



## Alternative Free Choice Minerals for Goats

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### Cooperators:

- Cheryl and Mike Hopkins – Walker

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### In a Nutshell

- Alternative supplements, such as natural minerals and kelp, are gaining popularity in some livestock production systems.
- These supplements are said to be more bioavailable to animals, increasing overall health.
- Cheryl Hopkins supplemented her goats with three different mineral treatments (mineral block, loose minerals and loose minerals plus kelp) over the 2015 grazing season.

### Key findings:

- The goat herd consumed more of the mineral block than the loose minerals or kelp.
- No significant differences in parasite load, body condition score or hoof health were observed over three mineral treatments; goats remained healthy throughout the trial.
- Based on consumption, the mineral block was the cheapest to feed and the loose mineral plus kelp was the most expensive. Cheryl will continue to feed the most expensive supplement because of perceived health benefits.

Project Timeline:

May 2015 – October 2015

### Background

During the grazing season, goats receive most of their nutrition from pasture, but a complete and healthy ration includes mineral supplementation. Many minerals are required for optimum function and performance (Luginbuhl, 2006). Trace minerals, which can be natural or



*Goats eating loose minerals and kelp out of a portable mineral feeder on pasture.  
Photo taken September 27, 2015.*

synthesized, organic or inorganic, are most commonly offered in a mineral block or a loose mineral mix. There are also natural supplements, such as kelp, that provide essential minerals and have gained popularity in natural and organic production systems.

Trace mineral intake and absorption help livestock achieve optimal performance and their genetic potential, making mineral absorption integral to a successful herd management program (Garret, 2011). Mineral supplement forms differ in content, bioavailability, palatability, and consumption rate (Nix, 2015). Organic trace minerals reportedly have higher bioavailability (due to chelation) than do inorganic sources, but are more expensive (Hale and Olson, 2001).

Consumption rate can differ when feeding a block versus loose mineral, as one form is licked and the other is eaten as a powder.

Cheryl and Mike Hopkins raise a herd of about 130 Boer-cross does, along with finishing kids and three bucks. The herd is grass-based, rotationally grazing through a series of thirteen paddocks during the grazing season and eating grass hay in the winter. In the past, Cheryl and Mike had sporadically offered mineral blocks at some of the water tanks in the pasture, so the goats only had access to the blocks when they used a particular tank in the pasture rotation. "We considered switching to loose mineral during the summer grazing season, but did not have a suitable pasture mineral feeder."

In general, the goats seemed to do well with commercial mineral mixes, but the Hopkins always wondered if the goats could do better. Cheryl wanted to get away from synthesized minerals and prefers more natural forms for two main reasons, “improved bioavailability and to avoid potential toxic contaminants that plague synthesized minerals.”

Cheryl's vet, Dr. Janet Sears, recommended feeding naturally mined minerals and kelp. Dr. Sears works with two organic livestock producers who have used these alternative supplements and reported their animals come into heat and breed back better, have seen fewer hoof health issues and support overall health. Dr. Sears believes these naturally sourced supplements are better utilized by the animal.

Cheryl wondered if a combination of proper rotational grazing and enhanced mineral supplementation could boost her herd's overall health. Cheryl fed three different mineral treatments to her goat herd and quantified the health benefits she observed. Cheryl's goal was to, “Try to find a mineral that is palatable and that would boost health – in particular, help with worms and hoof health, as the goats need good feet to graze.”

## Methods

This research project was conducted by Cheryl and Mike Hopkins, Frog Hollow Farm, near Walker in Linn County from May to October 2015. Three mineral treatments were provided to the goat herd throughout the 2015 grazing season, which started in April and ended in October. 114 goats were grazed; having access to all three treatments. The treatments were fed for approximately five weeks, with a salt block fed for one week between each treatment. Minerals were fed on pasture, using a portable free-choice feeder with a rubber flap to prevent minerals from blowing away or dissolving when exposed to the elements. **Table 1** lists the mineral treatment schedule with the type and brand of mineral fed.

