Vegetable Farming-Wine Not? A Study of Harvest Thyme Farm and Vineyards

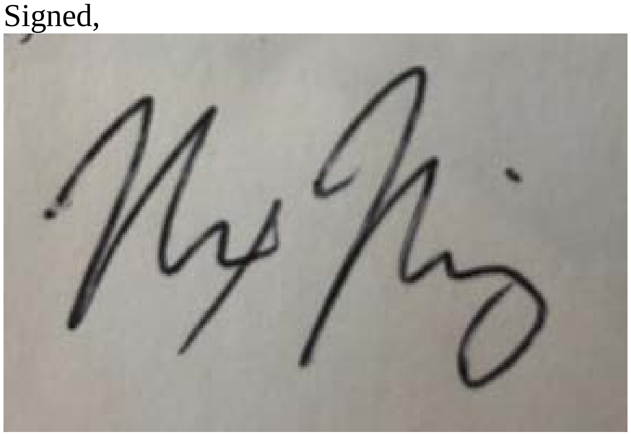
Nisha Gudal

University of Michigan Biological Station
EEB 405 Agroecology
August 18th, 2018
Katie Goodall

Vegetable Farming-Wine Not? A Study of Harvest Thyme Farm and Vineyards

Max Miley

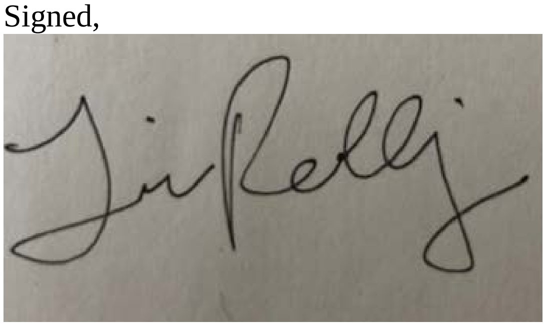
University of Michigan Biological Station
EEB 405 Agroecology
August 18th, 2018
Katie Goodall



Vegetable Farming-Wine Not? A Study of Harvest Thyme Farm and Vineyards

Olivia Rollinger

University of Michigan Biological Station
EEB 405 Agroecology
August 18th, 2018
Katie Goodall



Vegetable Farming - Wine Not? A Study of Harvest Thyme Farm and Vineyards

Nisha Gudal, Max Miley, Liv Rollinger
UMBS Agroecology 2018

Table of Contents

Introduction

The FarmLab investigation gave us the opportunity to interact weekly with farmers on a local farm, Harvest Thyme (HT), in Cheboygan, Michigan. Returning to this same farm each week and working first hand with the farmers allowed us to learn from them the complexities of their agroecosystem, gaining many insights which we wouldn't have grasped if we had only visited the farm once. To gain this deeper understanding of HT, we began by helping out with labor on the farms, primarily weeding and assisting with pest control, to familiarize ourselves with the farmers and their style of farmwork. As each agroecological system has its own unique ways of functioning, these three weeks of manually assisting the farmers were vital to our lab process. These weeks granted us the time to experience the intricacies involved in growing food at HT and supporting their livelihood as a small-farm business. The following weeks we collected data about the farm through participatory mapping, a semi-structured farmer interview, soil ion and organic matter analysis, and exploration of livelihood assets of the farm.

The investigative research we conducted provided a baseline for future Participatory Action Research (PAR). This type of research emphasizes a close working relationship between farmers and researchers in order to utilize each group's unique bank of knowledge and skill sets. Furthermore, this research requires commitment to long term studies from both parties as repeated cycles of farmer inspired research, collective reflection, and actionable findings are pivotal to this research style (Méndez, 2017).

We further explored aspects of the farm individually through literature reviews, our FarmLab Chapters. Each researcher focused on a farmer inspired issue in the agroecosystem to make recommendations for solutions or alternatives which may benefit the farm in the present and the future. The researchers concentrated on the farm's hens and their multiple potential applications on the farm, possible agroecological pest control methods, and weed control within the vineyard as well as the potential benefits of utilizing communities to gain strength and knowledge.

Site Description

Harvest Thyme is a farm located in Cheboygan county in Northern Lower Michigan, owned and operated by farmers Brendan Prewitt and Greta Jankoviak. The farm is about 10 miles southwest of the town Cheboygan, where produce is sold at the farmers market twice a week. The farm consists of two properties and the second, smaller piece of land is south of the first. The land is generally flat, with a 30-foot gradient running from northwest to southeast on the first property and no gradient on the second. Because of this landscape, the farm can get quite windy.

Harvest Thyme is located on family land. The first property belongs to Greta’s parents and the second was purchased last year from Greta’s great uncle. Before Brendan and Greta began cultivating the land, the fields were used for hay, and what is currently the vineyard was uncultivated and overgrown with invasive species. Brendan and Greta came to the land with the intention of starting a vineyard and winery, and ended up starting a vegetable CSA in the meantime to generate income as they wait for the grapes to mature. They grow a diverse variety of crops as well as raise laying-hens. The farm is managed organically, though it is not certified. Brendan and Greta have found that their good, trusting relationship with customers makes the certification unnecessary.

In order to manage the farm organically, Brendan and Greta put in a lot of work in the form of manual labor. Farm tasks include weeding, planting, harvesting and washing and packing produce. When pest control is necessary, organic sprays or mechanical management (e.g. row covers) are utilized. For weed control, besides hand and flame weeding, plastic mulch is used in some fields.

The vineyard is the only part of the farm that is currently not organically managed. The intention was for it to be so, but as the grapes mature they need a lot of moisture, and organic weed suppression was not working well, so the vineyard is currently treated with Roundup. Brendan and Greta are hoping to return to organic management of the vineyard in the future, which may become easier once the grapevines have matured and are not competing with weeds as much for water and nutrients.

Chapters

As part of our Farm Lab experience, each student created a chapter exploring a specific area of interest on the farm, in the form of a literature review. These chapters were farmer-inspired based on challenges the farm has been facing or areas that the farmers are interested in but have not been able to explore in depth. The hope is that the students were able to gain further insight on the complexities of running an agroecosystem and that the farmers can benefit from the in-depth research the students conducted. Our farm lab includes three chapters: The Benefits and Limitations of Introducing Chickens into a Crop-Livestock Agroecosystem, Agroecological Approaches to Pest Control, and Organic Vineyard Weed Management and Community Cooperation Strengths at Harvest Thyme Farms.

The Benefits and Limitations of Introducing Chickens into a Crop-Livestock Agroecosystem

Max Miley

Chickens have been domesticated and used as providers of meat and eggs throughout cultures globally. However, America in the 1940s produced the beginning of a trend towards an industrialized broiler system, developing into the CAFOs (confinement animal feeding operations) we know today (Constance and Tuinstra, 2005). This shift in practice, like many other industrialized agricultural practices takes little advantage of possible agroecological benefits intrinsic of plants and animals. As movements in agroecology become more prevalent, there has been a shift back towards utilizing these benefits, specifically with chicken production. In a Participatory Action Research project, I engaged with a farm, Harvest Thyme, in Cheboygan, MI, and learned how they utilized their laying hens. In this paper, I explore the benefits and limitations of crop-livestock applications of both laying hens and broiler chickens in an agroecological system.

The most widely used term used to describe the application of chickens to a farmland is *crop-livestock integration* (CL). This term can also refer to other forms of livestock, but for the purposes of this section, it will strictly refer to poultry. It describes an agricultural system that incorporates chickens and crops either spatially or temporally. This could take the form of chickens grazing on fallow crop fields intended for rotation, or incorporating chickens while crops are growing. Another term to note is *pastured production* (PP), which refers to chickens living outside continuously, save their choice to move into a shelter at night, and a diet that consists of pasture plants and grain (Hilimire, *et al.* 2012; Hilimire, 2011). PP is generally a type of CL due to farmers growing some profitable crop within the pasture. The final important term in this section is *organic*, which in reference to chickens denotes that any feed consumed by the chickens is grown without artificial inputs, and the chickens themselves have had no genetic modification. They also must have access to outdoor space, but are not required to be as free-range as PP (Blair, 2008). There are two main types of shelters used in these practices with chickens. A static chicken house is generally used to revitalize a relatively small area of grassland or pasture, whereas mobile shelters promote ease to move chickens around large areas (Xu *et al*., 2012).

There has been a recent increased interest in alternative meat production (Walker and Gordon, 2003; Hilimire, 2011), both from the producers' and consumers' perspective. Farmers have recognized the possible benefits of higher soil fertility and enhanced crop performance through CL, and consumers are motivated by the "natural" cultivation of organic foods and by the negative stigmas surrounding genetically modified organisms (Hilimire, *et al.*, 2012). Organic chicken comprises 60% of this growing trend, bringing 15% of U.S. consumers to regularly buy organic poultry meat, and 12% to regularly buy organic eggs (Hilimire, 2011).

Although there is a positive trend in CL and organic practices, there are limitations and challenges from the farmer's perspective. By nature of pasture land, the chickens need a significant amount of space so that overgrazing doesn't produce "hot spots", where nutrient leaching becomes a concern due to a build-up of feces (Xu *et al*., 2012). Long-term access is also difficult for some farmers, as 50% of the farmland in the United States is rented (US Census Bureau), and long-term access to land is key in a functional PP system (Lowy, 2009). Challenges also differ by local ecosystems; in a survey of California PP farmers, 44% responded that predation of birds is the largest challenge to raising chickens in a pasture. Most other challenges that apply refer to labor: a lack of knowledge about techniques in CL and PP systems, time consumption versus caged-raised birds, transportation of birds, and dealing with manure (Bamire and Amujoyegbe, 2008; Hilimire, 2011). Specifically for farmers that already have CAFO-like systems in place, the uncertainty introduced into the heavily controlled system via pastured diets is a prominent challenge (Walker and Gordon, 2003). While these challenges may seem daunting, literature shows that the benefits significantly outweigh the drawbacks.

