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# POTENTIAL OF VERMITEA AND NUTRIENT SOLUTION UNDER NON-CIRCULATING HYDROPONIC SYSTEM ON PRODUCTION PERFORMANCE OF PECHAY (*Brassica rapa* L.)

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**----------ABSTRACT----------**

***The study was conducted at SPAMAST, Buhangin, Malita, Davao Occidental Philippines from April to June 2022. It was conducted to evaluate the growth and yield performance of Pechay (Brassica rapa L.) using Vermitea and Nutrient Solution Under Non-Circulating Hydroponic System.***

***Complete Randomized Design (CRD) was laid out with four (4) treatments and replicated three (3) times as follows: Treatment 1 – 25 mL Simple Nutrient Addition Program (SNAP) per 10 Liters of water; Treatment 2 – 100 mL Vermitea per 10 Liters of water; Treatment 3 – 25 mL SNAP per 10 Liters of water +100 mL Vermitea per 10 Liters of water; and Treatment 4 – 12.5 mL SNAP per 10 Liters of water +50 ml Vermitea per 10 Liters of water.***

***The following parameter was gathered: Plant Height at 15 and 30 Days after Transplanting, Length of Leaves at 15 and 30 Days after Transplanting, Width of Leaves at 15 and 30 Days after Transplanting and Average Weight per Plant.***

***Result showed that the application of vermitea and nutrient solution under non circulating hydroponic system has significant effects on the Plant height at 15 and 30 Days after Transplanting, Length of Leaves at 15 and 30 Days after Transplanting, Width of Leaves at 30 Days after Transplanting and Average weight per Plant while there was no significant effect on the Width of leaves ast 15 Days after Transplanting.----------***

## INTRODUCTION

One of the most significant crops grown in the Philippines is pechay, hence it is crucial to find efficient methods of accelerating its growth rate in order to raise its potential output and, ultimately, the farmers' income (Prado, 2014).

The development of more nutrient-dense foods using existing agricultural techniques is hampered by the limited land and water resources available (Diaz and Rosenberg, 2008). Vegetable and herb crops may be produced in large quantities using hydroponics. Hydroponics is seen as a possible replacement for traditional agriculture in locations where water shortages or deteriorated soils result in limits. With the use of hydroponic farming, water, nutrients, and aeration may be precisely controlled and more effectively delivered to the root interface. When compared to conventional agriculture, hydroponics may cut water use by 70 to 90%. (Raviv and Lieth, 2008).

The hydroponics system may be enclosed or placed outside depending on the surrounding conditions and the crops being cultivated. However, vegetables produced hydroponically continue to rely on fertilizer solutions that contain pricey, inorganic nutrients derived from fossil fuels. Vermicomposts made of organic materials might be used as an alternate source of nutrients to complement the majority of current hydroponic systems powered by fossil fuels (Arancon and Owen, 2018). Agriculture has long recognized the advantages of traditional vermicompost products like worm castings (Churilova and Midmore, 2019). Vermi tea, commonly referred to as "worm tea" in colloquial use, is another less studied vermiculture product. It is a nutrient-rich liquid that drains through worm-beds containing vermicomposted wastes, bedding materials, and worm populations. According to reports, vermi tea is full of the

