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Frequency Application of Vermicast on the Horticultural Performances of Leaf Type Lettuce (*Lactuca sativa* Linn.) with 19-19-19+Microelements as Supplementation

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Abstract: ***The study was laid out in Randomized Complete Block Design (RCBD) with four treatments and three replications. The treatments were as follow: T1 – Untreated, T2 - Weekly Application, T3- Bi-weekly Application, and T4- Monthly Application. The data on percent (%) mortality were transformed using square root of transformation before Analysis of Variance (ANOVA). Results: revealed not significant in terms of percent mortality in weekly and monthly application of the treatment having a mean of 1.76 % and 3.09 %. However, significant differences were observed in horticultural performances such as; plant height with a mean of 10.63 cm in weekly application and 6.40 cm for the untreated, leaf width with a mean of 10.80 cm for the weekly application and 6.03 for the untreated, fresh weight with a mean of 25.67 g for the weekly application and 6.83 g for the untreated, and yield with a mean of 1,208.33 kg/ha for the weekly application and 327.08 kg/ha for the untreated, respectively. Results further exposed that profitability of lettuce in terms of Return of Production Cost (RPC) were; Bi-weekly with 91.01 %, Monthly with 68.20 %, Weekly with 25.34 % and Untreated (Control) with 16.69 %.***

Keywords: economic profitability, vermicast, percent mortality and 19-19-19+M.E

1. Introduction

Lettuce (*Lactuca sativa*) is an annual plant of the aster or sunflower family Asteraceae. It is most often grown as a leaf vegetable, but sometimes for its stem and seeds. Lettuce is the only member of the *Lactuca* genus to be grown commercially. It is an annual plant native to the Mediterranean area. Cultivation may have started as early as 4500 BC, perhaps initially for the edible oil extracted from its seeds. The primitive forms of lettuce were loose and leafy.

In 2011, the world production was 2, 432, 416 tons of lettuce. In the Philippines, 3, 519 tons of lettuce was produced in the same year [9].

Lettuce is not well known in the locality. Farmers thought that this crop is not adaptable to the climate that we have in lowland. But some new varieties can tolerate warmer conditions. Leaf type lettuce is an ideal type that has promising higher yield and easier to cultivate. It can be grown throughout the year. It has short span of growing to maturity. It can be harvested 50 days after sowing. Short growing period means lesser exposure to many threats during vegetative stage except soil nutrition.

Moreover, the move of Philippine government is toward organic agriculture and it is true after the approval of Republic Act 10068 also known as Organic Agriculture Act of 2010.

Likewise, vermicompost is an organic fertilizer that serves as soil conditioner and enhances soil fertility and promotes vigorous and healthy crop growth. It also contains humus with high levels of nutrients such as nitrogen, potassium, magnesium, and calcium. It is the system of stabilizing organic materials under controlled conditions by specific worm species or African Night Crawler and microorganisms under mesophilic temperatures.

Lettuce is often grown in cool weather and planted using vermicompost in our locality was not yet even tried. Supplementation of 19-19-19+M.E. will make it better since it contains N-P-K and selected microelements to meet the nutritive requirements of the crop. Thus, this study was conducted.

General Objective

This study was conducted to determine the effect of frequency application of vermicast as supplemented with 19-19-19+M.E. in lettuce.

Specific Objectives

1) To identify the agronomic performance of lettuce as affected by frequency application of vermicast as supplemented with 19-19-19+M.E.; and
2) To assess the economic profitability of lettuce as applied with vermicast as supplemented with 19-19-19+M.E.

2. Methodology

Location and Duration of the Study

The field experiment was conducted in Purok 3, Barangay Tiburcia, Kapalong, Davao del Norte from October 2018 to March 2019.

Experimental Design and Treatments

The study was laid out using Randomized Complete Block Design (RCBD) with four treatments and replicated three times. The treatments were as follow:

T1- Control
T2- Weekly Application
T3- Bi-weekly Application
T4- Monthly Application

Soil Sampling and Analysis
Soil was collected randomly using "X" pattern from the area, air dried and brought to Bureau of Soils, Department of Agriculture, Agdao, Davao City for analysis and fertilizer recommendation.

Land Preparation and Plot Establishment
The experimental field, measuring 148 m^2, was plowed thoroughly, using shovel, until the soil became well pulverized. This was done primarily to break the clods to ensure the growth of the plant. The area was divided into four treatments. Each treatment was further subdivided into three replication with the size of 2x4 m.

