AJVAH
e-ISSN: 2735-1165
DOI: https://doi.org/10.53797/ajvah.v2i2.4.2021

Effects of Chicken Manure and Shrimp Paste on Chili Pepper (*Capsicum Frustescens*) Growth

Mohd Kamaruddin, Mohamad Izzat Syafiq[1], Abdul Mutalib, Asilah[2*], Ismail, Zalina[3], Ab Latif, Zahidah[4] & Che Man, Shaibatul Islamiah[5]

[1,2*,3]Agricultural Science Department, Faculty of Technical and Vocational, Sultan Idris Education University, Tanjong Malim, Perak, 35900, MALAYSIA

[4]Family and Consumer Science Department, Faculty of Technical and Vocational, Sultan Idris Education University, Tanjong Malim, Perak, 35900, MALAYSIA

[5]Centre of Studies for Landscape Architecture, Faculty of Architecture, Planning and Surveying, Universiti Teknologi MARA, UiTM Puncak Alam, Selangor, 42300, MALAYSIA

*Corresponding author email: asilah@ftv.upsi.edu.my

Available online 03 December 2021

Abstract: Chemical fertilizer application is one of the most common procedures in today's developing intensive agriculture. However, long-term use of chemical fertilizers has resulted in many unintended consequences such as environmental pollution including contribution of toxicity to the soil. Excessive toxicity of soil may prevent the growing of plants roots and containing low nutrients in plants. Previous study has proven that organic fertilizers may increase the plants growth and its soil quality. Therefore, this study was conducted to determine the effects of chicken manure and shrimp paste application on chili pepper growth. This study used Randomized Complete Block Design (RCBD) as an experimental design. There were 4 treatments with 5 replications in this study. The treatments were supplied with: T1 (tap water); T2 (30 gram of chicken manure); T3 (30 mL of shrimp paste solution); T4 (15 gram of chicken manure and 15 mL of shrimp paste). The parameters that have been observed in this study were root length, shoot length, leaves number and soil pH. The data was analysed by using Analysis of Variance (ANOVA), Statistical Package for the Social Sciences (SPSS) and the differences between treatments mean were compared using Tukey test with significant level ($P \leq 0.05$). The results of this experiment showed that the chicken manure and shrimp paste solution had significant effects for all parameters measured except for soil pH value. All treatments were significantly higher compared to control. This study was conducted to provide more information as well as awareness to the agricultural industry and society to mainly use organic fertilizers in any cultivation of food product.

Keywords: Chili pepper, organic fertilizer, chicken manure, shrimp paste solution and Vocational education

1. Introduction

Chili pepper is one of the world's largest and most valuable vegetable crops. Therefore, the application of fertilizer is one of the important factors in enhancing growth and yield of chili pepper. Chemical fertilization is one of the most often used practices in today's developing intensive agriculture. Long-term use of chemical fertilizer, on the other hand, has had a number of unintended consequences. Approximately 50% of N and 90% of P have been observed to run out of crop fields and escape into the atmosphere or water, generating greenhouse gas emissions, aquatic eutrophication, and soil salinization (Ye et al., 2020). Excessive consumption of chemical fertilizers in certain cases will affect plant susceptibility to pests and diseases. Increasing resilience to chili is also impacted by improper use of the chemical pesticides. The application of an organic farming system with a balanced dose of fertilizer is a possible way to solve this issue (Halimah et al., 2019).

It is a smart choice to reduce the harmful environmental effects of chemical fertilizers by replacing chemical fertilizers with more organic fertilizers for farmers. In developing countries, however, most farmers choose to utilize chemical fertilizers over organic fertilizers, mostly because they fear losing income if they use organic fertilizers instead of chemical fertilizers (Wang et al., 2018). Ongoing long-term use of chemical fertilizers has created several unintended

**Corresponding author: asilah@ftv.upsi.edu.my*

results. For example, the cost of productivity does not scale linearly and results in a large waste of mineral resources (Ye et al., 2020). Therefore, farmers need to turn to more reliable organic fertilizers, such as chicken manure and shrimp paste, so that the crops are more efficient and achieve more yields and do not affect soil conditions. The waste treatment for dried shrimp paste can assist the community in decreasing environmental pollution while also supporting the household economy (Hapsari & Welasih, 2015). Furthermore, organic manure addition is known to alter soil aggregation and have a significant impact on soil microbial residues (Ding et al., 2015).

