The Effect of Different Grazing Systems on Dairy Goat Productivity
FNE02-409

1. Objectives

The three main objectives of this research were to:

i) examine two grazing methods to determine their effects on milk production, body condition, and parasitism
ii) assess the nutrient value of both grazing systems
iii) determine the amount of protein and butterfat produced by grazing dairy goats to aid in selecting animals best suited for low-supplement, rotational grazing.

2. Project Methods

This study is a second year continuation of a grant that was received last year. The methods were similar to those of 2001, except some additional information was gathered, including a nutrient analysis of the forage of both pastures, and the blood hematacrit levels of individual goats were determined.

We originally planned to milk 20 does this year, but we only managed to have 19 freshen in time to begin the study. For logistical reasons in the milk parlor, we split the goats into a group of 8 and a group of 11. We have a mixed breed herd with a purebred line of Nubians. We split the groups as follows: Once we started milking we measured individual production and ranked animals from highest to lowest. We split every other animal into one group to try to have somewhat equal average production to start with. We then switched animals around to split up twins so we could have genetic equivalents for comparison. Each group (grass or browse) was randomly determined.

Starting in May, a biweekly sample of the milk of each doe (combined from the morning and evening milking) was taken and analyzed for total butterfat and total protein. The pounds of milk produced by each animal per 24 hr period was also measured biweekly. Total milk yield for each group was measured at each milking as well.

From late April to the second week of June, all does were on pasture, since the browse was not fully leafed out and we needed to set up fencing infrastructure. This established a baseline for all the animals with equal feed opportunities. On June 14 we divided the groups and placed 8 animals in browse paddocks and 11 in pasture paddocks. All animals were out 24 hours a day. The browse paddocks had a perimeter of about 400 feet of elecronet fencing and were moved as needed, usually every 4 to 7 days. Browse plant composition varied from "old field" types including goldenrod, raspberry, and spirea to

more early pioneer growth with sumac, small maples, apple, poplar, and birch. We sometimes would fell small trees to extend the time in a paddock.

The pasture paddock was formed with a 150-foot long electronet fence was moved every 12 hours. We aimed for a pasture sward height of 8-10 inches to start, to minimize parasite infestation. We rotated through the pasture 4 to 5 times during the season. All milking does were fed a total of 3 pounds of concentrate in the parlor (16% protein) and free-choice access to a mixture of salt, and minerals and occasional access to kelp. We originally planned to cut the grain ration to 2 pounds for the second year of the study, but the body condition of the animals coming out of the winter was lower than we had hoped. This resulted in feeding approximately 45% of dry matter from concentrate instead of 30%. Hay was only accessible in the holding pen for milking (about 1 hr/ day accessibility) at the rate of 1 to 2 bales per week. Because both groups had access to the same feeder, hay consumption could not be measured. The pasture group appeared to eat hay much more vigorously than the browse group.

Total pounds of milk produced by each group was measured at each milking. We also measured the production, butterfat and protein of individual goats 6 times during the season. Animals were also weighed and body condition scored at the beginning and end of the season to determine if they were gaining or losing condition in either treatment.

Fecal samples were taken from 4 adults and 4 kids in each group every 2 weeks throughout the season. The kids on browse were in the same paddocks as the does on browse. The kids on pasture were with the adults on pasture early in the season, but they were moved to "cleaner" fields further from the barn in July. They were rotated through their paddocks 3 times throughout the summer.

3. Results

Milk Production

Table 1.

Milk Production data from 2002

	Before split		After split			
	grass	browse	grass	browse		
Milk Produced Daily (lbs per goat)	5.5	4.9	4.9	4.2		
Solids Produced Daily (ounces per goat)	5.43	5.84	4.62	4.82		

Milk Production Data from 2001

	grass	browse	grass	browse
Milk Produced Daily (lbs per goat)	5.65	5.53	4.91	5.21
Solids Produced Daily (ounces per goat)	6.38	6.84	4.90	6.64

Pasture type had no significant effect on milk production in 2002, unlike in 2001 when the goats on browse had higher production.

