# Impact of Chickens and Clover Cover-Cropping on Soil Fertility & 'MN Midget' Melon Plant Health at the Student Organic Farm


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## Introduction

In organic agriculture production systems, cover cropping with legume plants is one common way to help maintain soil fertility and high yields. Another common way that organic producers maintain soil fertility and high yields is to apply manure or incorporate grazing of livestock/animals. Together, they create benefits that range from increased soil organic matter (OM) content, increased aeration, and resistance to erosion, to supplying soil with nutrients needed for plant growth--including nitrogen (N), phosphorus (P), potassium (K), and other micronutrients [1, 2, 3].

While many organic producers use manure and cover cropping, the concept and efficacy of using both at the same time is not typical. Furthermore, it is underexplored in scientific studies. Moreover, while correlated, an exact and quantifiable impact of such organic inputs on soil fertility and plant health outcomes is variable and location-specific.

**Therefore, this study was performed to help gain understanding of how soil fertility and plant health may change under simultaneous use of manuring and cover-cropping in organic vegetable production systems.**

## Experiment Background & Hypothesis

At Cornercopia, the University of Minnesota's Student Organic Farm, a combined manuring-cover cropping scheme has been practiced since 2012. Fields are fallowed with clover, where chickens also graze. This combined technique has been used for 3 years on one plot (K2, 2012-2014), 1 year on a second plot (G3, 2017), and 0 years on a third plot (G2).

Based on this background and plot management at Cornercopia, my research asked: **How does length of time *under a combined chicken manure-clover cover crop scheme impact* soil fertility and crop health/performance? I hypothesized** that length of time under this management is positively related to soil fertility and crop health/performance.

## Experimental Design

5 data parameters were collected across 4 6'x30' research plots at Cornercopia (Table 1 and Figure 1), reflective of the natural variation in length of combined treatment across the farm. A fertilized and non-fertilized control plot were included. In each plot, 3 replicates and 2 buffer plants of 'MN Midget' melon plants were grown as a model crop on landscaping fabric (Figure 2).

| Field | # of Years of Treatment | Plot Name | Year(s) of Treatment |
|---|---|---|---|
| K2 | 3 | 3 Year | 2012-2014 |
| G3 | 1 | 1 Year | 2017 |
| G2 | 0 | 0 Control ("0 C") | N/A |
| G2 | 0 | 0 Fertilized ("0 F") | N/A |

Table 1. Research plot overview


Figure 1. Research plot map

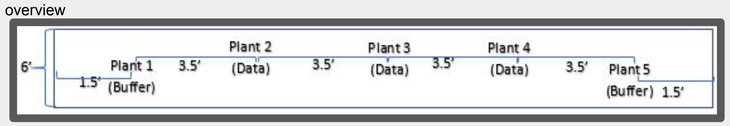


Figure 2. Research plot layout

## Methods & Data Collected: Soil

- Soil Nutrients & Qualities
  - 3 subsamples/plot taken at 6" depth, then mixed and submitted to UMN STRAL
  - pre- and post-season collections (5/8/18 and 10/3/18)
  - Soil Parameters: N03-N, P, K, % soil OM

## Methods & Data Collected: Plants

- Plant N content
  - as measured by SPAD testing of plant leaves (3 sub-samples/data plant)
  - SPAD evaluates chlorophyll content--and therefore plant N levels
- Plant Area (Size)
  - Measured the length of two randomly-selected diameters, then multiplied together for area
- Fruit Count (Yield)
  - Total # of harvested melons/plant over entire season
- Fruit Marketability (Quality)
  - Each harvested melon graded at harvest according to USDA grading standards
    - Fancy (marketable)
    - US #2 (marketable)
    - All else (not marketable)

## Results

### Soil Nutrients & Qualities

- 3 Year treatmentproduced highest P, K, and % OM levels
- 0 F produced highest N level
- Table 2

Table 2. Pre-season and post-season soil test results.

| Treatment | Soil Parameters | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | NO3-N (mg/kg soil) | | Bray P (mg/kg soil) | | NH4OAc-K (mg/kg soil) | | LOI OM (%) | |
| Soil Testing Date | 5/8/18 | 10/3/18 | 5/8/18 | 10/3/18 | 5/8/18 | 10/3/18 | 5/8/18 | 10/3/18 |
| **3 Year** | 10.39 | 25.2 | **341** | 335 | 648 | **692** | **7** | 6.9 |
| **1 Year** | 18.6 | 22.85 | 104 | 116 | 444 | 364 | 3.7 | 3.3 |
| **0 C** | 5.01 | 22.04 | 110.5 | 120 | 272 | 257 | 3.5 | 3.2 |
| **0 F** | 5.01 | **41.36** | 110.5 | 118 | 272 | 352 | 3.5 | 3.05 |