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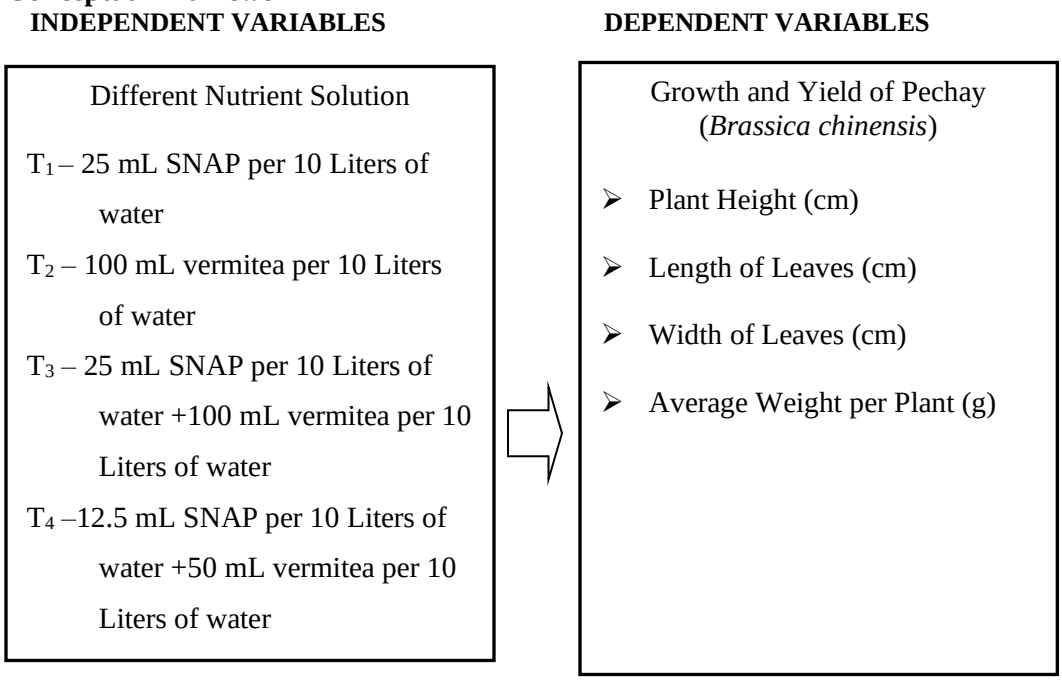
nutrients plants need to flourish, and it also helps plants grow and take up minerals (Garcia-Gomez *et al.*, 2008). Therefore, this study was conducted to determine the potential of vermitea and nutrient solution under non circulating hydroponic system on production performance of Pechay (*Brassica rapa* L.).

**Conceptual Framework**




## MATERIALS & METHODS

This study was laid out in a single factor Complete Randomized Design (CRD) with four (4) treatments replicated three (3) times. The following were representing the treatments of the study:

$T_1$ – 25 mL SNAP per 10 Liters of water
$T_2$ – 100 mL vermitea per 10 Liters of water
$T_3$ – 25 mL SNAP per 10 Liters of water +100 mL vermitea per 10 Liters of water
$T_4$ – 12.5 mL SNAP per 10 Liters of water +50 mL vermitea per 10 Liters of water

## VERMITEA PREPARATION

In the preparation of vermi tea, place 2 kilograms of vermicast and 2 kilograms of molasses in a 5 gallon bucket. Dissolved in 2 liters of water, and position the aerator. Cover the bucket to maintain it free from insects and livestock. Place the brewing out of immediate sunlight in a shaded region. Let it aerated for 18 to 24 hours of fermentation, stirring occasionally.

## NUTRIENT SOLUTION PREPARATION

Nutrient solution was mix with water based on the recommendation of the nutrient as stated in the treatment application. A long bamboo stick or similar material was used to mix the nutrient solution well. The prepared nutrient solution was then distributed to the culture boxes at about 10 L per box and 8 plants per box was used.

## PREPARATION OF GROWING MEDIA

Coco coir was thoroughly washed using fresh water. After washing coco coir will be boiled in a high temperature to eliminate microorganism that may cause damage on our sample plants. After sterilizing, it was drained from water and dry in the sun.

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## RESULTS AND DISCUSSIONS

### Plant Height

After spending 15 and 30 days after transplanting the Pechay developed and grew longer body parts. They displayed different heights depending on their assigned nutrient solution rate concentration as shown in Table 1.

Statistical results show that there was a significant effect on the plant height at 15 and 30 days after transplanting. It is shown that recommended rate of SNAP alone has superior results compared to other treatments. This was due to the amount of the nutrient content of the nutrient solution that supported the growth and development of pechay.

A Simple Nutrient Addition Program (SNAP) hydroponics has contained two solutions SNAP A and B. Nutrient analysis from the University of the Philippines Los Baños (2022) revealed SNAP B contains Nitrogen (N) (6.10 percent wt./vol), Calcium (Ca) (4.245 percent wt./vol), and Potassium (K) (3.09 percent wt./vol); and SNAP B contains Phosphorus (P) (0.376 percent wt./vol), Magnesium (Mg) (0.494 percent wt./vol), and iron (Fe) (0.151 wt./vol) and a trace amount of microelements Boron (Bo), Manganese (Mn) and Molybdenum (Mo) (see appendix ).

