Efficacy of organic nutrient sources to improve soil water holding capacity (WHC) during radish production

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Abstract & Background

Vegetable production depends on seasonal rainfall or high amount of irrigation water. However, the lack of quality irrigation water in South Texas has been a major concern in recent years. Therefore, this project will evaluate the comparative ability of different organic nutrient sources for a) radish (*Raphanus sativus* L. var. Cherry Belle) production and b) to improve water holding capacity of the soil. A pot experiment was conducted at Texas A&M University – Kingsville (TAMUK) greenhouse during Nov 2023 to Jan 2024. Our four treatments were: control (C), chicken manure (CM), vermicompost (VC), and horse manure (HM). We arranged three-gallon (11.3 L) pots per treatment in a randomized complete block design with four replications for each treatment. Three radish seeds were planted for each pot and thinning was done two weeks after seeding to keep the healthiest plant in the pot. Each pot was watered (450 ml per pot) on every alternate day till harvesting and soil samples (5 to 8 cm depth) were collected to calculate the gravimetric water content (GWC) of those pots. To compare the effect of the radish on soil water holding capacity (WHC), soil samples were collected from additional pots containing fertilizer treatments without any plants. Soil samples were collected before each watering event and gravimetric water content was analyzed. Leaf length and stem diameter were recorded along with chlorophyll content using a soil plant analytical development meter (SPAD). Our results indicate that VC performed best for radish production followed by HM and C. Our CM experiment did not grow quantifiable radish most likely due to physiological dry conditions. WHC was best in VC pots followed by HM, C and CM.

Objectives

Objective 1: Evaluate the efficiency of different organic nutrient sources to improve water holding capacity of the soil

Objective 2: Evaluate the effects of different organic nutrient sources on physiological parameters of radish

Objective 3: Provide experimental and experiential learning experiences to an undergraduate student through YES grant

Materials

Fertilizer treatments were:

a) Control (C; no fertilizer was applied) b) Chicken manure (CM)

c) Vermicompost (VC) d) Horse manure (HM)

Additionally, we had pots with C, CM, VC and HM where those fertilizers were applied but no crops were grown. Cherry Belle radish variety was used for this experiment

Methods and Activities

A pot experiment was conducted at Texas A&M University – Kingsville (TAMUK) greenhouse. The experiment consisted of four treatments (described in the materials) that were mixed with top soil in a 70:30 ratio. Three-gallon (11.3L) pots were used for each treatment and were arranged in a randomized complete block design (RCBD) with four replications for each treatment. Three okra seeds were planted for each pot and thinning was done at the four-leaf stage to keep the healthiest plant in the pot. Soils from each pot were also collected at harvesting and analyzed for physicochemical properties. Four additional pots were added and received the same four treatments, respectively, but no seeds were added so that WHC can be analyzed with and without plants.

Plants were watered every alternate day and each pot received 450 mL of water. Soil samples, stem diameter, leave height, and chlorophyll content were collected before each watering event. Soil samples collected to analyze gravimetric water content (GWC).

Work summary

Julianna Leal participated in this summer internship program funded by the USDA Southern SARE YES grant. She learned skills about organic farming and their effects on soil properties. It was an experimental and experiential learning experiences for her. Overall, she worked with TAMUK Soil Science graduate students in setting up the experiment and collecting data (both soil and plant parameters). She evaluated different organic nutrient sources for radish production (yield, plant physiological parameters) and improving water holding capacity of the soil (one of the major physical properties of soil).

Major issue during experiment: Our chicken manure did not perform well throughout the experiment. All the manures were received from a local farm and CM was somehow was very dry during application. Even after several water application, we did not find any seedlings in CM plots. However, since we had pots without any crops (for each fertilizer treatment) for soil samples, we were able to evaluate the water holding capacity of the soil received CM treatment along with other treatments.

Results and Discussion

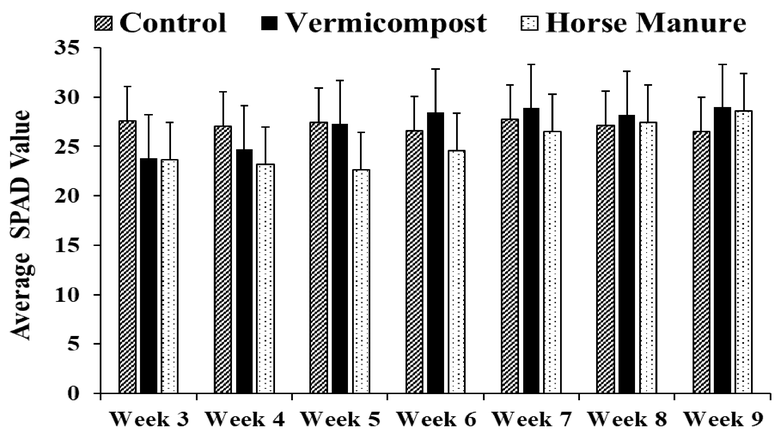
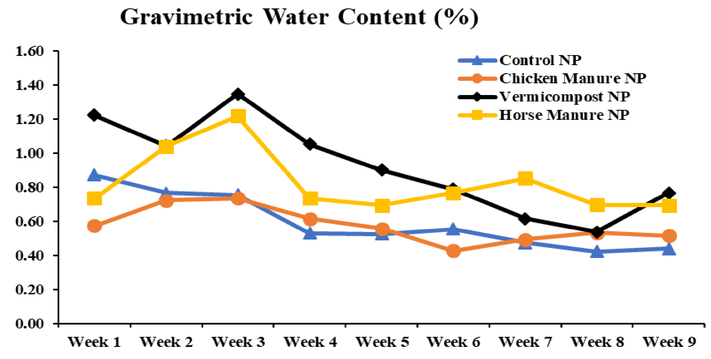


Figure 1: Pictures of the radish harvest from each treatment. Chicken manure did not grow any radish for this experiment



- Average SPAD readings (leaf chlorophyll content) were highest in VC (27.2) followed by C (27.1), HM (25.2) for this experiment.
- Average gravimetric moisture content was highest in VC (91%) followed by HM (82%), C (59%) and CM (57%).
- Average plant height was highest in VC (19 cm), followed by C (11 cm) and HM (9 cm). Yield was highest in VC as well

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