Using ruminants to optimize economic opportunities on horticultural lands

Shawn Archibeque, Ryan Rhoades, Joe Brummer

Colorado State University

Department of Animal Sciences

My Baggage

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- B. S. 1998 Colorado State University
  - Animal Science, Environmental Health
- M. S. 2000 North Carolina State University
  - Nutrition
- Ph.D. 2003 Texas A&M University
  - Nutrition
- Post Doc. 2003-2006

  USDA ARS U. S. Meat Animal Research Center, Clay Center, NE

Overview

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- Ruminants, why are they cool
- Business options for using ruminants
- Practical applications and concerns

Ruminant Digestion

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A. Herbivores
   - Largest % of herbivores

B. Use the world's largest CHO source for energy

C. Evolution
   - Available food
   - Safety

Production

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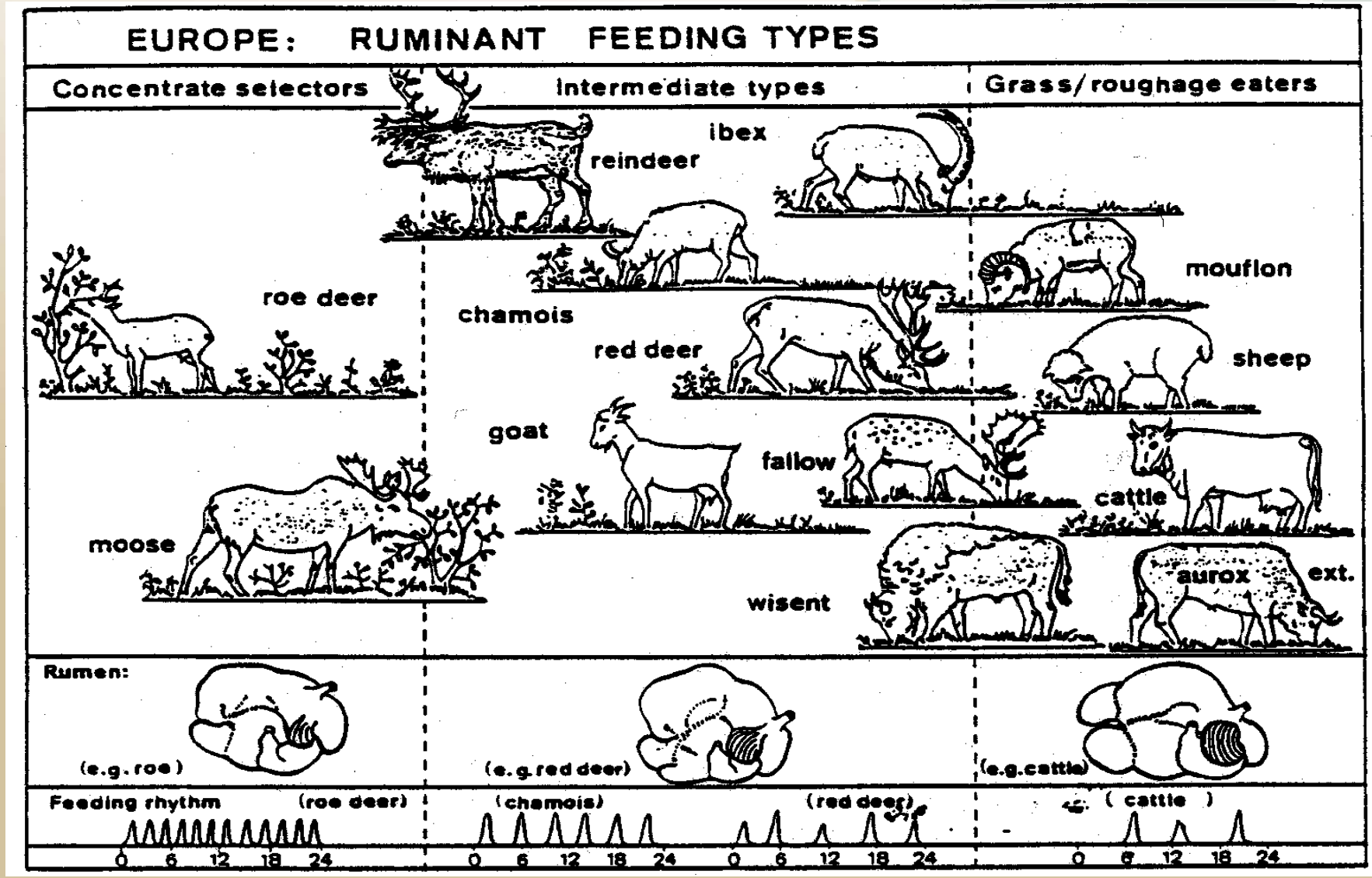
- Ruminant production systems are diverse.
- Diets ruminants consume are diverse.
- Ruminal fermentation has a major impact on nutrient supply to the host.
- Across these diverse production systems, feed costs represent 45 to 60% of total production costs!
- OPPORTUNITY!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!


