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Sustainable production of meat goats: grazing strategies and forage utilization

Jean-Marie Luginbuhl[1]

Departments of Crop Science & Animal Science,
North Carolina State University, Raleigh NC 27695

Abstract. In the Southeastern USA, meat goats (*Capra hircus hircus*) are becoming increasingly important contributors to the income of many small producers. Meat goats frequently obtain more than 50% of their daily ration from browse but will perform well in grazing situations if management practices match their grazing behavior. This "generalist" feeding behavior represents a clear advantage in the ability to utilize a variety of landscapes and plant communities. Furthermore, if managed to match goat nutritional demands, these plant communities, composed of pasture and browse species, can provide an abundant, low-cost feed supply supplanting the need for expensive feed supplements that represent the highest expense of any meat goat operation. This can be achieved by developing a year-round forage program allowing for as much grazing as possible throughout the year. In addition, goats can be very effective biological control agents in beef cattle pastures invaded by woody vegetation and broadleaf weeds, in view of environmental concerns and elevated costs of other control methods such as mechanical cutting and herbicide applications. This presentation describes grazing/browsing behavior, grazing strategies and forage utilization research results obtained with meat goats at North Carolina State University using cool-season and warm-season perennial forages as well as summer and winter annual forages.

Key words: Forage, Grazing strategies, Meat goat

Producción sostenible de cabras de carne: estrategias de pastoreo y la utilización del forraje

Resumen. En el sureste de los Estados Unidos, los caprinos para carne (*Capra hircus hircus*) están asumiendo un rol de importancia en la generación de ingresos para muchos pequeños productores. Estos caprinos frecuentemente obtienen más del 50% de su ración alimenticia diaria ramoneando, pero pueden presentar rendimientos productivos adecuados en condiciones de pastoreo, si las prácticas de manejo concuerdan con sus hábitos de pastoreo. Este comportamiento alimenticio "genérico" representa una clara ventaja que les permite utilizar una variedad de paisajes y comunidades vegetales. Más aún, si se manejan de manera de satisfacer los requerimientos nutricionales de los caprinos, estas comunidades vegetales, compuestas por pastizales y especies arbustivas para el ramoneo, pueden proporcionar una abundante provisión de alimento de bajo costo, reduciendo la necesidad de costosos suplementos alimenticios, los cuales representan los mayores costos de cualquier unidad de producción de caprinos de carne. Esto puede lograrse desarrollando un programa de producción de forrajes, que permita el pastoreo durante la mayor parte del año. Adicionalmente, los caprinos pueden ser agentes biológicos de control en pastizales de bovinos de carne invadidos por vegetación leñosa y malezas de hoja ancha, en vista de las preocupaciones ambientales, y los costos elevados de otros métodos de control tales como el corte mecánico y la aplicación de herbicidas. Esta presentación describe comportamientos de pastoreo/ramoneo, estrategias de pastoreo y de resultados de investigación sobre la utilización de forrajes con caprinos de carne en la Universidad Estatal de Carolina del Norte, utilizando forrajes perennes de climas fríos y cálidos, así como forrajes anuales de invierno y verano.

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[1] Corresponding autor: Jean-Marie Luginbuhl jmlugin@ncsu.edu Web page: http://meatgoats.ces.ncsu.edu

Palabras clave: Caprinos de carne, Estrategias de Pastoreo, Forrajes

Grazing/Browsing Behavior and Grazing Strategies

Goats (*Capra hircus hircus*) are classified as intermediate mixed feeders adapted to either grazing or browsing, exhibiting changes in diet choices according to forage availability, nutritive value and season (Hoffman, 1989; Van Soest, 1994). Coblentz (1977) classified goats as opportunistic generalists because they consume the most palatable and nutritious vegetation available, selecting a wide variety of plants of a higher quality than cattle and sheep. Compared to other domestic ruminants, goats choose the most nutritious parts and portions of plants and given a choice among grasses, forbs and shrubs, they usually prefer high shrub diets (Bryant *et al.*, 1979). Because of this versatile grazing/browsing behavior, goats can be used very effectively as biological control agents in beef cattle pastures invaded by woody vegetation and broad-leaf weeds, in view of environmental concerns and elevated costs of other control methods such as mechanical cutting and herbicide applications (Luginbuhl and Pietrosemoli, 2007; Luginbuhl *et al.*, 1999 and 2000a; Webb *et al.*, 2011). Nevertheless, goats will perform well in grazing situations if grazing management practices match their behavior.

