Inorganic Fertilizers (Ground and Foliar Application) and Organic Fertilizer: Their Effects on the Growth and Yield of Pechay (*Brassica napus* L. subsp. *chinensis* var. *Black Behi*)

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Abstract: The study was conducted to evaluate the growth and yield performance of Pechay applied with different types and levels of organic and inorganic fertilizers under different methods of application. In particular, the study aimed to evaluate the growth parameters, to determine the yield components, and to determine whether a significant difference between treatments exists on the growth and yield performance of Pechay using different nutrient sources and application methods. Randomized Complete Block Design (RCBD) was used with three replications and the experiment was conducted at Mindanao State University-Main Campus, Marawi City. Results of the study showed that T_2 (Recommended Rate (RR) Inorganic Fertilizer) plants are the tallest while T_1 (Control) plants are the shortest with a mean height of 14.56 and 8.66 cm, respectively. T_2 plants also have the highest mean growth rate of 3.015 mm/day, and T_7 (50% RR Organic Fertilizer + 50% RR Foliar Fertilizer) as the shortest with a mean growth rate of 1.237 mm/day. Further, T_5 (50% RR Inorganic Fertilizer + 50% RR Organic Fertilizer) plants show the highest mean number of leaves of 10.197, and T_1 plants are the least with a mean number of leaves of 6.867. Yield was also highest in T_2 and lowest in T_1 with a mean weight of 225.863 g and 50.853 g, respectively. Moreover, the results of the study are recommended to the Philippines' Department of Agriculture (DA) and Local Government Units (LGUs) to guide the farmers and consider adopting the recommendations of this study. These are also recommended to the Department of Trade and Industry (DTI) for the consumers to identify foods free from toxic substances.

Keywords: Pechay, Organic Fertilizers, Inorganic Fertilizers, Ground and Foliar Application, Urban Gardening, Randomized Complete Block Design

1. INTRODUCTION

Types and levels of fertilizer applied to crops are very important in crop production and play an important role in cropping systems. Relying on inorganic or chemical fertilizers is a major constraint due to its prohibitive cost though identified as an important factor in meeting the food requirements of a growing population.

In recent years there is a growing trend to reduce the use of mineral fertilizers, especially soil applied nutrients such as nitrogen (N), phosphorus (P) and potassium (K) and their use had decreased by seven times. Moreover, there is also increasing demand for organically-grown farm products. These create preconditions to recognize the importance of foliar fertilization and the use of organic fertilizers as an alternative to meet plant nutrient demand during the growing season (Kerin and Berova, 2003).

Foliar fertilization is an important tool for the sustainable and productive management of crops. In recent years, foliar fertilizers, especially organic ones, have proliferated in the agricultural fertilizer market (Eroy, 2015). Interest on foliar fertilization has risen because of the many advantages of the methods of application of foliar nutrients, such as rapid and effective response to plant needs, regardless of soil conditions (Kerin & Berova, 2003). However, few studies have been conducted to compare the effects of both ground and foliar application of fertilizers.

According to Tukey and Marczyński (1984), combined soil and foliar applications should be recommended to increase both plant productivity and yield quality. Kuepper (2003) also emphasized that foliar application of fertilizers is becoming more prevalent as practice in agricultural crop production because it is more directly targeted and potentially more friendly to the environment in contrast to soil fertilization. In fact, Johnson et al. (2001) suggested that supplying N to peach trees

using a combination of soil and foliar N fertilizers leads to optimal plant responses and limited environmental pollution risks.

Pechay (*Brassica napus* L. var. *Black Behi*) is major vegetable crop rich in vitamin C and contains significant amounts of nitrogen compounds known as indoles, as well as fiber—both of which appear to lower the risk of various forms of cancer. It has been selectively cultivated to produce a plant that has an exceptionally short life cycle of 30-45 days (Acero, 2013).

So far, crop production fertilizer studies focused both on organic and inorganic types. Limited studies had been made comparing reactions of plants to solid and liquid fertilizers and to different methods of application. Hence, this study focused on the effects of using different types and levels of organic and inorganic fertilizers under different methods of application to the growth and yield of *Pechay* and to determine if significant differences exist between and among treatments.

2. LITERATURE REVIEW

In a recent review, Fernández and Brown (2013) stated that foliar fertilization is an agricultural practice of increasing importance. In theory, application of nutrient sprays may indeed be an environmentally friendly fertilization method since the nutrients are directly delivered to the plant in limited amounts, thereby helping to reduce the environmental impact associated with soil fertilization. However, response to foliar sprays is often variable and not reproducible due to the existing lack of knowledge of many factors related to the penetration of the leaf-applied solution.

This fact causes farmers to shift to either organic fertilizers or inorganic fertilizers. Buckman and Brady (1974) reported that organic fertilizer increases the cation exchange capacity of the soil. Aside from its ability to supply nutrients, organic fertilizers are also capable of improving the physical, chemical, and biological properties of soil which could significantly improve the growth and development of plants. Pascual et al. (2013) pointed out that organic matter is an excellent source of plant-available nutrients and their addition to soil could maintain high microbial populations and activities.

2.1. *T. harzianum* + *E. fetida* Compost Application

Studies made by Bercero et al. (2014) found that application of *T. harzianum* + *E. fetida* compost produced comparable results as to the number of leaves, leaf width, leaf length, fresh weight and dry weight with the positive control (synthetic organic fertilizer (Urea) at 0.65 grams' plant⁻¹) indicating that it is a good alternative to application of inorganic fertilizer to the growth of *Pechay*. Compost derived from the application of *T. harzianum* + Vermi worms is highly recommended to produce *Pechay*.

2.2. Vermicompost Application

Ahirwar and Hussain (2015) studied the effect of vermicompost on growth, yield, and quality of vegetable crops. Results showed that growth of vegetable transplants was positively affected by addition of vermicompost, perhaps by altering the nutritional balance of the medium. Transplant quality was improved in peppers and eggplants while tomato transplant quality was slightly reduced. Also, there were no significant differences in field performance. Hence, vermicomposting is a sustainable technique for solid waste disposal.

Nurhidayati et al. (2016) studied the yield and quality of cabbage (*Brassica oleracea* L.var. *capitata*) under organic growing media using vermicompost and earthworm *Pontoscolex corethrurus* inoculation. Results showed that the application of vermicompost combined with inoculation of earthworm *P. corethrurus* significantly increased total biomass, marketable weight, crop diameter, and harvest index compared with the cabbage grown in inorganic media as well as the quality of cabbage which was determined by sugar and vitamin C content and storage loss. Each vermicompost provided the highest yield and quality at different earthworm population. Vermicompost made from the mixture of cow manure and vegetables residue gave a high yield and quality cabbage with population of *P. corethrurus* by 0-25 indiv.m⁻². Moreover, vermicompost made from the mixture of cow manure and leaf litter with population of *P. corethrurus* by 50 indiv.m⁻² gave a high yield and quality cabbage. Lastly, vermicompost made from the mixture of cow manure, vegetable residue, and leaf litter gave a high yield cabbage without inoculation earthworm *P. corethrurus* and with population of *P. corethrurus* by 75-100 indiv.m⁻² for a high-quality cabbage.

