Testing is essential to know what you are feeding


1) RFQ can help compare across forage types and to ranges necessary for the specific livestock class.
2) TDN and other energy values can be compared to the needs of the livestock class and similarly priced forages of the same species.
3) CP values can be compared to the needs of the livestock class and similarly priced forages of the same species.
4) Fiber and lignin levels can be compared to the needs of the livestock class and similarly priced forages of the same species.
5) Ensure that nitrates are in a range that is acceptable to the livestock class being fed and compare to similarly priced forages of the same species.
THE UNIVERSITY OF GEORGIA
COOPERATIVE EXTENSION
Feed and Environmental Water Labo
2300 College Station Road
Athens, Georgia 30602-4356
Web site: http://aesl.ces.uga.edu
Feed and Forage Analysis Report
Client Information
Georgia Farms
123 Bulldog Way
Prettytown, GA 37777
Sample: 01
Agent: I.M. Good
Lab Information
Jul 4, 2012
Jul 4, 2012
County Information
Scenic County
900 Dawgtrot Road
Prettytown, GA 37777
phone: 800-ASK-UGA1
Crop: ALFALFA
Use: Hay
Species: DAIRY
Class/Weight: LACTATING COWS
Ration Formulation: No
Near Infrared Reflectance (NIR) Analysis
As-Sampled
Dry-Matter
Crude Protein 21.5 % 24.0 %
Crude Fiber (Estimated) 18.7 % 20.9 %
Neutral Detergent Fiber 30.8 % 34.4 %
Acid Detergent Fiber 23.71 % 26.47 %
Lignin 4.44 % 4.95 %
Non-fibrous Carbohydrates 30.78 % 34.36 %
Digestible Neutral Detergent Fiber 16.39 % 18.30 %
Neutral Detergent Fiber Digestibility 47.62 % 53.15 %
Digestible Dry Matter (Estimated) 69.96 % 78.09 %
As-Sampled
Dry-Matter
Total Digestible Nutrients 61.9 % 69.1 %
Net Energy of Lactation 0.640 MC/lb 0.714 MC/lb
Net Energy of Maintenance 0.697 MC/lb 0.778 MC/lb
Net Energy of Gain 0.405 MC/lb 0.452 MC/lb
Metabolizable Energy 1131 KC/lb 1263 KC/lb
Moisture 10.4 % 0 %
Dry Matter 89.6 % 100 %
Other Analyses
As-Sampled
Dry-Matter
Nitrates 840 ppm 938 ppm
Learning for Life

Baleage is an option when weather conditions do not allow the forage to dry and make hay

Hay

If drying conditions are adequate, hay is usually cheaper

Investing in a hay barn will pay back the $ spent

Poor quality hay lead to poor results

Item	Pensacola bahiagrass hay
DM, %	92.5
OM, %DM	95.1
CP, %DM	8.9
NDF, %DM	84.7
ADF, %DM	48.0
Hay DM intake, %BW	2.46
Initial weight, lbs	515
Average Daily Gain, lbs	- 0.33

Adapted from Kostenbauder et al. (2007)

If you are investing your money, do it the right way…

- **Choose the right species**
- **Manage it right**
- **If conserving as hay or baleage, minimize your losses using proper management practices**
- **Increasing efficiency of production will improve profits**

Concluding remarks

- Forage quality affects animal performance
- In a scenario of declining market, increasing ranch profitability requires greater production efficiency
- Losses in conserved forages might lead to very expensive products at the end
- Management strategies might be implemented to improve forage quality, animal performance, and ultimately, ranch profits


Thank you
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