Studies overwhelmingly show that PP and CL increase available nitrogen, available phosphorus, available potassium, total soil carbon, organic matter, cation exchange capacity, and soil conductivity. These benefits mainly come from the replacement of pasture feed with feces, which introduce nutrients in naturally available ways (Xu *et al*., 2012; Hilimire, *et al.* 2012; Bamire and Amujoyegbe, 2008; Ravindran *et al.*, 2017; Lowy 2009). (Bamire and Amujoyegbe, 2008) also noted that the nutrient content and readily available nutrients are much higher in poultry manure compared to other livestock. This characteristic of poultry has been noticed by farmers—in a survey of 29 California PP farmers, a large majority said that soil fertility was the most noticeable benefit. As a soil amendment poultry manure is extremely versatile, and can be used from a range of casual application up to large, full-field agriculture, relatively inexpensively (Fukuoka, 2017). From an environmental perspective, pastured chickens produce higher plant densities and aboveground biomass (Xu *et al*., 2012).

In concert with the increased nutrient content, the use of PP and CL techniques reduces the need for external inputs such as inorganic fertilizer, feed, and labor time. Xu *et al*. (2012) found that PP chickens required 25% less feed than that of cage-raised birds, and Stanley (2011) found a significant reduction in labor time when using chickens as a weed and pest reduction agent. The application of chickens as pest management agents have been widely adopted, but haven't been represented as well in literature. However, CL systems do serve as viable approaches to control pest outbreaks and general population levels (Xu *et al*., 2012, 9, 11). Similarly, Stanley (2011), found that hens significantly reduced the number of weeds in an integrated hen-asparagus-cover crop system when grazing pre- and post-harvest.

Xu *et al*. (2012), Hilimire *et al*. (2012), and Hilimire (2011) all found that the effects on soil and factors like pests and weeds increased yield, thus increasing profit margins. The profitability of CL systems is well cited, but there is still skepticism surrounding the concept. Over a two-year period, Lowy (2009) increased their profits by 500% using a PP system, and Xu *et al*. (2012) found that a group of four workers can produce profits of $2 a chick in a meat-bird PP system. In the same survey study of California farmers mentioned previously, 50% of respondents noted that there was a direct profitability from PP, and 78% noted that there was an indirect profitability from the attraction of a free-range system. Those who did not report profitability mostly acknowledged that the chickens are worth the effort due to their soil amendment possibilities or pest and weed management.

CL systems such as PP, among others, with substantial attention and adaptation, especially within the first one to two years, have the potential to be both economically and environmentally incentivized.

References:

US Department of Commerce: Economics and Statistics Administration. (2010). *Who Owns America's Farmland?*

Bailey, Zach, Pawlowski, Aleksandra, Jaoude, Hady, & Guo, Di (2010) UBC Farm Chicken Shelter. *UBC Social Economic Development Studies*

Bamire, A., & Amujoyegbe, B. (2003). Economics of poultry manure utilization in land quality improvement among integrated poultry-maize-farmers in South-western Nigeria. *Nigerian Journal of Animal Production,30*(1). doi:10.4314/njap.v30i1.3319

Blair, R. (2018). *Nutrition and feeding of organic poultry*. Boston, MA: CABI.

Clark, M. S., & Gage, S. H. (1996). Effects of free-range chickens and geese on insect pests and weeds in an agroecosystem. *American Journal of Alternative Agriculture,11*(01), 39. doi:10.1017/s0889189300006718

Constance, Douglas H. & Tuinstra, Reny (2005) Corporate Chickens and Community Conflict in East Texas: Growers' and Neighbors' Views on the Impacts of the Industrial Broiler Production. *Culture and Agriculture,27*(01)

Hilimire, K. (2011). The grass is greener: Farmers experiences with pastured poultry. *Renewable Agriculture and Food Systems,27*(03), 173-179. doi:10.1017/s1742170511000287

Hilimire, K., Gliessman, S. R., & Muramoto, J. (2012). Soil fertility and crop growth under poultry/crop integration. *Renewable Agriculture and Food Systems,28*(02), 173-182. doi:10.1017/s174217051200021x

Hutchinson, C. M. (1999). Trichoderma virens-Inoculated Composted Chicken Manure for Biological Weed Control. *Biological Control,16*(2), 217-222. doi:10.1006/bcon.1999.0759

M., F., & M., F. (n.d.). *The One-Straw Revolution*.

Lee, J., Mun, S., Kim, D. H., Cho, C., Oh, D., & Han, K. (2017). Chicken (Gallus gallus) endogenous retrovirus generates genomic variations in the chicken genome. *Mobile DNA,8*(1). doi:10.1186/s13100-016-0085-5

Lowy, Peter. (2009). Excerpted (reprinted) <Integrating poultry and sheep on vegetable cropping land for increased economic return and enhanced fertility>, published by Sustainable Agriculture Research and Education (SARE) Outreach, USDA - National Institute of Food and Agriculture (NIFA)

Pote, D. H., & Haller, S. M. (2010). *U.S. Patent No. US 2010/0003087 A1*. Washington, DC: U.S. Patent and Trademark Office.

Ravindran, B., Mupambwa, H. A., Silwana, S., & Mnkeni, P. N. (2017). Assessment of nutrient quality, heavy metals and phytotoxic properties of chicken manure on selected commercial vegetable crops. *Heliyon,3*(12). doi:10.1016/j.heliyon.2017.e00493

Stanley, Marilyn. (2011). Excerpted (reprinted) <Using Chickens and a Cover Crop Barrier for Weed Control in Organic Asparagus>, published by Sustainable Agriculture Research and Education (SARE) Outreach, USDA - National Institute of Food and Agriculture (NIFA)

Walker, A., & Gordon, S. (2003). Intake of nutrients from pasture by poultry. *Proceedings of the Nutrition Society,62*(02), 253-256. doi:10.1079/pns2002198

Xu, H., Su, H., Su, B., Han, X., Biswas, D. K., & Li, Y. (2014). Restoring the degraded grassland and improving sustainability of grassland ecosystem through chicken farming: A case study in northern China. *Agriculture, Ecosystems & Environment,186*, 115-123. doi:10.1016/j.agee.2014.02.001

Agroecological Approaches to Pest Control

Nisha Gudal

Agroecological farming practices often look to traditional agriculture as a way of understanding how agricultural components interact with the surrounding ecosystems. These traditional agroecosystems are often highly diversified, and lower in external inputs, and in many cases have very good pest management (Altieri 2004). An important consideration when thinking about pest management in an agroecological context is that all insects in the agroecosytem do not need to be viewed as pests. Only when populations of insects are large enough to cause significant damage are they viewed as pests (Morales 2002). Through Participatory Action Research on Harvest Thyme Farm, I learned that there have been challenges with certain pests. Accordingly, this paper explores several agroecological approaches to management of cucumber beetles, cabbage maggots, and two-spotted spider mites.

Cucumber Beetle Control

There are a variety of strategies for managing striped cucumber beetles in order to reduce damage to crops. This paper reviews strategies such as presence of predators, plant density and diversity, physical barriers and trap cropping.

The presence of predators has been shown to alter the behavior of animals in some situations (Lima and Dill 1990), including insects in agricultural situations. While density of insects on plants may not change in the presence or absence of a predator, feeding behavior may be affected (Beckerman et al. 1997). Williams and Wise (2003) found that in the presence of a wolf spider (*Rabidosa rabida)*, a natural enemy of striped cucumber beetles, the beetles ate at half the rate that they did when spiders were not present. They also found that the percentage of beetles leaving a plant over a fifteen minute period increased when a spider was nearby (Williams and Wise 2003). So, even though the predators may not actually reduce the population size of the insect, their presence can significantly reduce damage to crops.

Crop diversity can also have an impact on cucumber beetle populations. In an experiment done by Bach (1980), cucumber beetles were 10-30 times more abundant in monoculture plantings of cucumbers as opposed to polycultures where cucumbers were planted alongside broccoli and corn. This same study also concluded that plant density had no effect on beetle populations.

Trap crops are another pest control strategy that can bring additional diversity onto the farm. A trap crop is a crop that is planted to attract pests to keep them from spreading to a main crop that is being grown to harvest and it falls into the category of acceptable pest management strategies by the USDA National Organic Standard (Matthews et al., 2017). Adler and Hazard (2009) explored the effectiveness of several perimeter trap crops on attracting cucumber beetles away from a butternut squash crop. They found that Blue Hubbard squash, buttercup squash, and zucchini were the most attractive to beetles (as compared to butternut squash and wild gourd). The researchers found it surprising that wild gourd was relatively unattractive to the cucumber beetles because it contains relatively high levels of cucurbitacin, which is a chemical defense that attracts cucumber beetles (Alder and Hazard, 2009). It has also been found that a diversified trap crop may increase yield of the main crop (Parker et al., 2016).

A similar idea to trap crops is companion planting, i.e. planting crops that either repel a pest or attract beneficial insects. For cucumber beetles, radishes, tansy, and nasturtium seem to be effective in repelling, while buckwheat, cowpeas, and sweet clover seem to attract beneficial insects (Cline et al., 2008). Planting combinations of these crops may prove effective in deterring cucumber beetles from main crops.

Cabbage Maggot Control

Cabbage maggots are primary pests of Brassica crops. Adult flies locate host plants based on leaf color and microbial volatiles (Matthews-Gehringer and Hough-Goldstein), and females lay eggs on the soil surface near plant roots (Royer et al., 1996) so that larvae can feed on the plant by tunneling through the roots. In the following section we will explore possible strategies for managing cabbage maggots, including the use of natural enemies, physical barriers, soil amendments and mulches. Using these strategies instead of insecticides can be favorable because cabbage maggots can develop resistance to repeated insecticide applications and insecticides can have a negative impact on natural enemies of the cabbage maggots (Matthews-Gehringer and Hough-Goldstein, 1988).