### Mineral block

With the purchase of a portable cattle mineral feeder with rubber flaps, the trial began. During the first five-week treatment beginning on May 23, Stockade Super 6 Mineral Blocks were fed, which is the same mineral supplement the Hopkins have used during past grazing seasons. It is touted as being an excellent all-around mineral for goats on pasture, hay, or when receiving additional fortification from other feed sources (Stockade, 2015).

### Loose mineral

During the second five-week treatment beginning on July 5, Natural Way Feeds Hy-Brix Free Choice loose mineral was fed. The minerals used in this treatment are described as “natural mined” minerals, which are harvested from clay versus rock, claiming to have a better cellular absorption rate over rock based conventional minerals (Natural Way Feeds, 2015).

### Loose mineral + kelp


During the third five-week treatment beginning on Sept. 4, Natural Way Feeds Hy-Brix Free Choice loose mineral and Acadian Seaplants Organic Dried Kelp was fed. Kelp is a supplement that contains a wide range of dietary nutrients such as vitamins, amino acids, carbohydrates and naturally-chelated minerals that the kelp absorbs from the ocean. Kelp is said to be highly bioavailable to your animals (Acadian Seaplants, 2015).

Cheryl wanted to try feeding minerals “cafeteria style” – where individual minerals are provided in separate boxes in a feeder so animals can balance their own mineral ration based on what they need (Dietzel, 2012), but could not source them for goats.


**Table 1**

**Date, treatment form, treatment brand and amount offered for the three mineral treatments.**


	Treatment form	Treatment brand	Amount offered
May 23	Mineral block	Stockade Super 6 Mineral Block	280 lb
Jun. 27	Salt block		100 lb
Jul. 5	Loose mineral	Natural Way Feeds Hy-Brix Free Choice	150 lb
Aug. 9	Salt block		63 lb
Sept. 4	Loose mineral + kelp	Natural Way Feeds Hy-Brix Free Choice + Acadian Seaplants Organic Dried Kelp	18.75 lb + 250 lb

Stockade		Guaranteed Analysis
 <p><b>Ingredients</b> Calcium Carbonate, Monocalcium Phosphate, Dicalcium Phosphate, Salt, Molasses Products, Soft Rock Phosphate, Lignosulfonate, Magnesium Mica, Soybean Oil, Manganese Oxide, Manganese Sulfate, Zinc Oxide, Zinc Sulfate, Copper Chloride, Copper Sulfate, Sodium Selenite, Ethylenediamine Dihydrochloride, Calcium Iodate, Cobalt Carbonate, Vitamin A Supplement, Vitamin D-3 Supplement, Vitamin E Supplement, Red Iron Oxide and Artificial Flavoring.</p>		Calcium (Min).....19.00%
		Calcium (Max).....22.80%
		Phosphorus (Min).....6.00%
		® Salt (Min).....10.00%
		Salt (Max).....12.00%
		Copper (Min).....250 ppm
		Copper (Max).....270 ppm
		Iodine (Min).....100 ppm
		Manganese (Min).....1,000 ppm
		Selenium (Min).....26 ppm
		Zinc (Min).....800 ppm
		Vitamin A (Min).....50,000 IU/lb
		Vitamin D-3 (Min).....5,000 IU/lb
		Vitamin E (Min).....50 IU/lb

**Ingredients and guaranteed analysis for Stockade Super 6 Mineral Blocks.**

NWF Natural Way Feeds		INGREDIENTS:
 <p><b>GUARANTEED ANALYSIS</b> Calcium.....min. 6% max. 7% Phosphorus.....min. 2% Salt(min).....max. 25% min. 20% Potassium.....min. 1.5% Selenium.....min. 20 ppm Vitamin A.....min. 40,000 IU/lb Vitamin D.....min. 30,000 IU/lb Vitamin E.....min. 600 IU/lb</p>		Sea Mineral Salts, Iron Oxide, Calcium Oxide, Magnesium Mica, Sulfur, Bentonite, Dicalcium Phosphate, Magnesium Oxide, Organic Saccharomyces Cerevisiae Yeast, Potassium Chloride, Choline Chloride, Iron Sulfate, Selenium Yeast, Magnesium Carbonate, Zinc Sulfate, Sodium Selenite, Vitamin E Supplement, Vitamin A Supplement, Vitamin D3 Supplement, Calcium Carbonate, Magnesium Oxide, and other Trace Elements.

