

Plant and chicken available nitrogen from cover crops

IN A NUTSHELL

Shiying wanted to understand the contribution of integrating meat chickens into her cover cropped garden area towards the fertility requirements of future vegetable production. As the chickens grazed across lanes over their grow-out period, she sampled cover crop biomass and took soil nitrate samples before and after grazing to better understand their impacts on nitrogen cycling over time.

- Grazing chickens roughly doubled soil nitrate levels compared to no-chicken control lanes.
- Soil nitrate levels rose again weeks after the chickens were in the space, emphasizing the priority to reseed a cover crop in the fall to capture the nitrogen from the chickens and keep it cycling in her garden.



FARMER-RESEARCHER

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Brilliant Meadows Farm

MOTIVATION

Shiying participated in the [Experimental Acres Project](#) in 2023 (reference 1) grazing broiler chickens in a cover cropped garden area. She thought combining them could reduce feed costs and capture fertility for the garden while improving soil health. The comparison demonstrated to her that chickens grazed on cover crops could have higher finishing weights compared to those raised solely on pasture. Seeing the benefits for cost of production, Shiying was also curious about how this practice affects nitrogen (N) cycling in her soil and how it could also benefit soil health, particularly plant available nitrogen (PAN).

METHODS

EXPERIMENTAL DESIGN

Shiying seeded a spring cover crop mix around May 12, 2024. The cover crop mix comprised of a blend of Speare's Seeds multi-species mix (oats, forage peas, crimson clover, Fragiblaster radish, sorghum sudangrass, sunflowers, and phacelia) and peas and oats mix, with the majority being mostly peas and oats.

Shiying's grow-out period for her chickens was eight weeks (55 days for the first batch; 56 days for the second batch). The chickens spent approximately the first 3 weeks in the brooder, and the remaining five weeks rotating on the field.

The field layout included four lanes with a control strip down the centre, as seen in **Figure 1**.

The field was approximately 50 x 115 feet and the Cackellac, a mobile chicken shelter, was 13 x 16 feet. This means the field was approximately four Cackellacs wide and seven Cackellacs long.

To accommodate the lane span, Shiying kept the control strip down the middle fairly narrow (under three feet wide). Each Cackellac position is noted in **Figure 1** with a number for the corresponding move. Position 1 and position 30 were off the cover cropped field. Positions 2-8 and 23-29 overlapped the outer edge of the field slightly, as seen in **Figure 1**. The Cackellac moved to a new position each time the birds finished a 25 kg bag of feed, to standardize manure deposition.

Netting used was 164 feet long, with posts spaced every 12 feet. With one piece of netting, the fenced paddock was 58 feet long, which accommodated three moves. The ends of the paddock are pointed to keep the sides of the



Shiying

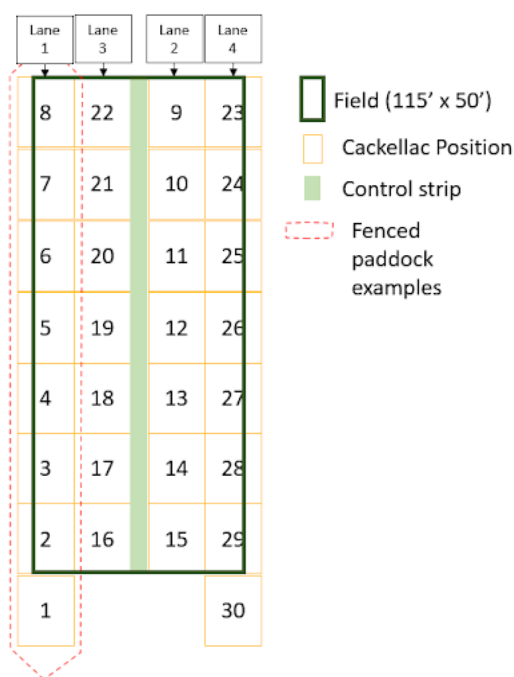


Figure 1. Field layout for Shiying's chicken grazing trial

paddock close to the Cackellac without sagging the fence.