Average goat production of overall solids was greater in 2001 than in 2002. This may be due to the fact that in 2002 we had 6 out of 19 goats as first fresheners and in 2001 we had only 3 out of 16 as first fresheners. Still, we were disappointed by this information and were looking at other possibilities for out general low production. One likely possibility is the course 1st cut hay we fed last winter and spring. The goats left most of it for bedding and seemed to come out of the winter in poor condition. This is the forage they were eating in the beginning of their lactation and this could have been a major setback. The other possibility is parasite infestation. This will be discussed later.

Body Condition and Parasite Management

We had originally planned to cut our feed rations down to 2# concentrate a day, but the animals seemed in poorer than normal condition coming out of winter so we continued with the 3# ration we used last year. To start the year, the goats who would spend the summer on pasture were in poorer condition and weighed less than the goats that would move to browse. Both groups gained weight and body condition by the end of August. (Table 2). However, with 30% of the herd in first lactation and many others under 5 years old, summer growth of stature and form would account for any changes in weight gain, and more gain would be expected.[1] This would not account for the increase in body condition but the increase in values were not significant, and are somewhat dubious anyway due to my inexperience at scoring.

Table 2.

Feed	Ave weight (lbs) in June	Ave Body Condition Score	Ave weight (lbs) August	Ave Body Condition Score
Browse	110.5	2.5	113.0	2.6
Pasture	103.5	2.1	108.5	2.3

The parasite egg levels in the adults did not appear to be influenced by the grazing system. (Table 3) Average egg counts were higher in the early season and then became quite low, often having individuals with 0 egg/g in samples. The egg counts were similar in scale to those we had last year and seemed to be reasonably low. Professionals accustomed to analyzing goat feces found the counts to be very low.[2] We thought that perhaps the grazing of pasture to a minimum of 6" was enough to keep the parasite larvae

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intake to a minimum and therefore make the difference between grass and browse grazing negligible. However, because our milk production seemed low, Carol Delaney suggested we measure hematacrit levels of the blood as a supplement to the fecal samples. Average hematicrit levels for goats in the U.S. is 0.25-0.30.[3] As can be seen in Table 3 all of our goats were quite anemic when measured on 8/15/02. The most likely cause for anemia would be infestation with a blood sucking parasite (*Haemonchus*), but this is not the only possible cause. To identify the type of parasites present we had a bulk herd sample taken to identify the species of parasites represented and *Haemonchus* eggs constituted 7% of the total sample (since they lay many eggs relative to others, 7% may indicate an actual population lower than 7%[4]) The predominate eggs found in our fecal sample were Osteragia (28%) and Trichostrongylus (57%). These parasites can be a common cause of diarrhea in goats and can reduce weight gains as well as be a cause of death[5].

Table 3.

Feed	Age	Ave egg/g Before July	Ave egg/g July/Aug	Hematacrit Ave 8/15	Hematacrit Ave 9/30
Browse	Adult	59.4	24.5	0.185	0.273
	Kid	0.66	16.1	0.205	0.290
Pasture	Adult	69	30.9	0.221	0.294
	Kid	6.6	5.1	0.151	0.310

As a result of these findings, we dewormed our kids with Ivermectin on August 15th, and put them inside for the rest of the season. Kids in both groups had not gained any weight in the previous 4 weeks, and gained an average of 10# in the following 6 weeks, so it appeared that intestinal parasites were holding them back despite the fact that their fecal counts were very low. This is a difficult finding to rectify, since fecal samples were taken regularly and they are considered to be an accurate representation of parasite loads. It does not appear that the fecal samples did represent the parasite loads in our kids.

A follow-up hematacrit measurement was done at the end of September. The kids values nearly doubled and were well into the healthy range. The adult hematacrit values also improved significantly, even though they had not been dewormed. There is uncertainty as to why this occurred but a suggested possibility is that the parasites are becoming less active in the fall.[6]

All this being said, the fecal counts were so low overall it was suggested that internal parasites were not the source of the anemia.[7] A copper deficiency in goats can lead to

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anemia, as can a type of blood virus. We did not investigate the possibility of the virus, but we did think about the possibility of a copper deficiency. Copper deficiency can be either due to a low intake or to an interference with high levels of Sulfur, Molybdenum, or Aluminum.[8] It is most likely that a copper deficiency on our farm would be intake related. Our goats generally have access to a dairy mineral mix with copper and a mix of kelp and salt (kelp has no copper). At times this summer the minerals were not refilled, and we do not know how much mineral mix the goats were ingesting when it was available, so we cannot eliminate a copper deficiency. In 2001 we had a mineral mix added directly to the feed so we knew the animals were consuming adequate amounts. After the initial results we made an extra effort to make sure the goats were getting enough mineral supplement (mixing some with kelp, which they love), so that would help explain the increase in hematacrit levels in the adults even though they were not dewormed. However, I find it surprising that a little extra boost to the mineral levels would have such a dramatic effect on the weight gain of the young stock. It seems more likely that the problem with the young stock was parasite related despite the fact that the fecal counts were low.