**Ingredients and guaranteed analysis for Natural Way Feed Hy-Brix Free Choice.**

Acadian Seaplants		Guaranteed Analysis
		Crude Protein, min. ....4.00%
		Crude Fat, min. ....2.00%
		Crude Fiber, max. ....8.00%
		Salt (NaCl), max. ....9.00%
		Potassium (K), min. ....1.50%
		Iodine (I), min. ....300ppm
		Ingredient: Organic Dried Kelp

**Ingredients and guaranteed analysis for Acadian Seaplants Organic Dried Kelp.**



During each mineral treatment period, herd health data was collected from the same group of does in the herd. Parasite load was quantified through fecal egg counts (FEC) and FAMACHA scores. Fecal samples were collected from the same group of four goats, three times during the trial period (at the end of each five-week mineral treatment). Fecal egg counts were conducted by Dr. Janet Sears, Oelwein Veterinary Clinic, using the McMaster procedure and quantified eggs per gram. FAMACHA scoring was done on the same group of six does every two weeks. Scores (1-5) are based on the paleness of the inside of the goats' eyelids. A score of 5 (very pale eyelids) means the animal is anemic and has a high parasite load (the Barber-Pole worm attaches to the stomach lining and sucks blood). A score of 1 (very pink eyelids) means the animal is not anemic and likely has a low Barber-Pole worm load (Dunn et al., 2014). Any animals showing signs of severe parasitism (FAMACHA  $\geq$  4 and FEC  $\geq$  2000 for mature does) were treated with chemical dewormers.

Body condition scores (BCS) were taken on the same six does once a month. BCS is on a 1-5 scale; 1=emaciated and 5=obese, with three being ideal. Hoof health was inspected on the same six does, three times throughout the trial (once during each mineral treatment period). Behavioral observations were also made throughout the trial period.

Amount of mineral consumed during each treatment was recorded by weighing what was not consumed at the end of the treatment and subtracting this from the amount offered at the beginning of the treatment period. Costs of each mineral treatment were tracked. Consumption and cost per head per day of each mineral treatment was calculated.



A goat ready for hoof trimming.

## Results and Discussion

### Fecal Egg Counts

Four does were selected for fecal sampling throughout the study period. Fecal samples were collected three times, once during each mineral treatment period. Strongyle and strongyloid ova was counted. Strongyles are of particular interest, as the notable *Haemonchus contortus* (Barber-Pole worm) is of this variety. Strongyloides worm infestations generally are short-lived and not of huge economic or health importance (Dunn et al., 2014).

All fecal egg counts (in eggs per gram, EPG) were under 500 EPG, except one (goat 3, October 7, while under the loose mineral + kelp treatment 2,600 EPG). Cheryl said, "This goat has always had parasite issues. She was dewormed four times over the grazing season, including after receiving the results of this fecal test." On average, the four goats had the least amount of parasite eggs during the loose mineral treatment, with goats 3 and 4 having zero EPG (**Figure 1**).

Overall, Cheryl said FEC improved from previous grazing seasons, which she attributes to rotational grazing and enhancing the mineral program. In past years, grazing goats did not always have access to minerals. "The mineral treatments seemed to boost immune response to parasite loads. The goats seem more resistant and resilient."

