Northern New York Agricultural Development Program
2025 Project Final Report

The Effect of Legume/Sorghum Intercropping on the Yield and Forage Quality of Corn Silage in Northern New York

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BACKGROUND:
Dairy farms that increase herd size, yet do not have the capacity to increase their feed crop acreage proportionally must rely more heavily on purchased feeds and may raise environmental concerns due to the overapplication of manure nutrients relative to crop uptake on their existing acres. Such operations tend to rely more on annual corn silage cropping and less on protein-rich perennial forages that are lower yielding. As a result, soybean meal and other protein supplements (some of the most expensive feeds to import onto the farm) must be purchased.

In areas where corn-on-corn monocultures have become the norm, corn as a high-yielding energy crop is becoming riskier to grow due to unpredictable weather patterns, new diseases, and regulations on chemicals such as neonicotinoids. Previous Northern New York Agricultural Development Program (NNYADP) interseeding research (Wilder, 2023) has taught us that we can grow/chop alternative forages alongside corn without impairing either yield or quality in northern New York. Project data showed numerical yield advantages and suggested that this type of cropping system (intercropping) could yield more general, but not protein-rich, biomass in the long-term. However, the 2023 project data suggested that growing any crop between a good stand of 30-inch-row corn and expecting it to yield significant protein-rich biomass may be unrealistic.

While not known for fiber digestibility, forage soybeans offer good potential for intercropping with corn since some of the same herbicides can be used. A lesser-known alternative forage legume is faba bean (*Vicia faba*), an upright, cool season annual that appears to have the unique ability to tolerate cold and wet soils. Both forage soybean and faba bean can achieve a crude protein content similar to alfalfa if maturity is optimal at harvest.

Our objective with this project in 2025 was to quantify the potential direct benefits that intercropping corn with two different annual grass/legume mixtures might have on the yield and quality of a corn silage crop by testing wide strips of alternative forage in between rows of high-population corn.

METHODS:

We aimed to create an intensive and resilient corn cropping system that included both legumes and grasses that could add protein and digestible fiber while utilizing sunlight that would normally fall between the corn. To accomplish this, we doubled the corn planting population in four row strips, alternating with four row strips of forage legume planted at the same time as the corn (May 14, 2025). When the corn and forage legumes were in the early vegetative stage, forage sorghum (KF Fiber Pro 74, King's Agriseeds, Inc, Lancaster, PA) was interseeded between the 30-inch rows of forage legumes/corn. This was done to aid in weed control while supplementing yield

The study was laid out as a replicated strip trial at the Miner Institute dairy farm in Chazy, New York, (Roundabout silt loam soil). There were three intercropping treatments:

1. Four rows of forage soybeans (cv Everest) with four rows of high population corn (60,000 ppa) + interseeded forage sorghum at the V4 corn stage.

2. Four rows of faba bean (cv 219-16) with four rows of high population corn (60,000 ppa) + interseeded forage sorghum at the V4 corn stage.

3. Control: corn monoculture (74 RM, 25X74, Hybrid 85 inc. Omaha, NE) planted at 30,000 plants/acre.

There were three replications at each location and the randomized treatment strips were eight rows wide and approximately five hundred feet in length. Both faba bean and soybean were planted at 150,000 plants/acre.

Due to the anticipated high demand for nutrients during the growing season, special care was taken to ensure that the research plots received adequate nitrogen (N) and sulfur (S) during the study. Thus, 220 units of N were applied/acre in a multi-pass program (knife-injected urea ammonium nitrate). Weed control included a pre-emergence application of glyphosate and S-metolachlor along with two post-emergence applications of Bentazon.

On September 8, 2025, each of the nine treatment strips was harvested individually with a self-propelled forage harvester equipped with a multidirectional head (run at its lowest setting). The forage material from each strip was weighed in trucks and a subsample was collected and ensiled in a bucket mini-silo (5 gal). After 30 days of fermentation, each mini-silo was opened and silage samples were sent for a Fermentrics wet chemistry analysis package at Dairyland Laboratories, Arcadia, Wisconsin, to determine the rates and extent of digestion by gas production. This package also included forage quality analysis using a mix of wet chemistry and near infrared spectroscopy (NIR).