SAMPLING PROTOCOL

Shiying took two samples per laneway in addition to samples taken in the cover crop control strip:

- She sampled the cover crop biomass by collecting from three quadrants in the represented laneway before the chickens entered and from the control at the same time. From the lab analysis, we obtained percent of dry matter (%DM), carbon to N ratio (C:N) and available N with percent N (%N).
- The area was then grazed by chickens (with N measured as a proxy for protein) and trampled into the soil, as PAN and soil nitrate.
- Shiying also took 10 composite soil core samples from the representative laneway and control strip to estimate the amount of nitrate and other nutrients in the soil before and after running the chickens in the laneway to determine how this varies over time with grazing duration. In addition, she took soil core samples on the designated butchering day.
- Shiying took a final soil composite sample of the entire field to look at nitrate levels remaining after the chickens were removed and reseeding the cover crop.

The dates of sampling were as follows with chickens entering the sampled lanes the following day:

- Lane 1 - July 24
- Lane 2 - August 7
- Lane 3 - August 15
- Lane 4 - August 22
- Leaving Lane 4 - August 29

Shiying reseeded the cover crop on September 8 and finished her last composite sampling 10 weeks after reseeding on November 5.

Methods for this trial referenced Jesse Way and Meghan Brandenburg's trial at Milky Way Farm in 2022, when they conducted a trial looking at PAN from low and high legume cover crop mixes planted before a carrot cash crop (reference 2). Their report provided the framework and relevance for measuring nitrogen cycling from cover crops on-farm; this trial adapted their sampling protocol but relied on direct soil nitrate measurements rather than a tissue-based PAN estimate.

DATA ANALYSIS

To evaluate the effect of chicken grazing on soil nitrate, we fit an analysis of variance (ANOVA) with treatment (chicken-grazed vs. control strip) and lane as factors, and used Fisher's LSD (least significant difference) at a 95% confidence level to compare treatment means. We could make these statistical calculations because the experimental design at Brilliant Meadows Farm involved replication of the treatments across four lanes.

FINDINGS

COVER CROP BIOMASS

Shiying's first cover crop sowing came in spotty and she decided not to run the trial with the first batch of chickens. She reseeded and introduced the second batch of chickens into the cover cropped area. She noted that the cover crop stand was more mature than she desired, with some of the peas setting



Lane before grazing by chickens

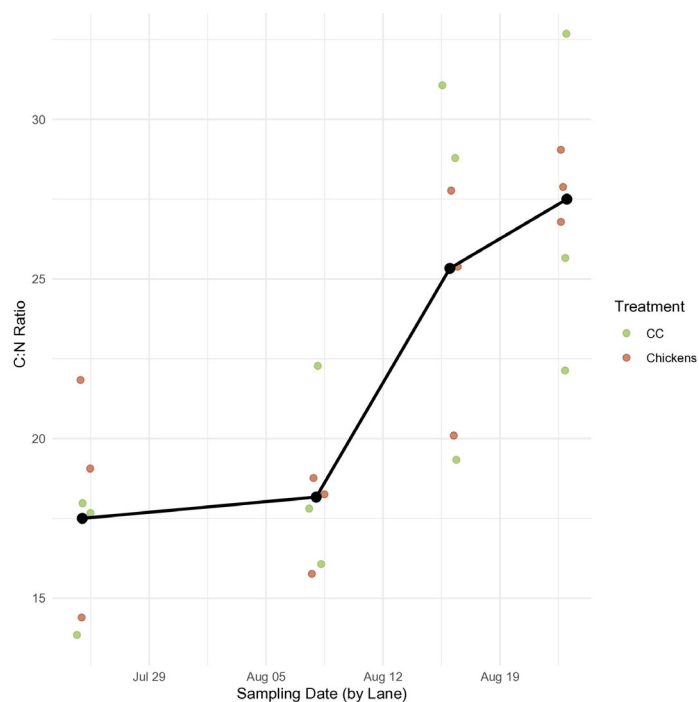


Figure 2. C:N ratio of cover crop tissue across the five-week grazing period. Points show individual samples by treatment (green = control strip, orange = chicken-grazed lane, sampled before chickens entered); the black line shows the overall mean trend by sampling date. C:N rose as the cover crop matured, regardless of treatment.

seed. There was also a laboratory mix up that impacted the ability to analyze the biomass portions of the trial statistically. Because of this, and because tissue %N and C:N didn't differ between grazed and control areas anyway, we relied on direct soil nitrate measurements rather than calculating a tissue-based PAN estimate for this trial.

Looking at cover cropped biomass samples in the areas with and without chickens, there was no detectable difference in C:N ratio, %N, and %DM ($p = 0.88$ for C:N, $p = 0.91$ for %N). This is as expected since both samples were taken before chickens entered a lane, meaning the cover crop grew up to this point without chickens present up to that point.