Kaur et al. (2015) studied the effect of vermicompost and vermiwash on growth of vegetables and found that organic waste material processed by the naturally occurring earthworm should be used to

produce vermicompost which will supply nutrients and other soil stimulants for plant growth and improve soil quality. Vermiculture provides the best answer for ecological agriculture, which is synonymous with “sustainable agriculture”.

Arancon and Edwards (2005) studied the effects of vermicompost on plant growth and found that when used at lower substitution rates, vermicompost can increase growth, flowering and yields of vegetable and ornamental crops. Similarly, vermicompost applied at very low rates e.g. 2.5 t/ha or 5 t/ha can significantly increase growth and yields of highly valuable vegetable and fruit crops in the field. The effects of vermicompost on plants are not solely attributed to the quality of mineral nutrition provided but also to its other growth regulating components such as plant growth hormones and humic acids. Moreover, the application of vermicompost in the field enhances the quality of soils by increasing microbial activity and microbial biomass which are key components in nutrient cycling, production of plant growth regulators and protecting plants soil-borne disease and arthropod pest attacks.

Vermicompost is worm castings or digested excretions, and is largely used by gardeners and landscapers as a soil amendment. These castings originate from organic materials, which the worms feed on (Tejada et al., 2010). Once ingested the organic material undergoes enzymatic digestion along with several other processes to ultimately create a casting. Vermicompost contains many plant available nutrients, and research indicates castings improve soil structure by enhancing soil porosity, aeration, and moisture holding capacity resulting in enhanced plant growth (Tejada et al., 2010; Atiyeh et al., 2000; Handreck, 1986; Grapelli et al., 1985). Aging of vermicompost has been studied focusing on microbiological or physical/chemical changes for up to 60 days of aging (Aira et al., 2007; Hindell et al., 1997; Parle, 1963).

Vermicompost is finely divided peat-like materials with high porosity, aeration, drainage, water-holding capacity (Tejada et al., 2010). Handreck (1986) reported that vermicompost tended to have pH values near neutrality which may be due to the production of carbon dioxide and organic acids produced during microbial metabolism. They also reported that their moisture content was reduced progressively during vermicomposting giving final moisture contents between 45% and 60%, the ideal moisture contents for land-applied composts (Tejada et al., 2010).

Arancon et al. (2004) studied the agronomic impacts of vermicompost and inorganic (chemical) fertilizers on strawberries when applied separately and in combination. Vermicompost was applied at 10 tons/ha while the inorganic fertilizers (nitrogen, phosphorus, potassium) at 85 (N)-155 (P)-125 (K) kg/ha. While there was not much difference in the dry shoot weight of strawberries, the yield of marketable strawberries and the weight of the largest fruit was greater on plants in plots grown on vermicompost as compared to inorganic fertilizers in 220 days after transplanting. In addition, there were more runners and flowers on plants grown on vermicompost. Also, farm soils applied with vermicompost had significantly greater microbial biomass than the one applied with inorganic fertilizers.

Vermicompost has demonstrated consistently beneficial effects on plant growth independent of nutrient transformations and availability (Dominguez & Gomez-Brandon, 2012). Theunissen et al. (2010) found that vermicompost contained plants nutrients including N, P, K, Ca, Mg, S, Fe, Mn, Zn, Cu and B, the uptake of which had positive effects on plant nutrition, photosynthesis, chlorophyll content of the leaves and improves the nutrient content of the different plant components (roots, shoots and the fruits).

Webster et al. (2005) studied the agronomic impact of vermicompost on cherries and found that it increased yield of cherries for three (3) years after single application. Application of vermicompost in soil builds up fertility and restore its vitality for long time and its further use can be reduced to a minimum after some years of application in farms. Buckerfield and Webster (1998) found that worm-worked waste (vermicompost) boosted grape yield by two-fold as compared to chemical fertilizers.

2.3. Organic Fertilizer Application

Lim and Vimala (2012) studied the growth and yield responses of four leafy vegetables to organic fertilizer. Results showed that organic fertilizer as the sole source of nutrients can give yields that are higher or comparable to inorganic fertilizer. Thus, an organic grower need not fear reduced yields, if

the correct rate of organic fertilizer is applied. The optimum responses of leafy vegetables to organic fertilizer rate was about 30 t/ha of poultry manure for leaf mustard, kangkung and lettuce and 36 t/ha for chinese spinach.

Zainab et al. (2016) studied the effects of organic and inorganic fertilizers on the growth of NH-Ae 47-4 variety of okra. Results obtained from the experiment showed that the effect of the treatments were significantly different from the control for all the parameters accessed with urea fertilizer having least effect. Plants treated with poultry litters have best performance by recording the highest fresh and dry weight (0.39g) at 4 weeks after planting (WAP); highest stem height 29.33cm for all the concentrations applied.

Dalal et al. (2014) studied the growth, yield, and quality of vegetables under chemical and organic farming. Results showed that in the final measurement, both two vegetables in organic fertilization treatments grew better and resulted in a final higher total yield, shoot length and branches than those in chemical fertilizer treatments, which was attributed to the high nutrient sustainability of organic fertilizer and the improved biological properties of the soil. Macronutrients Nitrogen (N), Phosphorous (P), Potassium (K) and Carbon (C) were increased by the application of organic manure. Total microbial count increases by using the organic fertilizers, shown the indication of healthy soil. Results of this experiment showed that chemical fertilizers were less suitable as compared to organic fertilizers. It is recommended that vegetables can be grown successfully with supplementation of organic fertilizers.

Subler and Edwards (undated) reported that the best plant growth responses are when organic fertilizer and traditional fertilizers are used together. In addition, Prado and Sampaga (2013) studied the response of *Pechay*, (*Brassica rapa*) to organic fertilizer under DMMMSU-NLUC condition, La Union, Philippines. *Pechay*, when applied with organic inputs for its growth, has comparative advantage over that of the farmers' practice of using urea. Although statistically insignificant in the ANOVA test, the differences in values favor the use of organic inputs. Likewise, raw recipes for *Pechay* are more nutritious, hence safer if organically grown due to the absence of chemicals. Moreover, growing organically is helping maintain a clean and safe environment to live in.

2.4. Different Levels of Compost Fertilizer

A study conducted by Gonzales et al. (2015) on the response of *Pechay* (*Brassica napus* L.) to different levels of compost fertilizer concluded that the application of 75% Pure Garden Soil: 25% Pure Compost provided the best growth and yield performance of *Pechay* in terms of leaf area and fresh weight. The result of the study showed that application of organic fertilizer greatly enhanced growth and yield performance of *Pechay*. The application of organic fertilizer in *Pechay* specifically, compost is recommended since it influences its growth and yield, especially on the leaf area and fresh weight.

Natsheh and Mousa (2014) studied the effect of organic and inorganic fertilizers application on soil and cucumber (*Cucumis sativus* L.) plant productivity. Results showed that the application of compost improved the soil characteristics; increased soil productivity and organic matter content. The experimental results confirmed that the use of organic fertilizers increased the crop productivity.

