

SUPPLEMENTAL FEEDING OF DAIRY SHEEP AND GOATS ON INTENSIVELY MANAGED PASTURES

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Background:

In the summer of 1998, I had a number of conversations with David Major, a dairy sheep farmer in Vermont, and with Keith and Leslie Quarrier, dairy goat farmers in New Hampshire. Those conversations centered around the difficulty both farms were having in determining if it would be worthwhile to supplement their lactating animals on pasture with a grain/concentrate supplement and, if so, how much concentrate/grain supplement should be fed. Both farms had many years of experience in developing and managing their pastures. As a result, their pasture quality was excellent and had been tested to show high nutritive value (>16%CP, >60% TDN).

In an attempt to answer these questions concerning supplementation, David Major had, the previous summer, conducted his own on-farm experiment. He randomly divided his dairy sheep flock (130 ewes) into two groups. One group was fed 1 lb of a corn/barley mix, the other group was fed 2 lbs of the same supplement. His results were that group 1 averaged 15 lbs of milk more per ewe for the lactation (150 days +/-) than group 2. Just the opposite of what he expected. However, because there had been no control group and no valid experimental design, the results were inconclusive at best and as David said, "it just goes to show how much in the dark we are". As a result of these conversations, I convened a meeting in the fall of 1998 which included David Major, the Quarriers, John Porter, UNHCE Dairy Specialist, Chet Parsons, UVMCE Sheep Specialist, and Heidi Smith, NRCS. The need for a research project to address these questions was confirmed and a decision to submit a proposal for a Sustainable Agriculture Research and Education (SARE) grant was made.

Subsequently, two well known and respected ruminant nutritionists, Dr. Doug Hogue from Cornell and Dr. Jim Welch from UVM, joined the group to help develop the grant proposal and assist with the study. Our proposal was for a three year study. SARE agreed to fund the project and we began the study in 1999.

Methods / Approach:

The project used a team approach involving farmers, researchers, UVM and UNH Cooperative Extension, and NRCS personnel. The project was conducted at two on-farm sites, Major Farm (dairy sheep), Westminster, Vermont and Quarrier Farm (dairy goats), Acworth, New Hampshire. Dr. James Welch, UVM, developed the experimental design.

In year one, we used a Randomized Complete Block design. i.e. All available animals were identified according to previous milk production, genetic potential for milk production, number of offspring nursed, weight and age. Animals were assigned to blocks of three according to the above criteria. Animals within blocks were randomly assigned to treatments 1, 2, or 3. Each animal was identified by ear tag or tattoo and by a colored leg band for quick ID at milking. The sheep used for the study were all from David Major's flock. They had been systematically crossbred by David over the previous ten years and were a mix of Dorset, Tunis, East Friesian and Rambouillet. Their average lactation yield was approximately 300lbs / 150 day lactation. The goats used were all from the Quarrier herd and were mostly Sanaans with a few Nubian – Sanaan crosses. None of the animals in the study were less than two years of age.

The three groups received different levels a of nutritionally complete supplement designed by Dr. Doug Hogue, Cornell University (see appendicies for formula). This supplement was designed utilizing the current information available on feeding high milk producing sheep and goats and utilized readily available feedstuffs. The resulting supplement was a 14-16% protein, high-energy dairy pellet with 20% soybean hulls as a source of highly fermentable fiber. The supplement was balanced for vitamins and minerals for each species. The National Research Council's Nutrient Requirements of Sheep, 6th edition, 1985 and Nutrient Requirements of Goats, 1981, were used as guidelines to determine the nutrient requirement baseline on which the level of supplementation was determined.

All three groups were grazed together and allowed unlimited consumption of the same high quality pasture. Pastures at both farms were well established and consisted primarily of a white clover and bluegrass mix. However, a survey of plant species was done in year one by Dr. Matt Sanderson and some of his staff from the USDS Pasture Research Lab at Penn State. That survey identified over 40 plant species in the pastures. The pastures had been and continued to be intensively managed. The pastures were subdivided into small paddocks using electric fencing . The animals were given a fresh paddock after every milking (approximately every 12 hours). There was always sufficient pasture to provide unlimited grazing. Pasture fertility was maintained with manure and lime. At milking each animal received the supplement according to which of the three groups it had been assigned. After milking the animals returned to a single group. All animals received care at the best management level throughout the life of the project. Animal care was monitored weekly by Extension Specialists or a licensed veterinarian.

