Intercropping Culinary Herbs with Red Russian Kale (*Brassica napus var. pabularia)* Affects the Aphid Population in an Organic Setting

Julia Carlin, Allison Malay, Neha Munagala, Muhammed Shelleh

Objective

To quantify the abundance of aphids residing on *B. pabularia* when intercropped with culinary herbs in order to determine which herb has the greatest repellent effect against aphids.

Introduction

As the population of humans rises, so does the need for nutritional crops. However, modern agriculture uses pesticides as a means to limit crop exposure to damaging pests. Conventional agricultural farming uses synthetic chemical pesticides, monoculture planting, and genetically modified organisms (GMO) that have adverse effects on human health and increase environmental degradation. These traditional practices are used for various reasons including increased crop yield, increased farming acreage, and reduced soil disturbance. Subsequently, humans have had increased exposure to pesticides over the past few decades. Such exposure has detrimental effects to human health (Sabarwal 2018). Studies have shown exposure to pesticides in agriculture has correlated to Parkinson's and Alzheimer's diseases, as well as endocrine disruption in human reproduction (Sabarwal 2018). Organic farming techniques seek to eliminate the use of synthetic chemical pesticides and monoculture planting by replacing them with naturally derived, and minimally processed chemicals along with crop rotation and mixed planting or intercropping. To limit exposure to pesticides, intercropping herbs is an organic gardening technique commonly used as an alternative to limit destructive pests on crops.

Intercropping is the practice of growing two or more crops simultaneously in the same area (Itulya 1998). The crops involved can be beneficial towards each other by decreasing pest abundance, increasing beneficial root interactions, and increasing insect predators. One particular herb that has proved beneficial to limiting destructive pests by intercropping is lavender, which has a repellent effect against pests from secondary metabolites in the herb (Ikureura 2012). Basil and parsley have also been proven to be successful with intercropping in increasing arthropod diversity on crops (de Araújo Hendges 2018). We are interested in how intercropping in an organic setting affects the aphid population abundance. Aphids are one of the most destructive agriculture pests in the world, and can reduce crop production, lowering the yield of edible food (Silva-Filho 2013).

The UCF Arboretum Community Garden, established in 2009, is an organic garden that provides it's crops to the Knights Helping Knights Pantry. The aim of the community garden is to provide fresh and organic produce to UCF students free of charge. Of all the produce grown, Red Russian kale is a nutritional favorite among UCF students. This study seeks to investigate

the effectiveness of reducing aphid abundance and increasing overall plant health by intercropping three common culinary herbs, African blue basil, Italian parsley, and lavender with Red Russian kale, a popular pantry crop. This has the potential to increase the overall yield of healthy Red Russian kale that is available for these students and the community to have access to.

Our research project is aimed to identify areas of improvement in an urban agriculture setting. The methods utilized can be applied to other urban ecological research projects and the results collected suggest how we can improve urban gardens without the use of pesticides. As space becomes a limiting factor in gardening and agricultural spaces around the world, small-scale agricultural techniques such as intercropping provide the opportunity to grow produce without the use of harmful pesticides. We hope that our project motivates other urban ecologists to pursue organic urban agriculture experiments to improve crop quality.

Socially, healthy eating has been promoted more regularly than in past years. However, it has been brought up quite a bit that eating healthy is difficult for low-income individuals or families. It is a possibility that because a majority of the general population are not educated about the practices of intercropping or how they would be able to grow organic produce themselves, they are not doing it. However, the results of our study could have the potential to educate the general public about how it is possible to do this on a small scale with relatively cheap household herbs. Creating a greater outreach and representing the ease of growing organic produce is a part of our goal for this research.

Materials and Methods

Experimental Design

The study was performed in the newly constructed Arboretum Community Garden at the University of Central Florida. Two raised beds, each 16 ft by 4 ft, were utilized (Figure 1). Within each bed were three treatment types; *Petroselinum crispum* (italian parsley plants), *Ocimum kilimandscharicum*, (african blue basil), *Lavandula spp.* (lavender plants), and one control group (only *Brassica napus* subsp. *Pabularia* (red-russian kale)). Six of each treatment herbs were planted surrounding three *B. napus* subsp. *Pabularia* plants with six inches between each plant (figure 1). Each treatment was replicated two times for a total of 24 *B. napus* subsp. *Pabularia* plants and 12 plants for each treatment herb. The location for each treatment setup within the garden bed was haphazardly chosen. To control for the experimental design, consistent conditions were exposed to the plants. All plants were planted using the same soil, equal amounts of sunlight throughout the day, as well as a consistent watering system reaching all the plants.