Shrimp paste is one of the Indonesian traditional shrimp fermentation products experiencing natural fermentation by indigenous microorganisms (Astuti et al., 2018). Farmers can lessen the consequences of environmental contamination by converting dried shrimp paste waste into liquid organic fertilizer that can be generated by the community and into a natural greening programme (Azza et al., 2019). Based on Apiratikorn (2020) study, the media of dragon fruit stem cuttings with shrimp paste and cocopeat can improve the root system. Eko (2019) reported that brown sugar and shrimp paste create the highest yield quality based on the weight per plant, weight per fruit and sugar content. The combination of liquid organic fertilizer containing shrimp paste is effective towards the growth and yield of tomato plants (Mooy et al., 2019).

Chicken dung is a mixture of faeces, feathers, waste feed, feathers and bedding material, and is the most common poultry manure (Ravindran et al., 2017). As reported by Smith & Williams (2016), cattle manure contributed for 80% of the total production of UK livestock manure during the housing period, of which about 53% were estimated to be solid, mainly straw-based cattle manure. However, chicken manure is the best type of manure, because it has a rich nutrient source and is most effective after being composted, as raw manure can be 'hot' and may contain high concentrations of nutrients in the plant that can burn or even kill the plant. Manure fertilizer of chicken contains large amounts of nitrogen, potassium and phosphorus. Using this type of manure fertilizer, a plant-growing soil that is larger and healthier can be produced. Chicken manures can be efficient sources of primary nutrients such as N and P as well as organic carbon (Ravindran et al., 2017). The available nutrients can be absorbed by plants leading to high fruit weight and fruit weight per plant (Eko, 2019). Hence, farmers need to have knowledge about fertilization using organic fertilizers such as manure so that planting is more effective and produces a lot of yields (Oviawe et al., 2021).

Therefore, the objective of this experiment was to determine the effects of which are chicken manure and shrimp paste solution on chili pepper growth which observing the shoot length, root length, number of leaves and soil pH value parameters. The conducted research may provide more information as well as awareness to the agricultural industry and society to mainly use organic fertilizers in any cultivation of food product.

2. Materials and Methods

2.1 Preparation of Chicken Manure

Chicken manure pallet was purchased through the ‘Shopee’ platform which is Aviafic brand produced by Kenso Corporation. This fertilizer was processed by decay (compost) and this process takes more than 6 months. Due to that, chicken manure pellet is an excellent organic fertilizer. It also produces a source of nutrients and organisms to the soil after sowing. Wood dust was used in the process of making this fertilizer (mixture), at the same time this can make chicken manure fertilizer fresher.

2.2 Preparation of Shrimp Paste Solution

Shrimp paste with 100 g weight was added and mixed together with brown sugar (100 g) and chlorine-free water (500 ml) into a container which had a volume of 1 L and above. All the ingredients were mixed until well-blended and the mixture was in a 1.5 L bottle. Next, the container lid was covered with gauze and was left for 2 weeks. After 2 weeks, the mixture was stirred again and strained into a new container. The solutions were stored for further used.

2.3 Seedling Germination

Before placing the seeds in a tray, the seeds were soaked in a warm water for overnight. The seeds of chili pepper were placed in the seedling tray with the growth medium to allow seeds to germinate. The germination of chili pepper seeds normally takes 1-2 weeks in the seedling tray, after which the seedlings were transferred into the pots.

2.4 Pot Preparation

Peat soil is the type of growth medium that has been used in this study. The medium was put into the seedling tray and pot to promote the growth of chili pepper.

2.5 Root Length

Root length from each treatment was measured by using a tape measure.

2.6 Shoot Length

Shoot length from each treatment was measured by using a tape measure.

2.7 Leaves Number

Leaves number from each treatment were counted from the all sizes of leaves.

2.8 Soil pH Value

Soil pH of each treatment was measured by using a pH meter by inserting the probes of the pH meter deeply into the soil.