It is difficult to assess exactly what was happening with our animals. When looking at these numbers we have to remember that the hematacrit values are actual measurements of the goats blood, and for whatever reason, the goats were indisputably anemic. The fecal samples are one step removed from the goat. They do not directly represent the number of adult parasites present in the goat, but how many eggs were laid in the individual pellets that were collected. Since the predominate species identified in our animals are those that produce fewer eggs, the internal parasite load may have been high with few eggs in the fecal sample. Additionally, parasites that do the most harm to animals are those in the developmental stage as opposed to the egg laying stage, and there are many different factors that will trigger an adult to lay or not lay eggs.[9] There have been studies done that show a correlation between fecal egg count and adults present in the animal, and clearly the fecal count is the most prevalent way of determining parasite load, but the validity of relying on these values to determine parasite loads has been called into question by this study.[10]

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[8] Dave Hoke, DVM

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4. Forage Analysis

The data from the forage samples taken is shown below (Table 4). Browse samples were taken by trying to replicate the plant parts the goats were consuming. Samples included: goldenrod, maple, poplar, birch, spirea, raspberry, sumac, fern, among other species. Likewise, pasture samples tried to replicate what the goats were favoring.

What seems most notable here is that the browse consistently had a higher percent digestable nutrients (%TDN) and NEL (net energy lactation) and lower Neutral Detergent fiber (%NDF) than did the pasture. The soluble protein in the pasture was higher in the pasture for the first two sample dates, but by the end of August, the protein content of the browse was greater.

This may be due to the fact that we were grazing the pasture when the grass length was quite high (8-12"). This length seemed important to keep parasite levels down, but it may not have provided the best nutrition for milk production.

Table 4

Pasture	03-Jul	30-Jul	21-Aug
DM	23.60	15.50	17.60
% sol pro	44	47.9	26.5
%ADF	33.7	27.6	37.5
%NDF	56.8	44.7	63.3
%TDN	65.7	70.5	62.7
Nel Mcal/lb	0.58	0.67	0.52

Browse	11-Jul	29-Jul	21-Aug
DM	26.50	30.30	36.80
% sol pro	26.3	27.6	32.3
%ADF	24.4	25.6	21.4
%NDF	31	32.4	31.8
%TDN	72.1	72.1	72.1

Minerals DM basis

Pasture	03-Jul	30-Jul	21-Aug
%Ca	0.55	0.75	0.77
%p	0.35	0.4	0.36
%K	2.98	3.71	3.1
%Mg	0.21	0.29	0.26
%S	0.25	0.27	0.31
%Na	0.001	0.001	0.001
ppm Fe	123	158	112
ppm Mn	42	37	97
ppm B	2	7	8
ppm Cu	10	14	11
ppm Zn	27	22	29

Browse	11-Jul	29-Jul	21-Aug
%Ca	0.88	1.05	0.93
%p	0.27	0.29	0.2
%K	2.21	1.53	1.28
%Mg	0.23	0.24	0.24
%S	0.22	0.17	0.17
%Na	0.001	0.001	0.001
ppm Fe	112	72	326
ppm Mn	184	166	388
ppm B	19	9	23
ppm Cu	11	6	11
ppm Zn	48	44	45

5. Plans for the Future

One of the objectives of this research was to find a way to manage pasture for dairy goats that generates high milk production and would result in healthy animals that need little or no chemical deworming. This study has not achieved that objective, but has carried us far in the exploration. Things that we have learned include:

-The goat kids in both groups were suffering from lack of weight gain and anemia, therefore grazing on previously used grass paddocks until the first week in June infects goats with parasite larvae. Goats that were moved to browse after that point maintained similar infestation loads (according to our measurements) as the goats who remained on grass throughout the summer, likewise the level of anemia was similar.