EUROPE: RUMINANT FEEDING TYPES
Concentrate selectors
Intermediate types
Grass/roughage eaters
ibex
reindeer
roe deer
mouflon
chamois
red deer
sheep
goat
fallow
cattle
moose
wisent
aurox
ext.
Rumen:
(e.g. roe)
(e.g. red deer)
(e.g. cattle)
Feeding rhythm
(roe deer)
(chamois)
(red deer)
(cattle)
0 6 12 18 24
0 6 12 18 24 0 6 12 18 24
0 6 12 18 24

The Ruminant Digestive System

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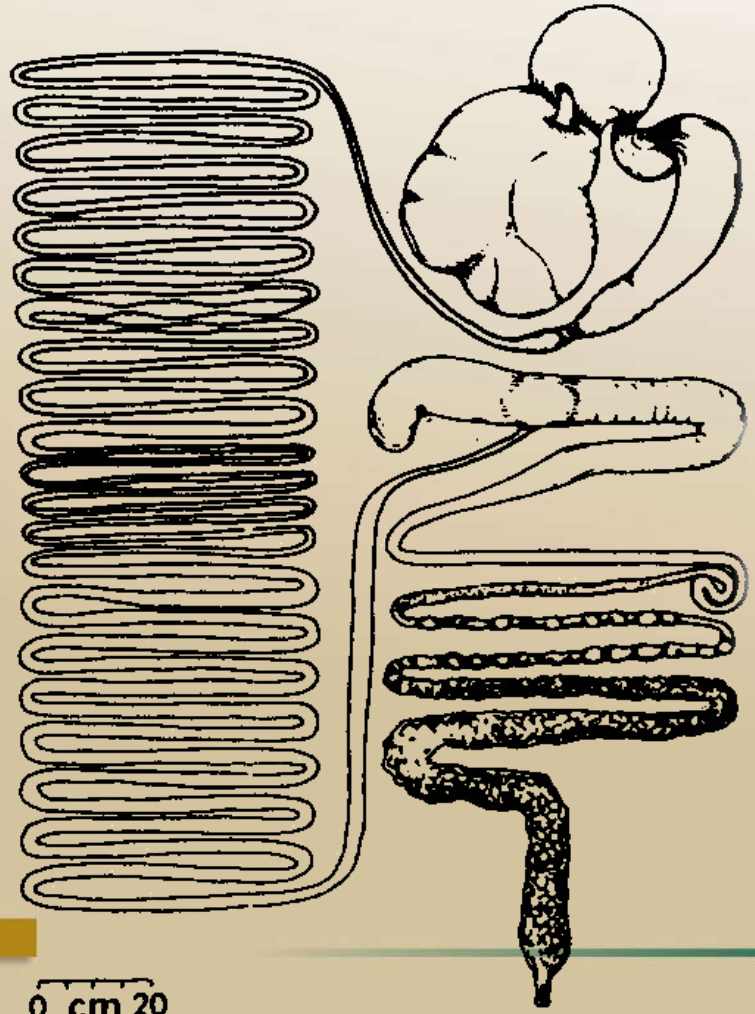
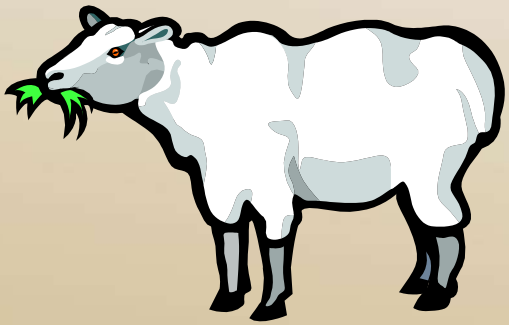