This suggests that the complete nutrient treatment or control indicates maximum plant height growth. The treatment of nutrient deficiency shows the average plant height is smaller than the control treatment. The opinion of Nugroho (2015) which states that the availability of nutrients will affect plant growth in this case is the availability of nutrients that plants need during vegetative and generative growth.

The recommended rate of SNAP contains nutrients that support the plant's needs from transplant to harvest, resulting in the tallest plants. This is because the SNAP solution given is a concentration that suits the needs of plants, such as pechay greens grown with a hydroponic system. This means the availability of all essential nutrients and their presence in appropriate ratios, and favorable external conditions as cited by Resh (2012). The effect of Nitrogen escalation on vegetative growth and cell division in the plant, especially the stem, and more photosynthetic extraction is expected to be produced by the plant, which is a good condition that provides for elongation of the stem (Nourmohammadi *et al.*, 2001). The amount of Nitrogen content in the nutrient solution can be attributed to the effect of pechay height (Imma & Angel, 2006).

Further, vermitea, in combination with SNAP, promotes the development of pechay. These findings demonstrated that the presence of organic compounds in vermitea increases the supply of N, P, K, and micronutrients to the crop, resulting in increased plant height, greater metabolic activities, higher carbohydrate synthesis, and ultimately higher yields (Barani and Anburani, 2004). According to Aslam and Ahmad (2020) vermi-tea contain Nitrogen (N), Potassium (K), Phosphorus (P), Calcium (Ca), and rhizobacteria that promote plant growth and contribute to initiating roots formation that enhances the growth of plants.

On the other hand, decreased plant height in pechay using vermitea alone could be due to nutrient deficiency from earlier growth stages, which caused the plants to repress the synthesis and maintenance of chlorophyll due to the higher requirement of some nutritional minerals during earlier growth stages, resulting in decreased plant height (Sarker and Oba, 2019). Simon *et al.*, (2016) found that nitrogen deficiency decreased plant height, length, and width of leaves, and finally caused the plant to die.

The results indicated that the influence on pechay height is dependent on the nutrient content of the solution that supports Pechay development.

**Table 1. Plant Height (15 and 30 days after transplanting) of Pechay (*Brassica rapa* L.) using Vermitea and Nutrient Solution Under Non-Circulating Hydroponic System**

| TREATMENTS | Plant Height (cm) | |
|---|---|---|
| | 15 DAT | 30 DAT |
| $T_1$ – 25 mL SNAP per 10 Liters of water | 14.03 | 20.98 |
| $T_2$ – 100 mL Vermitea per 10 Liters of water | $6.92^{**}$ | $11.48^{**}$ |
| $T_3$ – 25 mL SNAP per 10 Liters of water + 100 mL Vermitea per 10 Liters of water | $12.90^{ns}$ | $20.38^{ns}$ |
| $T_4$ – 12.5 mL SNAP per 10 Liters of water +50 mL Vermitea per 10 Liters of water | $12.79^{ns}$ | $20.13^{ns}$ |
| **CV (%)** | **21.04** | **15.38** |

*ns – not significant*
*** – highly significant*

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**Plate 1. Measuring the Pechay Height at 15 and 30 days after transplanting.**

15 Day after Transplanting

**Length of Leaves**

The result of a study showed a significant effect on the length (at 15 and 30 days after transplanting) of leaves using vermitea and nutrient solution under a non-circulating hydroponic system.

The recommended rate of SNAP obtained superior results compared to other treatments. This was due to the nutrient content of SNAP supporting the development of pechay that increases the length and width of leaves. A previous study by Sublett *et al.*, (2018) suggested that nutrients are the primary factors that influence plant growth and biomass production in hydroponic culture. Concentrations of the nutrient solution also affect the growth and yield of pechay when using hydroponic, because the concentration of a nutrient solution can affect metabolism in plant organs, such as the speed of photosynthesis and the potential for ions absorption by the plant roots that enhances the length and width of leaves.

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Subandi *et al.*, (2015) reported that a nutrient solution could affect the growth and yield of spinach on floating hydroponics. The nutrient content also affects the growth and yield of pechay on a hydroponic substrate, because the nutrient solution is one of the most important determining factors in the yield and quality in a hydroponic system. According to Atmaja (2017), plants with sufficient nutrients have continuous photosynthetic activity, which causes the leaves to seem greener. The plant's indicator length shows that nitrogen plays a role in vegetative growth (Koesriharti and Istiqomah, 2016).