Given that cabbage maggots live part of their lives in the soil, the effectiveness of control by nematodes (small worm-like creatures that live in soil) has been explored. Royer et al (1996) found that the *Steinernema carpocapsae* strain of nematodes was not attracted to cabbage maggot eggs but was attracted to the cabbage maggot larvae and in some cases followed the maggots into plant roots. Royer et al. acknowledged that further research is warranted on the timing of nematode application.

According to Matthews-Gehringer and Hough-Goldstein (1988), the most important time to protect plants from cabbage maggot infestation is during the first 5 to 7 weeks of seedling growth. Physical barriers can be effective not only in reducing cabbage maggot damage, but also in increasing growth and yield of some crop species. Matthews-Gehringer and Hough-Goldstein found that Reemay row covers were effective in controlling cabbage maggot levels in Chinese cabbage and broccoli crops at levels comparable to the insecticide diazinon. They also found that when the row cover was combined with plastic mulching, broccoli yields increased.

The use of tarpaper collars, or "tarred felt discs" was once a popular method of deterring cabbage maggots and was reported to be very effective by Wadsworth (1917). These collars are made by cutting a slit in a piece of tarpaper so that the paper may be placed around the stem of the plant and lie flat on the ground. Matthews-Gehringer and Hough-Goldstein (1996) did not find this method effective in their study, however, they acknowledged that their experiment may have been affected by inadequate fit of the collars. The effects of mulches on controlling cabbage maggots seem to be mixed and perhaps dependent on the crop being grown, and granular barriers such as woodash and sand are ineffective and actually increase maggot levels (Matthews-Gehringer and Hough-Goldstein, 1996).

Two-Spotted Spider Mite Control

Two-spotted spider mites have been reported as pests of many different crops, and it has been found that their egg-laying and generation rates can differ depending on what crop host they are residing on (Jepson et al., 1975). White and Liburd (2005) found that, in strawberries, low soil moisture and higher air temperatures promoted spider mite reproduction. However, other studies have shown that the relationship between mite reproduction and drought stress is not linear, i.e. spider mite abundance declined in slight and severe drought stress but increased at intermediate levels of drought stress (English-Loeb, 1989). In addition to these challenges, two-spotted spider mites can also develop resistance to a lot of acaricides, which kill mites and ticks (Sedaratian et al., 2009).

One possible strategy for management of two-spotted spider mites is growing crop varieties that are resistant to the mites. Maleknia et al. (2015) studied the success of spider mites on 12 different greenhouse cucumber varieties. They found that out of the varieties tested, Vida was the most susceptible to two-spotted spider mites and Caspian was the most resistant (Maleknia et al 2015).

In summary, there are several agroecological methods that can be used to control cucumber beetles, cabbage maggots and spider mites. The presence of natural enemies can be an effective strategy for either controlling populations of pests, in the case of the cabbage maggots, or in changing pest behavior to reduce damage to plants in the case of cucumber beetles. Though nematodes have not proved effective at controlling cabbage maggots at Harvest Thyme in the past, there are other options for controlling this pest that could be applicable at Harvest Thyme. For example, physical barriers can also be used as pest deterrents, such as plastic mulches, tarpaper collars, or row cover fabrics. Some of these practices are already in use at Harvest Thyme, and their continued use may be beneficial.

Planting resistant crop varieties is another option for avoiding pest damage, especially for spider mites, where there are few other options. Enhancing crop diversity can be an effective method of pest control as well as increasing crop yield in some instances by attracting pollinators. Examples of this are growing crops in polycultures, introducing companion plantings to attract beneficial insects or deter pests, planting trap crops to draw pests away from the main crop, or a combination of these practices. Harvest Thyme already has a diverse selection of crops, which is likely already providing many benefits to the farm. Something that could further enhance pest control would be incorporating multiple crops into the same row so that there aren't "small scale" monocultures for each crop type, though this could have the negative effect of increasing labor for planting and harvesting. An alternative, though potentially equally beneficial, option would be to incorporate non-cash crops into the main cash crop in the form of companion plants and trap crops.

References

Adler, L. S., & Hazzard, R. V. (2009). Comparison of perimeter trap crop varieties: Effects on herbivory, pollination, and yield in butternut squash. *Environmental Entomology, 38*(1), 207-215. doi:http://dx.doi.org.proxy.lib.umich.edu/10.1603/022.038.0126

Altieri, M. A. (2004) Linking ecologists and traditional farmers in the search for sustainable agriculture. Frontiers in Ecology and the Environment 2: 35-42.

Bach, C. E. (1980). Effects of plant density and diversity on the population dynamics of a specialist herbivore, the striped cucumber beetle, acalymma vittata (fab). *Ecology, 61*(6), 1515-1530. doi:http://dx.doi.org.proxy.lib.umich.edu/10.2307/1939058

Beckerman A. P. Uriarte M. Schmitz. O. J. 1997. Experimental evidence for a behavior-mediated trophic cascade in a terrestrial food chain. Proc. Natl. Acad. Sci . 94: 10735–10738.

Cline, G. R., Sedlacek, J. D., Hillman, S. L., Parker, S. K., & Silvernail, A. F. (2008). Organic management of cucumber beetles in watermelon and muskmelon production. *HortTechnology, 18*(3), 436-444. Retrieved from http://proxy.lib.umich.edu/login?url=https://search-proquest-com.proxy.lib.umich.edu/docview/46348995?accountid=14667

English-Loeb, G. M. 1989. Nonlinear responses of spider mites to drought-stressed host plants. Ecol. Entomol. 14: 45Ð55.

Jepson, L. R., H. H. Keifer, and E. W. Baker. 1975. Mites injurious to economic plants. Univ. California Press; Berkeley

Lima S. L. Dill. L. M. 1990. Behavioral decisions made under the risk of predation: a review and prospectus. Can. J. Zool . 68: 619–640.

Maleknia, B., Fathipour, Y., & Soufbaf, M. (2016). How greenhouse cucumber cultivars affect population growth and two-sex life table parameters of tetranychus urticae (acari: Tetranychidae). *International Journal of Acarology, 42*(2), 70-78. doi:http://dx.doi.org.proxy.lib.umich.edu/10.1080/01647954.2015.1118157

Mathews, C.R., Blaauw, B., Dively, G. et al. J Pest Sci (2017) 90: 1245. https://doi-org.proxy.lib.umich.edu/10.1007/s10340-017-0838-z

Matthews-Gehringer, D., & Hough-Goldstein, J. (1988). Physical barriers and cultural practices in cabbage maggot (diptera: Anthomyiidae) management on broccoli and chinese cabbage.

Journal of Economic Entomology, 81(1), 354-360.
doi:http://dx.doi.org.proxy.lib.umich.edu/10.1093/jee/81.1.354

Morales, H. Integrated Pest Management Reviews (2002) 7: 145.
https://doi.org/10.1023/B:IPMR.0000027502.91079.01

Parker, J. E., Crowder, D. W., Eigenbrode, S. D., & Snyder, W. E. (2016). Trap crop diversity enhances crop yield. *Agriculture, Ecosystems & Environment, 232*, 254-262.
doi:http://dx.doi.org.proxy.lib.umich.edu/10.1016/j.agee.2016.08.011

Royer, L., Belair, G., Boivin, G., & Fournier, Y. (1996). Attractiveness of cabbage maggot (diptera: Anthomyiidae) to entomopathogenic steinernematid nematodes. *Journal of Economic Entomology, 89*(3), 614-620. doi:http://dx.doi.org.proxy.lib.umich.edu/10.1093/jee/89.3.614

Sedaratian, A., Fathipour, Y. & Moharramipour, S. J Pest Sci (2009) 82: 163.
https://doi-org.proxy.lib.umich.edu/10.1007/s10340-008-0235-8

Wadsworth, J. T. 1917. Report on a trial of tarred felt "discs" for protecting cabbages and cauliflowers from attacks of the cabbage-root fly. Ann. Appl. BioI. 3: 82-92.

White, J. C., & Liburd, O. E. (2005). Effects of soil moisture and temperature on reproduction and development of twospotted spider mite (acari: Tetranychidae) in strawberries. *Journal of Economic Entomology, 98*(1), 154-158.
doi:http://dx.doi.org.proxy.lib.umich.edu/10.1093/jee/98.1.154

Williams, J. L., & Wise, D. H. (2003). Avoidance of wolf spiders (araneae: Lycosidae) by striped cucumber beetles (coleoptera: Chrysomelidae): Laboratory and field studies. *Environmental Entomology, 32*(3), 633-640.
doi:http://dx.doi.org.proxy.lib.umich.edu/10.1603/0046-225X-32.3.633

Organic Vineyard Weed Management and Community Cooperation Strengths at Harvest Thyme Farms

Liv Rollinger

Introduction

We are here for the benefit of Harvest Thyme Farm (HTF). Our review of the literature, hours spent together, and interviews conducted focus on benefiting HTF and the affiliate winery (name being determined) to come. Thus, here we will provide assistance and information on the current aspects of the farm which have been deemed particularly troublesome by the farmers, primarily Brendan, but also Gretta. Furthermore, as the winery has been described as the future of the farms production and main source of income, we focus on this developing asset.

The vineyard at HT consists of 3 red grape varieties, 3 white varieties for a total of 3,600 since this number of vines fits best on the land which is well suited for viticulture as its hilly and has good drainage. Within the vineyard and wine production portion of the current farm there are biological, socio-political, and economic factors which will be addressed through the summary and assessment of relevant literature. Foremost, the vineyard must produce grapes in order for HTF to transition into operating a winery as well as a vegetable farm. The vineyard was the first biological and economic input the farmers invested in to secure a sustainable livelihood. Once operating at full capacity, they will bring in enough profits to have a stable income (B. Prewitt, personal communication, July 25th, 2018). However, the grapes have had some issues growing due to the overwhelming presence of weeds in the vineyard rows and have impeded the success of this new income source.