In years two and three, we redesigned the experiments based on our analysis of the previous year's data.

The following measurements were taken in each of the three years of the project:

Weight - all animals were weighed at the beginning and end of each experiment period.

Milk - milk was weighed and analyzed regularly during each experiment for fat, protein, milk urea nitrogen (MUN), and somatic cell count.

- Pasture - pasture quantity and quality was measured/sampled and recorded daily during each testing period. A rising plate pasture meter designed and made in New Zealand was used for quantity measurement. Quality was analyzed at the Dairy One forage-testing lab, Ithaca, NY.
- Health - animal health and overall condition was assessed by a licensed veterinarian at the beginning and end of each experiment. A condition score of 1 to 5 was assigned each animal at each of these times. Health treatments were administered under the direction of the veterinarian.

An intern on each farm assisted in taking these measurements and in recording and compiling the data. All milk production data compiled was statistically analyzed by Dr. Steve Judd, UNHCE.

Results:

For the dairy sheep: in year one, following the methods detailed above, we compared three levels of concentrate feeding, .5 lb per ewe per day, 1.5 lbs per ewe per day, and 2.5 lbs per ewe per day. We found that there were no significant differences in milk yield or milk composition, or animal condition score between the three treatments.(see appendices for actual milk yield and composition figures)

Although not significantly different, the average milk yield and milk composition of the group fed 2.5 lbs per day was actually **lower** than the other two groups. We reasoned this was the result of the sheep reducing their consumption of pasture in favor of the supplement. Our hypothesis is that milk yield was reduced in the more heavily supplemented groups because the pasture was more nutritious than the supplement. We concluded that there was no reason for supplementing above the 1.5 level.

In year two we used a “switch-back” design to compare .5 lbs per ewe per day and 1.5 lbs per ewe per day. Again we found no significant difference.

In year three, we again randomly divided the flock into groups and fed one group .5 lbs per ewe per day, and the other group 1.5 lbs per ewe per day. However, we kept the groups on those treatments for the entire lactation with no “switch-back”. Again, there were “no significant differences”.

We concluded from our data that dairy sheep on well managed pastures lactating in the 3 lb/day range needed no more than .5 lbs per ewe per day concentrate supplementation. We didn't try zero concentrate supplementation because David Major felt that .5 lbs per ewe per day(.25 lbs/milking) was the minimum practical level of concentrate feeding necessary to attract the sheep into the milking parlor. It's interesting to note that eleven ewes in this study had average lactation yields >600 lbs/150 days, suggesting that a .5 lb level of supplementation may be adequate for ewes with the genetic potential for that level of milk production.

We used similar methods for the goats, although the feeding levels were higher at 1., 3.0 and 5.0 lbs per doe per day. We found that the does responded to increased concentrate. Our conclusion/recommendation for dairy goats grazing high quality pastures is to feed concentrate at a ratio of 1 lb of concentrate for each 3 lbs of milk yield.

In year three of the goat study, we compared the concentrate with fermentable fiber (soybean hulls) with a concentrate exactly the same except without fermentable fiber.. This comparison was done during lactation only. The results showed no significant difference in milk yield, milk composition, or animal condition score between the two formulations. The Quarriers did observe that by feeding the concentrate with fermentable fiber the last 4-6 weeks of gestation, they significantly reduced what had been a fairly high incidence of ketosis . For them, this was the most important economic benefit of this project.

Other results from this project include:

(1) a comprehensive data set on the nutritive quality of well managed pasture collected from the same pastures over three consecutive pasture seasons. These data show levels (on a dry matter basis) of crude protein averaging over 20% and as high as 28%, of TDN averaging over 60% and as high as 67%, and relative feed values averaging over 110 and as high as 159.

(2) A comprehensive data set on sheep and goat milk yield and milk composition (including fat, protein, MUN, SCC) collected from a significant number of animals (100 ewes, 60 does) and over three consecutive lactation periods. The sheep milk data are especially useful because the sheep dairy industry in North America is so young that data such as these collected under controlled conditions are not readily available.

