SIU Sustainability Council Projects
Final Report

Project title: Determination of Vermicompost Application for Optimum Yield and Ascorbic Acid Content in Broccoli and Bell Peppers
Project I.D. #
Award date: May 1, 2012
Completion date: June 30, 2012
Funds used (if different from award amount)
$8376.65 (total costs) - $4537.50 (received prior to project) = $3839.15

Brief write up of project/project experience (not to exceed 250 words):

An experiment was conducted at the Horticultural Research Center greenhouse and the SIUC Sustainable Vegetable Farm to assess the effects different vermicompost percentages (0%, 25%, 50%, 75%) added to a peat based plant media would have on broccoli seedling growth in the greenhouse and plant growth in the field. We further sought to see how amending the field plots at planting with three different vermicompost rates (0 tons/acre, 5 tons/acre, 10 tons/acre) would influence plant growth and if any combination of greenhouse vermicompost percentage and field vermicompost application rate would produce the best growth. Two studies were conducted; one in the fall and the other in the spring. We found that broccoli plants which had received 50% - 75% vermicompost in the greenhouse and 5 tons/acre in the field were significantly taller than those with lower rates. Although broccoli crowns were not of marketable quality, growth differences were evident. Therefore, we think using vermicompost in media at the 50%-75% rate with an amendment of 5 tons/acre could help reduce our reliance on blood and feather meal as a nitrogen source. This would reduce costs for these amendments and the cost of shipping both monetarily and environmentally by using vermicompost produced at the farm site with vegetable waste supplied by the dining halls. This project was also important in that it gave student workers a chance to learn how to set up greenhouse and field experiments, take data and interpret results. Both undergraduate students now feel more confident about their choices to attend graduate school.

Best things learned/produced from project:

The amount of vermicompost in the greenhouse media does seem to have a lasting effect on broccoli seedlings, allowing us to reduce the amendment rate in the field. This saves us vermicompost and labor costs. The student workers also learned important skills in experimental design, data collection and analysis. Both students were unsure about going to graduate school but now feel more confident.

How do you define sustainability?

I believe sustainability in farming means that you can continue farming while improving the land on which you farm, or at least doing no harm. This is very difficult to do because we are really asking quite a lot of the land, especially if you have a small farm where you can't take areas out of production to put into cover crops. Therefore, you have to constantly assess what you are taking out and how you're going to return this to the soil. The addition of vermicompost adds concentrated organic matter and biologically recharges the soil, improves soil structure and adds slow release nutrients and plant hormones. We feel this is a step in the right direction, along with reduced tillage by planning more permanent beds, cover crop use and careful crop rotation.

Has this changed over the course of your project? If so, how?

I think it has strengthened my belief that we can farm this way and still produce good vegetables. It has helped me fine tune what we can do with the vermicompost we have to use it more efficiently.

What do you see as the next step for the project?

I would like to do another spring season and see if we can reduce the rate of blood and feather meal we currently use by using these rates of vermicompost. I would also like to explore the effects of cover cropping on reducing these rates.

Optional: Suggestions for the SIUC Sustainability Council

Keep it up. This is really important for the university and has been certainly important for the existence of this farm as a place where students can get some real experience growing food sustainably.

Attach a minimum of five images – these will be used to promote interest in Sustainability Council projects.

Megan Ewers measuring out vermicompost to be used in greenhouse medium mix
Megan is in Animal Science and is applying to graduate school this fall.

Jessica Brunner is measuring the height of fall broccoli seedlings. You can the corn earworm damage on them. After this they took a turn for the worse and could not be planted in the field.
Jessica has a double major in Nutrition and Plant and Soil Science. She is also interested in graduate school and wants to work with kids in school gardens.

Megan measuring height of spring broccoli in the greenhouse. Some corn earworm damage but much better than in the fall.