Sampling Methodology

Sampling occurred between February 18 - March 20th, 2019. For the entirety of that duration, sampling was conducted twice a week (Monday, Wednesday), at 10:30 am. Total number of aphids were quantified and recorded for each leaf on every *B. napus* subsp. *Pabularia* plant. Data was collected in the field using field journals and analyzed using Microsoft Excel.

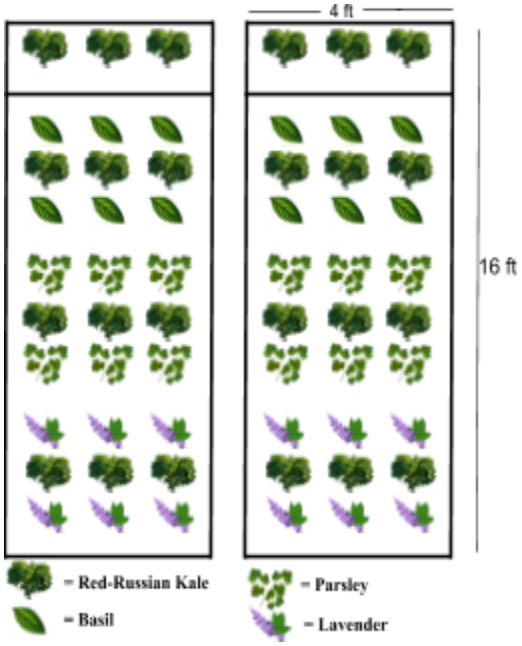

Figure 1: Digital rendition of garden beds featuring four treatment types surrounding

Figure 2: Garden bed from week 1 with newly planted *B. napus* subsp. *Pabularia* plants.

Results

A full statistical analysis was not conducted on each treatment because there was not an adequate sample size to produce enough statistical power to detect significant differences between them. However, a full enumeration of results for the four treatment types is found in both Figure 3 and Figure 4. The control group (only *B. napus* subsp. *Pabularia),* experienced the greatest total abundance of aphids consistently throughout the sampling period (Figures 3, 4). Basil and Parsley exhibited the lowest abundance of aphid populations on their leaves throughout the sampling period. However, it is important to note that on in the week of March 10, two *B. napus* subsp. *Pabularia* plants from one of the *O. kilimandscharicum* either died or went missing. Therefore there may be sampling inconsistencies after that date to do missing plants and therefore the inability to quantify aphid populations on the replicates of *O. kilimandscharicum* treatments.