2.5. Inorganic Fertilizer Application

Eifediyi and Remison (2010) studied the effects of inorganic fertilizer on the yield of two varieties of cucumber (*Cucumis sativus* L.). Results revealed significant differences ($P < 0.05$) among the varieties in terms of vine length, number of branches and leaf area. The growth and yield attributes of cucumber including the vine length, number of leaves per plant, number of branches, leaf area, number of fruits per plant, fruit length, fruit girth, fruit weight per plant, fruit number per plant and total yield per hectare increased significantly ($P < 0.05$) with increase in inorganic fertilizer application up to the highest level.

According to Pascual et al. (2013), to produce high yield, most growers use synthetically-based products, thus, the possibility of pesticides and chemical residue accumulation is very serious that poses threat to human health.

Synthetically-based fertilizers are the most common fertilizers used by the farmers. However, its use incurs a high cost and its supply is sometimes limited that many farmers now are still adapting the idea of using organic fertilizers no matter how long and laborious is the preparation (Gonzales et al., 2015).

Fertilizer application using either inorganic or organic fertilizer sources is one of the most common cultural management practices in vegetable production. According to Masarirambi et al. (2010), commercial and subsistence farming has been and is still relying on the use of inorganic fertilizers for growing crops. This is because they are easy to use, quickly absorbed and utilized by crops. However, these fertilizers are believed to contribute substantially to human, animal, food intoxication and environmental instability or degradation (Masarirambi et al., 2010).

Omidire et al. (2015) conducted a study entitled “Assessing the Impacts of Inorganic and Organic Fertilizer on Crop Performance Under a Microirrigation-Plastic Mulch Regime”. Results showed that the inorganic fertilizer had higher yields (lbs/acre) than organic fertilizer. The addition of microbes to the inorganic fertilizer significantly increased the numbers of cucumbers and okra per acre. Overall, the “Farmer mix” with or without the addition of microbes significantly increased yields for all crops compared to the organic-based fertilizer.

Lian et al. (2017) studied the effects of different proportions of inorganic fertilizer and organic fertilizer on yield and quality of amaranth. Results showed that inorganic fertilizer is a kind of fast, high nutrient chemicals, but too much inorganic fertilizers will lead to high levels of nitrate in vegetables, affecting the quality of vegetables. Organic fertilizers can provide a more comprehensive and lasting nutrients that needed for crop growth and development, but too much also to cause a decline in quality of vegetable. Many studies have shown that organic and inorganic fertilizer can complement each other, which can provide continuous, comprehensive nutrients to the growth of crops to increase crop yield and quality.

Ogundare et al. (2015) studied the growth and fruit yield of tomato as influenced by combined use of organic and inorganic fertilizer in Kabba, Nigeria. Result obtained from parameters studied (plant height, leaf numbers, branch number, stem girth, fruit number per plant and fruits weight) revealed that tomato performed better ($P < 0.05$) with the application of 125kg/ha NPK+3t/ha poultry manure application. The study showed that use of inorganic and organic fertilizer had better effects on growth and yield of tomato. Therefore, for good yield and better productivity of tomato, a combination of 125kg/ha NPK fertilizer + 3t/ha poultry waste is recommended for tomato production in the study area.

2.6. Foliar Fertilizer Application

Zaniewicz-Bajkowska et al. (2010) studied the yield quality of melon (*Cucumis melo* L.). Results showed that foliar-fertilized plants deliver high yields of good quality at lower rates of mineral fertilization. In horticultural practice foliar fertilization is also recommended as the most effective method of supplying plants with nutrients under deficiency conditions. An application of the foliar fertilizers reduced the total sugar and monosaccharides content in melon fruit. Regardless of the kind of foliar feeding, driest matter in the fruit was produced by ‘Pacstart’, total sugar and monosaccharides by ‘Yupi’ and ascorbic acid by ‘Legend’.

Rahman et al. (2015) studied “Review of Foliar Feeding in Various Vegetables and Cereal Crops Boosting Growth and Yield Attributes”. Results showed that foliar application of macro and micro nutrients play an important role in the production of good crop and higher yield.

Mandić et al. (2015) studied the effect of foliar fertilization on soybean grain yield. Results showed that foliar fertilizers significantly increased the values for all quantitative traits. Fertilizer I is more effective than Wuxal super in soybean because this fertilizer has higher concentration of macronutrients. Foliar fertilization of soybean reduced the negative impact of small amounts of rainfall during the summer months on grain yield.

Chaurasia et al. (2005) studied the effect of foliar application of water-soluble fertilizers on growth, yield, and quality of tomato (*Lycopersicon esculentum* L.). Results showed that the application of 5 foliar sprays of water-soluble fertilizers significantly increased the plant height, number of branches, Number of fruits, average fruit weight, fruit length, fruit diameter, TSS, yield and the net profit of tomatoes. The maximum plant height, number of branches/plant, fruit length, yield, net profit along with maximum C:B ratio were recorded by 5 foliar sprays of water soluble liquid fertilizers 19:09:19 followed by NPK 19:19:19. The minimum values in all the parameters were recorded in the control having only recommended dose of fertilizer.

Wójcik (2004) studied the uptake of mineral nutrients from foliar fertilization. Results of the study showed that foliar fertilization is most effective when soil nutrient availability is low, topsoil dry, and

root activity during the reproductive stage is decreased. Foliar fertilization is also successful in increasing content of fruit Ca²⁺ and cereal grain protein. It is proposed that this treatment should be recommended in the integrated plant production because it is environment friendly and increases productivity and yield quality.

3. METHODOLOGY

3.1. Research Design

The experiment was laid out using Randomized Complete Block Design (RCBD) with seven treatments replicated thrice. A total area of 10 m x 12 m (120 m²) was divided into three blocks each representing one replication. Distance between blocks is one (1) meter. Shown below are the treatments and their respective amount and types of fertilizers used.

3.2. Treatments

There were seven (7) treatment combinations used in the study. Each treatment was replicated three (3) times and consisted of fifteen (15) pots per replicate. The total number of treatment replications, each considered an experimental unit, was twenty-one (21).

Randomization was done through drawing of lots. The lay-out shown in Figure 1 below was done following the step-by-step procedure in RCBD experiment since it was conducted in an uncontrolled environment. The treatment combinations are the following:

T₁	=Control
T₂	= Recommended Rate (RR) Inorganic Fertilizer (60-40-60 kg N, P ₂ O ₅ , K ₂ O/ha)
T₃	= RR Organic Fertilizer (30t/ha; 30g/pot)
T₄	= RR Foliar Fertilizer (60ml/ 16 li H ₂ O)
T₅	= 50% RR Inorganic Fertilizer (30-20-30 kg N, P ₂ O ₅ , K ₂ O/ha) + 50% RR Organic Fertilizer (15t/ha; 15g/pot)
T₆	= 50% RR Inorganic Fertilizer (30-20-30 kg N, P ₂ O ₅ , K ₂ O/ha) + 50% RR Foliar Fertilizer (30ml/ 16 li H ₂ O)
T₇	= 50% RR Organic Fertilizer (15t/ha; 15g/pot) + 50% RR Foliar Fertilizer (30ml/ 16 li H ₂ O)

*Treatment (T)

Figure1. Field Layout

3.3. Materials

The following materials were used in this study: plastic pots, fertilizer materials (complete fertilizer, muriate of potash, ammonium sulfate, foliar fertilizer (crop giant) and vermicompost), garden soil,

spade, standard ruler, weighing scale, and *Pechay* seeds (*Brassica napus* L. var. *Black Behi*). Black Behi is an all-season variety adapted to both lowland and highland. It can be harvested in 25 to 39 days after sowing.