0% vermicompost in greenhouse

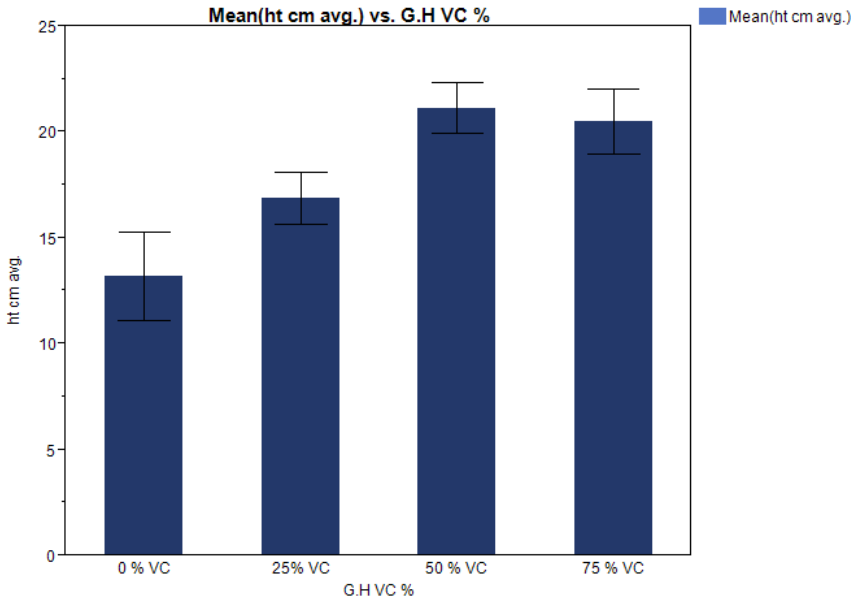
5 tons/acre vermicompost in field

50 % vermicompost in greenhouse

5 tons/acre vermicompost in field

2012 Fall Broccoli Oct. 1 Greenhouse Growth Data

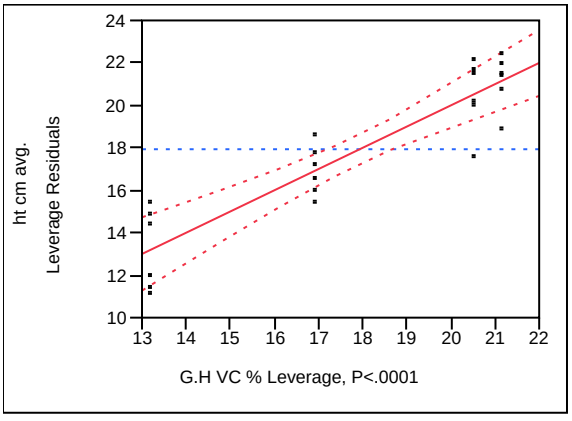
Broccoli Height Data:



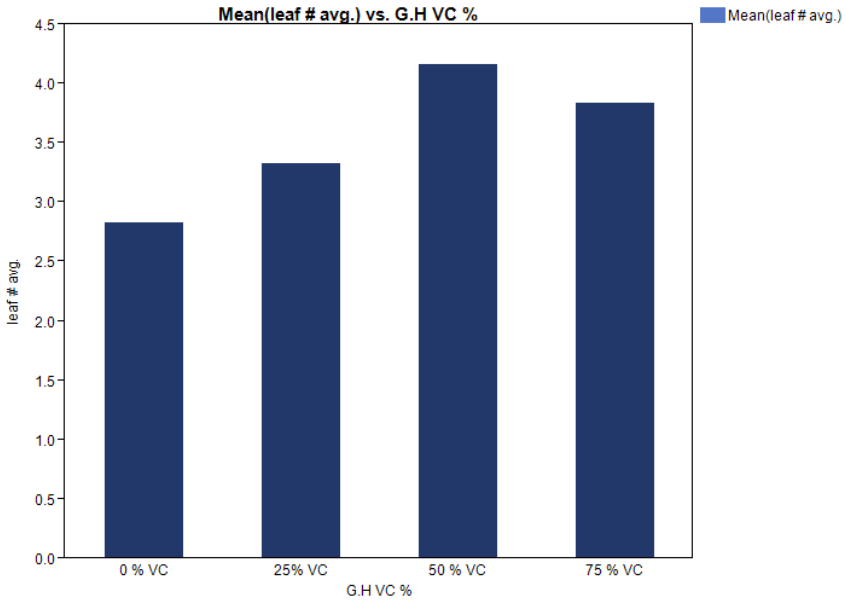
October 1st, 2012 Six week old 'De Cicco' broccoli greenhouse seedlings. VC = Vermicompost % in peat based potting mix.