We have complied literature in order to assess some possible solutions to problems faced by the farmers which would benefit natural aspects of the farm management, social, and human aspects of the farm. Spotted knapweed management should help the vineyard produce the desired amount of grapes, collective action from the Grape Growers Association may help increase market influence in the region, and UMBS can help the farm gain access to research and solve future farm problems.

From a biological viewpoint, one of the most prevalent plant pests harming the vineyard, spotted knapweed (*Centaurea maculosa)* causes issues specifically related to soil moisture, a vital aspect of successful grape cultivation. We address multiple ways spotted knapweed can be managed and make a recommendation for which best suits the needs and values of HTF. We also examine the importance of cooperative behavior and collective action as a facet of effective, profitable grape growing and wine production on our partner farm and within the whole Tip-of-the-Mitt winegrowing region. We aim to show how this socio-political factor of the farm can be utilized in order to gain market influence and increase profits individually and regionally. Lastly, we explore how continuing their relationship with the University of Michigan and sustained Participatory Action Research provide invaluable benefits to the farm as a whole, economically, socio-politically, and biologically.

Spotted Knapweed, Sheep, and Weevils

The invasive liana spotted knapweed has been established in the United States for over a century and causes issues with surface water runoff and sediment yield (Lacey, 1989). Spotted knapweed grows within the HTF vineyard and most likely causes these same problems, primarily harming grape production by reducing soil moisture as cultivation of full-grown grapes depends on high soil moisture (Lacey, 1989). We present three possible methods for controlling spotted knapweed, one a conventional herbicide method applied individually and in combination with grazing sheep, as well as a more natural treatment utilizing the current and increasing presence of biological control insects, also alone and in combination with selected sheep grazing.

Sheley (2004) describes strategies which farmers employed to control spotted knapweed. In this study, the researchers compared the effects of the herbicide 2,4-D application and repeated sheep grazing applied in combination and individually to spotted knapweed. The researchers concluded that four years after a single spring application of 2,4-D spotted knapweed density decreased by 40%. While these results seem to support the use of this herbicide, the researchers followed up this finding with a discussion on how this control strategy will allow the sites to return to spotted knapweed dominance without repeated applications. This caution from the researchers suggest that spotted knapweed management using this herbicide may be unsustainable in the long run and should only be used as a short-term strategy. The study also found sheep to be a successful control method as they tend to favor spotted knapweed over native grasses and shrubs. In some cases, the level of control by grazing sheep was higher than the 2,4-D alone. This evidence suggests that well-managed grazing sheep used in tandem with spring application of 2,4-D may provide a long-term solution to the disproportionate competitive advantage spotted knapweed has over other grasses (Sheley, 2011).

A study conducted by Mosley et al (2016) presents one viable option for spotted knapweed control on Harvest Thyme Farm. This study explores the effectiveness of three biological control treatments for decreasing spotted knapweed density and dominance. The researchers compared the sole use of biological control insects: knapweed flower weevil, knapweed root weevil, and sulfur knapweed root moth, to a combination of herbivory by grazing sheep and biological control insects. Furthermore, they looked at the difference between grazing done in late July when spotted knapweed is in its late bud-early flower stage, and grazing done in mid-August when spotted knapweed has reached its full-flower stage. During the four years of this study (2009-2012), researchers applied treatments and evaluated spotted knapweed response to the three treatment conditions: (1) only biological control insects, (2) biological control insects and target sheep grazing in July, and (3) biological control insects and target sheep grazing in August. The study found that treatments 2 and 3, combined biological control insects and herbivory, both suppressed spotted knapweed fitness more than biological control insects alone (treatment 1), and that July grazing was more successful than August grazing. In July-grazed areas, spotted knapweed plant density was 86% less and 61% less for August-grazed areas than areas treated with only biological control insects (Mosley, 2016).

This study, although conducted in Montana rather than Michigan, provides important information for Harvest Thyme Farm for controlling their vineyard's abundance of spotted knapweed. For annual successful cultivation of full grown grapes, the vines need abundant water and thus soil moisture content must be high. Spotted knapweed not only diverts water from grape vines for its own uses, it has also been documented as a large contributor to soil-water runoff (Lacey, 1989). Due to these problems caused by spotted knapweed, Harvest Thyme Farms would potentially be able to produce healthier, juicer grapes if this weed were less abundant and appropriated less of the grape's water source.

Based on the literature discussed above, Harvest Thyme Farms may benefit from investing in sheep which they could use to control the spotted knapweed by grazing the vineyard in July (Mosley, 2016). Brendan has already mentioned an interest in this practice and this compiled research supports the idea that this would be a beneficial investment for the farm.

While Brendan mentioned this strategy would involve training the sheep not to eat the grape vines, I believe the biological and economic benefits of healthy grapes wines and soil within the vineyard are worth the initial economic and temporal inputs of this practice.

As for the weevils, the literature on the topic of their density and distribution in Michigan is inconclusive (Corn, 2006). However, Brendan needn't worry about investing in releasing these insects as they are already found in the area (B. Shoultons, personal communication, July 28th 2018). The State of Michigan has invested in releasing both spotted knapweed root and flower weevils and that the populations from these initial releases have been increasing. This is the first year that he has found these species in the Pellston and Cheboygan areas and believes we will see widespread prevalence of them in spotted knapweed populations within the next 5 years. This makes the biological control insects combined with sheep grazing a potentially practical approach for HTF, as long as they are willing to invest economically in some sheep, and temporally in training and properly grazing those sheep.

Get the Grape Community Together, Then You are Powerful

A financial issue faced by HTF, torments small-scale farmers all over the United States, compared to Agribusinesses, small-scale farmers have practically limited power in the market and lack the ability to influence not only their own prices but also the policies within their industry.

Taylor (2018) provides a potential solution to the issue of small-scale farmers having limited market or political influence: cooperatives. This article describes the long-term struggle of black farmers in the United States as a whole, focusing on examples from Alabama and Michigan, in the present and past. Taylor reveals in detail how farmer cooperatives played a vital role in the survival of black farmers over the last century and a half. Without the power and strength provided by coming together as a collective, black farmers would never have gained the (albeit small) market influence and (limited) financial success they have today. More than just market and financial power, Taylor reports the importance of cooperatives for farmer-to-farmer communication and collaboration. These collections provide a source for information and knowledge sharing that can help farmers be more successful than they would be alone, as well as a way to pool resources "...to purchase farm supplies in bulk, share equipment, identify supply chains, expand their value-added operations, and consolidate their transactions to limit exposure to hostile merchants…" (Taylor, 2018). HT would benefit from these aspects of cooperation within the Grape Growers Association through decreased costs for shipping, equipment, and increasing market influence.

Further research supports the idea that cooperatives are helpful to small-farmers in order to overcome difficulties they face in the US agriculture system. Cook (1995) describes both the relatively minor role cooperatives play in comparison to agribusiness market influence and also the benefits cooperatives provide to farmers. In the study, the authors looked at the 100 largest agricultural cooperatives in the US and found that these accounted for only 6.9% of the total value of agriculture shipments. While this small number could work to discourage farmers from joining a cooperative, this percentage increased from the year before where total value was only 5.7%. These increases reinforce the idea that even at small influences, the cooperatives provide a stepping stone to gaining more market influence for small-scale farmers. Similarly, these cooperatives held 3.6% of the market share, up from the year before where the share was only 3.1% (Cook, 1995).

HTF could use the Grape Growers Association (GGA) like the powerful cooperative it has the potential to be, to gain political and market influence in this region, share service costs and labor, and marketing strategies. As a collective they can cultivate the soil, the vines, and the name Tip-of-the-Mitt into meaningful additions of the grapes growing and wine producing world. Farming is so uniquely collaborative, even Brendan doesn't understand why he tells his secrets to neighbors and competitors, but as agroecology pronounces, the nature of farming is community collaboration. The people interested in farming the land have respect for the practice, and role in society, of growing healthy food for people. This community could be utilized by compiling a reference base which provides advice, pro-tips, and tried solutions to problems farmers have faced and overcome. This type of farmer-to-farmer communication is invaluable and may help HTF to cultivate a healthy vineyard and produce the best wine they can.

Community Two, Go Blue and PAR Too!

Increasingly being used in agroecology, Participatory Action Research (PAR), provides numerous benefits to farmers involved and being studied. PAR focuses on bringing expertise of non-researchers (mainly small-scale farmers) forward through their active participation with researchers who are trained in research (Méndez, 2016). Méndez explains the principles of PAR research and explores the benefits and challenges associated with this type of research through 2 case studies in Central America. According to Méndez, PAR along with bringing farmers into the action, results in "…knowledge that is co-created and that is actionable…" Furthermore, the reliance on complex thinking within this approach is seen as a strength of this research and allows researchers and farmers to look at problems from multiple angles. This research also relies heavily on the authentic commitment and contribution from both parties involved over time. Méndez reviews this commitment to participation in one case study concluding that invested participation increased as time passed and the farmers and researchers fully committed to the project. Trust similarly increases as the commitment continues over time, and Méndez stresses the importance of working with the right partners for PAR research to be successful.

Therefore, beyond the potentially helpful, collective community of wine producers in the GGA, we recommend HTF utilize the University of Michigan Biological Station (UMBS) and the agroecology classes use of PAR as an additional community which could benefit their vineyard and winery. Harvest Thyme would benefit by getting limited manual labor assistance during the summer and helping students learn about agroecology, they also would get paid each year they participate in the class which they can put towards winery expenses. More importantly, a continued partnership between UMBS and HTF would embody the principles of the PAR process and provide the farm with free research such as soil tests, and various other topics explored in FarmLab Reports and Chapter Topics over the next decade. Ideally, this resource would help the farm to better understand the farm conditions over time relating to grape growing and wine manufacturing, so they could improve yield, profitability, and sustainability for their vineyard and wine production.

