Proceedings of the 2015 Northeast Pasture Consortium Annual Conference & Meeting held at the Waterfront Place Hotel & Conference Center in Morgantown, WV, March 11-12

Progress of the "Assisting Organic Dairy Producers to Meet the Demands of New and Emerging Milk Markets" research project - Flaxseed supplementation & Ryegrass Trials

After lunch, session 3, **Progress of the "Assisting Organic Dairy Producers to Meet the Demands of New and Emerging Milk Markets" research project - Flaxseed supplementation & Ryegrass Trials** began. It was moderated by Dr. Andre Brito, Assistant Professor, Dairy Nutrition Research Center, University of New Hampshire, Durham.

Dr. Heather Darby, Extension Associate Professor, Agronomic and Soils Specialist, University of Vermont, Burlington presented her presentation via webinar. This was the first time we had used this presentation vehicle. It went quite well in a seamless fashion with the other speakers who presented their papers in person. Her topic was *Integrating Annual Forages into Northeast Pasture Systems*. Dr. Darby said that annual grasses can be a great addition to the forage resources on the farm. They can enhance or extend the grazing season. The cold tolerant ones begin spring growth earlier than perennial forages providing forage before the perennial forage pastures reasonably can, without sacrificing their yield potential by grazing them too early and reducing their vigor for the rest of the season. Their quick growth response in late winter to early spring allows pasture producers to begin stocking their cattle on an annual pasture allowing their perennial pastures to grow ungrazed until later in the spring. Summer annuals can also take heat and drought better than our cool season pasture grasses. Therefore, they can fill gaps in forage availability that often occur in mid-summer as cool season grass growth rates slow down considerably or go completely dormant. In 2012, July and August produced less than a ton of cool season grass forage per acre. Typically, those two months require twice as much pasture acreage to feed the same number of grazing animals that were on the same pastures in the spring due to the slow growth rate of cool season perennial grasses and legumes. Summer annual forages typically produce more biomass especially during hot weather than our cool season perennial grasses. Another advantage is that they are multipurpose forages. They can be used for grazing, balage, and silage. Depending on the weather and the need for pasture, the annual forages can be harvested mechanically if approaching maturity and quality would be lost if grazing livestock could not be cycled through all the acreage quickly enough without wasting feed.

Dr. Darby reported that grazing corn was not successful in Vermont. Producers, there, liked sudangrass best for grazing. It is fine-stemmed, leafy, and regrows well after being grazed and allowed to recover before being grazed again. Sorghum and sorghum-sudangrass have stems too big for grazing livestock. They are better utilized as mechanically harvested forage. Japanese millet is free of prussic acid that can cause cyanide poisoning in livestock. It has even finer stems than sudangrass and is leafier too. Regrowth potential is good. It also tolerates cooler and wetter weather than sudangrass. Teff, a rather new annual forage introduction to the US, looks like annual ryegrass. It tolerates many different types of soil conditions. It is best, however, as a hay crop.

Establishment of summer annuals requires soil temperatures to be 60-65^{o} F. Grain drills work well as these annual grasses have relatively large seeds compared to cool season grass seed. For Vermont, plantings can be made from early June to early July. However, by early July, it may be too dry for good germination to occur unless some rain falls after planting. For grazing, thicker seeding rates are warranted to get a dense stand to promote finer stems. It is also good to do successional plantings of these annual grasses so that they do not all mature at once, and also as a hedge against weather-related damage to stand establishment. These annual forages grow best with some nitrogen (N) fertilization. Millet needs less N than sudangrass. Manure can have enough N for these annual grasses if the farm is an organic operation.

Sudangrass can be harvested up to 3 times. However, crude protein decreases from 23% at first harvest to 12% by third harvest.

One farmer lets some of his Japanese millet go to seed. He harvests the seed to plant it again next year and harvests the straw for bedding. The millet has better feed value and higher crude protein than brown midrib sorghum or sorghum-sudangrass and is a much cheaper seed to buy.

Experimenting with summer seedings of brassicas, they found that only one year out of three was successful. Brassicas lower the yield of the grasses since they take up some of the space and are broadleaf plants so they also shade the surrounding grasses.