3.4. Cultural Management

The variety used in this study was Black Behi from East-West Company. A total of three-hundred fifteen (315) pots were used corresponding to the number of treatments and the number of replications per treatment. Each pot was 8" in diameter and 10" in depth. Soils used in this study were taken from the Dairy Farm of the Mindanao State University-Marawi. The soil was homogenized or mixed thoroughly to ensure that each pot for each treatment and replicate was filled with the same soil quality.

Three seeds were sown per pot. Thinning was done to keep one plant per pot as the seedlings developed their first true leaves. Watering was done uniformly and as necessary for all treatments throughout the study period. The amount of water applied per pot was 200ml per watering. Insect pests were controlled by a combination of handpicking and spraying with crushed /pounded chili solution. The pots were kept weed-free by manual hand pulling where needed and prior to treatment application. Plants were harvested by hand-pulling 45 days after sowing.

3.5. Fertilizer Application/Application of Treatments

Treatment, rate, method, and time of application of fertilizer

Treatment	Description	Rate of Application per Plant	Method of Application	Time of Application
T1	Control	-	-	-
T2	Rec. Rate (RR) Inorganic Fertilizer (60-40-60 kg N, P ₂ O ₅ , K ₂ O/ha)	-2.86 g Complete (C) -3.33 g Muriate of Potash (MOP) - 9.52 g Ammonium Sulfate (AS)	Side dress	-7 days after planting (DAP) for C and MOP -14 days DAP for AS
T3	RR Organic Fertilizer (30t/ha; 30g/pot)	-30 g	Basal	-Before planting
T4	RR Foliar Fertilizer (60ml/ 16 li H ₂ O)	33.33 ml at a rate (3.75 ml per liter of water)	-Foliar spray	-7 DAP -14 DAP -21 DAP
T5	50% RR Inorganic Fertilizer (30-20-30 kg N, P ₂ O ₅ , K ₂ O/ha) + 50% RR Organic Fertilizer (15t/ha; 15g/pot)	-1.43 g Complete (C) -1.67 g Muriate of Potash (MOP) - 4.76 g Ammonium Sulfate (AS) -15g/pot	-Side dress -basal application	-7 days after planting (DAP) for C and MOP -14 days DAP for AS -before planting
T6	50% RR Inorganic Fertilizer (30-20-30 kg N, P ₂ O ₅ , K ₂ O/ha) + 50% RR Foliar Fertilizer (30ml/ 16 li H ₂ O)	-1.43 g Complete (C) -1.67 g Muriate of Potash (MOP) - 4.76 g Ammonium Sulfate (AS) -33.33 ml at a rate (1.88 ml per liter of water)	-Side dress -Foliar spray	-7 days after planting (DAP) for C and MOP -14 days DAP for AS -7 DAP -14 DAP -21 DAP
T7	50% RR Organic Fertilizer (15t/ha; 15g/pot) + 50% RR Foliar Fertilizer (30ml/ 16 li H ₂ O)	-15g/pot -33.33 ml at a rate (1.88 ml per liter of water)	-basal application -foliar spray	-before planting 7 DAP -14 DAP -21 DAP

* The weight of soil per pot is 2kg

*The weight of soil in 1 ha is 2,000,000kg

3.6. Data Gathering Procedures

1. Growth Parameters

1.1. Number of Leaves per plant

This was taken by counting the number of leaves per plant weekly after first treatment application.

1.2. Plant Height

This was taken by measuring from one inch from the base of the plant up to the tip of the highest leaf in weekly interval after first treatment application.

2. Yield Components

2.1. Weight of marketable plant (g)

This was taken by weighing the marketable plants.

2.2. Weight of non-marketable plants (g)

This was taken by weighing the non-marketable plants.

2.3. Total weight of the crop (g)

This was taken by adding the marketable and non-marketable weight of the plants.

3.7. Data Analysis

1. Analysis of Variance (ANOVA) for Randomized Complete Block Design (RCBD)

ANOVA was done for all the data gathered. The data which show significance were compared among treatments by using Tukey Test.

2. Tukey Test (or **Tukey** procedure), also called Tukey's Honest Significant Difference Test, is a post-hoc test based on the student range distribution. To find out which specific group's means (compared with each other) are different after running an ANOVA, Tukey Test should be employed. The test compares all possible pairs of means.

4. RESULTS AND DISCUSSION

4.1. Growth Parameters of *Pechay*

4.1.1. Plant Height (cm)

4.1.1.1. Plant Height at 14 Days After Emergence (DAE)

The plant height of *Pechay* 14 DAE was significantly influenced by different types, levels, and methods of application of fertilizers. As shown in Table 1 plants grown under T₃ (RR Organic Fertilizer (30t/ha; 30g/pot)) were significantly taller with a mean height of 8.12 cm than all others except T₄ and T₇ the latter also having organic fertilizer. Shortest plants were observed in T₁ (Control) with a mean height of 3.09 cm. Moreover, Table 1 shows that T₃ (RR Organic Fertilizer) mean plant height is not significantly different from T₄ (RR Foliar Fertilizer (60ml/ 16 li H₂O)) and T₇ (50% RR Organic Fertilizer + 50% RR Foliar Fertilizer).

Table1. Tukey HSD (Effect of Different Fertilizer Types, Levels and Mode of Application on the Mean Plant Height of *Pechay* (cm) at 14 Days After Emergence (DAE) with Three Replications in RCBD)

Treatments	Mean Plant Height in cm ^a
T1(Control(Garden Soil))	3.09d
T2(RR Inorganic Fertilizer)	6.12c
T3(RR Organic Fertilizer)	8.12a
T4(RR Foliar Fertilizer)	7.04abc
T5(50% RR Inorganic Fertilizer + 50% RR Organic Fertilizer)	6.83bc
T6(50% RR Inorganic Fertilizer + 50% RR Foliar Fertilizer)	6.76bc
T7(50%rRR Organic Fertilizer +50% Foliar Fertilizer)	7.49ab

^a Average of three replications

In the same column, means followed by a common letter(s) are not significantly different at 5% level by Tukey HSD test.