Across the lanes, C:N and %N did change over time, with higher C:N and lower tissue N present in the cover crop samples as the crop got older ($p < 0.0001$ for both measures). Because lanes were grazed sequentially over five weeks, this reflects the cover crop's maturity at the time each lane was sampled and highlights how PAN potential from the cover crop shifts as it ages.

SOIL NITRATE

Before the chickens started grazing, soil nitrate levels measured similarly across all laneways and in the control strip. Shying then introduced the chickens and kept them in position for as many days as it took them to consume one 25 kg bag of feed. After the chickens exited the lanes, soil nitrate levels reached just under two times the measured amount in the control lane (4.75 ppm in control vs. 9.50 ppm in chicken-grazed lanes; see **Table 1**)—a statistically significant difference ($p = 0.01$) that was consistent across all four lanes ($p = 0.30$). While the average across lanes remained under the 10 ppm threshold above which there is a risk of nitrate leaching, two of the four lanes individually exceeded it (lane 1: 12 ppm, lane 2: 10 ppm).

Shying reseeded cover crop in the area on September 9th and took soil cores again to measure nitrate. She sampled the area again on November 5th, 10 weeks after. The September samples showed elevated levels of nitrate in most lanes, particularly lane 3, which peaked at 19 ppm—well above the leaching risk threshold (**Figure 4**). Because all four lanes were sampled on the same date despite being grazed on a staggered schedule over five weeks, lanes differed in how much time had passed since chickens left: lane 1 had 48 days since grazing by this point, compared to just 19 days for lane 4. This likely explains at least part of the lower nitrate seen in lane 1 (1 ppm) and lane 2 (6 ppm), which simply had more time for nitrate to decline before being sampled. Shying also noted that regrowth in lanes 1 and 2—where the cover crop had gone to seed and was resprouting—could have locked up additional nitrate through renewed plant uptake.

By November 5th, the composite sampling across all lanes showed nitrate levels had dropped to around 4 ppm (**Figure 4**). Cooling soil temperatures likely slowed the ongoing release of new nitrate from the manure and cover crop residue through microbial mineralization, while the reseeded cover crop's nitrogen uptake—and perhaps some leaching, given wetter fall conditions—drew down the nitrate that remained. This reinforces the value of reseeding promptly after grazing: getting a cover crop established captures nitrogen through uptake right as the soil's own capacity to keep releasing new

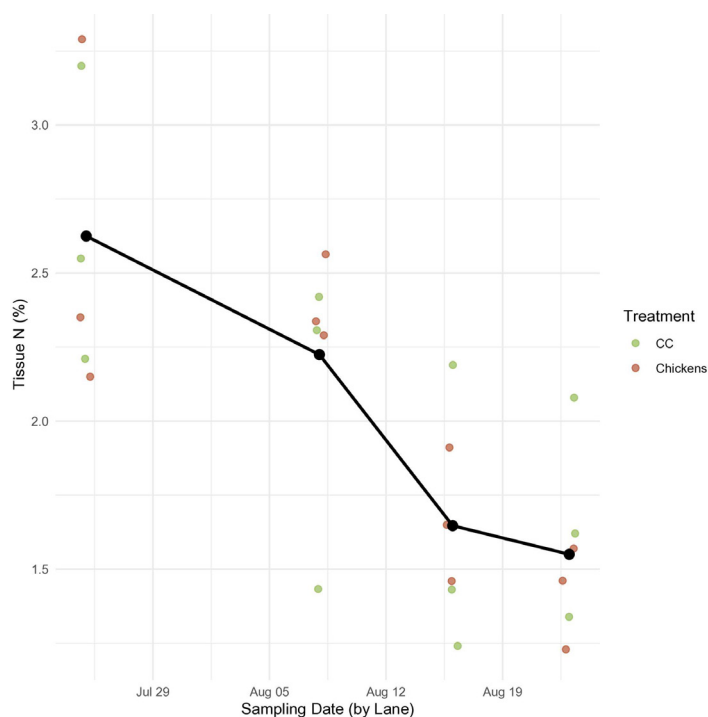


Figure 3. Percent nitrogen (%N) of cover crop tissue across the five-week grazing period. Points show individual samples by treatment (green = control strip, orange = chicken-grazed lane, sampled before chickens entered); the black line shows the overall mean trend by sampling date. Tissue %N declined as the cover crop matured, regardless of treatment.