-Leaving the grass long and only grazing down to about 6" of height does not seem to be sufficient to prevent infestation. Certainly, the parasite load on our animals was much lower than it would have been had we forced them to eat to the ground, (we had very

high levels (250+ egg/g) in some male animals that grazed close to the ground in 2001) but leaving the grass long was not enough to keep the effects of parasitism to a tolerable level. Additional management techniques need to be utilized, possibly including cutting pastures periodically or using another grazing species in the rotation.

-In August, we found that goats on grass were not eating forage that seemed leafy and suitable. There were several possibilities suggested: (1) the long forage length over the course of the summer was causing matting and a degree of rotting under the surface.[11] The smell of this deterred the animals from grazing, (2) the grass was far too fibrous and essentially indigestible for the goats, [12] (3) the grass was over fertilized with goat manure from earlier in the season and past years and the goats did not want to eat it,[13] and (4) parasitism depresses Dry Matter intake.[14] This period would correlate with a time of high parasite activity in the goats, and they were quite anemic at this point. It is also noted that after a killing frost, our goats eat the grass quite vigorously and will eat much closer to the ground without being pushed.

These observations have led to ideas for changes we will make for next year:

-We will put perimeter fencing around more of our property to increase our pasture land base, and turn several acres of young forest into browse.

-Paddock sizes will be larger with a "loafing" area in each (either movable hoophouse shelter or shaded woods area). This idea is a result of a pasture walk at the farm of another goat grazier, Lynn Rockwell. Her animals had access to the barnyard in the night and during hot weather. Goats enjoy having an area to relax in when not grazing and do most of their waste deposit in that area. Although this is not ideal for fertilizing fields, they could very well have this behavior to keep feces off their feed. The moveable hoophouse is a compromise idea, which will allow us to occasionally move the location to reduce nutrient loading and to keep the manure and flies away from milk barn and house. This moveable shelter will have the added benefit of allowing us to have animals outside later in the season when cold rainy whether becomes frequent.

-To reduce the level of nutrient transport from fields to "loafing"area and to reduce the amount of potential rot in the long sward as well as to reduce the infectious larvae on the grass, we will graze either beef cows or replacement heifers on our pasture areas.

5. Economic Impact

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[13] Dave Hoke, DVM
[14] Dave Hoke, DVM

The objective of this study was not to study the economics of grazing goats but to study the two grazing methods. However, it seems worthwhile to make note of the information we have. During winter months, our does and yearlings consumed 25 to 30 bales of hay per week. When milking in February, March, and half of April, we fed 4 pounds of concentrate per day. Once we started grazing, the hay consumption dropped to about 2 bales per week and concentrate down to 3 pounds. The savings in hay alone (at $2/bale) is $45-$55 per week over at least 25 weeks. This would be a feed savings of $1000 - $1125 on hay for our 20 milking does.

The costs of grazing include setting up the fencing and watering infrastructure. Costs to a farm would be very individual depending on the layout of the land. There are also maintenance costs to the fencing, since the electronet does not last forever. We will plan to replace 1-2 fence lengths per year ($150-$300).

Grazing goats may be more labor intensive than keeping them in confinement, especially the way we do it currently with setting paddocks with many strands of portable net fencing. However, we spend much less time handling hay and cleaning the barn than we would if our goats were inside. To tip the labor balance in our favor we plan to move to more permanent fencing and try using larger paddocks.

And of course, that which is not easily economically quantifiable is the health and happiness of our animals. They enjoy being outside, even at night, and they survive all kinds of summer weather with minimal complaints. I would also say that our goats eating browse, climbing trees, and leaping from ledges, have an added vitality over those merely chewing grass or clover in a flat pasture paddock with nothing more exciting to jump over than the fence.

6. Outreach Plan

We hosted a pasture walk this summer sponsored by the Vermont GrassFarmers, the Small Ruminant Dairy Project, and NOFA-VT.

Bill Murphy brought a UVM class on a field trip to our farm so we could describe the project.

We are having an article published in the MOFGA newsletter and possibly the Dariy Goat Journal this spring summarizing the findings.

Bill Murphy will present the findings at the VT GrassFarmers Conference in February and I will be a member of a farmer panel for question and answers.

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