This conforms with the study of Dalal et al. (2014) where vegetables applied with organic fertilizer grew better which resulted to higher total yield, shoot length, and branches than those applied with chemical fertilizers. Prado and Sampaga's (2013) study on the response of *Pechay* to organic fertilizer under DMMMSU-NLUC condition, La Union, Philippines also had similar results where the application of organic inputs for the growth development has comparative advantage over that of the farmers' practice of using urea. Moreover, the organically-fertilized plants being the tallest jibes with

a study by Gonzales et al. (2015) where 25% pure compost provided the best growth and yield performance of *Pechay* in terms of leaf area and fresh weight.

4.1.1.2. Plant Height at 21 Days After Emergence (DAE)

The plant height 21DAE was significantly influenced by different types, levels, and methods of application of fertilizers as shown in Table 2. The table reveals that plants grown in T₂ (RR Inorganic Fertilizer (60-40-60 kg N, P₂O₅, K₂O/ha)) were significantly the tallest versus all other treatments with a mean height of 9.85 cm. significantly shortest plants were observed in T₁ (Control) with a mean height of 4.99 cm.

Table2. Tukey HSD (Effect of Different Fertilizer Types, Levels and Mode of Application on the Mean Plant Height of Pechay (cm) at 21 Days after Emergence (DAE) with Three Replications in RCBD)

Treatments	Mean Plant Height in cm ^a
T1(Control(Garden Soil))	5.00e
T2(RR Inorganic Fertilizer)	9.85a
T3(RR Organic Fertilizer)	8.44d
T4(RR Foliar Fertilizer)	8.44d
T5(50% RR Inorganic Fertilizer + 50% RR Organic Fertilizer)	9.26b
T6(50% RR Inorganic Fertilizer + 50% RR Foliar Fertilizer)	9.34b
T7(50%rRR Organic Fertilizer +50% Foliar Fertilizer)	8.88c

^a Average of three replications

In the same column, means followed by a common letter(s) are not significantly different at 5% level by Tukey HSD test.

The results are similar with the findings of Eifediyi and Remison (2010) where use of inorganic fertilizer on cucumber revealed significant differences in terms of vine length, number of branches, and leaf area. This is followed by *Pechay* plants grown in T₆(50% RR Inorganic Fertilizer+ 50% RR Foliar Fertilizer) and T₅ (50% RR Inorganic Fertilizer + 50% RR Organic Fertilizer) which were also 50% inorganic fertilize-treated plants. Again, T₁ plants (Control) receiving no fertilizer were the shortest.

4.1.1.3. Plant Height at 28 Days After Emergence (DAE)

Plant height at 28 DAE was significantly influenced by different types, levels, and methods of application of fertilizers. As shown in Table 3, plants grown in T₂ (RR Inorganic Fertilizer (60-40-60 kg N, P₂O₅, K₂O/ha)) were significantly the tallest with a mean height of 14.02cm. The shortest plants were observed in T₁ (Control) with a mean height of 7.93 cm. Again, this conforms to the study by Eifediyi and Remison (2010) where cucumber plants applied with inorganic fertilizers showed superior vegetative growth.

Table3. Tukey HSD (Effect of Different Fertilizer Types, Levels and Mode of Application on the Mean Plant Height of Pechay (cm) at 28 Days after Emergence (DAE) with Three Replications in RCBD)

Treatments	Mean Plant Height in cm ^a
T1(Control(Garden Soil))	7.93g
T2(RR Inorganic Fertilizer)	14.02a
T3(RR Organic Fertilizer)	12.80d
T4(RR Foliar Fertilizer)	13.76b
T5(50% RR Inorganic Fertilizer + 50% RR Organic Fertilizer)	11.40e
T6(50% RR Inorganic Fertilizer + 50% RR Foliar Fertilizer)	13.27c
T7(50%rRR Organic Fertilizer +50% Foliar Fertilizer)	10.48f

^a Average of three replications

In the same column, means followed by a common letter(s) are not significantly different at 5% level by Tukey HSD test.

The result also agrees with the study of Masarirambi (2010) that commercial and subsistence farming has been and is still relying on the use of inorganic fertilizers for growing crops. In addition, Lian et al. (2017) found that the application of inorganic fertilizer improved the growth and development of crops faster than the application of organic fertilizers.

4.1.1.4. Plant Height at 35 Days after Emergence (DAE)

The data showed that the mean plant height of *Pechay* 35 DAE was significantly influenced by different types, levels, and methods of application of fertilizers (Table 4). T₂ Plants (RR Inorganic Fertilizer (60-40-60 kg N, P₂O₅, K₂O/ha)) remained significantly the tallest with a mean height of 14.39 cm. While T₁ (Control) plants also stayed the shortest with a mean height of 8.49 cm. Results at 35 DAE are consistent at 21 days after emergence. This means that *Pechay* plants even grown in pots under inorganic fertilizer are superior in height compared to organic and foliar fertilizer.

Table4. Tukey HSD (Effect of Different Fertilizer Types, Levels and Mode of Application on the Mean Plant Height of Pechay (cm) at 35 Days After Emergence (DAE) with Three Replications in RCBD)

Treatments	Mean Plant Height in cm ^a
T1(Control(Garden Soil))	8.50g
T2(RR Inorganic Fertilizer)	14.39a
T3(RR Organic Fertilizer)	13.14c
T4(RR Foliar Fertilizer)	13.03d
T5(50% RR Inorganic Fertilizer + 50% RR Organic Fertilizer)	11.84e
T6(50% RR Inorganic Fertilizer + 50% RR Foliar Fertilizer)	13.84b
T7(50%rRR Organic Fertilizer +50% Foliar Fertilizer)	10.75f

^a Average of three replications

In the same column, means followed by a common letter(s) are not significantly different at 5% level by Tukey HSD test.

This result further agrees with Omidire et al.'s (2015) study on the "Impacts of Inorganic and Organic Fertilizer on Crop Performance Under a Microirrigation-Plastic Mulch Regime" which showed that the inorganic fertilizer had higher yields (lbs/acre) than organic fertilizer.

4.1.1.5. Plant Height at 42 Days After Emergence (DAE)

The study showed that the mean plant height of *Pechay* 42 DAE was significantly influenced by different types, levels, and methods of application of fertilizers (Table 5). As shown in Table 5, T₂ plants (RR Inorganic Fertilizer (60-40-60 kg N, P₂O₅, K₂O/ha)) stayed significantly the tallest with a mean height of 14.56 cm. This was followed by T₆ (50% RR Inorganic Fertilizer + 50% RR Foliar Fertilizer) and T₃ (RR Organic Fertilizer (30t/ha; 30g/pot)) and T₄ (RR Foliar Fertilizer (60ml/ 16 li H₂O)); the latter two treatments being insignificantly different from each other having mean plant heights of 13.33 and 13.24 cm respectively. This shows that as far as plant height, T₃ plants applied with organic fertilizers are performing at par with T₄ plants applied with synthetic foliar fertilizer. The shortest plants were observed in T₁ (Control) with a mean height of 8.66 cm.