Summer annuals can be used on pastureland needing renovation and slated to be reestablished. The farmer can have his livestock graze the pasture rotationally one or two times before tilling the field and planting the summer annuals.

Winter annual grasses such as triticale can be sown in the fall and grazed the following spring. Grazed triticale can be 19% crude protein and have an NDF value of 48.5%. Triticale yields one grazing. Other winter small grain annuals can yield two grazing by May 3 before the perennial grass pastures are ready to be grazed.

Dr. Sid Bosworth was the next speaker for this session. His presentation was entitled *Productivity and Persistence of Multi-Cultivar Perennial Ryegrass Mixtures*. This was cooperative research effort done around the Northeast Region by the researchers: Howard Skinner: USDA-ARS, University Park, PA, Richard Smith: University of New Hampshire, Sid Bosworth: University of Vermont, Rick Kersbergen: University of Maine, Fred Pollnac: University of New Hampshire. Many studies have shown that increasing species diversity can increase yield, stabilize seasonal productivity and possibly extend the grazing season. Work done from 2005 to 2013 in the Northeast demonstrated that a 5 forage species mixture was most often more productive than a 2 species mixture during that time period. The researchers thought that perhaps multiple cultivar mixtures of perennial ryegrass might be more productive as well than just a single perennial ryegrass cultivar planted with a companion legume or a 2 cultivar ryegrass mixture with a legume.

The Perennial Ryegrass Mixture Study consisted of six mixture treatments (plus optional 7th) with five replications. Criteria for formulating mixtures were:

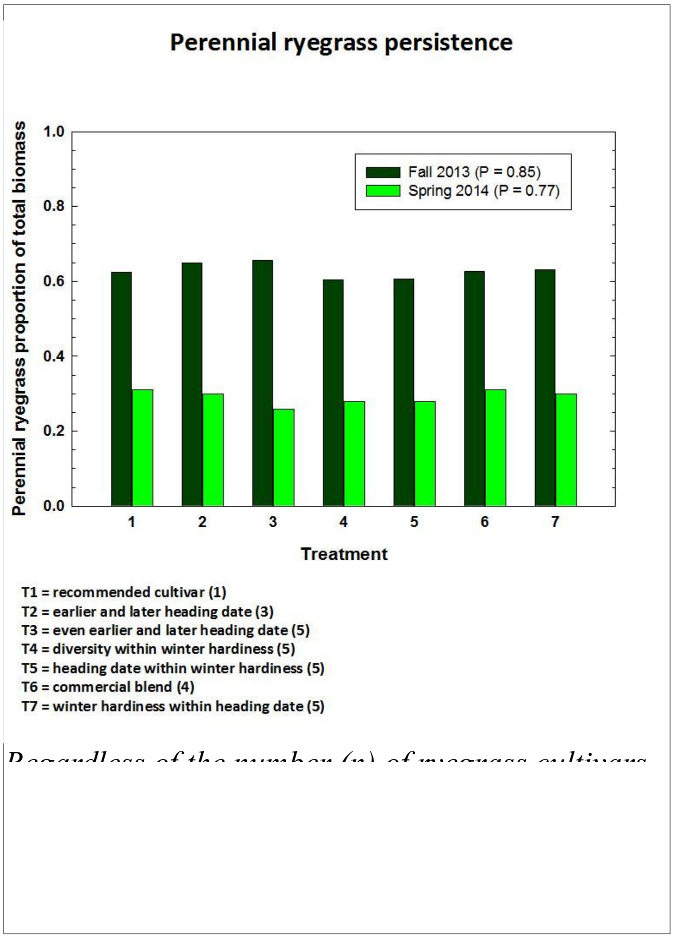
- Number of cultivars in the mixture
- Relative heading date
- Winter hardiness (WH) rating
- Ploidity level (2N verses 4N)

All the treatments included white clover as a companion crop. Their main hypothesis was: Cultivar diversity will add productivity, stability, and season extension potential in a perennial forage stand.