For additional observational data, seven non-replicated samples of the individual species from each treatment were submitted to the Dairy One lab in Ithaca, New York, for package 325, Forage NIR. In-vitro digestibility was also conducted for these samples at the 30-hour timepoint.

Note: The use of brand names or any mention/listing of specific commercial products or services herein is solely for educational purposes and does not imply endorsement by the Northern New York Agricultural Development or project collaborators, nor discrimination against similar brands, products, or services not mentioned.

RESULTS:

Yield and Moisture

The forage yield averaged approximately 2.5 tons/acre lower than the control for both the soybean and the faba bean intercropping treatments (Table 1). While this difference was not technically statistically significant, it does not position legume intercropping in a favorable light.

Table 1. Yield and quality of corn silage intercropping treatments.

Measure[1]	Control	Faba Bean / Corn	Soybean / Corn	Std. Error	*P* - Value
Yield (35% DM), t/a	17.5	15.0	15.1	1.1	0.198
Proportional Dry Matter	0.39[a]	0.38[a]	0.33[b]	0.01	0.009
Crude protein (CP), %	8.49[b]	9.64[a]	8.91[ab]	0.17	0.040
CP yield, t/a	0.52	0.51	0.47	0.04	0.549
Soluble CP, % CP	48.7	47.9	50.9	1.8	0.599
Acid insoluble CP, %	0.40[b]	0.91[a]	0.47[b]	0.03	0.001
Acid detergent Fiber, %	19.9	23.1	23.3	0.8	0.086
Neutral detergent fiber, %	34.7	39.5	39.6	1.2	0.065
Starch, %	34.6	31.7	30.5	1.4	0.265
Sugar, %	4.95[a]	3.91[a]	1.64[b]	0.37	0.015
240 h undegradable fiber, %	9.63	11.04	11.11	0.52	0.245
Lignin, %	1.85	2.03	2.26	0.12	0.208
Either extract, %	3.17	3.11	3.23	0.06	0.498
Ash%	3.54[b]	4.62[a]	4.41[ab]	0.17	0.040
Ca%	0.22[b]	0.28[ab]	0.30[a]	0.01	0.037
K %	1.02[b]	1.08[ab]	1.24[a]	0.03	0.024
P %	0.21	0.23	0.21	0.01	0.154
Mg %	0.16[b]	0.22[a]	0.21[a]	0.01	0.010
Microbial biomass, mg/g	131[a]	114[b]	116[ab]	3	0.032

[1]*Reported values are least squares means of the mixed model used to analyze the data. Numbers followed by no letters or the same letter are not significantly different from each other.*

The dry matter content of the forage was similar to the control for the faba bean treatment, but about 6 percentage points wetter for the soybean intercropping treatment. However, since the corn was a little dryer than is recommended for silage, the soybean intercrop forage was not wet enough that clostridial fermentation was a concern.

Forage Quality Metrics

Our objective was to create a high-yielding protein-rich blend of forages that could help farms reduce imported feed. Unfortunately, only the faba bean intercropping had statistically higher crude protein than the control corn, and this difference was little more than one percentage point. When evaluated on a yield basis, the crude protein harvested per acre was no different for the legume treatments than for the control. The underwhelming crude protein response appears to be driven by both a lower-than-expected crude protein for the legumes: 14.7 and 16.4 for soybean and faba bean plants respectively (Table 2) as well as a low legume yield contribution.

The in-vitro gas production assay produced the highest calculated microbial biomass production for the control corn treatment. The faba bean forage had the lowest microbial biomass, which was significantly lower than the control. The soybean intercrop silage had slightly better

Table 2. Forage test data for individual species grown in the experimental area. Different species combinations were tested separately with single samples being submitted from pooled material from different reps.