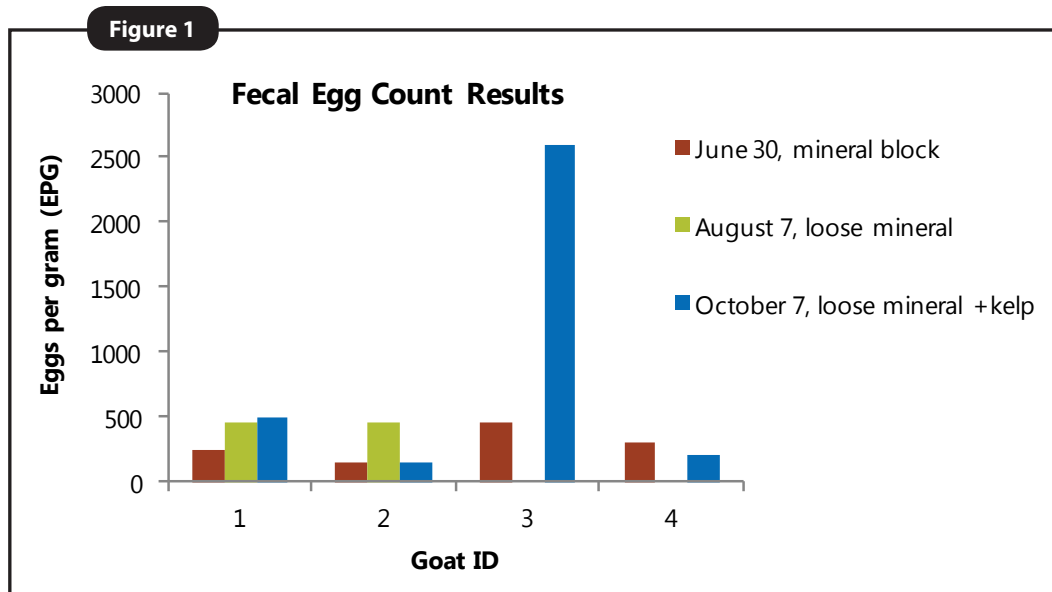


Figure 1. Fecal eggs counts (FEC) of internal parasite ova in four grazing does during the 2015 grazing season. For each doe, FEC are shown for each date feces were tested; the corresponding mineral treatment during that date is listed. The Hopkins deworm for FEC counts over 250 eggs/g for lactating does, 1,000 egg/g for kids, and 2,000 egg/g for mature goats.

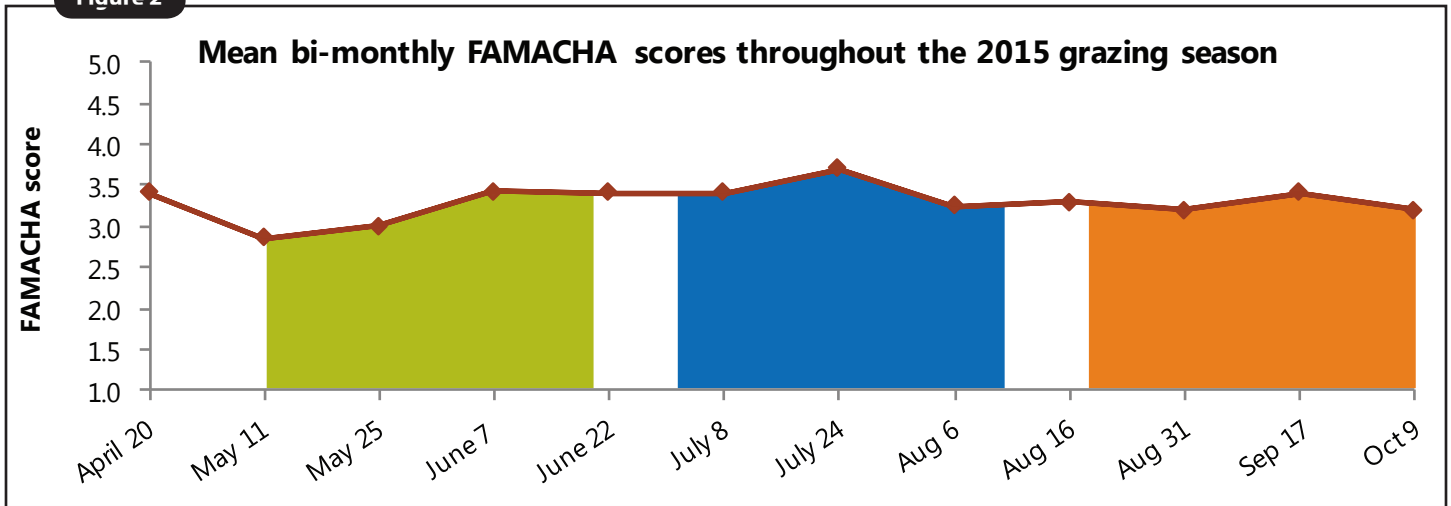
**Figure 2**

Figure 2. FAMACHA scores from six grazing does during the 2015 grazing season. A score of 1 is best; no indication of anemia. A score of 5 is worst, indicating the animal is heavily infected with blood-sucking parasites and very anemic. Animals that score  $\geq 4$  need deworming. The mineral block treatment (May 23- Jun. 26) is designated in green, loose mineral treatment (July 5-Aug. 8) in blue, and loose mineral + kelp (Sep. 4-Oct. 10) in orange.