Treatment	**Cultivar**	**Ploidy**	**Winter Hardiness**	**Heading date**
1) Most Adapted	Remington/Mara	4N/2N	6/7	31/28 May
2) Early/Later Heading	#1 plus			

	Barutti	2N	7	17 May
	Barelan	4N	6	1 Jun
3) Even Earlier/Later	#2 plus			
	Kilrea	2N	5	15 May
	Barnhem	2N	6	7 Jun
4) Heading date within Ploidy (2N)	Barata	2N	6	24 May
	Barnhem	2N	6	7 Jun
	Barutti	2N	7	17 May
	Barsprinter	2N	7	22 May
	Mara	2N	7	28 May
5) Heading date within Ploidy (4N)	Bargala	4N	6	19 May
	Remington	4N	6	31 May
	Barelan	4N	6	1 Jun
	Baraudi	4N	6	1 Jun
	Barsintra	4N	6	11 Jun
6) Commercial Blend	BG-24T/BG34	2N/4N		
7) WH within Heading Date	Barmotta	2N	4	25 May
	Glenariff	2N	5	25 May
	Barata	2N	6	24 May
	Barsprinter	2N	7	22 May
	Mara	2N	7	28 May

Ploidity is the number of sets of chromosomes within a cell or organism. Each set is designated N so one set is N is haploid, two sets is 2N is diploid, three sets is 3N is triploid, four sets is 4N is tetraploid, and so on. Perennial ryegrass is either 2N or 4N. Most turf type perennial ryegrasses are diploids. Tetraploid ryegrass cultivars tend to be forage types. Perennial ryegrass is naturally diploid; however, tetraploids have been developed to improve forage quality and productivity. Tetraploid ryegrasses have low summer survival, but under Northeast weather conditions where summers are shorter and cooler it was felt that the tetraploids should be included to see if they would survive since they are are more productive than diploids.



Different cultivars that respond differently to environmental conditions would tend to smooth out the seasonal distribution of forage production. Therefore, heading date differences among cultivars were used to provide different times to maturity. Winter hardiness is a must for longevity of forage stands in the Northeast so winter hardiness ratings were used to select cultivars with varying degrees of winter hardiness (7 - most winter hardy). The ryegrass study confirmed that tetraploids are not as winter hardy as diploids. Mara, Barsprinter, and Barutti, all diploids, had some survival when subjected to a temperature of - 4^{o} F in greenhouse trials. All were rated a 7 in winter hardiness. Mara, however, had the best survival of slightly over 50% at that low temperature. Survival of Barsprinter and Barutti was less than 20% at - 4^{o} F. Since winters in the Northeast can be much colder than that for a few days off and on, snow cover during those days is imperative for winter survival of perennial ryegrass. Ten centimeters (4 inches) of snow cover has been reported to be enough to maintain soil surface temperatures near 32^{o} F. In the winter of 2013-2014, the minimum temperature recorded at each trial with less than 4 inches of snow on the ground was Maine (-5^{o} F), New Hampshire (4^{o} F), Pennsylvania (-9^{o} F), and Vermont (-2^{o} F).

Summary of trends in main plot ryegrass biomass are:

- No significant treatment effects for mid or late season harvests.
- Biomass differences most detectable early in the season - Highlights potential for season extension
- Treatment 5 - Heading date within Ploidy (4N) (tetraploid) was consistently low yielding.
- Mixtures had consistently higher early season mean yields than recommended cultivar in NH

and PA, but not in ME and VT.
- Except for treatment 5, none of the mixtures yielded less than the recommended cultivar at any point in the growing season, i.e. no yield penalty for planting mixtures.

The winter of 2014 was hard on perennial ryegrass persistence in 3 locations. Perennial ryegrass proportion of total biomass dropped regionally from 60-67% in the fall of 2013 to 25-32% in the spring of 2014. Production was cut in half or more. The drop in proportion of total biomass in the Spring of 2014 was most noticeable in Maine (12% ryegrass), New Hampshire (28%), and Pennsylvania (7%). Vermont in the spring of 2014 still had a very respectable proportion of total biomass coming from perennial ryegrass of nearly 70%. This superior overwintering at Vermont might be due to the trials being conducted on a sandy soil. However, it is also important that there is sufficient snow cover at the time that minimum air temperatures for the winter occur. This insulates the plants from those extreme low temperatures.