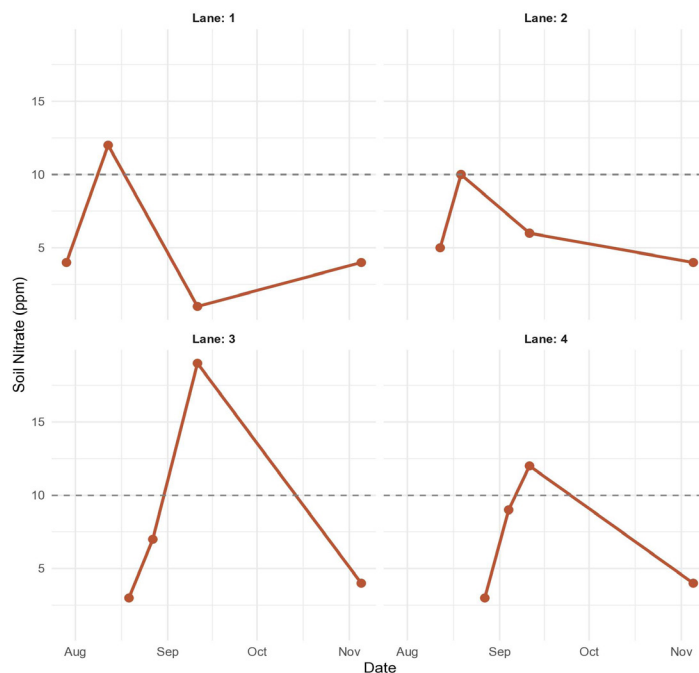


Figure 4. Soil nitrate over time by lane, from early grazing through 10 weeks post-reseed. Dashed line marks the 10 ppm leaching risk threshold. Note: Shying did not collect samples between mid-September and November and the line simply connects the two nearest measured points. The November value is a single whole-field composite sample, shown in each panel.

nitrate is winding down for the season.

OBSERVATIONS FROM 2023

Shiying also observed the garden area where chickens grazed in 2023 during the Experimental Acres project. She grew a diverse mix of vegetables in 2024, including: asian greens, corn, squash, cucumbers, bitter melons, tomatoes, sweet potatoes, peppers, eggplants, potatoes. She noted that the area appeared to have great fertility, some weed suppression, very little potato beetle pressure and overall low pest pressure. She was uncertain whether the chickens affected the overall pest populations or whether the good soil nutrition made the plants more resistant to pest pressure.

NEXT STEPS

In 2025 Shiying continued to use this protocol for grazing her birds. She added a cover crop mix consisting of Japanese millet, buckwheat and sunhemp for seeding in July/August while continuing to use peas and oats for cool season seedings. She moved away from the multi-species mix that contained sunflowers because it made moving the Cackellac difficult. She reseeds a lane as soon as the birds exit by first flail mowing any remaining vegetation, broadcasting the new cover crop seeds and lightly tilling in order to work in the biomass and seed.

TAKE HOME MESSAGE

Shiying had several valuable insights from her trial results and the practice of integrating the chickens into a cover cropped area:

- The continued rise in nitrate even after reseeding validated the priority of getting a cover crop back in the ground quickly after chickens—to capture that nitrogen and keep it cycling in her garden rather than risk it leaching.
- The method of standardizing manure deposition by moving chickens based on feed consumption seems to have worked! The results are reassuring and make it easier for future fertility planning.
- She would like to try integrating a fall-sown cover crop that would start growing early in the spring. This would also minimize the pressure to get the cover crops in line with chickens' timeline.

ACKNOWLEDGEMENTS

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REFERENCES

- 1) Wellington County. 2023. Establishment of new bed to establish 3 year rotation on vegetable garden. <https://www.wellington.ca/media/file/experimental-acres-project-outlines>
- 2) EFAO. 2023. Measuring plant available nitrogen from cover crops. <https://efao.ca/wp-content/uploads/EFAO-PAN-Cover-Crops-Research-Report-2022-Final-28Feb2023.pdf>

Table 1. Soil nitrate (ppm) in control strips versus chicken-grazed lanes, measured after chickens exited each lane.

LANE	CONTROL (CC)	CHICKEN-GRAZED	RATIO (WITH : WITHOUT CHICKENS)
1	4	12	3.0
2	6	10	1.7
3	4	7	1.75
4	5	9	1.8
Mean	4.75	9.50	2.0

Statistical comparison (LSD, $\alpha = 0.05$): Control = 4.75 ppm, Chickens = 9.50 ppm; groups do not overlap, $p = 0.01$.



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