(3) A clear demonstration that high quality data, that can serve as a solid basis for management recommendations, can be successfully generated from on-farm experiments through the collaboration of university researchers, Extension and USDA agency staff, dedicated farmers, and SARE funding support.

Impacts:

The primary impact we were after was the answer to our question, “what is the optimal level of concentrate supplementation needed for lactating sheep and goats grazing intensively managed pastures?” As detailed above, we were successful in achieving that impact.

Other impacts from our project include:

(1) Cost savings to dairy sheep producers who adopt our results of approximately \$13/ewe per lactation (see detail in next section of this report).

(2) Most dairy sheep and many goat producers in the VT-NH-MA area now use the concentrate formulated by Dr. Hogue for this project.

(3) David Major credits his involvement in the project as the primary reason his per ewe milk yield increased over 50% during the three years of the project.

- (4) The camaraderie that developed between project participants was very valuable and was cited by each participant as a personal impact of the project.

Economic analysis:

The results from the project allowed us to do a very straightforward economic analysis.

For the dairy sheep producer, the economic benefit is substantial. Previous to our work, dairy sheep producers were typically feeding 1.5 - 2.0 lbs of supplement/ewe/day in the form of whole grain or pelleted concentrate. Also, scouring and other symptoms of acidosis were commonly seen.

Our results point to two economic benefits for dairy sheep producers:

- (1) Our recommendation of feeding .5lbs of supplement/ewe/day rather than 1.5 -2.0 lbs/ewe/day saves the cost of 1.0 - 1.5 lbs supplement/ewe/day. At an average cost of \$.09/lb, times an average 150 day lactation, gives a savings of \$13.50 - \$20.25 per ewe. Multiply this times the number of ewes in a flock (in Major's case over 100 ewes), and the savings are substantial.
- (2) The other benefit is the improvement in milk production. David Major reported a 50% increase in milk production over the three years of the project (see letter in appendices). He credits most of this increase to improvement in the metabolic health of his ewes due to the proper balancing of their pasture diet with a concentrate supplement that contained 20% fermentable fiber. If we credited the project with just a 20% improvement in milk production, then the increase in income would be calculated as 20% times 3 lbs/milk/ewe/day times 150 days times the price of milk at \$.70/lb equals an increased income of \$63/ewe/lactation.

The economic benefits to a goat producer were not as direct. Our work did not point out any savings in feed costs, however, the generation of data to substantiate the recommendation of feeding supplement at the ratio of 1 lb of supplement to every 3 lbs of milk will likely result in economic benefits due to more accurate feeding of supplement. The Quarriers also reported significant increases in milk production over the three years of the project which they also credit to the improvement in the metabolic health of their does (see letter in appendices). The Quarrier's also reported that the use of Dr. Hogue's concentrate formula reduced a serious ketosis problem in their herd.

Appendices

1. Study Team Members:

Team Leader:

Bruce Clement, UNHCE, 59 College Rd., Durham, NH 03824

Farmers:

David Major, 875 Patch Road, Putney, VT 05346

Keith and Leslie Quarrier, POB 125, Alstead, NH 03602

Research Advisors:

Dr. Douglas Hogue, Professor Emeritus, Cornell University, 255 Morrison Hall, Ithaca, NY 14853

Dr. James Welch, Professor Emeritus, University of Vermont, 16 Raymond Rd, Colchester, VT 05446

Technical Advisors:

Carol Delaney, UVM, Small Ruminant Dairy Specialist, 212 Terrill Hall, UVM, Burlington, VT 05405

Dr. Peter Erickson, UNH Dairy Specialist, 129 Main St., Kendall Hall, Durham, NH 03824

Dr. Stephen Major, DVM, Green Mtn. Bovine Clinic, 27 Bovine Ave., W. Chesterfield, NH 03466

Chester Parsons, UVM Sustainable Ag. Specialist, 278 S. Main St., St. Albans, VT 05478

John Porter, UNH Dairy Specialist, 315 D.W. Highway, Boscawen, NH 03303

Heidi Smith, NRCS, Rt. 1, Box 315, Walpole, NH 03608

Ag Economist:

Mike Sciabarrasi, UNH Ag Business Management Specialist, 56 College RD, James Hall, Durham, NH 03824

Statistician:

Dr Stephen Judd, UNH Information Technology Specialist, 59 College Rd, Taylor Hall, Durham, NH 03824

2. Testimonials:

February 21, 2002

TO: Bruce Clement

FROM: Doug Hogue

RE: Some comments on SARE project.