Item	SB sorghum	FB sorghum	Soybean (SB)	Faba bean (FB)	Control corn	FB Corn	SB Corn
Moisture, %	80	79.6	75.8	76.8	65.1	64.5	64.4
Crude protein (CP), %	10.2	9.8	14.7	16.4	6.2	6.3	5.9
Soluble CP, %	38	35	39	38	30	30	28
Acid det. fiber, %	33.1	33.7	35	37.2	26.9	23.8	27.5
Neutral detergent Fiber, %	54	57.2	49.8	49	47	41.6	48.9
In-vitro true digestibility, %	85	82	74	73	81	83	82
Fiber digestibility, 30 h, %	72	69	48	44	59	58	62
Non-fiber carbohydrates, %	24.8	23.5	25.3	24.2	41.5	46.2	40
Calcium, %	0.38	0.38	0.96	1.18	0.24	0.16	0.25
Phosphorus, %	0.28	0.25	0.21	0.32	0.2	0.19	0.17
Magnesium, %	0.25	0.25	0.4	0.35	0.12	0.11	0.11
Potassium, %	1.93	1.72	1.61	1.08	0.69	0.62	0.6
Sulfur, %	0.14	0.15	0.21	0.18	0.08	0.07	0.07
Total digestible nutrients, %	70	71	61	63	76	77	74
Net energy - lactation, mcal	0.67	0.67	0.61	0.62	0.76	0.79	0.74

[1] Letters generated from Tukey HSD test means separation procedure (α=0.05). Levels not connected by the same letter are significantly different. Least squares means with the same or no letters are not statistically different from each other.

microbial biomass levels than the faba bean intercrop, to which it was statistically similar, along with the control.

The sugar content of the silage was lower for the soybean treatment than for the faba bean and the control; however, this difference may have been primarily driven by the differing dry matter content of the silage.

Mineral content differed slightly by treatment with both intercrop silages having elevated magnesium, the soybean intercrop showing elevated calcium and potassium, and the faba bean intercrop forage having elevated ash content.

CONCLUSIONS:

The intercropping of forage legumes and sorghum with corn for silage did not appear to be beneficial under the conditions of this single-year experiment. The additional crude protein provided by the legume biomass was not substantial enough to make a meaningful and positive quality difference in the combined silage, especially given that no additional total yield was achieved. While these intercropping systems do provide high species diversity, it is evident that adjustments (see Recommendations) would need to be made to justify its use to produce dairy feed crops on northern New York farms. **Further research is needed to establish more definitive conclusions on the utility of intercropping on Northern New York dairy farms.**

Recommendations:

- To our knowledge, this is the first time that faba bean has been tested as a forage in northern New York. While faba bean does appear to have some desirable characteristics, our experience suggests that it needs to be planted earlier than corn in order to maximize its potential. This would allow flowering to take place at cooler temperatures and provide higher bean yields. Furthermore, the faba bean plants in this limited trial received considerable insect damage (primarily potato leaf hopper) during the 2025 growing season. While we are not aware of an IPM threshold, insecticides may be

necessary for this crop if grown in northern New York in the future.

- While the forage soybeans tested in this trial grew to more than five feet tall, they had considerable trouble with lodging during the later half of the growing season. If this was responsible for the unexpectedly low yield and crude protein content of this forage, these taller varieties may deserve further study at a lower plant population. Nevertheless, grain-type soybeans in the R7 stage may be better suited for intercropping from both an agronomic and nutritional standpoint.

- Weed management is considerably more difficult in a multi-species system. While our weed control program provided reasonable control, the program was notably weak on certain weeds (e.g., pigweed) that could become a problem over multiple years since only a single mode of action may be available for certain weeds.