2.9 Statistical Analysis

This study was laid out by using factorial Randomized Complete Block Design (RCBD) as an experimental design. There were 4 treatments with 5 replications which were T1 (control); T2 (30 g chicken manure); T3 (30 mL shrimp paste); T4 (30 g chicken manure and 30 mL shrimp paste). The data analysis was used Analysis of Variance (ANOVA), Statistical Package for the Social Sciences (SPSS) and the differences between treatments mean were compared using Tukey test with significant level ($P \leq 0.05$).

3. Results

3.1 Root Length

From the Fig. 1, it shows that there was a significant difference for root length observed under difference application of treatments which were chicken manure and shrimp paste. Treatment 1 was significantly different between plants in Treatment 2 and Treatment 4 that were treated with chicken manure and shrimp paste. However, the root length of plants in Treatment 2 were not significantly different compared to plants in Treatment 4. The highest length of root was recorded from Treatment 2 that was treated with single factor of chicken manure.

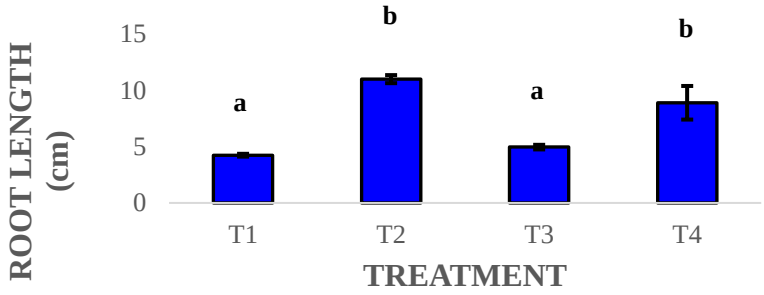

Fig. 1: Effects of chicken manure and shrimp paste application on root length of chili pepper

3.2 Shoot Length

From the Fig. 2, it shows that there was a significant difference for shoot length observed under difference application of treatments which were chicken manure and shrimp paste. Treatment 1 was significantly different between plants in Treatment 2 and Treatment 4 that was treated with chicken manure and shrimp paste. However, there was no significant difference with those in Treatment 3 that was treated with shrimp paste only. The shoot length of plants in Treatment 2 were not significantly different compared to plants in Treatment 4. The highest length of shoot was recorded from Treatment 2 that was treated with single factor of chicken manure.

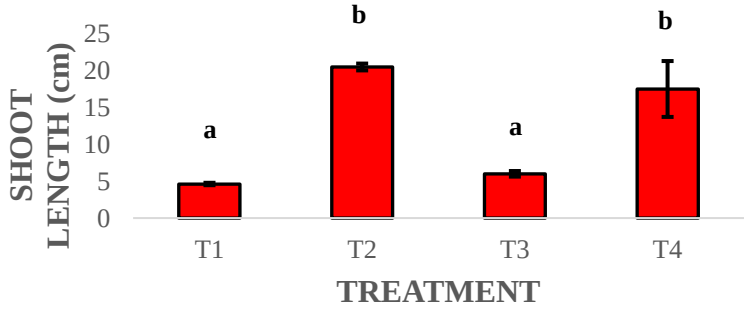

Fig. 2: Effects of chicken manure and shrimp paste application on shoot length of chili pepper

3.3 Leaves Number

From the Fig. 3, it shows that there was a significant difference for leaves number observed under difference application of organic fertilizers which were chicken manure and shrimp paste. Treatment 1 was significantly different between plants in Treatment 2 and Treatment 4 that was treated with chicken manure and shrimp paste. The leaves number of plants in Treatment 2 were not significantly different compared to plants in Treatment 4. The highest leaves number was recorded from Treatment 2 that was treated with single factor of chicken manure.

