

THE IMPACT OF INSECT FRASS ON VEGETABLE PRODUCTION LARIMER COUNTY

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PROJECT INTRODUCTION

Black soldier fly larvae (BSFL) have become a species of particular interest in the past few decades. The protein content of the larvae is high, around 42 - 48%, and farmers can use them as a food source for other livestock. BSFL are also known to provide additional benefits: reducing the oviposition of house flies, *E. coli* populations, and odor causing compounds in manure. One major issue is the leftover substrates produced by the larvae during the rearing process. Due to its concentration of nitrogen and phosphorus, this product has the potential to be utilized in agriculture by reducing excess nutrients from existing waste streams and reducing peat application during crop production. Studies have been conducted to investigate uses of frass for application in horticultural production. Setti et al., 2019 used BSFL frass as a growth medium replacement for peat. They found that a 10:90% BSFL frass and peat mixture, respectively, could adequately replace a 100% peat based medium. Additionally, Enterra Feed Corporations conducted a study to test their BSFL frass product and found that the fertilizer was an effective amendment for potatoes, bok choy, and lettuce at a rate of 5 tons/hectare. Another amendment like BSFL frass is vermicompost, or earthworms' manure. Vermicompost may increase yield, soil organic matter, fertility, and fruit quality and can decrease pathogens and disease in crop production. The BSFL industry could provide an amendment like vermicompost, but at a much lower cost. We tested frass and vermicompost treatments as an additional amendment in greenhouse experiments.

INTERNSHIP GOALS

We had two major goals this summer (2022):

1. Monitor the impact of frass on lettuce and arugula growth at the adult and seedling stages.
2. Assess the needs and interest of Larimer County vegetable farmers in relationship to their peat usage.

HOW DOES THIS APPLY TO YOUR EDUCATION

I am finishing my PhD in Ecology this year. This program helped fund the last chapter of my dissertation and provided an opportunity to connect with local farmers and plan for future studies.

WHAT YOU DID

This summer I utilized black soldier fly larvae (BSFL) frass as a soil amendment in greenhouse pot studies at the CSU Horticulture Center from July 20 to August 11 of 2022. This experiment was carried out as a randomized complete block design (RCBD) using 7 levels total (three treatments of each amendment and 100% commercial peat control), two crop species, and 10 replicates/level over the growing period. The amendments, frass (BSFL) and vermicompost (VC), were mixed into a traditional growing peat media at the following percentages: 40%, 20%, 10%, in addition to a 100% peat control. Means were calculated within each treatment. One way ANOVA and Wilcoxon Signed Rank tests were used to analyze the differences in means for each treatment. A threshold of a 0.05 p value was considered as significant. Tukey HD and the Dunn method for Joint Ranks was used to analyze pair wise comparisons when appropriate (SAS JPM, R).

I attended the Larimer County Farmers Market (Fort Collins, Colorado) with Alison O'Connor, Extension horticulture professor. There I was introduced to several vegetable farmers. These farms were interested because of their germination practices using peat. Many farmers are interested in more sustainable options than peat moss. I scheduled interviews with three of these farmers and discussed their major questions and concerns with potentially adopting this material. Based on these conversations, I created a short informal fact sheet for farmers to reference in the future.



Figure 1. Vegetable crops grown in the greenhouse

Lettuce, on the left, and arugula, on the right, grown in the greenhouse pot studies. Crops grown in the 3 insect frass treatments are on the left, the control peat is in the middle, and vermicompost treatments are on the right.

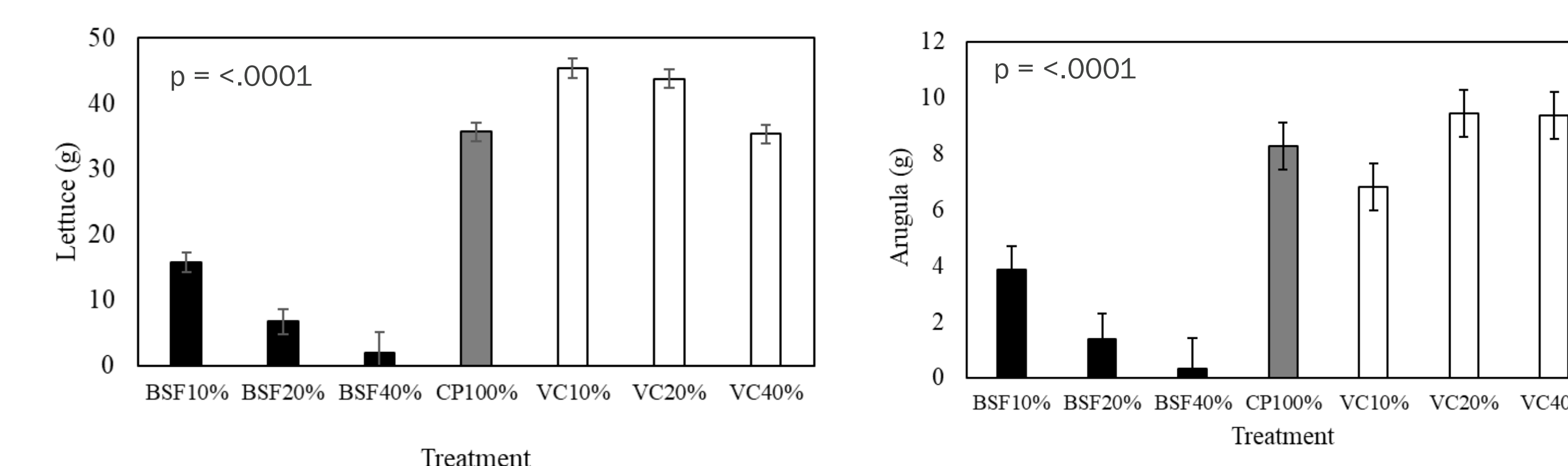
WHAT YOU LEARNED

Early analysis showed that the original starting material of the insect frass impacts plant productivity at both adult and seedling stages. Distillery grains have properties more suitable for optimal yield than brewery grains. Response to extreme heat events seemed to be influenced by treatment effects as well. Vermicompost additions may mitigate some of the negative impacts of frass.

Questions from farmers:

- How to use it? Why?
- Can it be made into a compost tea?
- What are the micronutrients?
- Is this organic? What are the organic guidelines?
- How much is delivered at a time?
- Are there local sources?
- Can the flies be introduced into the ecosystem in some way. Will a colony persist in this climate? Will they become problematic?
- How to make a useable fertility product from compost that can be land applied?

Table 1. Yield data of lettuce and arugula grown in the greenhouse using black soldier fly larvae-digested brewery grains



NEXT STEPS

I will continue to analyze and publish the data from these experiments.

I am starting a post doc at CSU SPUR campus, Terra Building, in January 2023 to continue studying controlled environment agriculture and rooftop gardens.