Leverage Plot Tukeys HSD means separation

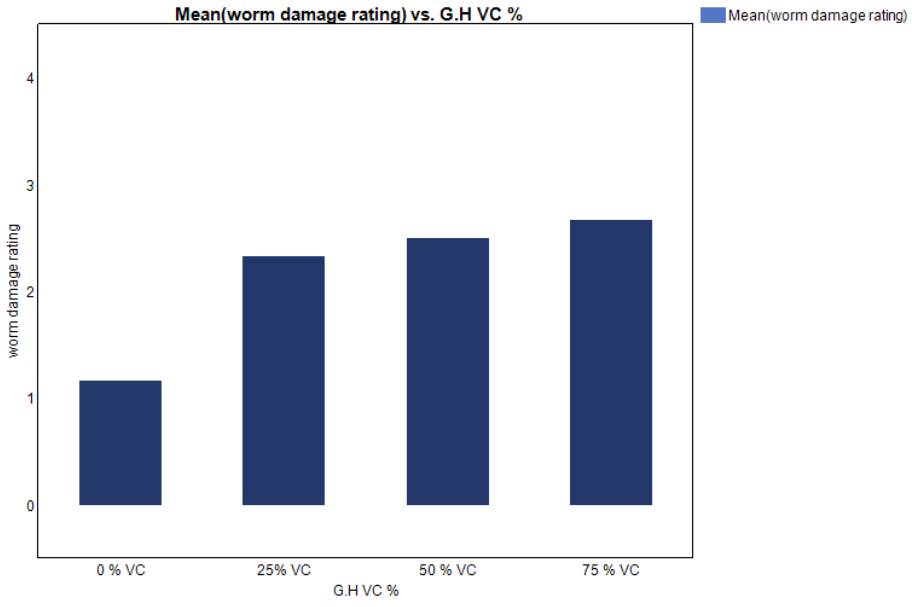
Level				Least Sq Mean
50 % VC	A			21.133333
75 % VC	A			20.500000
25% VC		B		16.900000
0 % VC			C	13.200000



Broccoli leaf number and cabbage worm damage:



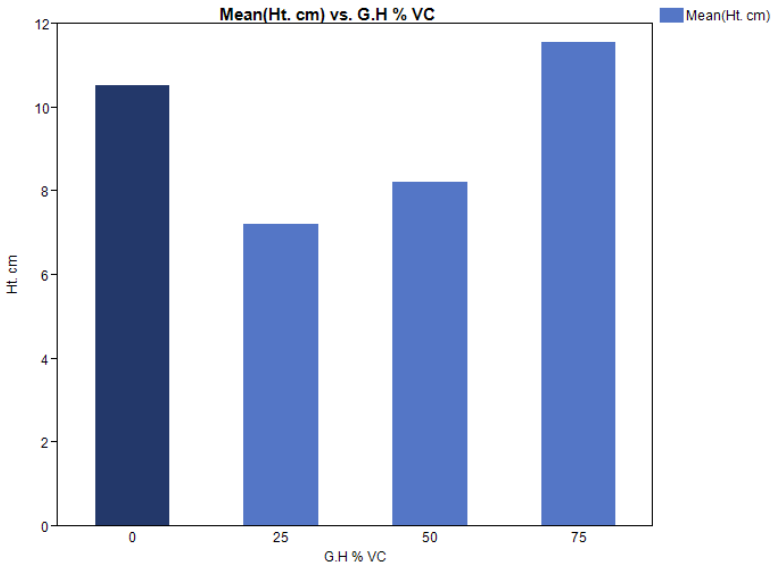
Source	Nparm	DF	L-R ChiSquare	Prob>ChiSq
block	2	2	2.11799352	0.3468
G.H VC %	3	3	19.2787547	0.0002*



Source	Nparm	DF	L-R ChiSquare	Prob>ChiSq
block	2	2	2.65838547	0.2647
G.H VC %	3	3	6.99577625	0.0720

2013 Spring Broccoli Feb. 19th Greenhouse Growth Data

Broccoli height data:



Feb. 19, 2012 Five week old 'De Cicco' broccoli greenhouse seedlings. VC = Vermicompost % in peat based potting mix.