### Plant N-content

- Figure 3
  - Levels of statistical difference significance marked with *a* and *b* ($p < 0.05$)
  - 0 C produced lowest values
  - Values for 1 Year and 3 Year treatments matched that of 0 F
- Plant SPAD values serve as a reliable indicators of both soil N and plant health

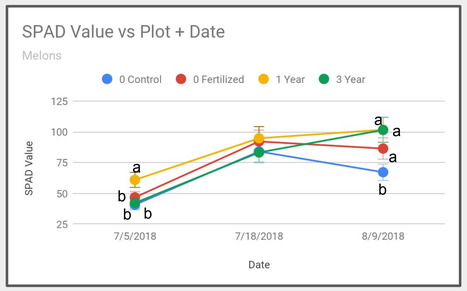


Figure 3. Plant N-content by plot and sampling date

### Plant Area (Size)

- Figure 4
  - No statistically-significant differences
  - 0 C consistently produced smallest plants
  - 0 F consistently produced largest plants
  - 1 Year and 3 Year treatments consistently produced medium-size plants similar yields inferior to 0 F

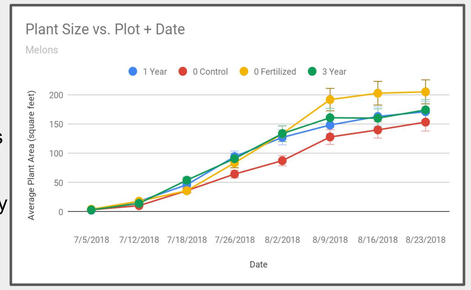


Figure 4. Plant area by plot and sampling date

### Fruit Count (Yield)

- Figure 5
  - Differences not statistically significant ($p=0.52$)
  - 0 F produced highest yield
  - 0 C, 1 Year, and 3 Year treatments produced similar yields inferior to that of 0 F

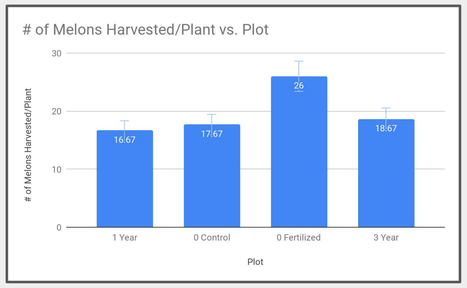


Figure 5. Average fruit yield (# of melons) per-plant by plot.

### Fruit Marketability (Quality)

% Marketable Melons of Total Harvest--no statistical differences ($p=0.46$)

| 85% | 56% | 92% | 62% |
|---|---|---|---|
| 1 Year | 0 Control | 0 Fertilized | 3 Year |

## Discussion & Conclusions

While treatment did provide enhanced soil fertilities and qualities (with the exception of N), treatment wasn't closely correlated to improved plant health and crop performance of melons. Rather, concentrated fertilization of the 0 F plot provided the outcomes that were sought and hypothesized to come from treated.

This apparent disconnect between outcomes of treatment in soil fertility and outcomes of treatment in plant health and crop performance may be explained by how melons have a relatively-high nutrient demand and intense soil nutrient removal [4]. Although treatment did provide much P and K to melons, the lack of NO3-N in the soil furnished by treatments was apparently limiting to plant health and crop performance. Conversely, it appears that fertilizer in the 0 F plot provided sufficient plant-available N, which in turn supported superior outcomes in comparison to treatment results.

**Given these dynamics, for this experiment's model crop ('MN Midget' melons) at this experimental location (Cornercopia), it appears that combined manuring and clover-cover cropping is insufficient in order to produce optimal plant health and crop performance.**

### Further Research Opportunities

While the conclusion for this research may likely hold true when replicated with similar "heavy-feeding" crops and/or when replicated at different sites with similar natural soil fertility and quality characteristics, "ligher-feeding" crops, different soils, and different fertility managements ***may respond differently to the treatments used in this experiment.***

Further research with the same treatments-- but with different soil fertility histories and techniques, different native soil qualities and characteristics, and different model crops--would be valuable in verifying this presumption and furthering the understanding of how a combined chicken manure-clover cover crop scheme impacts soil fertility and crop health/performance.

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## References


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