### FAMACHA Scores

Six does were selected for FAMACHA scoring, which was taken approximately every two weeks during the grazing season. FAMACHA scores for the six does were averaged, and ranged from 2.9-3.7, which is acceptable. At the beginning of the grazing season and prior to any mineral supplementation, scores averaged 3.4 (Apr. 20) and by the end of the grazing season, scores averaged 3.2 (Oct. 9, while under the loose mineral + kelp treatment) (**Figure 2**). FAMACHA scores trended upward during peak parasite season in early to mid-summer. May and June were rainy and warm and August was drier, which helps to dry up eggs.

The animals that individually scored a four (no five scores were recorded) were chemically dewormed with levamisole. By only deworming the animals that need it, instead of the whole herd, the potential for the development of resistance to chemical dewormers is minimized, which is an ever-increasing issue in small ruminant production.

The Hopkins routinely deworm in the late fall, after the growing season ends, and in the spring just before kidding. Outside of

the standard herd deworming, they track the individual goats requiring deworming during the grazing season when parasite pressure is greatest. Cheryl and Mike's goal is to select for breeding stock from does that do not require extra deworming during grazing season in hopes of improving herd resistance and resilience to internal parasites.

Through data collection and record keeping the last two grazing seasons, Cheryl was able to quantify the percentage of the herd that was dewormed each year. During the 2014 grazing season, 65% of the herd was dewormed. During the 2015 grazing season, only 41% of the herd was dewormed. "We credit this improvement to pasture management, replacement breeding stock selection criteria, and adding Kiko goats to the herd this year, which have higher parasite resistance," stated Cheryl. "The mineral treatments combined also definitely helped support the herd's health and immunity, allowing them to better fend off parasites," she added.

### Body Condition Score

Body condition score was taken monthly on the same six does, four of which were lactating. BCS scores for the six does were averaged, and ranged from 2.4 to 2.7 (**Figure 3**). Cheryl does not believe the mineral treatments are directly related to differences in body condition score, although, the results indicate the goats maintained condition during each treatment.

A BCS of three is ideal, meaning the animal is not lacking for nutrients, but is also not overly fat. Lactating does tend to lose BCS, which may have dragged down the herd average (Dunn et al., 2014). "At first the scores looked disappointing because does should start putting on weight after weaning in July, when I expected to start seeing an upward trend. When I weighed animals, I realized that the older does loose muscle tone over their top line as they age, resulting in lower BCS," stated Cheryl.