I know of no other data set or data analysis that is as carefully or completely collected and recorded in an on-farm experiment with milking sheep and lactating goats.

Provides a data set on the production level, lactation curves and milk composition under controlled conditions, the results from which should be applicable to many on-farm situations.

The feeding level comparisons serve as a solid base for supplemental feeding recommendations for both milking sheep and lactating goats.

While not comparative, the diet formulation should be useful, especially for lactating goats in the prevention of metabolic disturbances.

Level of participation by the cooperating producers was excellent and they should have confidence in the results and the application of the findings.

These producers most probably will communicate with others and thus their confidence should enhance the application of the resulting recommendations throughout the northeast.

Also while I don't think the results were surprising or unexpected based on our nutritional knowledge, many producers milking either sheep or goats base many of their procedures on hearsay or personal opinion and the data collected here should connect them back to a more scientific base.

This SARE project "committee" consisted of producers, county and state level extension personnel as well as research scientists which gave the project a lot of "oomph" in both breadth and depth. This contributed greatly to the overall success.

These comments are all of a "general" nature and should be used as an add-on to the specific results garnered from the data on production, etc. However I think they are important to realize the potential usefulness of the project results.

The camaraderie developed between and among the many project participants alone should enhance future developments in this general area.

Finally, the leadership of the project coordinator (or whatever his title is) (I mean you, Bruce) cannot be overestimated in bringing off a rather intense 3-year effort.

Hope these are useful.

Bruce

The most significant outcome of the project was the finding that the sheep were able to meet their lactation requirements from grass alone. The standard thought is that lactating ruminants can not consume enough roughage to maximize lactation output. This is certainly true of dairy cattle and was apparently true to some extent with the goats. I think that the sheep were not lactating at a level that would require nutrients above their ability to eat grass to maximize milk output. With the higher milk-producing sheep, grass intake was certainly at a very high level. The experiments were remarkably well run, for field trials. This was due to several factors, but most important, the high quality of the owners. They were very capable people with a high level of interest and persistence.

James Welch

Jan. 10, 2002

To Whom It May Concern,

We feel very fortunate to have been asked to be a part of this SARE grant experiment. Although we hoped for more similar results to what the Major's sheep farm found, which would have been very exciting, we had no big surprises with the results we got. It still felt like very worthwhile three years. The committee, which Bruce put together, was terrific and everyone worked incredibly well together. Even though we put the animals through a lot of feed changes, which we expected to hurt our production, our production actually increased significantly. We credit this a lot to the concentrate that Doug Hogue formulated for the experiment, which appeared in early lactation to help out with Ketosis problems and got the goats through kidding transitions smoother than ever. Once they settled into milking the feed wasn't as important, but having the grant gave us a focus on the farm, which made a big difference. Steve Judd helped so much with getting all of the farm information into the computer on a Data Base program. This makes all of our record keeping much more thorough and easy to use. Jim Welch was great to have on the committee because he has collected so much data himself, giving him area 1 understanding of how best to approach that end of the project. Having the vet asses the herd regularly was very reassuring. We looked forward to every meeting. Everyone's support and enthusiasm for the project was very motivating and helped us keep focused on what we were doing all the time.

We plan to continue freshening our herd with Doug's formula and will feed out concentrate according to milk production using the quantities that the experiment showed best. I'm not sure how many other farms have gained from what we did, but there is definitely a lot of curiosity to hear about it. I just wish we had three more years!