In summary, planting perennial ryegrass in multi-cultivar mixtures did not necessarily improve yield. The one mixture treatment that consistently yielded lower in the first harvest was made up of all tetraploid cultivars (#5). This seems to refute that tetraploids are better yielding than diploids, at least in this Region. The proportion of ryegrass declined significantly between fall 2013 and spring 2014 regardless of treatment. Winter survival in Vermont was much greater than would be predicted based on extreme cold weather alone. Although conditions are expected to become more favorable for perennial ryegrass cultivation in the Northeast as the climate warms, cold winters such as we experienced in 2013-2014 will continue to pose a threat to persistence.

Mr. A. Fay Benson, Project Manager NY Organic Dairy Initiative, Cornell University, Cortland, NY presented next on *Using Brassicas to Extend Grazing Seasons*. He started his talk listing the good attributes brassicas can bring to a grazing operation. First of all, they are nutritious. Their nutritional attributes are:
- Provide high quality feed in summer and autumn when perennial pasture quality is often low.
- High digestibility, energy (11-14 M Joules ME/kg DM) and protein (15-25% in brassica leaves, 9-16% in turnip and swede bulbs)
- Reported livestock weight gains while grazing brassicas:
    - ¾ to 1.2 lbs/head/day for lambs
    - 1.5 to 2.25 lbs/d for growing cattle

Brassicas can be used as a catch crop when preparing to reseed a pasture. They are fast growing in cool weather (less than 50^{o} F), so plant in early spring or late summer. They produce grazing forage in 2 months. They can be grazed through November since they are frost resistant. Sugar content actually increases with freezing temperatures. The frozen plants retain their feed value. Their roots have beneficial effect on soil health by reducing surface soil compaction. Any residue can be disked in the following spring for early planting of new grazing stand. Kale and swedes planted in spring provide grazing in November and December. Rape, turnips, and stemless kale planted in spring provide summer grazing. Rape, turnips, and turnip hybrids planted in late summer provide grazing in November and December.

Brassicas can improve soil health in a number of ways:
1. Heavy feeders, good to take up nutrients in sacrifice areas in pastures.

2. Non-Mycorrhizae, add diversity to soil
3. Tubers and root hairs loosen soil and feed soil biology.

One dairy farm operation seeds oats and kale or oats and turnips in August fertilizing it with pig manure. The turnips and oats yielded 2.8 tons of dry matter per acre in November. It was 30% crude protein with an acid detergent fiber (ADF) of 21% and a neutral detergent fiber (NDF) of 28%. Its potassium content (2.8%) was too high to be fed to dry cows.

Lush fall grazing with winter annuals

A large sheep operation overwinters sheep on 170 acres with 40 acres of it being turnips that are planted in the fall on a 4-year rotation. These turnips are grazed rotationally on a 3-day cycle. The first day the turnips tops are eaten, the second day the tubers are eaten, and on the third day the sheep eat balage before being moved to a new paddock of turnips. This provides enough dry matter intake to feed the sheep for 100 days of winter weather.

There are some feeding concerns with brassicas that need to be addressed by management. They are:

1. Cool season growth along with nitrogen fertilization can lead to Nitrate Poisoning.
2. High protein content can cause bloat.
3. Hypothyroidism or thyroid condition
4. Potassium level is too high for dry cows, do not feed to them.
5. Keep away from dairy cows 4 hours before milking to avoid off-flavors in the milk.

Use these very important management techniques:

1. Introduce grazing animals to brassica pastures slowly.
2. Avoid abrupt changes from dry summer pastures to lush brassica pastures. Do not turn hungry animals that are not adapted to brassicas into a brassica pasture.
3. Brassica crops should not constitute more than 75 percent of the animal's diet. Supplement with dry hay if continually grazing brassicas or allow grazing animals access to grass pastures

while grazing brassicas.

4. Feed Kelp or other Iodine Source
5. No-till establishment into existing sod will reduce the risk of these disorders because of grass in the brassica pasture (Be sure to get an effective burndown of the grass though).
6. Avoid using high rates of nitrogen fertilizer or nitrogen-rich manures.