Sheep



Adaptability of the rumen

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- **Types of microorganisms in the rumen**
  - **Bacteria**
  - **Archea**
  - **Protozoa**
  - **Fungi**
  - **Mycoplasma**
  - **Bacteriophages**
- **Considerable diversity in the population**
  - **Traditional culturing techniques**
    - **Bacteria: 22 Genera and 68 species**
    - **Protozoa: 6 Genera and 15 species**
    - **Fungi: 3 Genera and species**
  - **Molecular techniques**
    - **Bacteria: 116 Genera and 300 species**
    - **?????**

- Cellulolytic bacteria
  - pH 6.0-7.0
  - Will not grow at pH < 6.0
  - Reasons:
    - Depletion of HCO_3
    - VFAs are inhibitory
    - Destruction of membrane potential
  - NH3

- Hemicellulolytic bacteria
  - Hemicellulose
    - A major component of plant cell walls
    - A chain of hexoses, pentoses, and uronic acids bound by beta-1,4-linkages
    - Digestibility determined by lignification

Food Supply

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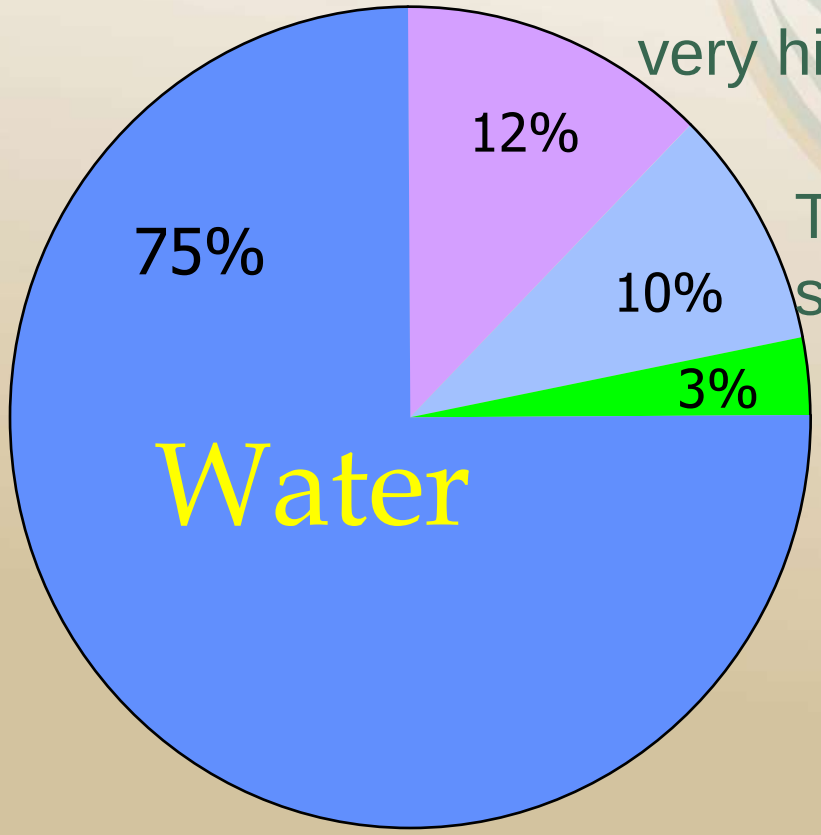

Polar caps, swamps, deserts, very high mountains

Too cold, wet, rocky, steep, dry, paved, etc.

Tillable

Animal Ag & The World

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- Increase in human population
- Socio-economic status and meat consumption
- Animal Ag and competition with humans
  - Alternative feeds/water
  - Edible feeds not fit for humans
  - Feed on non-arable lands

What does it mean?

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- In ruminants, microbial fermentation precedes enzymatic digestion and intestinal absorption
- Non-competitive feeds
- Extensive use of forages
- Byproducts

Long History of Waste Use

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- Desert ruminants
- Pastoral societies
- Potato Famine
- Commercial Food
  - Yellow Grease
  - Brewers Grains
  - Bakery Waste
  - Etc.