Keith and Leslie Quarrier

Final Notes on the SARE Funded Research Project on Feed Supplements for Pasture Based Small Ruminant Dairies -David Major- 1-28-02

The recently completed 3 year long research project on feed supplements for pasture based small ruminant dairies was a definite success from the point of view of Major Farm, the farm that represented dairy sheep in this study. The process of developing and implementing the research guidelines went well. The results proved interesting and they will have a substantial impact on how we operate Major Farm in the future. With some luck and communication, the results may be able to help other pasture based northeast sheep dairies lower their input costs and increase their production as well. Process: Bruce Clement, the chief architect and coordinator of the project did an outstanding job assembling an experienced and committed group of extension and research professionals to help design and oversee the project. This group of advisors obviously appreciated the value of on-farm research and seemed willing to work around the limitations that go along with such research -designing the experiment to fit in with the scheduling and equipment peculiar to Major Farm. In retrospect, the one constructive criticism I have is that we could have profitably put more effort in defining exactly what pasture data would be useful and analyzing it better. By the end of the study we learned that the pasture portion of the sheep's diet was the most critical portion in determining their production; had we known at the beginning, we might have put more emphasis on the pasture data.

Results: From my point of view, the two most important results of our research are, 1) a lower protein, high fiber pelleted concentrate is a good choice supplement for dairy ewes on high quality pasture, and 2) so long as the dairy ewes have continuous access to high quality pasture, they do best on very low levels of supplement, meaning .5 pound per day or less.

Usefulness: The effect on our farm of our new found knowledge as been profound and it will continue to be so in the future. Partly as a result of management changes instituted during the course of the SARE research, our per ewe milk production has increased 50% in three years. In the future, we will be able to reduce our per ewe feed bill with the knowledge that we can rely more heavily on pasture and reduce the level of supplemental concentrates without cutting the ewes short.

The results of this research are relevant to all sheep dairies. I'm sure others will find the results useful as soon as they learn about them through conferences and the media. I am happy that I could help in a research project that finished up with such practical, useful results for a segment of the agricultural community.

Sincerely, David Major

3. Concentrate formula:

Bruce,

As you know, depending on availability we were using either soy hulls or beet pulp in the ration for the SARE project. The formula as designed and typically shipped for the 14% was:

Fine Corn Meal 567
Ground Beet Pulp 380
Wheat Middlings 364
Red Dog Wheat 200
Distillers Grains w/Solubles 150
48% Soybean Meal 110
Molasses 80
Bakery Product 50
Limestone 42
Salt 20
Dicalcium Phosphate 15
Pellet Binder 12
NEF Sheep Premix 10

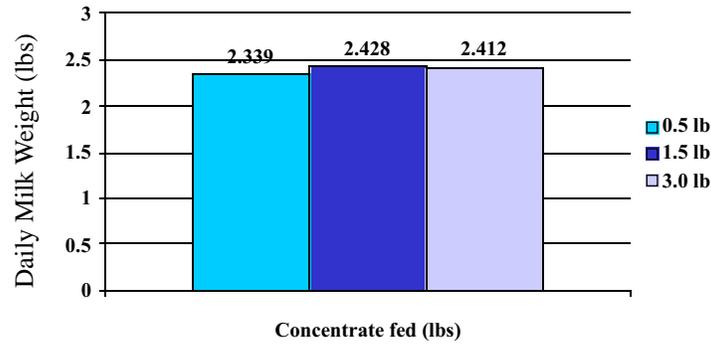
Thanks again for your interest in New England Feeds for this project. We appreciate the opportunity to have worked with you the producers who participated in this project.

Please don't hesitate to call if you have any questions.

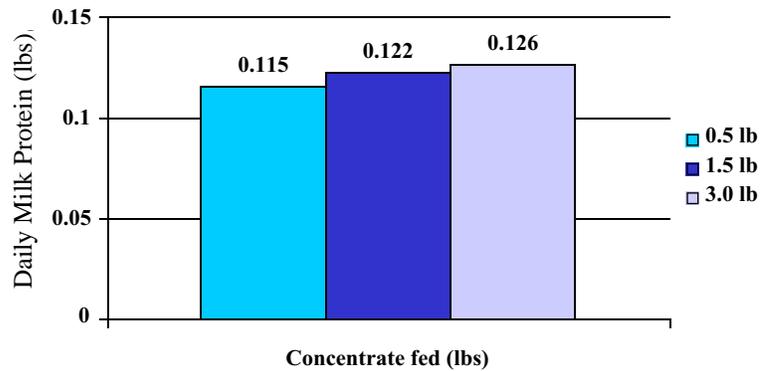
Gordon Smith, New England Feeds, Inc., 22 Kimball Place, Fitchburg, MA 01420
(800) 545-6655 gsmith@newenglandfeeds.com