Reference List

- Cook, M. L. (1995). The Future of U.S. Agricultural Cooperatives: A Neo-Institutional Approach. *American Journal of Agricultural Economics, 77*(5), 1153. doi:10.2307/1243338

- Corn, J. G., Story, J. M., & White, L. J. (2006). Impacts of the biological control agent Cyphocleonus achates on spotted knapweed, Centaurea maculosa, in experimental plots. *Biological Control,37*(1), 75-81. doi:10.1016/j.biocontrol.2006.01.003
- Lacey, J. R., Marlow, C. B., & Lane, J. R. (1989). Influence of Spotted Knapweed (Centaurea maculosa) on Surface Runoff and Sediment Yield. *Weed Technology, 3*(04), 627-631. doi:10.1017/s0890037x00032929
- Méndez, V., Caswell, M., Gliessman, S., & Cohen, R. (2017). Integrating Agroecology and Participatory Action Research (PAR): Lessons from Central America. Sustainability, 9(5), 705. doi:10.3390/su9050705
- Mosley, J. C., Frost, R. A., Roeder, B. L., Mosley, T. K., & Marks, G. (2016). Combined Herbivory by Targeted Sheep Grazing and Biological Control Insects to Suppress Spotted Knapweed (Centaurea stoebe). *Invasive Plant Science and Management, 9*(01), 22-32. doi:10.1614/ipsm-d-15-00034.1
- Sheley, R., Jacobs, J., & Martin, J. (2011). Integrating 2,4-D and sheep grazing to rehabilitate spotted knapweed infestations. *Journal of Range Management, 57*(4). doi:10.2458/azu_jrm_v57i4_sheley
- Scholtens, B. Personal Interview. (2018, July 30). University of Michigan Biological Station.
- Taylor, D. E. (2018). Black Farmers in the USA and Michigan: Longevity, Empowerment, and Food Sovereignty. *Journal of African American Studies, 22*(1), 49-76. doi:10.1007/s12111-018-9394-8

Methods

Participatory Mapping

For our participatory mapping investigation, the goal was to create a map of the farm to physically represent what the farmers are putting into their landscapes while also learning agroecological knowledge and the rationale for arrangement and management decisions from the farmer. We conducted our participatory mapping investigation on July 18, 2018 and gathered data by walking around the farm with Brendan. As he gave us a tour, two people took notes and asked questions while one drew a map. After leaving the farm, we met up to compile notes and redraw the map with a more holistic view of the farm. We finished with digital versions of the map, one for each property and one showing the spatial relation of the two properties.

Farmer Interview

In our fifth week we conducted a semi-structured interview with our farmers. A semi-structured interview involves asking some open-ended questions and some more specific questions. This approach allowed us to gain knowledge about Harvest Thyme in a conversational manner while also providing some guidance to answer specific questions we had. We structured our interview so that we could ease into it with general clarifying and background questions and later move into more specific questions related to our farm chapters and livelihood assets. We prefaced our interview by clarifying that the interview would be for internal use in this report and our public Farm Lab presentation at the University of Michigan Biological Station, but that it would not be published. We also established that there was no obligation to answer every question.

The interview took place on July 25, 2018 in the pole barn at Harvest Thyme and lasted for an hour and 15 minutes. Each group member was able to play the role of interviewer to ask about our farm chapters and each of us asked questions about one of the livelihood assets that we chose to explore (natural, human, and political). The interview was recorded and each group member took notes as well. After the interview, notes were all compiled.

Soil Analysis

Soil analysis was conducted in our sixth and final week at the farm, on August 1, 2018. The previous week, we had consulted with Brendan about areas on the farm where he wanted soil tests and comparisons done. We identified two comparison sites for transect sampling and two areas for composite sampling. The transect sampling was conducted by taking soil cores every two feet along a 10 foot transect, for a total of five separate samples at each site.

The transect sites we chose for comparison were the east versus west side of hoop house 5 on the first property and the east versus west side of the field on the second property. We chose to investigate the soil in the hoop houses to find out why crops were growing better on the east side of the hoop house than the west side. Soils on the east and west side of the second property field were chosen to find out whether there were nutrient differences on the two sides of the property, a question inspired by information that there were two soil types on the land in that location.

Composite samples were taken by obtaining multiple soil cores in an area of interest and pooling them into one sample. These samples occurred in the vineyard, comparing soil in the grape rows versus between the grape rows, and in the pepper row in the west field, comparing the soil on the left side of the row versus the right side. We sampled the vineyard to see whether spraying roundup was having an effect on the soil chemistry, as had been observed in the past. In the pepper rows, we had noticed that one side of the row was growing better than the other side and wanted to find out if there was a difference in the soil on each side.

After soil sampling occurred, soils were taken back to UMBS in glass jars, dried, and sieved. 0.1 grams of each soil sample was sent to the lab for analysis of nitrogen, phosphorus, potassium, calcium, magnesium, sodium, pH, and soil organic matter.

Results

Participatory Mapping

Through walking the properties of HT with Brendan, we created three maps that: represented the size of properties and distance between them (Figure 1), detailed the layouts of the main property (Figure 2) and the second property (Figure 3).

On the main property, the apples are the only section not currently in production. HT is considering revisiting the apples as a source of income once the vineyard is producing consistently, possibly also brewing hard cider.

A future possible change to the layout of the main field is between the North and South Fields, where the greenhouse is currently. The fields are too small to run a tractor through and they would like to move the greenhouse, so the field stretches the same length as the East Field. In addition, Brendan and Greta have talked about getting rid of the chickens to make room for more flowers, given that the flowers are more profitable. And for the vineyard, they would like to expand the grapes both on their property and to possible future land purchases.

For the lower property, there are many notable future changes for land use and production. The west side of the field is currently uncultivated, but they wish to use the land for crops in the near future. They also plan to rotate their crops to leave a section fallow for soil rejuvenation once production has increased substantially. As of now, there is no irrigation to the second property, so they have had to rely on rain. This has created the need for a well on the property, but the placement has not yet been determined. Finally, the southeast corner of the property is where Brendan and Greta plan to build their future home and winery.

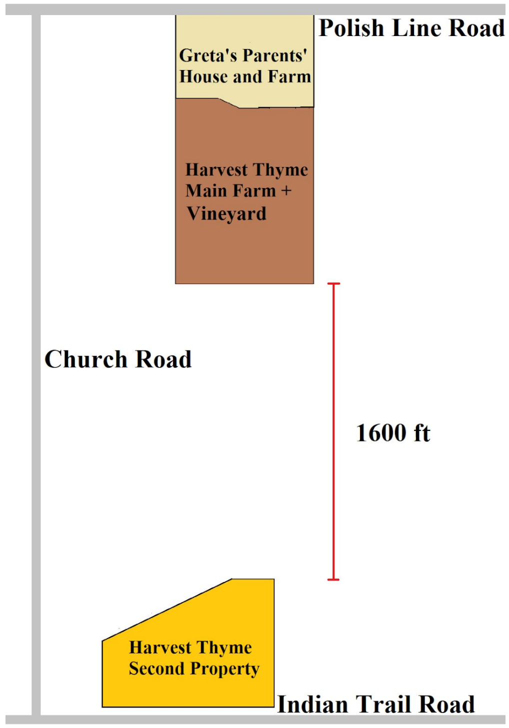
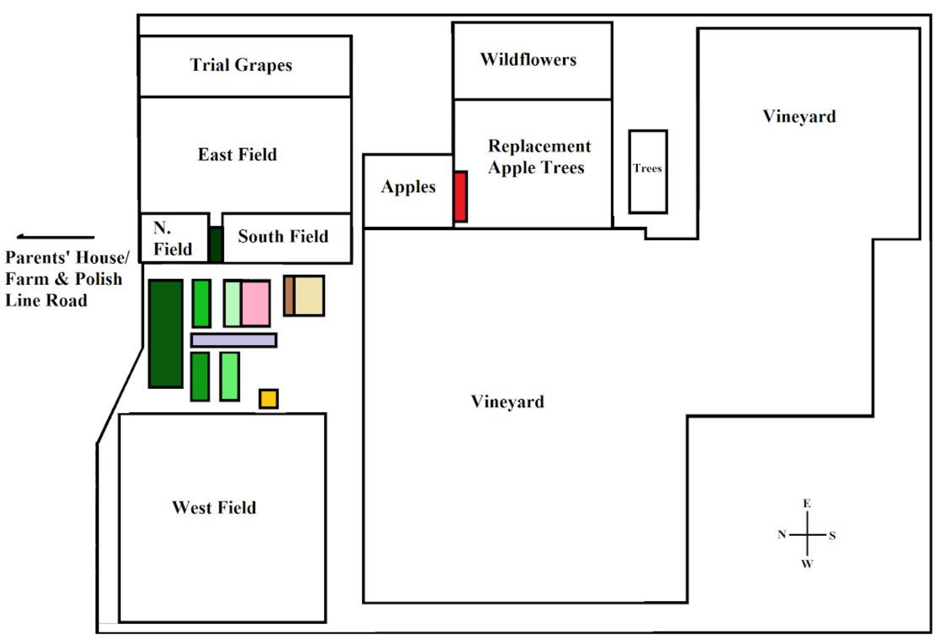


Figure 1. Map of both of Harvest Thyme's properties in relation to each other with surrounding roads.