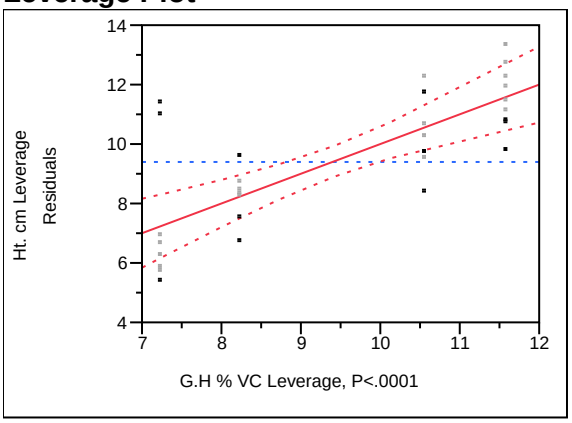
We believe there may be two explanations for why the 0% vermicompost seedlings grew as well as the 75% % VC. Several broccoli/vermicompost studies have been carried out in the greenhouse and never has the 0% VC treatment done as well. The response is usually more like what was seen in the Oct. 1, 2012 height data, with the best growth response increasing from 0%VC to 50% VC and then declining slightly at 75% VC.

One explanation for this is that the 0% VC treatments were fertilized accidently. However, blocking was used and even though block 1 was found to be significantly higher in height than the other blocks (this would have also been the block most likely to be accidently fertilized as it bordered other plants not in the study), when we excluded block 1 from analysis, the overall results were not changed.

Another explanation could be that these seedlings were measured at the 5 week stage instead of the 6 -8 week stage as in previous studies at SIUC. The vermicompost is a slow release fertilizer with maximum nutrient release around 8 weeks. By that time the nutrients in a standard potting mix could be depleted and deficiencies and stunted growth may begin to occur while the growth of those seedlings with vermicompost could increase. The seedlings were measured a week earlier due to corn earworm pressure in the greenhouse and we feared that we could lose the seedlings. In comparing the height data for 0% VC between Oct. 1, 2012 (6 week seedlings) and Feb. 19, 2013 (5 week old seedlings), you can see that the height is similar and not much growth occurred, while the height of those with vermicompost were much higher.

Broccoli Feb.19th, 2013 height (5 week seedlings)