Table5. Tukey HSD (Effect of Different Fertilizer Types, Levels and Mode of Application on the Mean Plant Height of Pechay (cm) at 42 Days After Emergence (DAE) with Three Replications in RCBD)

Treatments	Mean Plant Height in cm ^a
T1(Control(Garden Soil))	8.66f
T2(RR Inorganic Fertilizer)	14.56a
T3(RR Organic Fertilizer)	13.33c
T4(RR Foliar Fertilizer)	13.24c
T5(50% RR Inorganic Fertilizer + 50% RR Organic Fertilizer)	11.90d
T6(50% RR Inorganic Fertilizer + 50% RR Foliar Fertilizer)	13.74b
T7(50%rRR Organic Fertilizer +50% Foliar Fertilizer)	10.95e

^a Average of three replications

In the same column, means followed by a common letter(s) are not significantly different at 5% level by Tukey HSD test.

Lian et al. (2017) support this result in that they found, inorganic fertilizer is a kind of fast and high nutrient chemicals. Moreover, Eifediyi and Remison's (2010) study on "The Effects of Inorganic Fertilizer on the Yield of Two Varieties of Cucumber (*Cucumis sativus* L.)" also conforms with this. They found that the growth and yield attributes of cucumber increased significantly with increase in inorganic fertilizer application.

These facts cause the farmers to use inorganic fertilizers. Studies by Pascual et al. (2013), pointed out that to produce high yield, most growers use synthetically-based products. Synthetically-based fertilizers are the most common fertilizers used by the farmers (Gonzales et al., 2015).

Result of the study showed T₂ (RR Inorganic Fertilizer (60-40-60 kg N, P₂O₅, K₂O/ha)) plants as the tallest, followed by T₆(50% RR Inorganic Fertilizer + 50% RR Foliar Fertilizer) plants. T₆plants are nearly comparable with T₂. This shows that foliar fertilizer is also a viable alternative in *Pechay* production. The results conform with Zaniewiez-Bajkowska et al.'s (2010) study on "The Yield Quality of Melon (*Cucumis melo* L.)" where foliar-fertilized plants deliver high yields of good quality at lower rates of mineral fertilization. In horticultural practice, foliar fertilization is also recommended as the most effective method of supplying plants with nutrients under deficiency conditions.

Rahman et al.'s (2015) study entitled "Foliar Feeding in Various Vegetables and Cereal Crops Boosting Growth and Yield Attributes" also agrees that T₆(50% RR Inorganic Fertilizer + 50% RR Foliar Fertilizer) is a viable alternative to T₂ (RR Inorganic Fertilizer (60-40-60 kg N, P₂O₅, K₂O/ha)). Results of their study showed that foliar application of macro and micro nutrients play an important role in the production of good crop and higher yield.

4.1.2. Growth Rate

Table 6 shows that the mean growth rate of *Pechay* 42 DAE was significantly influenced by different types, levels, and methods of application of fertilizers. It revealed that the highest growth rate of *Pechay* was observed in T₂ (RR Inorganic Fertilizer (60-40-60 kg N, P₂O₅, K₂O/ha)) with the mean growth rate of 3.015 mm per day. The shortest growth rate was observed in T₇ (50% RR Organic Fertilizer (15t/ha; 15g/pot) + 50% RR Foliar Fertilizer (30ml/ 16 li H₂O)) with the mean value of 1.237 mm per day. Moreover, Table 6 showed that T₂ is significantly different from all other treatments.

Table 6. Tukey HSD (Effect of Different Fertilizer Types, Levels and Mode of Application on the Growth Rate of *Pechay* (mm/day) from Day 14 to 42 Days After Emergence (DAE) with Three Replications in RCBD)

Treatments	Mean Growth Rate mm/day ^a
T1(Control(Garden Soil))	1.988c
T2(RR Inorganic Fertilizer)	3.015a
T3(RR Organic Fertilizer)	1.863c
T4(RR Foliar Fertilizer)	2.216bc
T5(50% RR Inorganic Fertilizer + 50% RR Organic Fertilizer)	1.811c
T6(50% RR Inorganic Fertilizer + 50% RR Foliar Fertilizer)	2.493b
T7(50%rRR Organic Fertilizer +50% Foliar Fertilizer)	1.237d

^a Average of three replications

In the same column, means followed by a common letter(s) are not significantly different at 5% level by Tukey HSD test.

Figure2. Effect of the Different Fertilizer Types, Levels and Mode of Application on the Mean Growth Rate of *Pechay* from 14 to 42 Days After Emergence (DAE)

Masarirambi (2010) pointed out that commercial and subsistence farming has been and is still relying on the use of inorganic fertilizers for growing crops. This is because they are easy to use, quickly absorbed and utilized by crops. This, therefore, proves that the application of inorganic fertilizer yields higher than organic fertilizer. In addition, Omidire et al. (2015) showed that inorganic fertilizer

had higher yields (lbs/acre) than organic fertilizer. Lian et al. (2017) also revealed that inorganic fertilizer is a kind of fast and high nutrient chemicals.

Nurhidayatia et al. (2016) studied the yield and quality of cabbage (*Brassica oleracea* L. var. *capitata*) under organic growing media using vermicompost and earthworm *Pontoscolex corethrurus* inoculation contradicts to the result of the study. Results revealed that the application of vermicompost combined with inoculation of earthworm *P. corethrurus* significantly increased total biomass, marketable weight, crop diameter, and harvest index compared with the cabbage grown in inorganic media. However, Ahirwar and Hussain's (2015) study on the effect of vermicompost on growth, yield, and quality of vegetable crops contradicts to the result of the present study. They found that the application of vermicompost positively affected the growth of vegetable transplants, perhaps by altering the nutritional balance of the medium. Transplant quality was improved in peppers and eggplants while tomato transplant quality was slightly reduced. Further, there were no significant differences in field performance. Hence, vermicomposting is a sustainable technique for solid waste disposal.

Figure3. Effect of the Different Fertilizer Types, Levels and Mode of Application on the Mean Plant Height of Pechay from 14 to 42 Days After Emergence (DAE)

Legend:

- Red:** T₁ Control (garden soil)
- Green:** T₂ RR Inorganic Fertilizer
- Blue:** T₃ RR Organic Fertilizer (30t/ha; 30g/pot)
- Yellow:** T₄ RR Foliar Fertilizer
- Violet:** T₅ 50% RR Inorganic Fertilizer + 50% RR Organic Fertilizer
- Lavender:** T₆ 50% RR Inorganic Fertilizer + 50% Foliar Fertilizer
- Brown:** T₇ 50% Organic Fertilizer + 50% Foliar Fertilizer

4.1.3. Number of Leaves

4.1.3.1. Number of Leaves at 14 Days After Emergence (DAE)

Table 7 shows that the mean number of leaves 14 DAE was significantly influenced by different types, levels, and methods of application of fertilizers. The highest number of leaves was observed in T₃ (RR Organic Fertilizer (30t/ha; 30g/pot)) which was significantly different from the rest except T₇ (50% RR Organic Fertilizer (15t/ha; 15g/pot) + 50% RR Foliar Fertilizer (30ml/ 16 li H₂O)) with a mean of 4.267 and 3.900 respectively. The least number of leaves was observed in T₁ (Control) with a mean value of 2.953. (30ml/ 16 li H₂O)) but significantly different from all other treatments.

