<table>
<thead>
<tr>
<th>Diet Preference Animal Species</th>
<th>Type of Diet</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Grasses (%)</td>
</tr>
<tr>
<td>Cattle</td>
<td>65 -75</td>
</tr>
<tr>
<td>Horses</td>
<td>70 - 80</td>
</tr>
<tr>
<td>Sheep</td>
<td>45 - 55</td>
</tr>
<tr>
<td>Goats</td>
<td>20 - 30</td>
</tr>
<tr>
<td>White-tail deer</td>
<td>10 - 30</td>
</tr>
<tr>
<td>Elk, red, and fallow deer</td>
<td>30 - 60</td>
</tr>
</tbody>
</table>

1 Shrubs or trees


---

Ruminant Digestive System

- Primary fermentation vat
- 5-10 gallons (mature goat)
- Contents in 3 layers: liquid, fibrous mat, gas
- Cud-chewing, saliva

Rumen

- Papillae lining
- VFA absorption
  - Acetate, propionate, and butyrate
  - Propionate highest energy content
  - Acetate used in udder to produce milkfat
Reticulum

- Smaller fermentation pouch
- Assists in contractions
- Captures foreign objects

Rumen Microbes

- Bacteria, protozoa, and fungi
- 150+ species identified
- Five major groups:
  - Fiber fermenting bacteria
  - General purpose bacteria
  - NSC fermenting bacteria
  - Secondary feeders
  - Protozoa
- All working in harmony (if fed properly!)

Omasum

- "Many plies"
- Hardball-sized chamber
- Regulates particle passage from rumen
- Absorbs excess water from digesta
Abomasum

- “True” stomach - acid digestion
- Similar to humans and pigs
- Digestive enzymes, hydrochloric acid break down complex proteins and carbohydrates for absorption in small intestine

Rumen Dysfunctions

- Acidosis
  - Excess grain (starch), insufficient fiber results in overgrowth of lactic acid-producing bacteria, lowered rumen pH
  - Milkfat depression
  - Rumen damage
- Heat Stress
  - Decreased dry matter intake
  - Panting

Comparative Capacity of the GI Tract

![Graph showing comparative capacity of the GI Tract for Man, Pig, Cattle, Sheep & Goats, and Horse.]
FIVE Basic Classes of Nutrients

- WATER
- PROTEIN
- ENERGY (carbohydrates / fats)
- VITAMINS
- MINERALS

WATER
- The most important of the nutrients
- Fresh, Clean, ALWAYS available
- 1.5 gallons per head per day (doe)
- Deprived - loss of 1.5% BW in 4 days
- Decreased forage consumption
- Increased body temperature, respiration rate and pulse rate
- Milk production - 1:5 DM:Water ratio

PROTEIN
- The major component of muscle, hair, hooves, skin, internal organs and body chemicals
- Composed of smaller units, Amino Acids
- Goat rations balanced for protein rather than individual amino acids
- Rumen microbes digest most of protein and change it to microbial protein
Forage Quality & Goat Requirements

**PROTEIN**

<table>
<thead>
<tr>
<th>Protein (CP) requirement for different classes of meat goats</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pasture Veget.</td>
</tr>
<tr>
<td>Buck</td>
</tr>
<tr>
<td>5</td>
</tr>
</tbody>
</table>

**Forage Quality & Goat Requirements**

**PROTEIN**

- Weanling - Does in Early Lactation
- Yearlings
- Dry and Early Pregnant Does

**Energy Physiological Priorities**

Energy - the number ONE effect on reproduction

- Basal metabolism
- Activity
- Growth
- Energy reserves
- Pregnancy
- Lactation
- Energy reserves (milk fat)
- Estrus cycle / Initiation of pregnancy
- Excess energy reserves
Pearson Square Method

% CP in Feed 1
Ex. 36%

Feed 1 as % of Mixture
Ex. 3/27 = 11.1%

Target CP
Ex. 12%

% CP in Feed 2
Ex. 9%

Feed 2 as % of Mixture
Ex. 24/27 = 88.9%

Forage Quality & Goat Requirements
(TDN - Total Digestible Nutrients)

TDN %

Pasture Veget.  Pasture Mature  Pasture Dead

Nutrient Requirements
(on a dry matter basis)