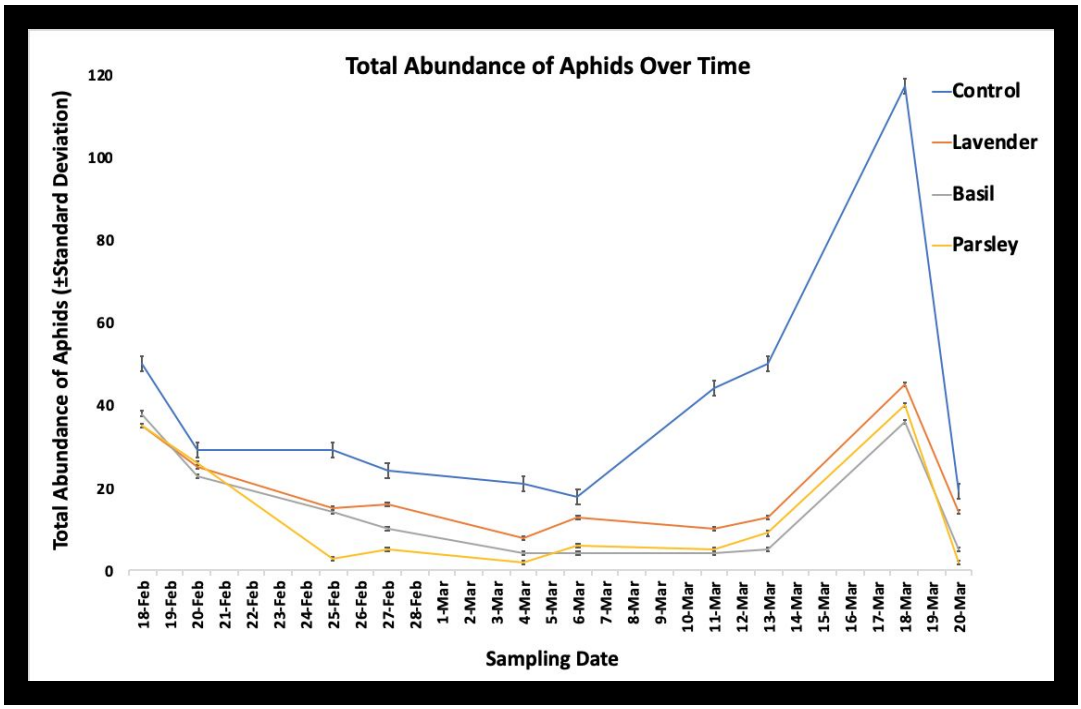

Figure 3: Total abundance of aphids throughout the experiment for each treatment.

Controls	18-Feb	20-Feb	25-Feb	27-Feb	4-Mar	6-Mar	11-Mar	13-Mar	18-Mar	20-Mar
1	6	3	7	6	15	6	19	27	106	17
2	5	3	8	5	1	4	5	4	3	2
3	8	4	7	7	4	8	7	5	5	0
Lavender										
1	8	4	4	3	2	2	2	5	20	9
2	4	3	4	4	1	2	3	3	15	0
3	5	5	3	4	1	3	2	2	7	3
Basil										
1	4	3	3	2	0	0	0	0	11	1
2	5	2	3	3	1	3	2	2	25	3
3	3	2	2	1	1	0	2	3	0	1
Parsley										
1	6	4	0	0	0	1	0	1	3	2
2	0	3	0	1	0	0	1	1	0	0
3	5	4	1	1	0	4	3	2	18	2
Controls										
4	13	1	4	3	0	0	2	2	X	X
5	6	3	3	2	0	0	7	9	1	0
6	12	9	0	1	1	0	4	3	2	0
Lavender										
4	2	2	1	2	1	3	1	0	1	0
5	6	4	1	1	1	1	1	1	0	0
6	10	7	2	2	2	2	1	2	2	2
Basil										
4	6	6	2	1	1	1	X	X	X	X
5	8	4	3	3	0	0	X	X	X	X
6	12	6	1	0	1	X	X	X	X	X
Parsley										
4	10	4	0	2	0	0	0	1	15	0
5	3	2	0	0	1	1	1	2	2	0
6	11	9	2	1	1	0	0	2	2	0

Figure 4: Complete data-set taken throughout the duration of the experiment

Discussion

The results found indicate that planting culinary herbs around *B. napus* subsp. *Pabularia* in an organic setting does help decrease the aphid population on the target crop. Although longer studies with more replicates should be pursued before stating a definite conclusion, we noticed the correlation of more aphids on the control *B. napus* subsp. *Pabularias*. It should be noted that the control *B. napus* subsp. *Pabularias* grew the most biomass, most likely due to the most amount of root space available. If we had more space to utilize during the experiment, we would have spaced out all plants more. The correlations we observed will hopefully improve crop quantity and quality from the UCF Arboretum to be donated to Knights Pantry.

Furthermore, our results are consistent with previous literature in which basil and parsley were proven to be successful with intercropping by increasing arthropod diversity on crops, which will therefore lower the subsequent aphid population (de Araújo Hendges 2018). Our study could be proving similar results due to the increase in arthropod populations on crops. However, due to limited sampling periods and time of study, we did not quantify any arthropod population within our garden beds. Therefore we hypothesize that the reason for the low aphid populations on the basil and parsley intercropped *B. napus* subsp. *Pabularia* plants could be due to the potential increase in arthropod diversity.

Furthermore, the close proximity of the culinary herbs could have produced a multiplying effect of their properties to decrease the aphid population on the *B. napus* subsp. *Pabularia* plants. For example, predators such as wasps and bees have been shown to decrease aphid populations on *B. napus* subsp. *Pabularia* through intercropping culinary herbs due to herbs such as lavender. This is because lavender has a repellent effect against pests from secondary metabolites in the herb (Ikureura 2012). Therefore, due to the close proximity of lavender to all other treatment types, it could have attracted predators to decrease the aphid population on *B. napus* subsp. *Pabularia* plants.

References

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