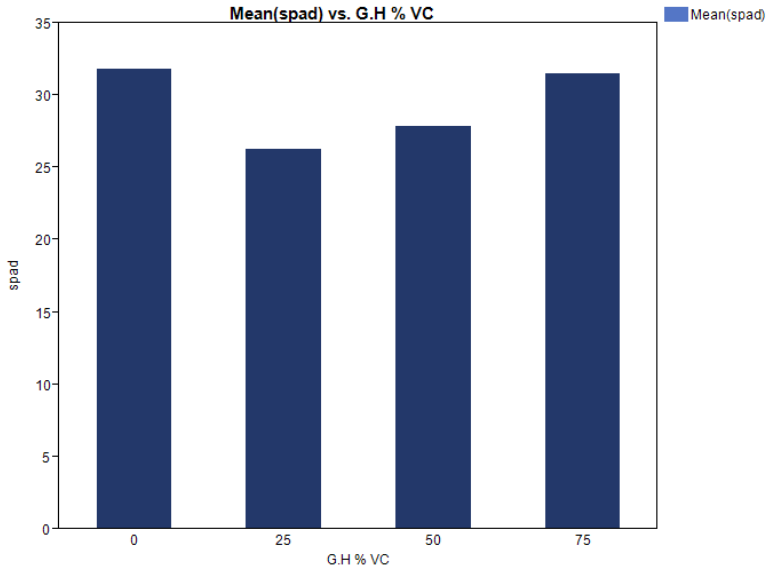
Leverage Plot

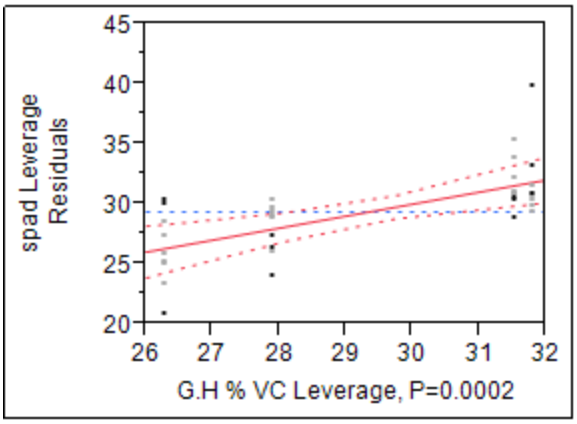


Tukey HSD means separation

Level			Least Sq Mean
75	A		11.577778
0	A		10.544444
50		B	8.233333
25		B	7.233333

Spad (measures chlorophyll and had been shown to highly correlate with nitrogen content of leaves:

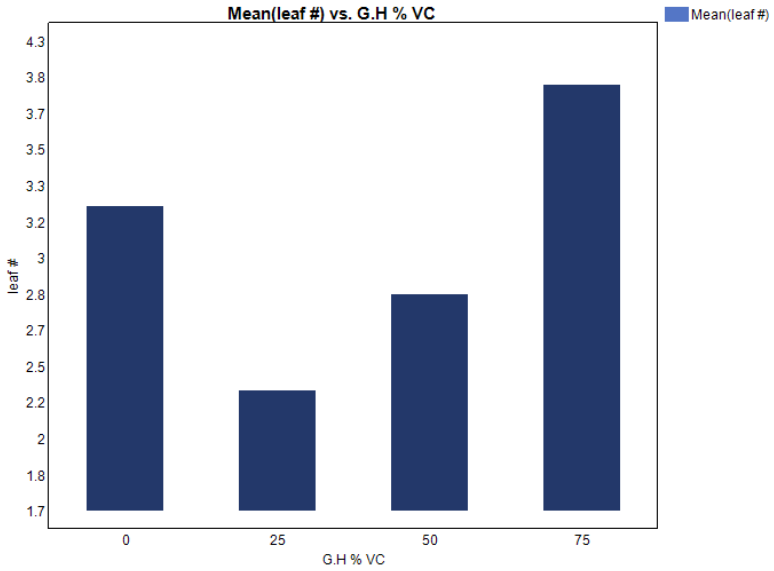




Tukeys HSD means separation

Level			Least Sq Mean
0	A		31.800000
75	A		31.511111
50		B	27.877778
25		B	26.277778

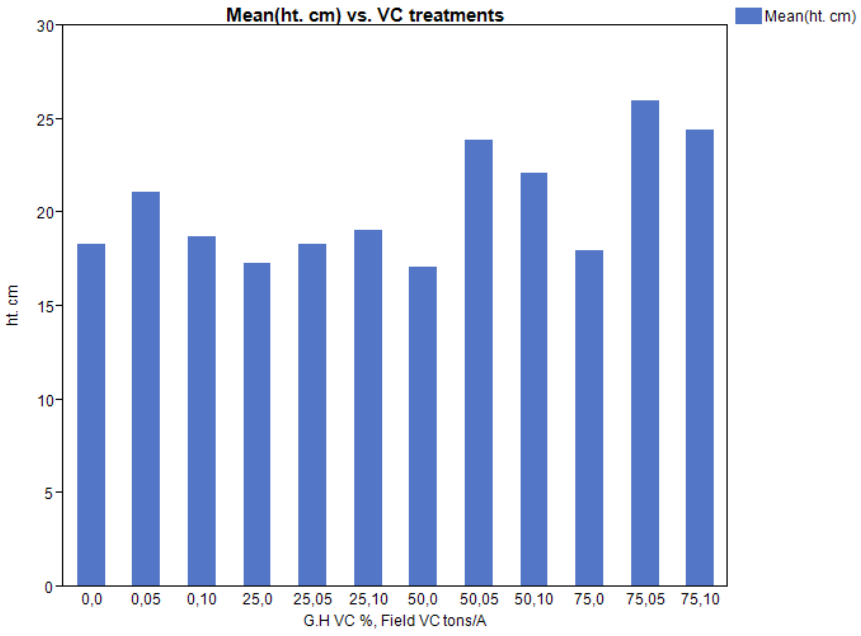
Broccoli Leaf number:



Source	Nparm	DF	L-R ChiSquare	Prob>ChiSq
G.H % VC	3	3	32.4196419	<.0001*

2013 Spring Broccoli May/June Field Growth Data

Spring Broccoli Field height May 30th, 2013



Greenhouse vermicompost %, Field vermicompost tons/Acre.

In the field vermicompost amended plots, you can see that plant height is highest in most plots with 5 tons/acre added. Furthermore, an increase in height can be seen in the field from 25% vermicompost to 75% vermicompost used to amend the greenhouse potting mix. Plants with the 0% vermicompost greenhouse treatment were taller than those with 25% vermicompost, but this have been due to possible accidental fertilization in the greenhouse.

Source	Nparm	DF	Sum of Squares	F Ratio	Prob > F
Block	2	2	251.36167	10.3700	0.0007*
G.H % VC	3	3	107.08750	2.9453	0.0553
Field tons/A VC	2	2	138.73167	5.7234	0.0100*
G.H % VC*Field tons/A VC	6	6	60.85500	0.8369	0.5547

Block effect

Level			Least Sq Mean
3	A		23.841667
1		B	19.850000
2		B	17.433333

Levels not connected by same letter are significantly different.

Spring Broccoli Field Plant Height May 30, 2013

Greenhouse media vermicompost %

Level			Least Sq Mean
75	A		22.811111
50	A	B	21.044444
0	A	B	19.411111
25		B	18.233333

Tukeys HSD means separation

Field Vermicompost tons/acre

Level			Least Sq Mean
5	A		22.333333
10	A	B	21.100000
0		B	17.691667

Levels not connected by same letter are significantly different.
Tukeys HSD means separation

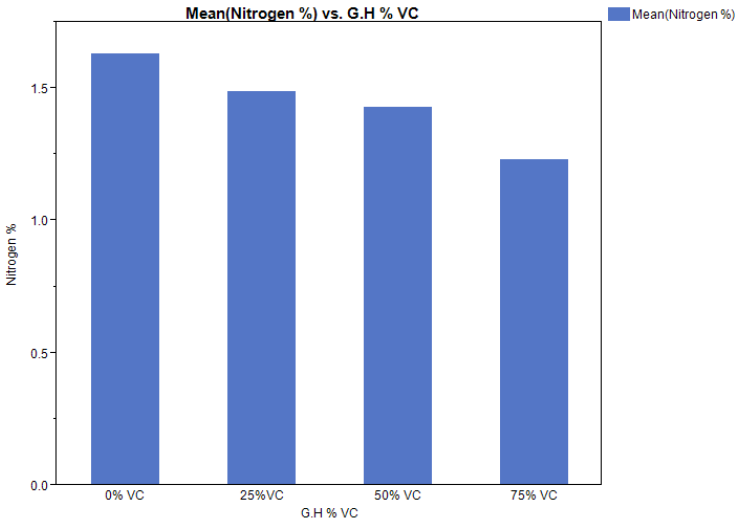
Greenhouse Vermicompost %, Field Vermicompost tons/acre

Level					Least Sq Mean
75,5	A				25.966667
75,10	A	B			24.466667
50,5	A	B	C		23.900000
50,10	A	B	C	D	22.100000
0,5	A	B	C	D	21.133333
25,10		B	C	D	19.066667
0,10		B	C	D	18.766667
0,0			C	D	18.333333
25,5			C	D	18.333333
75,0				D	18.000000
25,0				D	17.300000
50,0				D	17.133333

Levels not connected by same letter are significantly different.
Students T means separation

From these results we can see that using 50%- 75% vermicompost in the greenhouse media mix along with a field amendment of 5 tons/acre may positively influence broccoli plant height. However, these results are not highly significant and no conclusions or recommendations can be made at this time.