Location On Farm	Crops Grown
North Field	Flowers
South Field	Lettuce, Radishes
West Field	Radishes, Rutabaga, Sunflowers, Celery, Chard, Cabbage, Broccoli, Flowers, Peppers, Tomatoes, Cucumbers, Summer Squash, Kale, Peas, Cauliflower, Garlic, Onions, Leeks
East Field	Carrots, Mixed Beets
Hoop House 1	Iznik Cucumbers
Hoop House 2	Cherry Tomatoes
Hoop House 3	Corinto Cucumbers
Hoop House 4	Cherry Tomatoes
Hoop House 5	Tomatoes, Eggplants, Basil, Heirloom Tomatoes
Hoop House Field 1	Green Onions
Greenhouse	Transplants, Personal Plants
Second Property	Potatoes, Winter Squash, Broccoli, Cauliflower, Brussel Sprouts

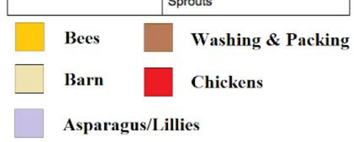


Figure 2. Map of land use on Harvest Thyme's main property.

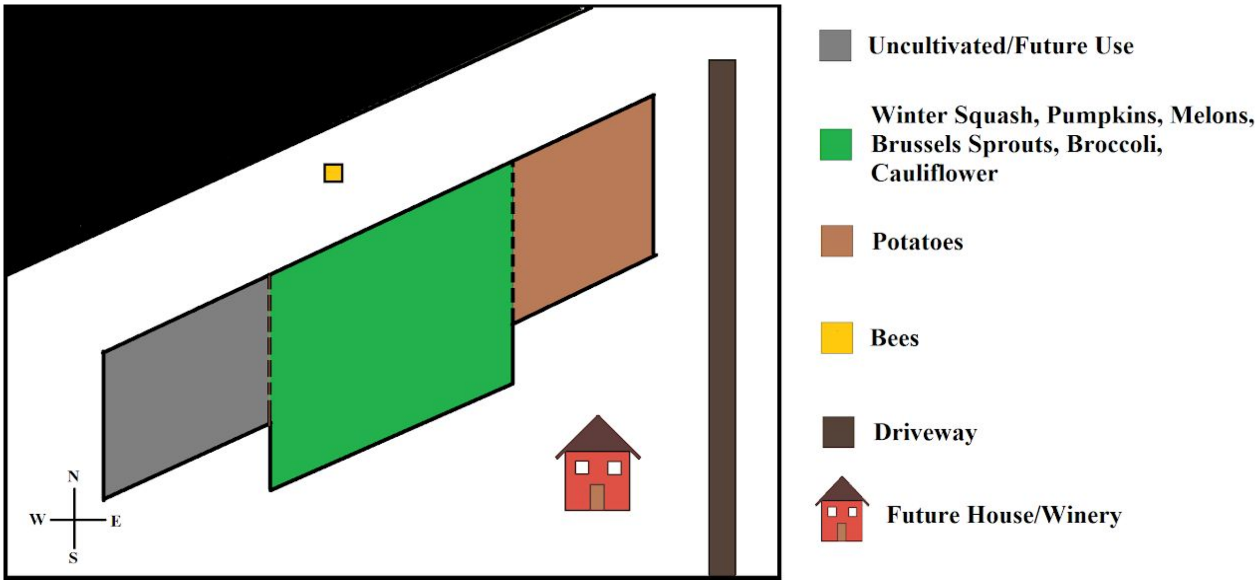


Figure 3. Map of land use on Harvest Thyme's second property.

Farmer Interview

The following sections correspond to specific types of questions asked in the semi-structured interview. They contain the information we gained from Brendan's answers and the discussion that came from each question or answer.

Farmer Background

Brendan and Greta have been farming since 2014. Prior to farming, they lived in Montana, where they both worked in the Montana Conservation Corps and Tennessee, where Brendan made a living in landscape services. On a Traverse City winery tour, they were introduced to the idea of owning a vineyard and winery, which was appealing to the two due to the combination of manufacturing and farming. They started growing grapes on Greta's parents' land, and as a source of income, started a vegetable farm in 2014. Prior to their use of the land, it was producing hay within the last 20 years. The area the vineyard now occupies was previously overgrown with invasive trees such as autumn olive and scotch pine.

For the first year, Greta was working full-time with the Little Traverse Conservancy while Brendan tended to Harvest Thyme. In 2015, Greta worked part-time in each venture because Brendan needed help with the CSA membership program introduced that year. In 2016, Greta was working full-time with the farm, taking lead on the CSA. In the fall of 2017, they purchased a second property, and started production in the spring of 2018. Their production area in 2014 was a 60ft by 100ft garden on the main property, whereas in the current year they have about 100 acres in production between the two sites.

The first few years of Harvest Thyme brought some contentions on decisions regarding resource allocation, specifically water use and irrigation, with Greta's parents. However, Brendan and Greta have grown out of Greta's parents' scope of farming knowledge, and hold more autonomy currently.

In terms of production, their diversity of crops grew from low to high in the first four years, and they are now scaling back based on what has worked and what hasn't. Yield has increased every year, and as a result, along with marketing techniques, their sales at the Cheboygan Farmer's market has increased as well. They made about $3,500 during their first year at the market, and Brendan expressed that they made that much the week before we conducted the interview. Their goal for annual sales in 2018 is now $50,000.

As a final note of background information, we asked Brendan what advice he would give to himself in 2014 when he started Harvest Thyme. His response was that he wished he had not been so ambitious. He would have started smaller, and possibly not engage with a CSA so quickly. He noted that they started the CSA to build a customer base, but ended up having a strong, loyal customer base at the farmers' market that are not part of the CSA.

Livelihood Assets

The following sections refer to the types of assets we had chosen as interesting contributors to the livelihood assets of Harvest Thyme. The information following the headers does not necessarily represent direct connection to each respective assets type, but came from questions that were asking about said assets type.

Natural. Brendan found nature difficult to describe, but ultimately used the word "undisturbed". Harvest Thyme tries to value natural processes as much as possible on their farm, examples being their pollinator habitat and toleration of pests and weeds by not using harsh chemicals to remove them. They also choose to rotate their crops so the nutrient removal from the soil is different from year to year, reducing leaching. In dealing with farm processes, Brendan expressed that he thought the tractor they purchased was the best investment they have made thus far.

Human. Brendan and Greta use farmer to farmer interactions as an important source of information, as well as YouTube, and university information sources. When asked about what he would miss if he and Greta were to disconnect themselves from vegetable farming or the CSA, he explained that seeing the physical harvests at the end of a growing system was rewarding, and that working for himself was something he enjoyed. While Brendan and Greta work full-time as vegetable farmers, they do not use their produce as a primary food source. They freeze some products for the winter, but buy most of the food they eat.

Political. Brendan expressed that he doesn't know the extent to which the government and agriculture should be connected, but he has strong opinions that the relationship is too strong currently. He feels that government involvement creates competitive advantages and disadvantages via grants and subsidies for larger farms which leave smaller farms to fend for themselves. He also noted that the U.S. government has not pushed organic agriculture even though farmers and consumers are, alluding to the fact that the recent increased trend in organic produce is regulated by consumers. Harvest Thyme's experience with the government has been mainly with USDA grants—pollinator habitat and hoop house subsidies. Brendan explained that the grants "came to them" because they know the grant auditor through personal connections. However, he acknowledged that some farmers either don't have easy access to grants, or they don't prefer to use them. One specific criticism he had on the grant process was given in an example he had experienced with other farms in his area. He knows of two farms that have taken advantage of the same hoop house grants as Harvest Thyme, but are using them for ventures not related to the farms. His criticism is that it seems as though the government does not check deeply enough the extent to which a farm needs the subsidy.

Soil Analysis

In the two soil comparison analyses done (Hoop House #5 and Second Property), there were two significant differences (Table 1) between ammonium, potassium, magnesium, and calcium concentrations (Figure 4).

Location	Ammonium	Potassium	Magnesium	Calcium
Hoop House #5	0.03175*	0.3095	0.6905	0.03175*
Second Property	0.5476	0.8413	0.05556	0.1508

Table 1. *p*-values of soil cation comparisons for Hoop House #5 and the Second Property; * denotes a significant result.