Table7. Tukey HSD (Effect of Different Fertilizer Types, Levels and Mode of Application on the Number of Leaves of Pechay at 14 Days After Emergence (DAE) with Three Replications in RCBD)

Treatments	Mean Number of Leaves ^a
T1(Control(Garden Soil))	2.953d
T2(RR Inorganic Fertilizer)	3.553bc
T3(RR Organic Fertilizer)	4.267a
T4(RR Foliar Fertilizer)	3.490bc
T5(50% RR Inorganic Fertilizer + 50% RR Organic Fertilizer)	3.623bc
T6(50% RR Inorganic Fertilizer + 50% RR Foliar Fertilizer)	3.290cd
T7(50%rRR Organic Fertilizer +50% Foliar Fertilizer)	3.900ab

^a Average of three replications

In the same column, means followed by a common letter(s) are not significantly different at 5% level by Tukey HSD test.

The results conform with the findings of Kaur et al. (2015) in their study “The Effect of Vermicompost and Vermiwash on Growth of Vegetables”. They found that organic waste material processed by the naturally occurring earthworm was used to produce vermicompost which supplies nutrients and other soil stimulants for plant growth and improve soil quality. Another study by Arancon and Edwards (2005) supports the result of this study where vermicompost used at lower substitution rates, increases growth, flowering and yields of vegetable and ornamental crops.

4.1.3.2. Number of Leaves at 21 Days after Emergence (DAE)

Table 8 shows that the mean number of leaves of plants 21 DAE was to some extent significantly influenced by different types, levels, and methods of application of fertilizers. Table 8 shows that the highest number of leaves was observed in T₃ (RR Organic Fertilizer (30t/ha; 30g/pot)) with a mean of 6.930. Coming second is T₆ (50% RR Inorganic Fertilizer (30-20-30 kg N, P₂O₅, K₂O/ha) + 50% RR Foliar Fertilizer (30ml/ 16 li H₂O)) and then third is T₄ (RR Foliar Fertilizer (60ml/ 16 li H₂O)), T₅ (50% RR Inorganic Fertilizer (30-20-30 kg N, P₂O₅, K₂O/ha) + 50% RR Organic Fertilizer (15t/ha; 15g/pot)) and T₇ (50% RR Organic Fertilizer (15t/ha; 15g/pot) + 50% RR Foliar Fertilizer (30ml/ 16 li H₂O)). The least number of leaves was observed in T₁ (Control) with the mean value of 4.113. Moreover, T₃ (RR Organic Fertilizer (30t/ha; 30g/pot)) is significantly different from all other treatments.

Table8. Tukey HSD (Effect of Different Fertilizer Types, Levels and Mode of Application on the Number of Leaves of Pechay at 21 Days After Emergence (DAE) with Three Replications in RCBD)

Treatments	Mean Number of Leaves ^a
T1(Control(Garden Soil))	4.113d
T2(RR Inorganic Fertilizer)	5.490c
T3(RR Organic Fertilizer)	6.930a
T4(RR Foliar Fertilizer)	5.510c
T5(50% RR Inorganic Fertilizer + 50% RR Organic Fertilizer)	5.623c
T6(50% RR Inorganic Fertilizer + 50% RR Foliar Fertilizer)	6.290b
T7(50%rRR Organic Fertilizer +50% Foliar Fertilizer)	5.510c

^a Average of three replications

In the same column, means followed by a common letter(s) are not significantly different at 5% level by Tukey HSD test.

The result of the study agrees with Bercero et al. (2014) who pointed out that the application of *T. harzianum* + *E. fetida* compost produced comparable results as to the number of leaves, leaf width, leaf length, fresh weight and dry weight with the positive control (inorganic fertilizer (Urea) at 0.65

grams' plant⁻¹) indicating that it is a good alternative to application of inorganic fertilizer to the growth of *Pechay*. Compost derived from the application of *T. harzianum* + Vermi worms is highly recommended to produce *Pechay*.

4.1.3.3. Number of Leaves at 28 Days After Emergence (DAE)

Table 9 shows that the mean number of leaves of plants 28 DAE was not significantly influenced by different types, levels, and methods of application of fertilizers. Table 9 shows that all treated plants (T₂ – T₇) are not significantly different from each other which shows that the number of leaves is not affected by the different types, levels, and methods of fertilizer application.

Table9. Tukey HSD (Effect of Different Fertilizer Types, Levels and Mode of Application on the Number of Leaves of Pechay at 28 Days After Emergence (DAE) with Three Replications in RCBD)

Treatments	Mean Number of Leaves ^a
T1(Control [Garden Soil])	5.490b
T2(RR Inorganic Fertilizer)	7.133a
T3(RR Organic Fertilizer)	7.890a
T4(RR Foliar Fertilizer)	8.087a
T5(50% RR Inorganic Fertilizer + 50% RR Organic Fertilizer)	8.023a
T6(50% RR Inorganic Fertilizer + 50% RR Foliar Fertilizer)	7.290a
T7(50%rRR Organic Fertilizer +50% Foliar Fertilizer)	7.510a

^a Average of three replications

In the same column, means followed by a common letter(s) are not significantly different at 5% level by Tukey HSD test.

4.1.3.4. Number of Leaves at 35 Days After Emergence (DAE)

Table 10 shows that the mean number of leaves 35 DAE was significantly influenced by different types, levels, and methods of application of fertilizers. As shown, the highest number of leaves of plant was observed in T₅ (50% RR Inorganic Fertilizer (30-20-30 kg N, P₂O₅, K₂O/ha) + 50% RR Organic Fertilizer (15t/ha; 15g/pot)) with a mean leaf number of 9.847. The least number of leaves was observed in T₁ (Control) with a mean value of 6.490. Moreover, while T₅ is significantly different from all other treatments, all T₂, T₃, T₄, T₆ and T₇ are not significantly different from one another. Again, this may confirm an earlier finding of this study that the number of leaves is not significantly affected by the different types, levels, and methods of fertilizer application. This is also seen in Table 11 where practically all plants receiving fertilizers (T₂ – T₇) except (T₆) are not significantly different from one another in terms of the number of leaves.

Table10. Tukey HSD (Effect of Different Fertilizer Types, Levels and Mode of Application on the Number of Leaves of Pechay at 35 Days After Emergence (DAE) with Three Replications in RCBD)

Treatments	Mean Number of Leaves ^a
T1(Control [Garden Soil])	6.490c
T2(RR Inorganic Fertilizer)	8.290b
T3(RR Organic Fertilizer)	8.667b
T4(RR Foliar Fertilizer)	8.433b
T5(50% RR Inorganic Fertilizer + 50% RR Organic Fertilizer)	9.847a
T6(50% RR Inorganic Fertilizer + 50% RR Foliar Fertilizer)	8.290b
T7(50%rRR Organic Fertilizer +50% Foliar Fertilizer)	8.513b

^a Average of three replications

In the same column, means followed by a common letter(s) are not significantly different at 5% level by Tukey HSD test.