In a pasture situation, goats tend to graze from the top to the bottom of plants and do not like to graze near the soil surface. Therefore, goats will more uniformly graze a canopy than other ruminants. As goats do best when moved frequently to a fresh paddock or a section of a paddock, the basic principle of control grazing (Mueller *et al.*, 1995) is to allow goats to graze for a limited time leaving a leafy stubble, and then to move them to another pasture or another section of a subdivided pasture. Under control grazing management, legumes and native grasses may reappear in the pasture, and producers often report that the pasture plant community becomes more diverse. Control grazing can be used to improve pastures, extend the grazing season, and enable producers to provide higher quality forage at a lower cost with fewer purchased inputs. Control grazing can also be useful in reducing internal parasite problems if producers are careful to move the goats before the forage plants are grazed too short (less than about 10 cm). Strip grazing can be easily superimposed on control grazing in large paddocks by placing movable electric fences ahead and behind the goats, giving them sufficient forage for 2 to 3 days. Strip grazing is very effective and results in high pasture utilization because otherwise goats will not graze soiled forage well. Strip grazing results in higher average daily gain (ADG), increased gain per hectare, and in rapid improvement of body condition when pastures are vegetative and of excellent quality such as during cool weather when plant quality declines only slowly. Conversely, strip grazing is not recommended when pastures are of low quality because of reduced goat selectivity.

The differences in feeding behavior among cattle, sheep and goats uniquely fit each species to the utilization of different feeds available on a farm. These differences should be considered in determining the best animal species to utilize a particular feed resource. Feeding behavior is also important in determining whether a single or multi species will best utilize available plant materials. Most studies indicate greater production and better pasture utilization when sheep and cattle or sheep, cattle and goats are grazed together as opposed to grazing only sheep, goats or cattle alone (Merrill and Taylor, 1981). Because of their complimentary grazing habits, their differential preferences and the wide variation in vegetation within most pastures, one to two goats can be grazed with every beef cow without adversely affecting the feed supply of the beef herd (Luginbuhl *et al.*, 2000). The selective grazing habits of goats grazing in combination with cattle will eventually produce pastures that are more productive, of higher quality, and with little weed and brush problem (Luginbuhl *et al.*, 2000a). Judicial mixed species grazing can have additional benefits. Because gastrointestinal parasites from goats or sheep cannot survive in the gastrointestinal tract of cattle, and vice versa, mixed species grazing will decrease gastrointestinal parasite loads and slow resistance of gastrointestinal parasites to conventional anthelmintics.

Goats can be controlled with 4 to 5 strands of smooth, high tensile electrified wire (Luginbuhl *et al.*, 2000). The wire spacing can vary from 15 to 20 cm near the ground to 15 to 30 cm for the top strands. Perimeter fence height should be at least 110 cm. A high wire, or an offset wire set 30 cm inside the fence near the top may be needed if goat jumping is a problem. As a rule, goats will crawl under rather than jump over a fence, so the bottom wire should be kept close to the ground. A grounded barb wire laid along the ground will help with predator control, especially in mountainous areas. Training animals to respect electric wire fences can be done effectively by forcing animals to stay in a small paddock which encourages them to "test" the electrified wire. Woven wire (15 cm x 15 cm

opening) is effective, but costs at least twice that of a 5-strands electric fence. Furthermore, horned goats frequently become caught in the wire. To address this problem with existing woven wire fences, an electric wire offset about 20 cm from the woven wire fence and about 30 to 40 cm from the ground will reduce the number of animals caught in the woven wire fence. This practice, however, also reduces control of forage growth under the fence line. Woven wire with a 15 cm x 30 cm opening is a cheaper alternative than the woven wire with a 15 cm x 15 cm opening that does not require an electric offset wire. Horned goats usually do not get caught or, if caught, they are able to free themselves because of the larger opening. High tensile, fixed knots woven wire fences that spring back if animals rub on them, and with very small openings close to the ground, are now available and are very effective in keeping goats in and predators out (http://www.saytuff.com). Boundary fences should control all stock at all times. Interior fences, however, may be made of 3 to 4 strands of braided, UV-stabilized polyethylene plastic wires interwoven with 3 to 9 stainless steel filaments, and UV-stabilized polyethylene plastic tread-in posts, assuming animals are trained. Because goats like to climb, the corners of permanent fences should not have the diagonal bracing for posts and should be constructed with H-braces.

Forage Evaluation and Animal Performance

In the Southeastern USA, meat goats are becoming increasingly important contributors to the income of many small producers due to the demand for goat meat by various ethnic groups. Nevertheless, few research data are available from the region specifically directed toward intensive grazing programs for goats reared for meat production. This section focuses on some grazing trials conducted at the NCSU Meat Goat and Forage Program field research station in Raleigh, NC (35.8°N latitude and 78.7°W longitude) toward the development of year-round grazing systems for meat goats, using control strip grazing as a tool to manage animals according to forage availability.