<table>
<thead>
<tr>
<th></th>
<th>30 lb Kid*</th>
<th>60 lb Kid*</th>
</tr>
</thead>
<tbody>
<tr>
<td>Daily Feed Intake, lb</td>
<td>2.0</td>
<td>3.0</td>
</tr>
<tr>
<td>TDN, %</td>
<td>68</td>
<td>65</td>
</tr>
<tr>
<td>Protein, %</td>
<td>14</td>
<td>12</td>
</tr>
</tbody>
</table>

*gaining 0.44 lb/day
Creep Feeding a Supplement

VITAMIN Supplement for Goats

• Organic elements
• Water Soluble - B's, C
• Fat Soluble - A, D, E, K
• Energy metabolism
• Protein Synthesis
• Bone formation
• Absorption
• Imbalance and metabolic diseases
MINERALS

- Skeletal formation
- Cellular activity
- Oxygen transport
- Chemical reactions
- Enzyme systems
- Fluid balance

MINERALS

- Inorganic elements

- **Macro-minerals** - Calcium, Phosphorus, Potassium, Sodium, Chloride, Magnesium, Sulfur

- **Micro-minerals** - Iron, Iodine, Zinc, Copper, Selenium

- Ratios - Ca:P (2:1) and Zn:Cu (4:1)

- Toxic, deficient, unabsorbable

Mineral Supplement for Goats

- Phosphorus = 8 – 10%
- Calcium = 2 x Phosphorus
- Copper = 2,000 ppm (higher or lower depending on consumption – organic sources preferable)
- Lower NaCl for goats (< 10%)
- Magnesium = 2-4% (maybe higher if grass tetany is problem)
- Selenium = 50 – 80 ppm
Mineral Supplement for Goats

- Cobalt – 40+ ppm
- Manganese – minimum 3,500 ppm
- Zinc – minimum 4,000 to 10,000 ppm

Sulfates more absorbable than carbonates than oxides

Chelate package – Zinc Methionine Complex

Consumption per head per day – 0.25 to 0.31 ounces

Kelp meal – feed free choice (Atlantic or cold water)

Mineral Supplement for Sheep

- **Copper - < 300 ppm (wool sheep)
- **Sulfur – 1,000 ppm
- Zinc – 1,000 ppm
- Cobalt – 20 ppm
- Iodine – 100 ppm
- **Selenium – 50 ppm

Body Condition Score (BCS)

<table>
<thead>
<tr>
<th>BCS 2</th>
<th>BCS 7</th>
</tr>
</thead>
<tbody>
<tr>
<td>Extremely thin</td>
<td>Spine processes not visible</td>
</tr>
<tr>
<td>Spine and ribs visible</td>
<td>Frame not visible</td>
</tr>
<tr>
<td>Sternum protruding</td>
<td>Sternum covered</td>
</tr>
<tr>
<td>Skin on bone</td>
<td>Hooks and pins rounded</td>
</tr>
<tr>
<td>“V” cavity at tailhead</td>
<td>Flat between hooks</td>
</tr>
</tbody>
</table>
### ENVIRONMENTAL STRESS

- Heat and Cold
- Weather (precipitation and humidity)
- Nutrient density
- Quality of feed on offer
  - Predation
  - Travel (activity)
- Topography

### Major Effects of THERMAL STRESS on Nutrient Requirements

- Reduction in voluntary feed intake
- Digestibility and energy metabolism lowered
- Increased water consumption
- Mineral requirements shift – K and Na
- Forage quality decreases

### DEGREE of STRESS

(affected by)

- Breed of small ruminant
- Physiological state
- Age / Body size / Sex
- Nutritional status
- Social dominance
- Fight / flight distance
**ECONOMIC LOSS**

- Decreased reproductive performance of both males and females
- Inability to maintain body condition score
- Decreased growth rate of offspring
- Increased incidences of internal parasitism
- Suppressed immune system
Goat's Eye

1) Young green leaves / stems
   70 - 75% digestible
   20% CP
   24 - 30 hour turn over rate

2) Old green leaves
   60 - 65% digestible

3) Dead / brown leaves

4) Mature stems
   30% digestible
   4% CP
   72 hour turn over rate

Chemical composition of various plants browsed by goats (%)