- Direct chopping a multi-species mixture of corn, sorghum, and legumes is possible without significant modifications to a multidirectional corn head. However, we did experience some cases where the forage soybeans failed to feed into the harvester properly. We believe that this was due, in part, to the lodging issues with the soybean. Yet, species with a tendency to branch and become tangled may impair intercrop forage harvesting.

OUTREACH:

These results will be summarized and shared in the Miner Institute Farm Report and at summer grower meetings throughout the region.

NEXT STEPS:

Future work should further investigate the potential of faba bean as a forage crop for northern New York. If planted earlier, it may function well as a relay crop grown in sequence with some overlap with corn. Additionally, future soybean intercropping research should compare forage soybeans at a lower population to grain-type soybeans.

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FOR MORE INFORMATION:

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The Effect of Legume/Sorghum Intercropping on the Yield and Forage Quality of Corn Silage in Northern New York
APPENDIX: Figures and Photos

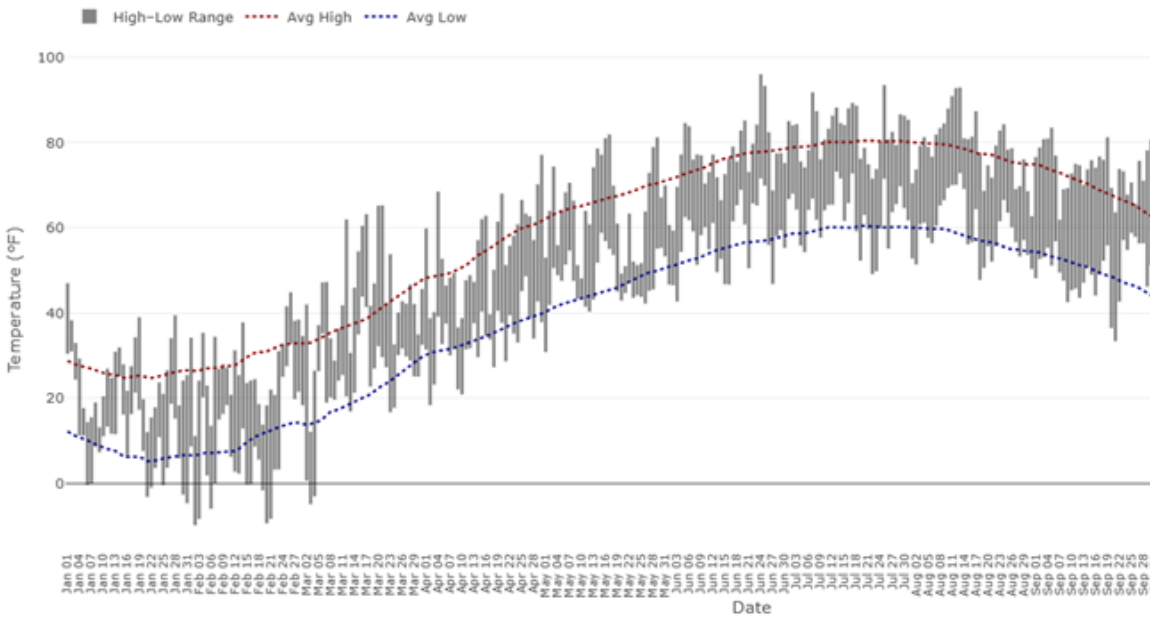

Figure 1. Average daily temperature for Miner Institute during the 2025 growing season at Chazy, New York.