Winter Annual Forages

A 3-year (YR) study was conducted to evaluate the performance of crossbred (50 to 75%) Boer replacement does and castrated males strip grazed on *Secale cereale* L. cv. Elbon, *Lolium multiflorum* L. cv. Marshall and *x Triticosecale Wittm*. cv. Resource Seeds 102 (Luginbuhl *et al.*, 2012). The forage species were sod-drilled in late September or early October and seeding rates averaged 124 kg/ha for *S. cereale*, 35 kg/ha for *L. multiflorum*, and 121 kg/ha for *x T. Wittm*. All forages were fertilized each year with ammonium nitrate at a rate of 56 kg N/ha in November and February. The grazing area consisted of a total of 1.7 ha, divided into nine plots measuring 0.19 ha each. Each forage species was seeded in three different plots. Goats averaged 30 kg body weight (BW) at the start of the study, and six goats were grazed in each plot. Goats were moved to a fresh strip of grass three to four times per week according to forage availability and back fenced immediately. In addition, they had free-choice access to a goat mineral, water and movable shelters. Additional goats were used as put-and-take animals to keep up with forage growth. Grazing usually started in late February and ended from late March to mid-May depending on the grass species and year. Forage measurements were taken at 2-week intervals to characterize forage availability (Chamblee and Green, 1995). Forage biomass ranged from 1491 to 3471 kg/ha for *L. multiflorum*, 1560 to 3117 kg/ha for *S. cereale*, and 1584 to 3639 kg/ha for *x T. Wittm*.). Crude protein (CP) concentrations (avg: 22.6%) indicated that these forages were of excellent quality and more than sufficient to meet the nutritional requirements of any class of goat from mature dry does, does in early gestation and mature bucks, to yearlings and weanlings and does lactating and in late gestation (NRC, 2007). Forage species had little effect on ADG, of 137 g/d for females and 186 g/d for castrated males. Total gain per hectare was greater ($P < 0.01$) for *L. multiflorum* (avg: 409 kg) than for *S. cereale* (avg: 209 kg) or *x T. Wittm.* (avg: 210 kg) because *S. cereale* and *x T. Wittm*. were grazed for shorter periods and thus had fewer total grazing days per hectare (avg: 3463, 1672, and 1799, respectively). In conclusion, growing goats achieved satisfactory weight gains when fed only on these forages under control strip grazing management, but *L. multiflorum* resulted in superior per hectare BW gains.

Annual Forages

Luginbuhl and Mueller, (2013) conducted a 3-YR grazing study to evaluate the performance of recently-weaned doe kids born in March-April, weaned 10 weeks later (1/2 Boer; initial BW: 17 kg) and control grazed on *Pennisetum glaucum* L. cv. Tifleaf II (PG), *Glycine max* (L.) Merr. cv. Johnston (GM), and *Vigna unguiculata* (L.) Walp. cv. Pinkeye Purplehull BVR (VU). The experimental area was divided into nine plots of 0.07 ha each with three field replications. Forage species seeds were sod-drilled in early May (kg/ha, corrected for germination: PG, 24; GM, 109; VU, 129) and PG was fertilized with ammonium nitrate (56 kg N/ha) 32 d after planting. Grazing started 37 to 56 d after planting depending on the forage species and year.

Kids (YR 1, 18; YR 2, 27; YR 3, 27) were placed into groups of animals with similar BW and randomly assigned to treatments. Plots were divided into six sections and goats were moved to a new section every 2 to 4 d before they had eaten all the leaves of the GM and UV plants to ensure faster regrowth. Using this strategy, each GM and UV plot was grazed three times during the growing season. Additional goats were used as put-and-take animals to control forage growth. Goats had free-choice access to a mineral mix and water but no shade was provided. The CP values of forage samples hand-plucked periodically from experimental pastures averaged 18.8, 30.4 and 25.0% for PG, GM and VU, respectively, more than sufficient to meet the nutritional requirements of any class of goat. Forage species had no effect on ADG (YR 1: 78, 114, 96 g/d; YR 2: 61, 70, 90 g/d; YR 3: 65, 71, 67 g/d for PG, GM and UV, respectively). Gain/ha did not differ between PG and GM in YR 1 (320 and 326 kg, respectively), but was lower for UV (185 kg, P< 0.01). In YR 2, gain/ha was greater for PG (480 kg; P <0.03) while GM and UV did not differ (266 and 280 kg, respectively), whereas in YR 3, gain/ha was similar for PG and GM (263 and 267 kg, respectively) but greater than for UV (163 kg; P < 0.01). In conclusion, doe kids ADG were disappointing but not unusual given the hot climatic conditions and that these animals had been recently weaned and were in a post-weaning 'slump'. Nevertheless, total gains per hectare were satisfactory but responses varied substantially between years.