<table>
<thead>
<tr>
<th>Browse type</th>
<th>Crude protein</th>
<th>Neutral detergent fiber</th>
<th>Calcium</th>
<th>Phosphorous</th>
</tr>
</thead>
<tbody>
<tr>
<td>Multiflora rose</td>
<td>18.8</td>
<td>34.5</td>
<td>0.99</td>
<td>0.32</td>
</tr>
<tr>
<td>Honeysuckle</td>
<td>12.8</td>
<td>34.5</td>
<td>1.21</td>
<td>0.30</td>
</tr>
<tr>
<td>Brambles</td>
<td>15.9</td>
<td>24.5</td>
<td>0.23</td>
<td>0.84</td>
</tr>
<tr>
<td>Privet</td>
<td>18.0</td>
<td>26.8</td>
<td>0.89</td>
<td>0.34</td>
</tr>
<tr>
<td>Green briar</td>
<td>17.0</td>
<td>39.5</td>
<td>0.60</td>
<td>0.18</td>
</tr>
<tr>
<td>Kudzu leaves</td>
<td>23.7</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Trumpet creeper</td>
<td>16.7</td>
<td>43.1</td>
<td>0.42</td>
<td>0.22</td>
</tr>
</tbody>
</table>
### Browsing Calendar
(based on the goat)

<table>
<thead>
<tr>
<th>Specie</th>
<th>Preferred Time of Production</th>
<th>Not Preferred</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Yellow Star Thistle</td>
<td>Leaf phase through seedhead production</td>
<td>Core heads are dead &amp; empty</td>
<td>All ages &amp; classes select 1st of various growth phases</td>
</tr>
<tr>
<td>Scotch Broom</td>
<td>Before flowering</td>
<td>Flowering</td>
<td>Caution using young doelings &amp; pregnant does</td>
</tr>
<tr>
<td>Chamise</td>
<td>Fall / winter / spring</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Buckeye</td>
<td>Fall as leaves die</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Tamarisk</td>
<td>New shoots, Young branched</td>
<td>Old decayed plants</td>
<td>Chronically barking &amp; trampling</td>
</tr>
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<td></td>
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</tr>
</tbody>
</table>

### Nutrition
Energy and protein levels in balance to reflect stage of production. Vitamin and mineral requirements are being met.

- Environment / weather
- Breed
- Stage of production
- Age and sex of goats
- Body weight and body condition
- Activity and exercise

### Soil Behavior

- Vegetation
- Energy Requirement of Goats
- Dietary Preference
- Quality

- Management Practices
- Plant species
- Nitrogen content
- Chemical composition
- Fertility
- Moisture
- Organic Matter
Electric Fencing
(Portable Solar Powered)

Maximize utilization of forage
Allocation based on forage quality and physical condition of goat
Manage individual or mixed plant species

Maintain healthy environment for vegetation and livestock
Recommendation: 1 to 2 goats per head of cattle

Lemon Orchard using Goats

Before

YEAR 1

After

YEAR 4

Forest Management
(Ladder Fuel Reduction)
Experimental site NCSU after four years of grazing

Nutrition Management Tips

- doelings separate
- Care of gestating does based on stage of pregnancy (first/second/third trimester), post-kidding and dry does
- Mineral / vitamin balance (enhance immune system)
- Maintain body condition score

- INTER · RELATIONSHIPS -

<table>
<thead>
<tr>
<th>ITEM</th>
<th>PLANT</th>
<th>ANIMAL</th>
<th>SOIL</th>
<th>ECONOMICS</th>
<th>SOCIAL</th>
</tr>
</thead>
<tbody>
<tr>
<td>Herd Objectives</td>
<td></td>
<td></td>
<td></td>
<td></td>
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</tr>
<tr>
<td>Unit Size</td>
<td></td>
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</tr>
<tr>
<td>Feed on Offer</td>
<td></td>
<td></td>
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<tr>
<td>Desired Residual</td>
<td></td>
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<tr>
<td>Growth Rate</td>
<td></td>
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</tr>
<tr>
<td>Growing Conditions</td>
<td></td>
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<td></td>
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</tr>
<tr>
<td>Animal Conditions</td>
<td></td>
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<td></td>
<td></td>
</tr>
<tr>
<td>Days Browse</td>
<td></td>
<td></td>
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<td></td>
<td></td>
</tr>
<tr>
<td>Days Grazed</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
KEEP AGRICULTURE SUSTAINABLE