Seedling Preparation
The 'Red Rapid Variety' was used as planting materials. Seedbox was prepared approximately 5-6 inches deep, covered with vermicast. The seeds were sown with a distance of 2 cm between rows and 2 cm between hills. The seeds were covered with fine soil approximately 1-2 cm high and pressed carefully, water moderately after sowing. The seedbed was watered every morning until the seedlings were fully grown or as necessary.

Pricking
The seedlings were pricked into banana leaf cups three days of after the emergence.

Hardening
Hardening of seedling was done five days after the emergence (DAE) by exposing the seedling to direct sunlight with simultaneous reduction of watering. This was done to make the seedlings more prepared to field condition or transplanting shock.

Transplanting
Lettuce seedlings were placed unto individual seedlings with the distance of 12 inches between hills and within rows. Once transplanted, the seedlings were watered immediately to prevent transplanting shock that will affect survival rate of the transplanted seedlings. Transplanting was done late in the afternoon to conserve moisture in the soil during the transplanting.

Watering
Watering was done regularly to maintain the moisture in the lettuce beds. Since lettuce is shallow-rooted, the soil was kept evenly moist.

Treatments Application
A 50 grams of vermicast were applied basally per hill and 2 tbps of Crop Giant® (19-19-19+M.E.) in 16 liters of water were mixed and then applied at weekly, bi-weekly and monthly interval through foliar application. This was done early in the morning.

Weeding
Manual weeding was done to remove weeds between hills and around the plant, 10 days after transplanting (DAT).

Pests Control
This was done by spraying 2tbps/16L of water of cypermethrin 15DAT.

Harvesting
Leaf type lettuce was harvested 50 days after sowing (DAS). Uprooting was done early in the morning to remain the crispiness and freshness of the harvest. Plastic bags were used as container after uprooting.

Postharvest
Lettuce can easily wilt due to pressure. It can be removed from field immediately, washed gently 2-3 times with cold water, packed using smooth cellophane pricked in both sides using needle.

Data Gathered

Plant Height (cm)
Data were taken from ten sample plants per plot by measuring from the base up to the tip of the crop at harvest time using tape measure.

Leaf Width (cm)
This was taken at harvest from ten sample plants per plot by measuring midpoint of the widest leaves. This was measured using tape measure.

Fresh Weight (g)
This was taken at harvest from ten samples per plot using the newly purchased vegetable weighing scale.

Percent Mortality (%)
The data were taken by counting the number of plants died per plot using the formula below:

$$\% \text{ Mortality} = \frac{\text{Number of plants died per plot}}{\text{Total number of plants per plot}} \text{ X } 100$$

Yield (kg/ha)
The data was taken by weighing all the harvested plants from each treatment and converted to a hectare basis using the formula below:

$$\text{Yield (kg/ha)} = \frac{\text{Yield / plot (kg)}}{\text{Plot size (m}^2\text{)}} \text{ X } 10000 \text{ m}^2 \text{ / ha}$$

Economic Analysis
The Return of Production Cost (RPC) was computed using the formula below:

$$\text{RPC} = \frac{\text{Total expenses}}{\text{Net income}} \text{ X } 100$$

Statistical Analysis
The data were gathered and tabulated using Analysis of Variance (ANOVA) in Randomized Complete Block Design (RCBD). The zero means underwent transformation using square root of transformation before ANOVA. The significant difference among treatment means was further analyzed using Tukey's Honestly Significant Difference (HSD) Test at 5% level of significance.

3. Results and Discussion

Plant Height (cm)

Table 1 shows the data on the average plant height (cm) of lettuce as affected by frequency application of vermicast as supplemented with 19-19-19+M.E. The results revealed highly significant differences among treatment means.

Weekly application got the highest mean of 10.63 cm. This indicates that lettuce grow taller when applied with vermicast as supplemented with 19-19-19+M.E. and the lowest plant height was attained by Control with a mean of 6.40 cm. [1-2] reported that the highest level of nitrogen fertilizer (180 kg N ha^{-1}) produced the tallest plants and the shortest plants formed in the control (without N). Similar results have been reported in investigations conducted by [3].