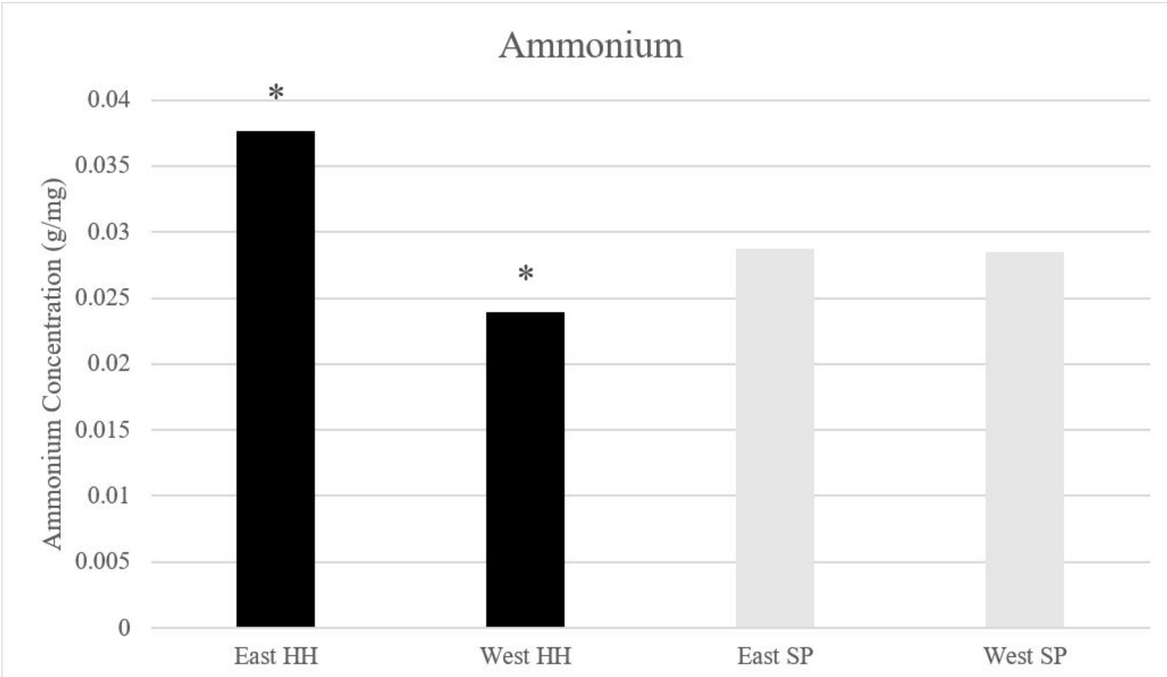
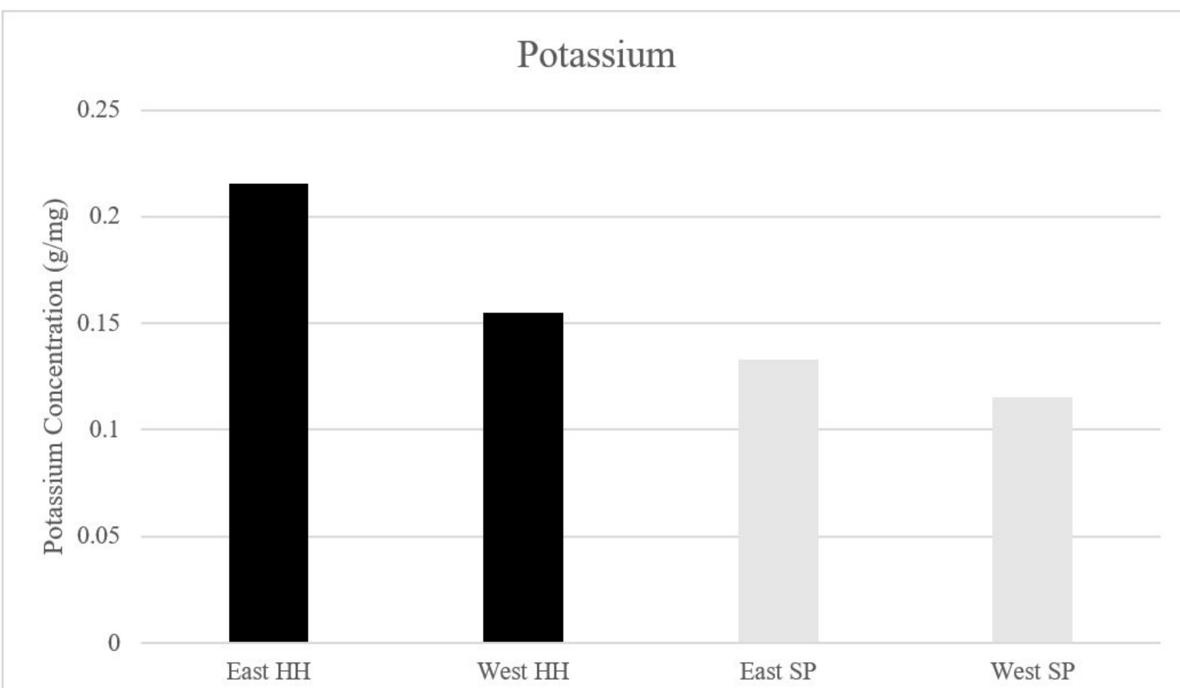


Figure 4. Ammonium concentrations for each sampling site at Hoop House #5 and the Second Property; * denotes a significant difference



ce.

Figure 5. Potassium concentrations for each sampling site at Hoop House #5 and the Second Property.

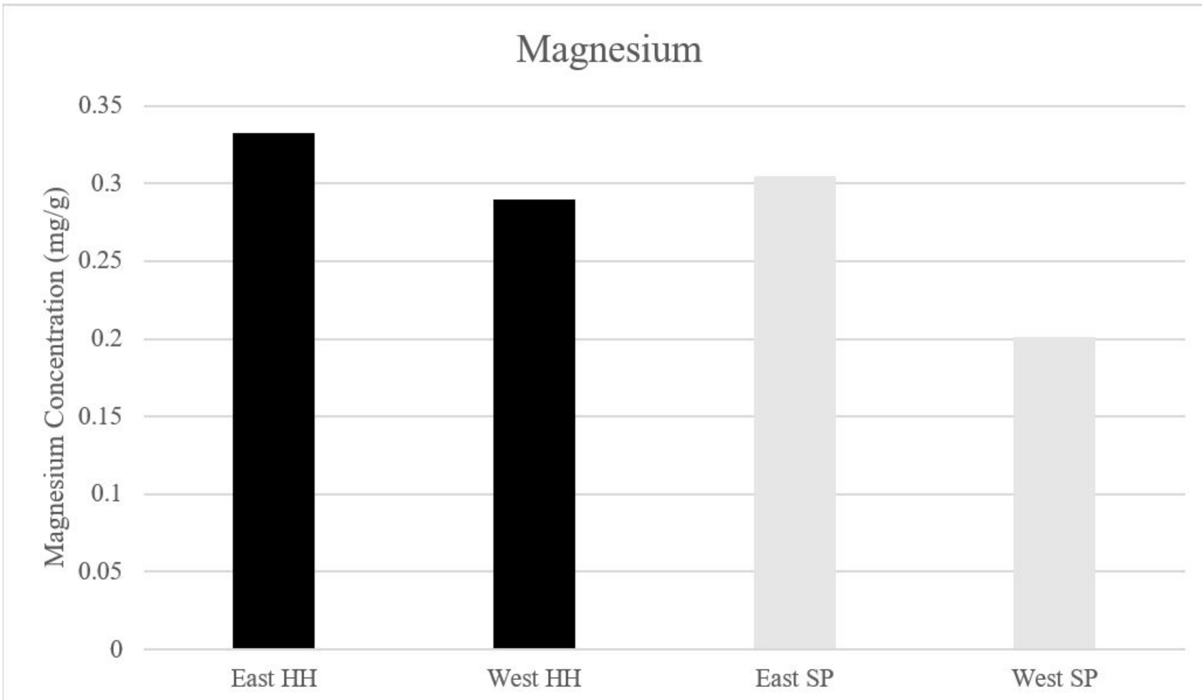


Figure 6. Magnesium concentrations for each sampling site at Hoop House #5 and the Second Property.

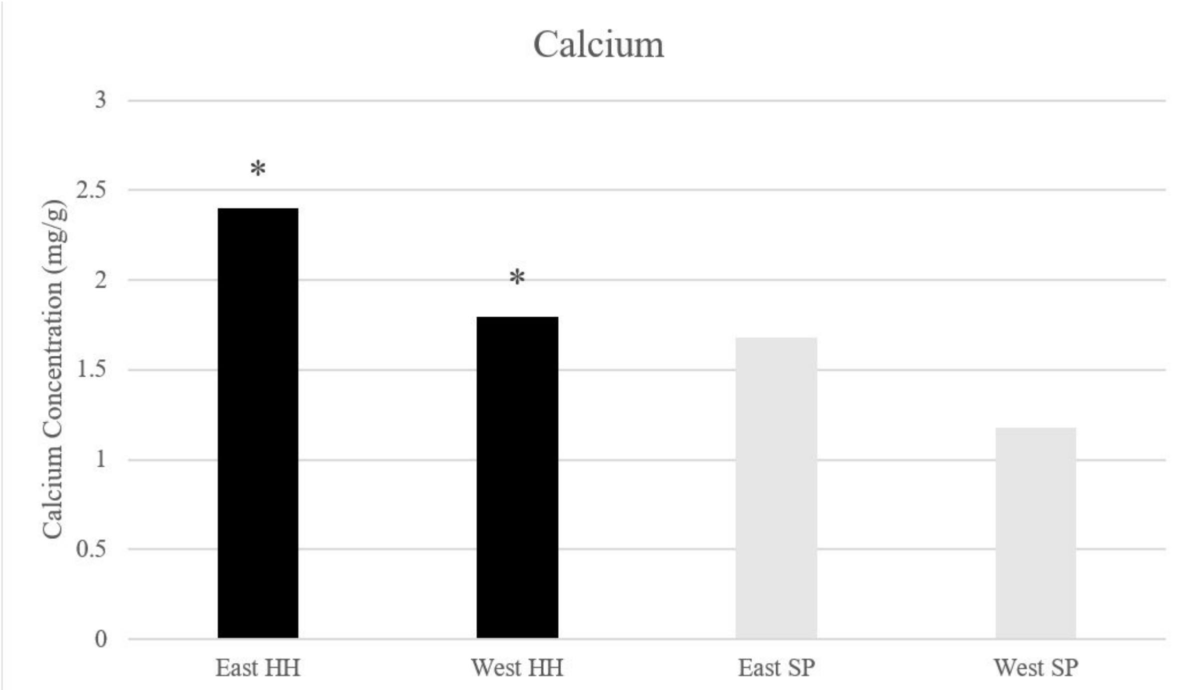


Figure 7. Calcium concentrations for each sampling site at Hoop House #5 and the Second Property; * denotes a significant difference.

Discussion

Participatory Mapping

From our participatory mapping investigation we revisited the layout of Harvest Thyme farm after having worked there three weeks. Through this investigation we gained insight on the rationale behind the spatial layout of the farm and the management of different areas. These discussions helped to inform us in refining our Farm Lab chapter topics as well as develop questions to ask in the interview the following week. Our exploration of the farm also helped to inform our soil sampling locations, which will be discussed later in this report.

Through the mapping, we learned about tentative future plans for the farm, such as eventual expansion of the vineyard, the possibility of hiring a farm manager, and the possibility of getting rid of the chickens. Interestingly, this was framed as “scaling back” in terms of involvement of the vegetable farm, even though the idea is to expand their production land for grapes. This perhaps reflects the efficiency-mindset that Brendan brings to his farm. Though they may end up cultivating a larger amount of land through the vineyard, it may end up being easier to manage than the diverse requirements of a vegetable farm and CSA.