Potential

- Low- moderate quality forages
- Improve nutrient availability for forage-fed ruminants
  - Bacteria that digest cellulose prefer non-protein N
- Determine optimum levels of supplements to optimize production
- Utilize forages to improve manure value
  - N:P ratio

Common Practices

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Integrating Livestock: Methods

- Livestock grazing annual forage (cover crops) within cash-crop rotations
  - Established for temporary soil cover
  - Success limited by moisture availability
- Grazing of crop residue
  - Residues remaining after grain harvest
  - Simple and most economical method of integration

Benefits

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Integrating Livestock: Environmental

- Improve Soil Condition
  - Manure from livestock increases within farm nutrient cycling = less fertilizer needed
  - Build soil organic carbon = higher yield potential
  - Conservation (cover crops example)
    - Resistance to soil erosion
    - Increased water infiltration
    - Improved weed control (competition)

Benefits

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Integrating Livestock: Economic

- Improve Profitability
  - Diversify revenue- reduce production and financial risk associated with raising a single product
  - Profit un-used resource- increase farm net worth (>$10,000; crops + beef cows vs. crops only)
  - Flexibility of what and when to sell- declining market prices for most commodities
  - Potential to increase productivity and reduce input costs

Challenges

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Integrating Livestock: Resources

- Lack of Infrastructure
  - Farm size and spatial distribution of fields
  - Water, fence, and working facilities
  - Labor availability, ability, and cost
- Lack of Skill Set
  - Managerial complexity with diversification
  - Livestock feeding (requirements)
  - Ownership decision
    - Cow-calf vs. stockers
    - Purchase vs. contract graze

Challenges

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Integrating Livestock: Biggest Concern

- Soil Compaction = negative crop yield (?)
  - Minimal to no impact influenced by
    - Weight of animal
    - Grazing management
    - Animal density
    - Forage species present
    - Soil moisture
  - Impact can be minimized by
    - Grazing restricted to periods when dry or frozen
    - Soil appropriately tilled before planting cash-crop

Management Considerations

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Integrating Livestock: Annual Forages

- Species Selection
  - Grasses- Cereal grains, warm-seasons like sudangrass, sorghum-sudangrass, and millets
  - Broadleaf- Brassicas (>80% water)
  - Legumes- Clovers and peas (winter survival problem)
  - Mixes (two or more species)- works best
- Variable Production & Nutritional Value
  - Amount of light (affected by residue amount)
  - Appropriate water and growth temperature
  - Soil fertility (residual N)
  - Depends on what species are planted

Management Considerations

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Integrating Livestock: Annual Forages

- Variable Animal Performance
  - Minimal data available
  - Crop mixtures mostly brassica = lower gains
  - Dry forage (wheat straw or corn stalks) improves gains
- General Management
  - Plant as soon as possible following cash crop harvest
  - Start grazing at appropriate height and leave at least 4 inches of residue after grazing
  - Fall grazing can likely begin around October 1

Management Considerations

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Integrating Livestock: Crop Residue

- Stocking Rate
  - Scout fields prior to grazing (amount of grain & look for piles that could cause overload)
  - Based on bushel yield per acre (UNL-calculator)
  - Estimate stocking rate or grazing days
    - Quick example- 180 bushel yield/3.5 = 51 grazing days/ac
  - Consider rotating livestock- several paddocks
    - Use moveable polywire and step-in posts
    - Improves harvest efficiency
    - Keeps diet quality more uniform until end of grazing period
  - Be flexible

Management Considerations

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Integrating Livestock: Crop Residue

- Supplementation
  - Cows
    - Mature non-lactating spring calving cows in BCS 5 or higher = no supplement (mineral-yes)
    - Fall calving cows & First-calf heifers (spring calving) = protein and energy supplement (3.5 - 4.5 lbs/head/day 30% CP)
  - Stockers
    - Weaned calves targeted gain (1.0 lb/d) = protein and energy supplement (2-3 lbs/head/day 30% CP)
  - Weather Concerns
    - Drought stressed can have elevated nitrates (bottom of stalk)
    - Frost- prussic acid potential with sorghums
    - Deep snow can limit cattle ability to graze residue

Conclusions

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- Ruminants can make use of products other animals cannot use.
- Diversified crop-livestock systems are more:
  - Productive
  - Sustainable
  - Economically competitive
- Planning important in integrating livestock and cropping systems

Questions?

Source: Savory Institute