Brassicas compare well with organic corn in economic return for the cost of production. Yet, brassica use has not caught on well yet with producers. The following table shows the pros and cons to brassica production on pasture-based farms.

PROS	CONS
RAPID GROWTH AFTER PLANTING	SHORT GROWING SEASON
MINERAL PROFILE GOOD FOR DAIRY	CAN HAVE HEALTH AND FLAVOR ISSUES
INEXPENSIVE SEED	DOES NOT PERSIST
GOOD AS NURSE OR CATCH CROP	DOES NOT TOLERATE DROUGHT
TILLAGE IS PREFERED METHOD OF ESTABLISHMENT	

No-Till seeding into existing pastures would solve many of the issues by reducing cost of establishment. These over-seeded pastures would already have grasses to balance diet in crude protein and nitrogen. It could lengthen the grazing season on those pastures, and it would allow adding additional seed of legumes or grasses for future grazing.

To burn-back existing grasses in pastures organically in order to get no-till establishment of brassicas on green pastures, acetic acid was used on three test farms. Two concentrations were used, 10% and 20% acetic acid. There was not too much difference in forage quality between the two rates of acetic acid application. Burn-back was excellent, but rainy weather allowed the existing grass sward to come back faster than was desirable for getting turnips established on two of the farms. The third farm had a noticeable difference in the composition of the pasture sward. This allowed some comparisons to be made between the control pasture and a pasture that had good amount of turnips in it. Cows can eat 1.3% of their body weight of NDF from forage on a dry matter (DM) basis. The turnips changed NDF from 50 to 36 over the control. This allows cows to eat 43 lbs. Pasture w/Turnip versus 31 lbs. of Control Pasture (DM basis). Greater intake means more milk flow. In an example Mr. Benson gave, a 1,200 lb. cow, giving 50 lbs of milk requires 23 lbs. control pasture + 8 lbs. Corn Meal, OR 43 lbs. of pasture with turnip. This is a cost difference of $1.60/ cow/day in favor of the pasture with turnips.

In another study funded by Northeast Sustainable Agriculture Research and Education (NESARE) and Organic Research and Education Initiative (OREI), Daikon radishes were used to alleviate soil compaction in pastures. It was noticed that grass growth was much better under hot wires at paddock divisions than in the paddocks themselves. Soil was not compacted under the break wire by livestock hooves, but it was in the paddocks on either side of the wire. To establish the radishes no-till, 10% acetic acid at 20 gallons per acre was used to burn-down growing grass on the organic plots. Unfortunately, even though the burn-down was thorough, it only lasted about 4 weeks and the grass was too competitive with the radishes turning them yellow. At two months, the over-seeded plot looked the same as the control plot with just grass and no radishes. On the conventional plots, Roundup herbicide was used as a burn-down. Radishes grew better there but were still yellow. It was due to lack of biological activity in the soil. It turned out that a no-till drill with shoe-type seed slot openers increased biological activity by disturbing the soil more (aeration) along the seed slot than no-till drills with disc openers. The radishes were not yellow where the shoe type no-till drill was used. Next year Mr. Benson plans to use some Chilean nitrate or other small amount of nitrogen fertilizer in the seed box to feed the soil biology to get healthier radishes. Using the Cornell soil health test that looks at physical, biological, chemical properties of soils, it was found the chemical test was good, but the biological and physical properties were poor. The most limiting factors were surface hardness (compaction) in the physical property, and low mineralizable nitrogen and active soil carbon in the biological properties.

Using winter annual forages to extend the grazing season

Dr. Kathy Soder, Animal Scientist, USDA-ARS, Pasture Systems & Watershed Management Research Unit, University Park, PA spoke next. The title of her presentation was *OREI On-farm Study*. The study objectives were:

1. Monitor pasture, feeding and management strategies over a 4-year period (grazing and non-grazing season)
2. Enrich fatty acid profile of milk in winter by feeding flaxseed
3. Include forage-only farms for controls (3).