Along the same lines, we learned during the mapping investigation that there is a possibility of discontinuing the CSA in the future due to the immense amount of time it requires to distribute the produce - time that could otherwise be spent tending to on-site farm duties. Further reflecting this mindset of efficiency and looking toward the future, the possibility of hiring a farm manager to look after the vegetable farm was discussed. The hope for this is that Brendan and Greta would have to spend less time tending to the vegetable farm so that they could devote more time to management of the vineyard and winery and also perhaps have more free time off of the farm. One concern expressed with the possibility of a farm manager is that the person hired would have to have a very good grasp on how to run the farm - if someone capable of doing this was hired it could be a huge help to Brendan and Greta and help streamline farm processes, but if the person was less experienced or their management strategies did not align with those of Brendan and Greta, it could result in more work for the farm owners instead of less. Another future goal for increasing efficiency of the farm is to join the north and south fields by removing the small greenhouse in between them to facilitate tractor use in the area.

During the mapping, we learned that Harvest Thyme also currently employs some farm practices that reflect a strive for efficiency. Drip irrigation is used in the hoop houses as well as fields for more efficient irrigation of crops. All irrigation on the farm is set on timers as well, removing the need for human labor in that area. We also learned that the peat moss left over from growing microgreens in the greenhouse is saved and reused in the hoophouses to reduce the need for buying additional potting soil, reflecting a money-saving innovation. Finally, Brendan and Greta have invested in a washing machine that they turned into a salad spinner to facilitate their wash and pack process when preparing produce to go to market.

Two key aspects of agroecology are that it encourages participatory research and that it is a transdisciplinary field (Mendez, 2017). Through our mapping investigation, we were able to experience firsthand the participatory nature of agroecology by engaging directly with the farmer in our research, and the transdisciplinary nature of agroecology by integrating our knowledge of the farm and its processes from an academic perspective with Brendan's knowledge of the agroecosystem as the farmer who runs it.

Farmer Interview

The participatory mapping section of our FarmLab provided information about the way Brendan and Greta planned for operations and management of the farm to pan out, how things worked in practice, and why they do what they do. Our semi-structured, open-ended interview allowed us to further explore the knowledge gained through the first three weeks of farm labor and the mapping activity. Specifically, we learned how certain aspects of the farm expected to proceed one way, changed in reality as a result of unexpected challenges faced by our farmers.

We learned that farmers don't always know how situations are going to evolve. We saw this explicitly through the uncertainty that brought Brendan and Greta to Michigan. Initially living in Montana and Tennessee, they had not intended to move to Michigan. Though originally working in conservation and landscaping, Brendan and Greta became farmers as a way to gain livelihood stability. This happened only because once in Michigan Brendan and Greta happened to go on a Traverse City Winery Tour that sparked their interest in the combination of farming and manufacturing that is winemaking. This was possible as Greta's parents had land in the Cheboygan area which Brendan and Greta were able to put into cultivation. Even once in Michigan they had intended to do this through viticulture, yet the challenge of multiple year requirements for growth before maturation of grape vines necessitated the addition of vegetable farming in order to facilitate immediate livelihood stability. Brendan and Greta had to adapt through livelihood diversification from viticulture to vegetables in order to maintain their livelihood stability (Ellis, 2000).

Furthermore, we came to understand the unexpected challenges related to farm management which Brendan and Greta have dealt with in order to maintain their livelihood. This includes problems related to pest management such as spider mites and cabbage maggots, lack of irrigation on their second property, and infrastructure damaging storms. On the farm, new challenges present themselves each day, and our partner farmers dealt with these issues as they arose. The farmers often rely on the internet to help them solve problems, youtube videos, farmer-to-farmer podcasts, and university extensions provide important information for management strategies which they can try on the farm to help increase yield and thus maintain, as well as increase their livelihood stability. Our farmers also rely heavily on neighboring farmers for advice, external inputs, and a sense of community.

We also came to understand the farmers perspectives on the role of government in agriculture. According to Brendan, agriculture grants for hoop houses and subsidies of cash crops create competitive advantages for some farmers. He sees this as unfair and would prefer that the government had less of an influence as to allow farmers the control over practices, inputs, and market impact.

Livelihood assets also play a large role in the way HT manages their property. The human assets of HT are their most substantial livelihood assets as it is incorporated into all aspects of their farm from acquiring the land initially, to production of crops, to marketing and selling. Specifically, human assets in the form of family has created connections that allowed Brendan and Greta to use the current main property of HT, noting that Greta's parents own the land. In addition, Greta's father has introduced the opportunities of the Straits Area Grape

Growers' Association and USDA grants through his own personal connections to Brendan and Greta. Manual labor is one of the most important aspects of HT. This human assets serves as the means by which vegetables are grown through planting, weeding, harvesting, and preparing crops for sale. Connected to the sale of crops, the human interactions through their CSA and farmers' market stand provide strong personal relationships that keep their customer base loyal and their profits stable. Finally, Brendan described farmer-to-farmer relationships as the most beneficial outlet for problem solving thus far in their farming endeavors.

Natural assets is pertinent to farming due to the dependence on ecosystem processes to grow crops. Two examples of HT valuing their natural assets include organic soil amendments and pollinator support through wildflowers. HT has used a variety of soil amendments to make up for lost nutrients, but each amendment is as natural as possible. There have been times of economic or efficiency limitations, but the majority of their soil amendments are organically certified. They also took advantage of a USDA grant which subsidized costs towards planting a field of wildflowers. These wildflowers not only support the surrounding ecosystem, but they help pollinate the crops at HT. A limitation of natural assets for HT includes the difficulty of drilling a well on the second property. Thus far, it has been a difficult and costly process, all to reach water for irrigation.

Their political assets is not extensive, but the most interesting part of this investigation of political assets was Brendan's opinions on government in agriculture. They have used two USDA grants to support sections of their farm. The first was for hoop houses, which is where they grow cucumbers and tomatoes that don't do as well exposed to the elements. This significantly increases their yield. The other grant was explained previously—the wildflower field. While they have used the USDA to support endeavors on their farm, Brendan acknowledges that there are inequalities in the agricultural system between who has access to certain subsidies and grants. He feels that the government does not always respond to the needs of all farmers, and disproportionately supports conventional farming.

Soil Analysis

Our soil analysis returned with two statistically significant comparisons, both occurred in Hoop House #5 (Table 1). These comparisons showed that calcium and ammonium cations were in higher concentrations on the east side of the hoop house versus the west (Figure 4, Figure 7). The differences in these concentrations match the observation made by Brendan that the crops were growing better on the east side than the west side. Possible explanations for this include uneven topography and practices by Brendan and Greta to level the unevenness in the hoop house. Harvest Thyme's main property sits on a slope from high ground at the north-west corner of the field to a low ground at the south-east corner (Figure 8). This east to west slope could create a gradient in which nutrients are leached, thus creating a higher concentration of nutrients down-slope (Wang and Tang, 2006). As a solution to the gradient, Brendan and Greta leveled the ground in the hoop house by moving soil from the west side to the east side. In doing this, nutrients in the west side may have been displaced to the east side, compounding the nutrient density on the east side. This information on nutrient differences may be useful to Harvest Thyme in their decisions to correct the observations made of differing crop growth.

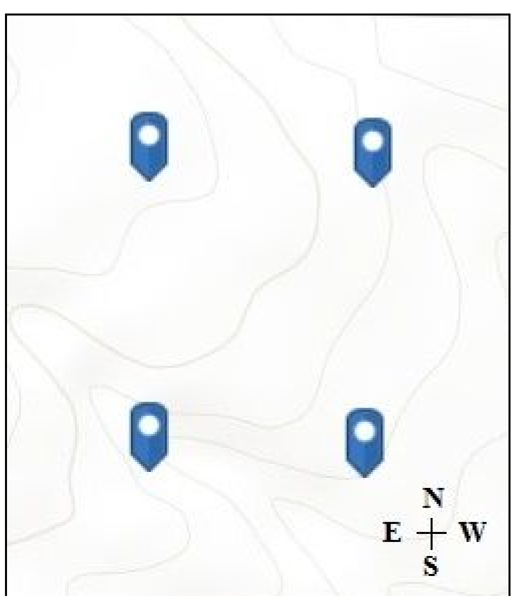


Figure 8. A topographic map of Harvest Thyme's main field where each marker represents a corner of the field. Consecutive topographic lines represent a 10ft change in altitude. Map from NRCS Web Soil Survey.

As for the second property, there were no statistically significant differences (Table 1). However, with a more broad sample size, further analyses could show significant statistics. There is reason to investigate these differences based on soil types surrounding the second property. To the east of the property is a soil very different in nature than the sandy soils of the farm. It is a mucky soil, rich in nutrients (Soil Survey Staff, 2018), that could affect the nutrient density in a positive way of the proximal Harvest Thyme property.

References

Ellis, F. (2000), The Determinants of Rural Livelihood Diversification in Developing Countries. Journal of Agricultural Economics, 51: 289-302.

Méndez, V.E., M. Caswell, S.R. Gliessman, R. Cohen. (2017) Integrating Agroecology and Participatory Action Research (PAR): Lessons from Central America. Sustainability: 9, 705.

Li, Y., Wang, C., & Tang, H. (2006). Research advances in nutrient runoff on sloping land in watersheds. *Aquatic Ecosystem Health & Management,9*(1), 27-32. doi:10.1080/14634980600559379

Soil Survey Staff, Natural Resources Conservation Service, United States Department of Agriculture. Web Soil Survey. Available online at the following link: https://websoilsurvey.sc.egov.usda.gov/. Accessed [08/2018].