Further, because of the nutrient content of vermitea, which increases the length of pechay leaves, the mixture of SNAP and vermitea did not differ significantly from the control. Vermitea is rich in nutrients, minerals, enzymes dissolved in organic nutrients, and hormones (Shivsubramanian and Ganeshkumar, (2004). With the addition of vermitea the crops' quality, yield, and plant vigor were improved (Shoji, 2005). It also improved the root length, shoot length, membrane stability, and crop growth (Siddiqui *et al.*, 2008).

On the other hand, using vermitea alone resulted in the shortest length and width of leaves. This was due to vermitea's lack of nutritional content, which hindered pechay growth. Plant development is slowed by a lack of nutrient content, particularly Nitrogen. Lack of Nitrogen components also causes slow development, yellowish, short, old leaves soon become yellow and die, and then miscarried, chlorosis in older leaves grows worse generally on new leaves, and nitrogen deficit not only causes poor growth but also hinders blooming initiation in fruit harvests (Rustiawan *et al.*, 2017).

**Table 2. Length of Leaves (15 and 30 days after transplanting) of Pechay (*Brassica rapa* L.) using Vermitea and Nutrient Solution Under Non-Circulating Hydroponic System**

| TREATMENTS | Length (cm) | |
|---|---|---|
| | 15 DAT | 30 DAT |
| $T_1$ – 25 mL SNAP per 10 Liters of water | 7.13 | 12.65 |
| $T_2$ – 100 mL Vermitea per 10 Liters of water | 2.64** | 5.75** |
| $T_3$ – 25 mL SNAP per 10 Liters of water + 100 mL Vermitea per 10 Liters of water | 6.6ns | 11.80ns |
| $T_4$ – 12.5 mL SNAP per 10 Liters of water +50 mL Vermitea per 10 Liters of water | 6.60ns | 11.31ns |
| **CV (%)** | **27.91** | **16.03** |

*ns – not significant*
*** – highly significant*

**Plate 2. Measuring the length of leaves.**


15 Days after Transplanting

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15 Days after Transplanting

**Width of Leaves**

The result of a study showed a significant effect on the width at 30 days after transplanting while there was no significant effect at 15 days after transplanting using vermitea and nutrient solution under a non-circulating hydroponic system.

Nugraha (2014) states that the composition of macro and micronutrients is very influential on plants. As a result, fertilizer application must be adjusted according to the demands of the plant. The rate of leaf creation has quickened because plants need nutrients, notably nitrogen, which is important for the vegetative phase. The nutrient Nitrogen (N) has a function in plant vegetative growth, as evidenced by an increase in plant length (Akasika *et al.*, 2014).

The further mixture of SNAP and vermitea has not significantly different from Treatment 1. This was due to the nutrient content of SNAP supplemented with vermitea that supplies the nutrient need of pechay to enhance the development of pechay. Golchin *et al.,* (2006) reported that vermitea exhibited growth-promoting effects on the ecomorphological characters such as length and width of leaves. In addition, vermicompost tea was able to supply balanced nutrients to plant roots and stimulate growth; increase the organic matter content of the compost including the 'humic substances' that affect the nutrient accumulation and promote root growth (Canellas *et al.*, 2002).

On the other hand, the application of vermitea alone has significantly different from Treatment 1. The nutrient content of vermitea alone is not enough to enhance the development of Pechay resulting reduce the width of leaves.

Based on the difference in concentration which is considered sufficient in plant tissue, the higher the availability of plant nutrients, the higher the possibility of plant production if other factors also support it, if the availability of plant nutrients is large but other factors do not support the plant will not grow perfectly (Fitriani *et al.*, 2015).