This is an on-farm supplementation study using flaxseed during the winter feeding period when cows are not on pasture, but instead eat stored forages. A total of 14 organic dairy farms in NH, ME, VT, NY, and PA are collaborating with the project by conducting on-farm research. All farms are enrolled in Dairy Herd Improvement (DHI) record-keeping. This enables the research team to collect information about herd milk production and composition, animal management strategies, and reproductive health at each farm. Twice monthly visits have taken place for the last 4 years to collect data including pasture biomass, quality and intake. Feed concentrate samples and body condition scores of the dairy cows are also collected monthly. Of the 14 farms, 8 farms in the winter of 2013-2014 fed flaxseed to half their cows. The other cows on the farms were a control group. There were 205 cows for each treatment, flaxseed fed at 6% of the ration and no flaxseed in the feed ration. This was repeated again during the winter of 2014-2015. During the grazing season, no flaxseed supplement was fed while the cows were on pasture. Information was collected on pasture yield and quality, botanical composition, cow productivity, conserved feeds fed, milk samples for fatty acid analysis. They used some of the information to estimate dry matter intake (DMI) of pasture using the Large Ruminant Nutrition System (LRNS). They also did an economics survey.

Challenges involved in doing this on-farm research study was insuring the farmers were feeding proper level of flax (one farm avoided feeding flaxseed altogether) and keeping good farmer records, communicating with farmers, communicating with collaborators, and impromptu changes in farm management.

Proportion of pasture fed of the total ration used on grazing dairy farms in this study was 60% pasture on farms using a partial total mixed ration (TMR) or moderate feed input (MI), 90% pasture on those farms supplementing pasture with grain (GS), and 96% pasture on forage only (FO) farms. The latter group fed some dry hay to round out the feed ration. Only 7% of the pastures in the study did not meet crude protein content of 14.1% of DMI for lactating dairy cows. On average, pastures with excessive CP provided 143% of requirement. The most limiting nutrient was energy. Thirty-nine percent of the pastures were below 1.37 Mcal/kg of net energy lactation (NEL). On average, the deficient pastures only met 89% of the energy required. Thirty-five percent of the pastures were also low on calcium to meet dietary needs of a lactating Holstein and 18% were low on phosphorus and 10% low in sulfur.

Table 1. Protein, energy, and macro-mineral requirements of lactating dairy cows and incidence of pasture samples that did not meet minimum dietary requirements.

	Animal requirements (% of total diet), Dairy NRC 2001	% of samples <u>not</u> meeting minimum animal requirements
	680 kg Holstein cow, producing 25 kg/day, 3.5% milk fat, 3.0% milk protein[1]	
CP, %	14.1	7
NEL, Mcal/kg	1.37	39
Ca, %	0.62	35
P, %	0.32	18
Mg, %	0.18	1
K, %	0.24	0
S, %	0.22	10

[1]Additional cow parameters used in NRC model to estimate requirements: body condition score = 3.0 (on a scale of 1-5); cow is 65 months of age, environmental conditions are default (confinement, tie stall), total mixed ration.

Milk production was highest on MI farms (averaging 50 lb/d), and comparable between GS and FO farms (averaging 33 lb/d). Rumen-N balance was negative on farms that supplemented pasture with a grain mix.

The overall nutritional quality of pastures was high. Mineral supplementation of Ca, P, and S should be considered for grazing dairy cows. More research is needed on the use of grain-only (and alternatives) supplementation with high-quality pasture and the potential impacts on rumen-N balance. High quality pasture and diverse supplementation strategies allow farmers to use feed resources such as pasture and homegrown forages and grains to meet goals for milk production on their farm.