Table 1: Plant height (cm) of lettuce as affected by frequency application of vermicast as supplemented with 19-19-19+M.E

Treatment	Plant Height (cm)			Treatment	
	I	II	III	Total	Mean**
Control	6.60	5.70	6.90	19.20	6.40[c]
Weekly Application	11.10	10.00	10.80	31.90	10.63[a]
Bi-weekly Application	9.70	10.80	9.80	30.30	10.10[a]
Monthly Application	8.70	9.30	9.40	27.40	9.13[b]
RT	36.10	35.80	36.90		
GT				108.80	
GM					9.07

Treatment means having the same letter superscript are not significantly different from each other.
CV%= 6.82 **= highly significant
RT = Replication Total; GT = Grand Total; GM =Grand Mean

Moreover, as fertilizer, vermicast contains nutrients forms that are readily taken up by plants, such as nitrates, exchangeable phosphorous, soluble potassium, calcium and magnesium. Vermicast promotes the production of plant hormones, auxins,gibberellins and cytokinins from organic waste dramatically auxins are responsible for cell elongation, cytokinins for promoting cell division and gibberellins for stem elongation. These hormones are dose significant and play a fundamental role in plant metabolism. They can influence plant growth and development as well as crop quality significantly when present at very low concentrations [10].

Likewise, foliar fertilizer is any substance applied in a liquid form. Many different NPK formulation combinations can be made, depending on the application required. These elements are required for plant growth and development and true in peanut [5] and Bell pepper [2].

Results further reveal that lettuce is sensitive to heavy applications of nitrogen and other micro and macroelements and its plant height (cm) was affected by varying frequency application of vermicast as supplemented with 19-19-19+M.E.

Leaf Width (cm)

Table 2 shows the data on the average leaf width (cm) of lettuce as affected by varying frequency application of vermicast as supplemented with 19-19-19+M.E. The results exposed significant differences among treatment means.

Table 2: Leaf Width (cm) of lettuce as affected by frequency application of vermicast as supplemented with 19-19-19+M.E.

Treatment	Leaf Width (cm)			Treatment	
	I	II	III	Total	Mean**
Control	6.40	5.50	6.20	18.10	6.03[c]
Weekly Application	11.70	10.30	10.40	32.40	10.80[a]
Bi-weekly Application	9.40	10.60	9.70	29.70	9.90[a]
Monthly Application	8.70	8.90	8.70	26.30	8.77[b]
RT	36.20	35.30	35.00		
GT				106.50	
GM					8.88

CV%= 6.94 **= highly significant. Treatment means having the same letter superscript are significantly different from each other.
RT = Replication Total; GT = Grand Total; GM =Grand Mean

Weekly application got the highest mean of 10.80 cm. This indicates that lettuce responded well in terms of leaf width when applied with vermicast as supplemented with 19-19-19+M.E. and the lowest leaf width was attained by Control with a mean of 6.03 cm.

As reported by [7-8] stated that, vermicompost have the same benefits as pasteurized or composted soil conditioners when incorporated into soil. These include reduction of soil erosion, particularly in exposed soil areas, increased water retention in the upper soil profile, thereby reducing the frequency of watering to maintain plant growth, release of nutrients for plant growth such as root elongation and leaf width, thus reducing the need for chemical fertilizers.

Similarly, with foliar feeding, as it is known, the nutrients are absorbed directly through the leaves of the plant. They work their way down the roots, but they also stimulate activity in the leaves, which in turn stimulates root development, because the plant starts to demand more water. Applying foliar fertilizer can increase uptake of nutrients from the soil by encouraging plants to take up more water, in addition to providing immediate benefits for a plant which may be suffering from deficiency[8]. Results reveal that the leaf width (cm) of lettuce was affected by varying frequency application of vermicast as supplemented with 19-19-19+M.E..

Fresh Weight (g)

Table 3 shows the data on the average fresh weight (g) of lettuce as affected by varying frequency application of vermicast as supplemented with 19-19-19+M.E. The results revealed significant differences among treatment means.

The data shows that weekly application of vermicast as supplemented with 19-19-19+M.E. in lettuce statistically gave the heaviest weight with a mean of 25.67 g while control got the lightest weight with a mean of 6.83 g.

Table 3: Fresh weight (g) of lettuce as affected by varying frequency application of vermicast as supplemented with 19-19-19+M.E.