4. Statistical Data

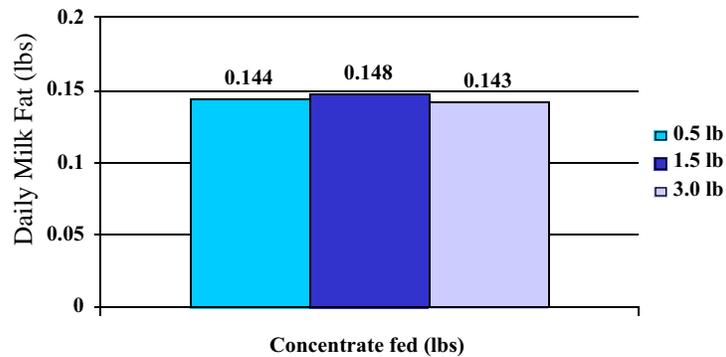
Sheep Daily Milk Weight vs. Concentrate Fed (1999)



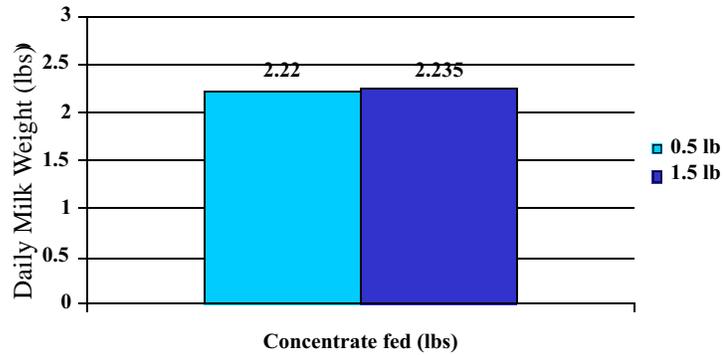
Sheep Daily Milk Protein vs. Concentrate Fed (1999)



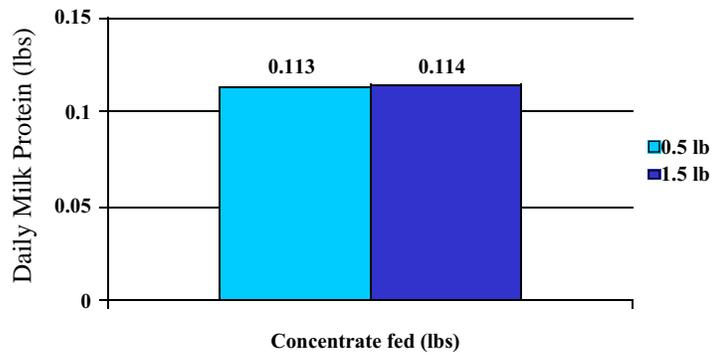
Sheep Daily Milk Fat vs. Concentrate Fed (1999)



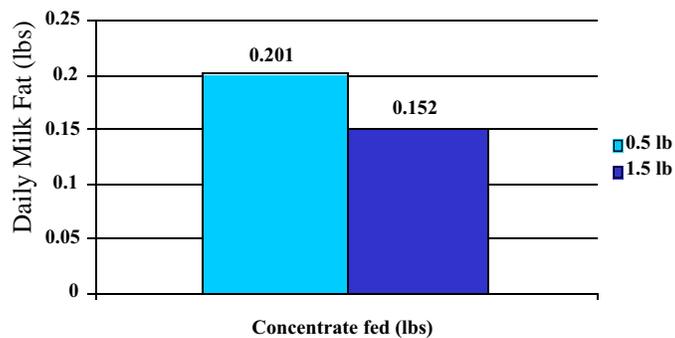
Sheep Daily Milk Weight vs. Concentrate Fed (2000)



Sheep Daily Milk Protein vs. Concentrate Fed (2000)



Sheep Daily Milk Fat vs. Concentrate Fed (2000)



Sheep Daily Milk Weight vs. Concentrate Fed (2001)