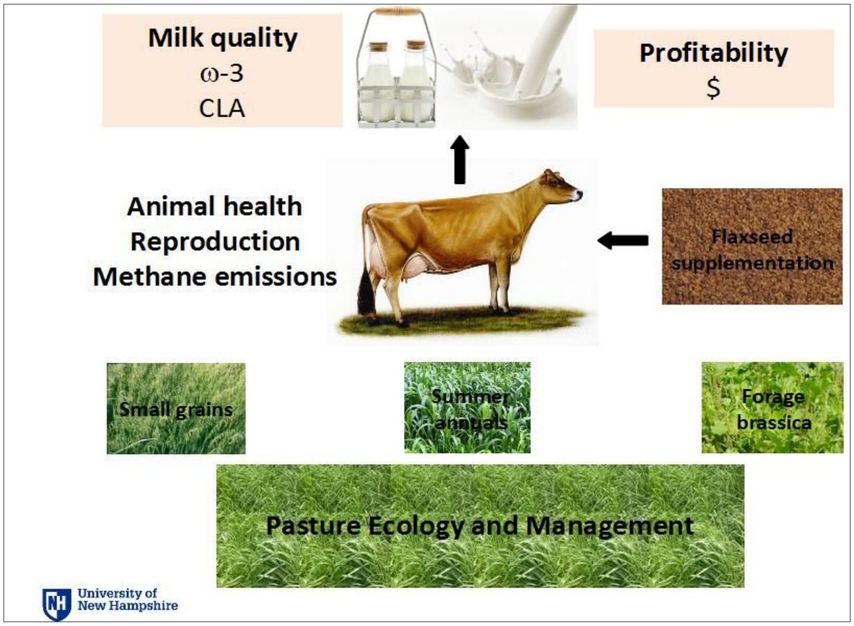
The results of the flaxseed supplementation during the non-grazing season (November-April) showed, on average, an omega-3 content increase in milk of 60% when lactating cows were fed flaxseed over those who were not. Season, grazing versus non-grazing, did not change average Omega-3 overall over all the farms, but there was a high farm-to-farm variation. Omega-6 levels were not affected on average across all farms studied that fed flaxseed, but again there was some farm-to-farm variation. There was no seasonal change either. As a result, the omega-6 to omega-3 ration declined 36% when flaxseed was fed. Season did not change average Omega-6:3 ratio, but again there was a high farm-to-farm variation. Pasture-fed cows have higher omega-3 content in their milk. Organic dairy cows fed a flaxseed supplement in their winter feed ration mimics the pasture effect so these cows' milk always has a higher omega-3 content than confinement-fed cows fed conventional dairy rations.

There was also a 34% increase in conjugated linoleic acid (CLA) fatty acid in the milk when flax was fed to dairy cows on a non-grazing feed ration. Even with this increase, there was still a 40% decrease in CLA during the non-grazing season to cows fed flaxseed compared to milk being produced from pasture during the grazing season.

To do this on-farm study, each trip covered 1800 miles to visit 11 farms over 5 days from University Park to Maine and the Canadian border and back. Some of the northern dairy herds were not grazing in mid-May yet in 2014. There was great variation in pasture composition and quality from farm to farm and as well in cows. Cows were Jerseys, Jersey/Holstein crosses, Holsteins, and some other herds of several breeds or crosses.

Dr. Andre Brito, session moderator, was the last speaker for this session. His presentation was *Feeding Flaxseed to Organic Dairy Cows*. To produce organic milk with better fatty acid content and do it economically and environmentally on a farm requires pasture ecology and management, perhaps small grains, summer annuals, brassicas, flaxseed supplementation during the non-grazing period, and paying attention to animal health, reproduction, and methane emissions.

To discover the effects of ground flax on milk production and fatty acids (FA) profiles in organic Jersey cows, this team of researchers was involved: André F. Brito (UNH), Kathy Soder (USDA-ARS), Jana Kraft (UVM), Brianna Isenberg (UNH), Tales Resende (Federal University of Minas Gerais-Brazil, Diego Oitschach (Federal University of Viçosa-Brazil), André Pereira (UNH), and Melissa Rubano (USDA-ARS). Two experiments were set up. Experiment 1 involved twenty lactating organic Jersey cows that received (% of diet DM): 0, 5, 10, or 15% of ground flaxseed during the winter season. Experiment 2 involved twenty lactating organic Jersey cows that received (% of diet DM): 0 or 10% of flaxseed during the grazing season.