Treatment	Fresh Weight (g)			Treatment	
	I	II	III	Total	Mean**
Control	6.50	6.00	8.00	20.50	6.83[c]
Weekly Application	28.00	24.00	25.00	77.00	25.67[a]
Bi-weekly Application	21.00	24.50	23.00	68.50	22.83[a]
Monthly Application	12.50	12.00	11.50	36.00	12.00[b]
RT	68.00	66.50	67.50		
GT				202.00	
GM					16.83

CV%= 10.06 **= highly significant .Treatment means having the same letter superscript are significantly different from each other.

RT = Replication Total; GT = Grand Total; GM =Grand Mean

According to the Morarka Foundation in India (2008) as cited by [7], the higher the rate of vermicast application, the more the crop needs sufficient nutrient quantity that helps in better growth and production of such crop.

In the same way, foliar fertilizer is designed as a supplement which will increase efficiency and improve plant health. Uptake of nutrients from the soil can be very inefficient, and it can take several days for noticeable effects to occur. Foliar fertilizers act more quickly, and far more efficiently, as most of the fertilizer ends up in the plant, rather than in the soil [6-7].

The results uncover that varying frequency application of vermicast as supplemented with 19-19-19+M.E. affects the fresh weight (g) of lettuce.

Percent Mortality (%)

The data on the percent mortality of lettuce as affected by the varying frequency application of vermicast as supplemented with 19-19-19+M.E. Analysis of Variance reveals insignificant differences among treatment means.

Table 4: Percent mortality (%) of lettuce as affected by varying frequency application of vermicast as supplemented with 19-19-19+M.E.

Treatment	Percent Mortality (%)			Treatment	
	I	II	III	Total	Mean[ns]
Control	2.83	2.83	3.24	8.90	2.97
Weekly Application	1.73	2.83	0.71	5.27	1.76
Bi-weekly Application	2.83	2.35	3.24	8.42	2.81
Monthly Application	3.61	2.83	2.83	9.27	3.09
RT	11.00	10.84	10.02		
GT				31.86	
GM					2.66

CV%= 26.74 [ns]= not significant. Data were transformed using square root of transformation before ANOVA.
RT = Replication Total; GT = Grand Total; GM =Grand Mean

Weekly application got the lowest number of mortality with a mean of 1.76 %. On the other hand, Monthly Application got the highest number of mortality with a mean of 3.09 %.

The results exposed that varying frequency application of vermicast as supplemented with 19-19-19+M.E. does not affect the percent mortality of lettuce.

Yield (kg/ha)

The data on the average yield (kg/ha) of lettuce as affected by varying frequency application of vermicast as supplemented with 19-19-19+M.E. is shown in Table 5. Analysis of variance reveals highly significant differences among treatment means.

Weekly application got the highest mean of 1208.33 kg/ha. This indicates that lettuce gives higher yield when applied with vermicast as supplemented with 19-19-19+M.E. and the lowest yield was attained by Control with a mean of 6.40 cm.

The highest level of vermicast (In. Fert. + 200% Vermicompost) gave the highest yield and lowest yield was attained by Control (without vermicompost) [7]. According to Webster (1997) as cited by [3], vermicompost gave highest yields on all crops tested due to highest absorbability of macro and micro nutrients in vermicast compared to any other product.

Foliar spray is the most effective method of micronutrients application because it determines the deficiency symptoms due to particular nutrients. The results exposed that varying frequency application of vermicast as supplemented with 19-19-19+M.E. affects the yield (kg/ha) of lettuce.

Table 5: Yield (kg/ha) of lettuce as affected by varying frequency application of vermicast as supplemented with 19-19-19+M.E.

Treatment	Yield (kg/ha)			Treatment	
	I	II	III	Total	Mean**
Control	268.75	275.00	437.50	981.25	327.08[c]
Weekly Application	1350.00	1112.50	1162.50	3625.00	1208.33[a]
Bi-weekly Application	937.50	1137.50	1025.00	3100.00	1033.33[a]
Monthly Application	550.00	575.00	537.50	1662.50	554.17[b]
RT	3106.25	3100.00	3162.50		
GT				9368.75	
GM					780.73

CV%= 13.83 **= highly significant. Treatment means having the same letter superscript are not significantly different from each other.

RT = Replication Total; GT = Grand Total; GM =Grand Mean

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