Cool-Season Perennials Forages

A 3-YR grazing study evaluated the performance of nursing does and their suckling kids (7/8 to fullblood Boer) strip grazed on *Festuca arundinacea* L. Schreb. cv. Kentucky 31 infected ($K31^+$) with an alkaloid-producing endophyte fungus, cv. Jessup non-infected (J^-) and cv. Jessup 'MaxQ' novel endophyte (MQ) fertilized with 112 kg N/ha annually in two split applications. (Luginbuhl *et al*., 2009). The experimental area consisted of 9, 0.19 ha plots with three field replications. Throughout the 3-YR study, percent tillers producing alkaloids averaged 1, 2 and 96% for MQ, J^- and $K31^+$, respectively. Starting and ending grazing dates, number of does and kids grazed, and initial age and BW of kids were, respectively: 16 April and 26 May, 45 does, 70 kids, 12.5 kg for YR 1; 29 March and 25 May, 36 does, 63 kids, 7.4 kg for YR 2; 4 April and 16 May, 36 does, 72 kids, 8.5 kg for YR 3. The CP values of hand-plucked forage samples averaged 21, 20, and 21% for MQ, J^- and $K31^+$, respectively. Suckling kids gained more weight (g/d) on MQ and J^- than on $K31^+$ in YR 1 (136, 133, 99; P < 0.01) and YR 3 (173, 165, 134; P < 0.04), whereas gains were similar in YR 2 (138, 133, 113). Average kid gain/ha were similar for MQ (271 kg) and J^- (275 kg) but were higher (P < 0.01) than for $K31^+$ (215 kg). Nursing does gained weight (g/d) on MQ and J^- compared to $K31^+$ in YR 1 (46, 39, -66; P < 0.02), and lost less weight on MQ and J^- than on $K31^+$ in YR 2 (-4, -7, -62; P < 0.01) and YR 3 (-62, -19, -144; P < 0.01). Does plasma urea N were similar regardless of forage and grazing year (avg: 26.2 mg/dL). Serum prolactin levels (ng/mL) were higher in does on MQ and J^- than on $K31^+$ in YR 1 (174, 145, 47; P < 0.01), YR 2 (139, 136, 62; P < 0.01) and YR 3 (149, 148, 45; P < 0.01). Results indicated that suckling kids performed well although those on $K31^+$ gained less. Nursing does grazing $K31^+$ were unable to maintain their BW and the dramatic decrease in serum prolactin levels observed in those does due to the presence of alkaloids could have important reproductive implications.

In another 3-YR study, the performance of suckling kids (75 to 100% Boer) and nursing does strip grazed on *Fescuca arundinacea* L. Schreb. cv. Jessup 'MaxQ' novel endophyte (MQ) and *Dactylis glomerata* L. cv. Persist (DG) were compared. The seed cost per ha is more than double for MQ than for DG. Seeding rates corrected for germination were 16 and 17 kg/ha for DG and MQ, respectively. Planting method, fertilization and grazing management were similar to the previous experiment. The grazing area consisted of six, 0.16 ha plots with three field replications. Each grazing season started with 24 does and 48 kids, all twins. Depending on forage availability, the number of animals had to be reduced to 3 does and 6 kids on certain plots. Grazing periods ranged from 10 April to 22 May, 25 March to 13 May and 25 March to 10 May in YR 1, 2 and 3, respectively. Plucked forage CP concentrations averaged 21%. The ADG of suckling kids strip grazed on DG and MQ averaged 141 and 122 g/d, and total kid weight gain 344 and 336 kg/ha, respectively. Nursing does maintained their BW during YR 1, gained weight in YR 3 (avg: 15 g/d), but lost an average of 113 g/d during YR 2. In summary, these two forages are excellent for spring grazing. Nevertheless, producers should consider the following: 1) Goats grazed DG closer to the ground than MQ and, therefore, DG requires a higher level of grazing management; 2) Despite our efforts, one plot of DG did not subsist after two years due to a combination of being grazed too close to the ground and excess water washing over the plot from a nearby road; 3) Another DG plot had thinned considerably by YR 3 and was being colonized by other plants; 4) The third DG plot, which always produced more forage because it was located on better soil, still had a good stand after three years; 5) despite claims made for the variety used in this

trial, DG is known to persist better at higher elevations; 6) conversely, the MQ plots still had excellent stands after four years of grazing and this factor could offset seeding costs in some situations.

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