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**Table 3. Width of Leaves (15 and 30 days after transplanting) Pechay (*Brassica rapa* L.) using Vermitea and Nutrient Solution Under Non-Circulating Hydroponic System**

| TREATMENTS | Width (cm) | |
|---|---|---|
| | 15 DAT | 30 DAT |
| $T_1$ – 25 mL SNAP per 10 Liters of water | 5.83 | 10.55 |
| $T_2$ – 100 mL Vermitea per 10 Liters of water | 1.77 | $3.97^{**}$ |
| $T_3$ – 25 mL SNAP per 10 Liters of water + 100 mL Vermitea per 10 Liters of water | 5.09 | $10.12^{ns}$ |
| $T_4$ – 12.5 mL SNAP per 10 Liters of water +50 mL Vermitea per 10 Liters of water | 5.31 | $9.66^{ns}$ |
| **CV (%)** | **35.40** | **19.96** |

*ns – not significant*
*** – highly significant*

**Plate 3. Measuring the width of leaves after Transplanting**


**Average Weight per Plant**

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The average weight of pechay affects significantly using the different concentrations of nutrient solution. The application of recommended rate of SNAP has the highest average weight recorded among the treatments. This was due to the nutrient content of SNAP supplying the need for pechay for growth and development. In hydroponics, fertilizers are supplied as ions in the nutrient solution (Savvan, 2003) because the sole source of mineral nutrients for plants cultivated hydroponically is the nutrient solution. To easily satisfy the varied nutritional needs of different crops, the chemical makeup of hydroponic solution may be changed (Caruso *et al.,* 2011).

The nutritional requirements of plants vary with the developmental stage (Fageria and Baligar, 2005). Several studies have shown that changes in nutrient solution concentration influence plant growth characteristics (Maruyama *et al.,* 2010). Sufficient nutrient content in SNAP leads to the best plant performance in terms of length and width of leaves and weight. This conclusion was comparable to that of Luisa *et al.,* (2011), who found that providing enough nutrients for plant growth and development resulted in beneficial impacts on root biomass, leaf area, and greenness, as well as positive effects on post-harvest quality.

Furthermore, a nutrient solution often contains all required plant nutrients in water-soluble forms and at the proper concentrations. Because of the amount of nutrients in the vermitea as a nutrient solution, the application of vermitea alone reduced the average weight of pechay. Because the nutrient solution is the only source of mineral nutrients in hydroponically-grown plants extremely low concentrations of nutrients generally lead to growth inhibition. On the other hand, extremely high nutrient solution concentration causes osmotic stress, ionic toxicity, and growth restriction (Savvas and Adamidis, 2000). Nevertheless, the supply buffering capacity of a nutrient solution is nearly null (Gorbe, 2009), leading to high danger for hydroponic plants to nutrient deficiency and ion toxicity (Gorbe and Calatayud, 2010).

**Table 4. Average weight per plant of Pechay (*Brassica rapa* L.) using Vermitea and Nutrient Solution Under Non-Circulating Hydroponic System**

| TREATMENTS | Average Weight per Plant |
|---|---|
| $T_1$ – 25 mL SNAP per 10 Liters of water | 56.67 |
| $T_2$ – 100 mL Vermitea per 10 Liters of water | 12.33$^{**}$ |
| $T_3$ – 25 mL SNAP per 10 Liters of water + 100 mL Vermitea per 10 Liters of water | 42.33$^{ns}$ |
| $T_4$ – 12.5 mL SNAP per 10 Liters of water +50 mL Vermitea per 10 Liters of water | 38.00$^{ns}$ |
| **CV (%)** | **36.70** |

*ns – not significant*
*** – highly significant*

## CONCLUSION

Based on the results, the researcher concluded that using vermitea and nutrient solution in a non-circulating hydroponic system has a significant impact on pechay growth and yield parameters. The use of SNAP at the recommended rate had the best effects among the treatments. However, a mixture of the half-recommended rate of SNAP and vermitea did well since the growth of pechay has a similar effect to the recommended rate of SNAP.

## RECOMMENDATION

Treatment 4 with 12.5 mL SNAP per 10 Liters of water +50 mL vermitea per 10 Liters of water can be utilized since it has a comparable effect to control, and using half the recommended amount of SNAP and vermitea is more efficient. It was also suggested that styrofoam must be used to keep the consistency of the material used as a container. Conduct the study with additional parameters such as pH and temperature monitoring that cause no significance as a result of the study. Further investigation into the total amount of nutrients that can be extracted from vermicompost and the optimal frequency of extraction could aid in the understanding of best practices for brewing, as well as expected nutrient contribution.

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