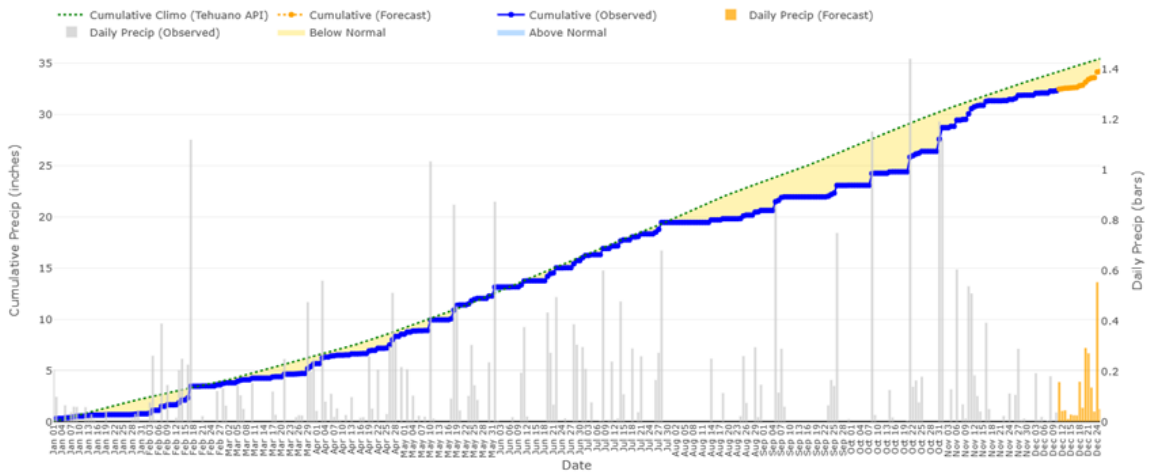

Figure 2. Daily precipitation during the 2025 growing season at Chazy, NY. The season started out with near normal precipitation, then turned unseasonably dry in August. Furthermore, very few precipitation events exceeded one inch (most less than 0.4 inches).

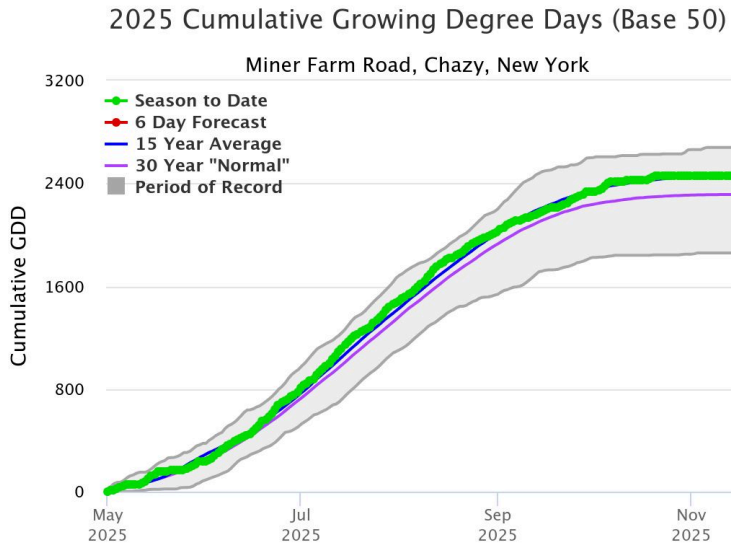

Figure 3. Seasonal growing degree day (heat unit) accumulation throughout the 2025 growing season in Chazy, New York. Degree days followed the 15-year average for most of the growing season and approached the upper end of the range following hot spells during the summer.



Figure 4, left. Sorghum emerging between faba bean/corn intercrop trial.
Figure 5, center. A corn/forage soybean/sorghum intercrop strip at Miner Institute. The rapid soybean growth during the summer months outcompeted the sorghum.
Figure 6, right. Forage sorghum grew well with faba bean and filled in row gaps as the beans began to dry down.

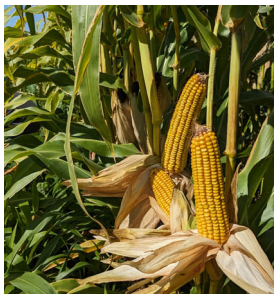


Figure 7, left. Corn ears adjacent to faba bean strip.
Figure 8, right: Faba bean pods in various stages of development. Some plants set seed reasonably well, but many flowers appeared to abort due to the unseasonably warm weather.

Figure 4-8 photos credit: Miner Institute.