4.1.3.5. Number of Leaves at 42 Days after Emergence (DAE)

Table 11 shows that the mean number of leaves 42 DAE was to a great extent not significantly influenced by the different types, levels, and methods of application of fertilizers. As shown, the highest number of leaves was observed in T₅ (50% RR Inorganic Fertilizer (30-20-30 kg N, P₂O₅, K₂O/ha) + 50% RR Organic Fertilizer (15t/ha; 15g/pot)) with a mean of 10.197. The least number of leaves was observed in T₁ (Control (garden soil)) with a mean value of 6.867. However, no significant differences can be seen between and among the fertilizer treated plants as to number of leaves. This again leads to an earlier observation (since at 28 DAE) that the different types, levels, and methods of

application did not affect the total number of leaves. This contradicts the results obtained by Ogundare et al. (2015) where plant height, leaf numbers, branch number, and fruit number per plant of tomato among others were significantly affected by the combined use of organic and inorganic fertilizers.

Table11. Tukey HSD (Effect of Different Fertilizer Types, Levels and Mode of Application on the Number of Leaves of Pechay at 42 Days After Emergence (DAE) with Three Replications in RCBD)

Treatments	Mean Number of Leaves ^a
T1(Control(Garden Soil))	6.867b
T2(RR Inorganic Fertilizer)	8.800a
T3(RR Organic Fertilizer)	8.953a
T4(RR Foliar Fertilizer)	8.897a
T5(50% RR Inorganic Fertilizer + 50% RR Organic Fertilizer)	10.197a
T6(50% RR Inorganic Fertilizer + 50% RR Foliar Fertilizer)	8.580ab
T7(50%rRR Organic Fertilizer +50% Foliar Fertilizer)	8.917a

^a Average of three replications

In the same column, means followed by a common letter(s) are not significantly different at 5% level by Tukey HSD test.

4.2. Yield Components (Weight of Marketable Plant [in g])

Table 12 shows that the different types, levels, and methods of fertilizer application used had highly significant influence on the total weight of the plants. As shown in Table 12, T₂ (Rec. Rate (RR) Inorganic Fertilizer (60-40-60 kg N, P₂O₅, K₂O/ha)) came out the highest in total weight or yield with a mean of 225.863. this was subsequently followed by T₆ (50% RR Inorganic Fertilizer (30-20-30 kg N, P₂O₅, K₂O/ha) + 50% RR Foliar Fertilizer (30ml/ 16 li H₂O)), T₃(RR Organic Fertilizer (30t/ha; 30g/pot)), T₄ (RR Foliar Fertilizer (60ml/ 16 li H₂O)), T₇ (50% RR Organic Fertilizer (15t/ha; 15g/pot) + 50% RR Foliar Fertilizer (30ml/ 16 li H₂O)) and T₅ (50% RR Inorganic Fertilizer (30-20-30 kg N, P₂O₅, K₂O/ha) + 50% RR Organic Fertilizer (15t/ha; 15g/pot)) with mean weights of 201.503 g, 187.290 g, 185.580 g, 164.203 g, and 154.557 g, respectively.

Table12. Tukey HSD (Effect of Different Fertilizer Types, Levels and Methods of Application on the Mean Weight of Marketable Pechay in Grams with Three Replications in RCBD)

Treatments	Mean Weight in gram ^a
T1(Control [Garden Soil])	-
T2(RR Inorganic Fertilizer)	225.863a
T3(RR Organic Fertilizer)	187.290c
T4(RR Foliar Fertilizer)	185.580d
T5(50% RR Inorganic Fertilizer + 50% RR Organic Fertilizer)	154.557f
T6(50% RR Inorganic Fertilizer + 50% RR Foliar Fertilizer)	201.503b
T7(50%rRR Organic Fertilizer +50% Foliar Fertilizer)	164.203e

^a Average of three replications

In the same column, means followed by a common letter(s) are not significantly different at 5% level by Tukey HSD test.

^{ns} = not significant

^{**} = significant at $\alpha = 0.01$

cv = 0.15 %

The result of the study conforms with the study by Eifediyi and Remison (2010) which showed that fruit number per plant and total yield including the vegetative parameter increased significantly ($P < 0.05$) with the increase in inorganic fertilizer application up to the highest level. In this study, the two highest marketable weights were T₂ (Rec. Rate (RR) Inorganic Fertilizer (60-40-60 kg N, P₂O₅, K₂O/ha)) and T₆ (50% RR Inorganic Fertilizer (30-20-30 kg N, P₂O₅, K₂O/ha) + 50% RR Foliar Fertilizer (30ml/ 16 li H₂O)); both commercial inorganic fertilizers, although half of the fertilizer applied in T₆ was foliar. Zaniewicz-Bajkowska et al. (2010) cite that in horticultural practice, foliar fertilization is also recommended as the most effective method of supplying plants with nutrients under deficiency conditions.

5. CONCLUSION

First, the use of all inorganic fertilizer (T_2 and T_6), in *Pechay* production either applied on the ground or foliar is more effective in terms of total marketable weight or yield. Moreover, it can be said that as far as this study the different types, levels and methods of fertilizer application only had significant results or differences between treatments on the plant height and marketable weight parameters, not on the number of leaves for the most part.

Second, as far as plant height and marketable weight, T_3 (RR Organic Fertilizer (30t/ha; 30g/pot)) came a close third after T_2 (Rec. Rate (RR) Inorganic Fertilizer (60-40-60 kg N, P_2O_5 , K_2O /ha)) and T_6 (50% RR Inorganic Fertilizer (30-20-30 kg N, P_2O_5 , K_2O /ha) + 50% RR Foliar Fertilizer (30ml/16 li H_2O)). In addition, T_3 topped the sales due to much lower production cost, the use of all organic fertilizer (in this case, vermicompost) is a very viable alternative to higher and more profitable *Pechay* production which is safe for human consumption.

RECOMMENDATIONS

Based on the results and conclusions of this study, the use of organic fertilizers is therefore highly recommended. This will foster the conversion of biodegradable farm wastes to inexpensive organic fertilizers and produce vegetables that are safe for human consumption.

In areas where land area is a problem, this study showed that the use of pots can be a viable alternative to increase vegetable production and provide food in urban settings. Moreover, the result of the study is recommended for dissemination to the Department of Agriculture (DA) to guide the farmers to use safe fertilizer options. Further studies on *Pechay* production is recommended especially on the use of different organic fertilizer sources and the foliar method of fertilizer application.

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Citation: Abdani D. Bandera, (2020). "Inorganic Fertilizers (Ground and Foliar Application) and Organic Fertilizer: Their Effects on the Growth and Yield of Pechay (*Brassica napus* L. subsp. *chinensis* var. *Black Behi*)", *International Journal of Research Studies in Agricultural Sciences (IJRSAS)*, 6(5), pp. 38-55. DOI: <http://dx.doi.org/10.20431/2454-6224.0606005>

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