Ground flax nutrient composition is:

- Crude protein (CP(, % DM 22.8
- Neutral detergent fiber (NDF), % DM 25.2
- Organic matter, % DM 96.5
- Crude fat, % DM 33.6
- Oleic acid, g/100 g FA 19.2
- Linoleic acid (ω -6 FA), g/100 g FA 15.4
- α-Linolenic acid (ω -3 FA), g/100 g FA 53.8

Winter Ground Flax Study Methods were:

- 20 lactating organic Jersey cows (111 ± 62 DIM) were used in 5 replicated 4 × 4 Latin square design.
- Each period lasted 21 days with 14 days for diet adaptation and 7 days for data and samples collection.
- Animals were individually fed twice daily with refusals recorded daily before each feeding.
- Milk production was recorded throughout the 84-day study.
- Blood, rumen, urine, feces, and feed samples were also collected.

Ingredient Composition of TMR Fed During the Winter Season				
	Flaxseed % diet			
Item	0%	5%	10%	15%
Amount of flax fed, lb/day	0.0	2.1	3.9	6.0
	-----------% diet dry matter------------			
Balage	55.0	55.0	55.0	55.0
Grass hay	8.0	8.0	8.0	8.0
Ground flax	0.0	5.0	10.0	15.0
Soybean meal	6.0	4.8	3.5	2.0
Roasted soybean	2.0	2.0	2.0	2.0
Corn meal	27.0	23.3	19.7	16.0
Minerals & vitamins	2.0	2.0	2.0	2.0

Diet Composition During the Grazing Season

Item	Ground Flax 0%	Ground Flax 10%
	------------------% of diet DM[1]------------------	
Amount of flax, lb/day	0.0	4.2
Pasture	40.0	40
TMR[2]		
Balage	25.0	25.0
Liquid molasses	1.9	1.9
Ground flaxseed	0.0	10.0
Organic grain meal	33.1	23.1

[1]Dry Matter [2]Total Mixed Ration

Nutrient Composition

	Diet		Ingredient			
Nutrients	**0% Flax**	**10% Flax**	**Pasture**	**TMR**	**Corn/Soy Mix**	**Flax**
Dry matter (DM), %	45.8	45.3	21.5	52.9	91.6	92.7
Crude protein, % DM	16.5	17.4	19.9	13.4	21.7	28.1
Neutral detergent fiber, % DM	39.7	42.8	50.0	39.4	10.5	33.9
Acid detergent fiber, % DM	23.9	26.4	30.1	24.2	4.2	23.8
Crude fat, % DM	3.8	6.4	3.8	3.4	5.8	30.8
α-linolenic acid, % fatty acids	25.2	30.0	46.6	15.6	5.0	42.2
IVDMD[1], % of DM	74.4	71.1	72.5	74.3	84.9	50.4

[1]In vitro dry matter digestibility

In the second experiment, Effects of Ground Flax on Milk Production, Milk Composition, and Methane Emissions in Organic Dairy Cows During the Grazing Season, more researchers were involved. They were André F. Brito (UNH), Brianna Isenberg (UNH), André Pereira (UNH), Kathy Soder (ARS-USDA), Nancy Whitehouse (UNH), Alexandra Catalano (UNH), Kelly O'Connor (UNH), Monica Stimmel (Virginia Tech), and Milena Lima (UESC). In this experiment, grazing organic milk cows either received no ground flax or 10% of their feed ration was ground flax.

Grazing season ground flax study methods were:

- 20 lactating organic Jersey cows (112 DIM) were used in a completely randomized design.
- Each period lasted 30 days with the last 7 days used for data and samples collection.
- Animals were individually fed TMR twice daily with refusals recorded daily before each feeding.
- Milk production was recorded throughout the 120-day study.
- Blood, rumen, urine, feces, and feed samples were also collected.

Milk production, milk fat content, and milk protein content were not affected by ground flax during the grazing season. Milk alpha-linolenic acid was highest in cows fed flax during the grazing season. Milk omega-6 FA decreased and milk omega-3 FA increased with ground flax during the grazing season. Milk omega-6 to omega-3 ratio lowest in cows fed ground flax during the grazing season. The ratio dropped from 3.0 to 1.5. In general, supplementing pasture with ground flax (i.e., 10% diet DM) did not negatively affect milk production and composition, but increased milk omega-3 fatty acids.

An economic analysis is important to determine how to best utilize ground flax in organic dairy diets.