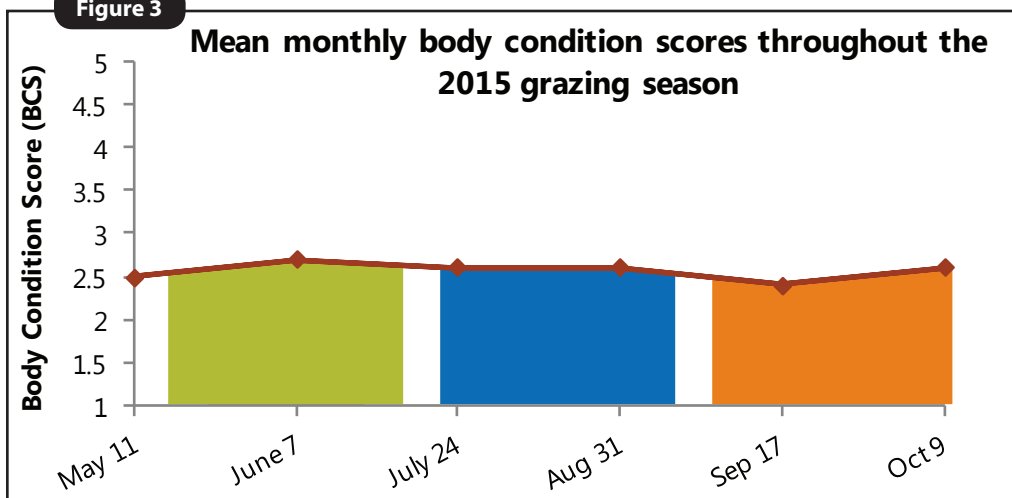
**Figure 3**

Figure 3. Body condition scores from six grazing does during the 2015 grazing season. Scores range from 1-5, with 1 being emaciated and 5 being obese. A score of 3 is ideal. The mineral block treatment (May 23- Jun. 26) is designated in green, loose mineral treatment (July 5-Aug. 8) in blue, and loose mineral + kelp (Sep. 4-Oct. 10) in orange.

Considering that four of the six BCS does were lactating, on pasture, and dealing with parasite pressure, Cheryl thought BCS was acceptable, but would have liked to have seen improvements.

### Hoof Health Records

Summer 2015 brought hoof rot issues; the worst Cheryl and Mike had ever seen. "I attribute this to the wet, cool weather in late spring and early summer," stated Cheryl. In August, almost every animal had one or more hoof with problems, even the Kikos, which are known to have healthy hooves.

Hoof health was reported for the same six does scored for FAMACHA and BCS, once during each mineral treatment. On August 4, during the loose mineral treatment, three out of the six does had hoof rot in the outer wall of the hoof. On July 22 and October 9, during the mineral block and loose mineral + kelp periods, respectively, no problems were found in the hooves of the six does. "If we didn't have the minerals, I think the problem could have been much worse," noted Cheryl. Affected animals were treated by trimming hooves and applying copper sulfate. Cheryl mentioned the goats with hoof rot responded well to the hoof care and their hooves grew out and healed very nicely. She thinks the minerals helped with this response – healthy animals bounced back quickly.

### Consumption Rates

#### Mineral block

There was a period of time when goats were grazing before minerals were offered (April 20 – May 22). During this time, the goats were licking rocks, obviously in need of salt and/or minerals. On May 23, the mineral trial began with Cheryl offering seven, 40 lb Stockade Super 6 Mineral Blocks over 34 days. Cheryl reported the goats "went bonkers" for the blocks as soon as she put them in the pasture.

280 lb of mineral block was offered during the first treatment period, and by the end of the treatment, 114 goats had consumed 268.81 lb or 1.1 oz./head/day of the mineral block (**Table 2**). Stockade's recommended consumption rate for goats is 0.25 to 0.5 oz./head/day. The goat herd far exceeded the recommended rate, presumably because they were making up for what they lacked in before minerals were offered. Cheryl also believes these minerals were less bioavailable, prompting the goats to eat more to meet their needs.

Two, 50 lb salt blocks were offered from Jun. 27 to Jul. 4. Salt was offered as a transition from treatment to treatment.

#### Loose mineral

On July 7, Cheryl removed the salt blocks and offered three, 50 lb bags of Natural Way Feeds Hy-Brix Free Choice over 35 days. The loose mineral was fed in a cattle mineral feeder with a rubber flap on top. It took the goats one to two days to learn how to use the flap, but after that, they resumed usual consumption activity.

150 lb of loose mineral was offered and by the end of the second treatment, 114 goats had consumed 101.5 lb or 0.41 oz./head/day of the loose mineral (**Table 2**). The goats did not consume as much loose mineral as mineral block, which Cheryl attributes to the loose minerals likely being more bioavailable – meaning goats need less to meet mineral requirements. The



**Cheryl and Mike fastened a cattle mineral feeder onto a pallet in order to make portable. Photo taken September 17, 2015.**

loose minerals used during this treatment are naturally chelated, resulting in higher bioavailability (Garret, 2011; Hale and Olson, 2001). Consumption rate also may have been affected by the mineral treatment schedule; they may have eaten more if it was offered at the beginning of the grazing season after being restricted.

Salt blocks were offered from Aug. 9 to Sept. 3.