Spring Broccoli Nitrogen leaf nutrient analysis June 3, 2013:

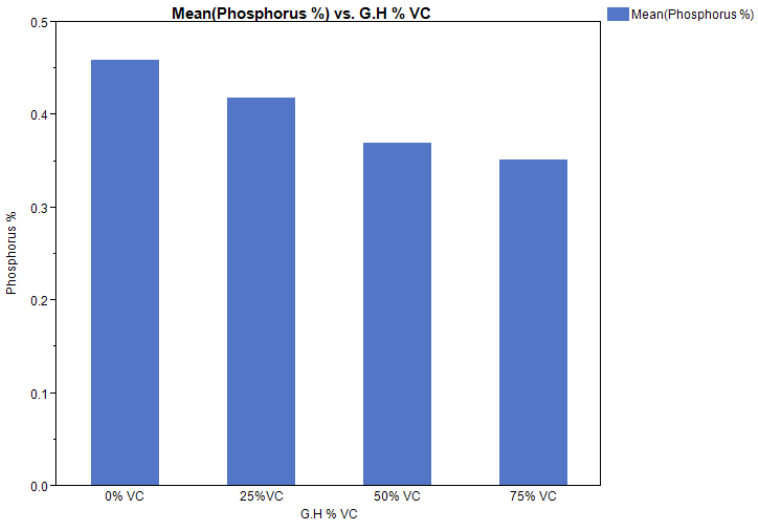


Source	Nparm	DF	Sum of Squares	F Ratio	Prob > F
Block	2	2	0.03042222	0.4345	0.6530
G.H % VC	3	3	0.74400833	7.0848	0.0017*
Field Tons/A VC	2	2	0.10583889	1.5118	0.2426
G.H % VC*Field Tons/A VC	6	6	0.37471667	1.7841	0.1490

Level			Least Sq Mean
0% VC	A		1.6300000
25%VC	A		1.4900000
50% VC	A	B	1.4311111
75% VC		B	1.2300000

Levels not connected by same letter are significantly different.
Tukeys HSD means separation

Spring Broccoli Phosphorus leaf nutrient analysis June 3, 2013:



Source	Nparm	DF	Sum of Squares	F Ratio	Prob > F
Block	2	2	0.06286617	8.8295	0.0015*
G.H % VC	3	3	0.06355053	5.9504	0.0039*
Field Tons/A VC	2	2	0.01869117	2.6252	0.0950
G.H % VC*Field Tons/A VC	6	6	0.01758506	0.8233	0.5641

Level			Least Sq Mean
0% VC	A		0.45888889
25%VC	A	B	0.41911111
50% VC		B	0.36977778
75% VC		B	0.35188889

Levels not connected by same letter are significantly different.

Tukeys HSD means separation.

These results are interesting in that higher nutrient concentrations of nitrogen and phosphorus were found to be highest in plants that had 0% vermicompost in the greenhouse and then decline as the percentage of vermicompost increased. These leaf samples were taken in the field when the broccoli was 5 months old. More research is needed to see the effects early nutrient deficiencies can have on the later growth and nutrient storage of broccoli plants. It appears while the nutrient levels are higher, growth was not positively influenced. These higher levels may then be the result of nutrient concentration in the smaller leaves of these plants.

Crown formation was not uniform enough to collect statistically viable data. It appears that the vermicompost alone was not enough to produce marketable broccoli crowns. In other growth experiments on the SIUC Sustainable Farm, we have found that the addition of blood or feather meal to broccoli beds prior to planting based upon 150/lbs nitrogen/acre, will produce marketable broccoli crowns. We believe that if we increase to 50% vermicompost addition to the greenhouse media and amend plot with 5 tons/acre vermicompost, we may be able to decrease the use of blood/feather meal with the locally produced vermicompost. This would reduce our shipping costs for the blood/feather meal and our reliance on shipping for our fertilizer needs.