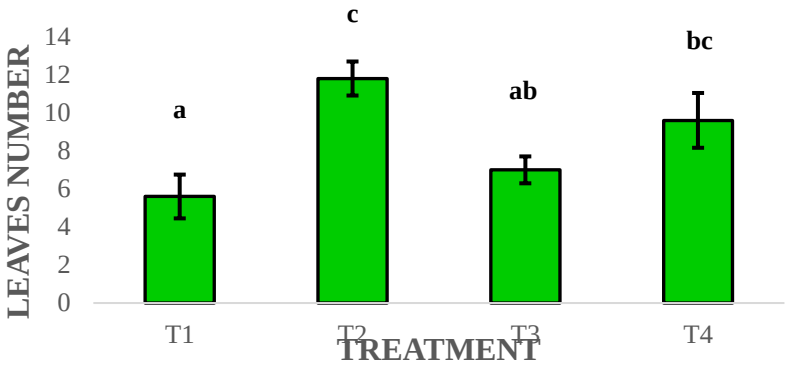

Fig. 3: Effects of chicken manure and shrimp paste application on leaves number of chili pepper

3.4 Soil pH

There was no significant difference for soil pH value observed under difference application of organic fertilizers which were chicken manure and shrimp paste. It might be due to the error occurred during the measurement.

4. Discussion

Undeniably, intensive farming with heavy use of chemical fertilizers boosted agricultural sustainability, but on the other hand it also disrupted agro-ecosystems and damaged soil and water quality to a considerable extent. Therefore, better management practices, such as chicken manure and shrimp paste solution as organic fertilizers, can be implemented to increase crop productivity while causing minimal or no harm to the environment. This study proved that the application of chicken manure and shrimp paste improved growth of chili pepper. However, the application of chicken manure resulted the better growth of chili pepper than shrimp paste. In this study, chicken manure showed the significant highest of parameters measured which were shoot length, root length, leaves number and leaves length than shrimp paste. Chicken manure may have boosted nitrogen use efficiency, micro and macronutrient recovery, P solubilization, uptake by plants and K availability, resulting in improved chili pepper development. Bergfeldt et al. (2018) reported that potassium (K) water solubility was the largest in the chicken manure with 87.1% in their study and the largest solubility with water at around 40% for phosphorus (P) and 60% for nitrogen (N) was identified in the chicken manure. Chicken manure is a good source of organic carbon, which is necessary for soil quality improvement, and the nitrogen it provides is essential for plant growth (Ravindran et al., 2017).

This study showed that chili pepper plant treated with compost chicken manure (T2) produced the best results in parameters measured which were shoot length, root length, leaves number and leaves length and followed by combination of compost chicken manure and shrimp paste solution (T4), shrimp paste solution (T3) and control (T1) that supplied with tap water. Due to the balanced supply of nutrients, organic manure provides a number of advantages, including micronutrients that increased soil nutrient availability due to increased soil microbial activity, the decomposition of hazardous elements, improved soil structure and root development, and increased soil water availability (Han et al., 2016). However, soil pH value shows no significant effect and it might be error occurred during the measurement. In this study, shrimp paste showed significant lower growth rate of chili pepper. However, according to Eko (2019), brown sugar and shrimp paste create the highest yield quality based on the weight per plant, weight per fruit and sugar content. Combination of liquid organic fertilizer containing shrimp paste is effective towards the yield of chili plants (Mooy et al., 2019). So, it is clearly that shrimp paste solution gave better results in chili pepper yield rather than the plant growth parameters. Moreover, according to Suwandi et al. (2020), fermentation liquids made from enrichment of shrimp waste compost extract with shrimp paste are protective of curly red chili viruses and of their aphid vector, *Aphis gossypii*.

5. Conclusion

This study indicated that different types of organic fertilizer affected the growth characteristics of chili pepper. The results showed Treatment 2 (chicken manure) was the most optimum organic fertilizer supplied on chili pepper growth. Furthermore, chili plants also showed favourable growth for the Treatment 4 (interaction of chicken manure and shrimp paste). However, soil pH value showed no significant difference on the chili pepper soil. Thus, it can be concluded that

the organic fertilizers (chicken manure and shrimp paste) had significantly affected the growth of the chili pepper which the results were higher than the control measured in the study. Therefore, chicken manure and shrimp paste were recommended for chili pepper in this study.

Acknowledgement

The work has carried out at the Sultan Idris Education University (UPSI), Malaysia for fulfilment of the requirements for the Bachelor of Education (Agricultural Science) with honours. We grateful to the Sultan Idris Education University, Malaysia for the support and providing all the materials and facilities for this research.

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