#### Loose mineral + kelp

On Sept. 4, Cheryl removed the salt blocks and offered the rest of loose mineral that remained in the already opened bag, which was 18.75 lb. She also added five, 50 lb bags of Acadian Seaplants Organic Dried Kelp over the 37 day-period. The loose mineral and the kelp were fed in separate compartments in the feeder, so the goats could choose what they wanted. At first, the goats went for the loose mineral and avoided the kelp. Four days later Cheryl observed some goats, including nursing kids, eating the kelp. By the third week of September, the goats were eating it very well. Cheryl checked the feeder daily to see if more loose mineral was needed throughout the treatment, but the goats seemed to only be interested in the kelp.

18.75 lb of loose mineral and 250 lb of kelp was offered and by the end of the third treatment period, 114 goats had consumed 10 lbs or 0.03 oz./head/day of the loose mineral and 236.25 lb or 0.90 oz./head/day of kelp, totaling .93 oz./head/day (Table 2). "Obviously, the goats had a preference for kelp but I'm not ready to feed only kelp and no minerals, because I'm not sure it has every nutrient they need," declared Cheryl.

Cheryl mentioned that a common issue on their farm is milk goiter, which happens when kids are growing quickly and their thyroid enlarges. Iodine, a main ingredient in kelp, relieves goiter. This year was the first time they had not seen any kids with goiters. "As soon as we ran out of kelp, kids got goiters, so we will continue feeding kelp," said Cheryl.

**Table 2**

**Amount offered and amount consumed for each mineral treatment.**

Treatment	Amount offered (lb)	Amount consumed (lb)	Consumption/hd/day (oz)*
Mineral block	280	268.81	1.1096
Loose mineral	150	101.5	0.4070
Loose mineral + kelp	18.75 + 250	10 +236.25	0.9341

\*Amount consumed per head per day was calculated by amount consumed/114 goats/days in each trial (34, 35, 37 d). This number was converted from lb to oz by multiplying by 16.



## Costs

Purchase costs for each mineral treatment, cost per pound and cost per head per day are listed in **Table 3**. The total costs for mineral block, loose mineral and loose mineral + kelp were \$87.31, \$117.74, and \$204.24, respectively.

The loose mineral + kelp treatment was considerably more expensive than the other two treatments, and the mineral block was the cheapest.

**Table 3**

Costs for each mineral treatment.				
Treatment	Price	Total cost (\$)	Cost/pound (\$)	Cost/hd/day (\$) <sup>a</sup>
Mineral block	\$12.99/40 lb block	\$90.93	\$0.3248	\$0.0234
Loose mineral	\$58.00/50 lb bag	\$174	\$1.16	\$0.0436
Loose mineral + kelp	\$58.00/50 lb bag +\$40.77/50 lb bag	\$21.75 +\$203.85	\$1.16 +\$0.8154	\$0.0535

<sup>a</sup>Cost per head per day was calculated by total cost/114 goats/days in each trial (34, 35, 37 d).

## Conclusions and Next Steps

Cheryl and Mike Hopkins used enhanced mineral supplementation in an effort to observe any herd health benefits. Parasite loads, determined by FEC and FAMACHA, did not appear to differ among any of the mineral supplementation treatments. The Hopkins believe that along with sufficient mineral supplementation, a combination of improved livestock management – more frequent pasture moves, improved pasture species diversity and strict selection of breeding stock – have increased overall herd health and resulted in a 24% reduction in necessary deworming compared to the previous year.

All three mineral treatments seemed to support the health of the herd, but differed in cost. Cheryl used this trial to evaluate benefits to animal performance in relation to added costs, and has decided to continue feeding loose minerals + kelp. She will offer the loose mineral and kelp in separate compartments and refill as needed, so the goats always have free choice.

No significant animal performance differences were measured in this trial, but next year Cheryl is interested in testing goat hair for nutrient mineral levels. This would quantify the amount of each mineral the goats are receiving. She would also like to track market kid weights and average daily gains while kids consume kelp in order to compare them to weights in past years.



*The Hopkins' herd grazing in September 2015*

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## PFI Cooperators' Program

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