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Influence of Different Forms of Rabbit (*Oryctologuscuniculus*) Manure on the Growth and Yield Response of Onion (Allium cepa) 'RED PINOY' VAR. in Magsaysay, Occidental Mindoro

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Abstract: ***This study employed the experimental method of research to determine the growth response of onion applied with different forms of rabbit manure. It was conducted in SitioCabag, Brgy. Poblacion, Magsaysay, Occidental Mindoro from December 24, 2020 to April 2020. The same cultural management practices was used to each replication to produce healthy onions, the only variation is the treatment used such as commercial organic fertilizer, fresh rabbit manure and rabbit vermicompost. Result shows that the onion bulbs applied with the fresh rabbit manure got the highest growth response in terms of number of leaves and length of roots as well as the highest yield response in terms of bulb size, fresh weight of bulbs; and dry weight of bulbs as compared to the other treatments. Further, there is no significant difference on the growth and yield response of bulb onion applied with different forms of rabbit manure.***

Keywords: bulb size, vermicompost, rabbit manure

1. Introduction

Organic agriculture is a pathway to address not only hunger and malnutrition but also other challenges including poverty, water use, climate change, and unsustainable production and consumption (IFOAM, nd). It is a holistic system designed to optimize the productivity and appropriateness of diverse communities within the agro-ecosystem.

Sustainable and organic agriculture practices apply management ideals that include a diverse assembly of farming methods, usually with a reduced reliance on purchased inputs (Hue & Silva, 2000) this is especially for new farmers with limited resources (Smith J& El-Swaify, 2006). As commercial fertilizer price increase, farmers have realized the need for locally available fertilizers from organic sources to improve soil fertility, crop health, and productivity. Further, the adverse impacts of input-intensive agriculture on the environment and health has been one of the concerns that needs to be solved using organic fertilizer.

In years to come, utilization of organic manure to meet crop nutrient requirement will be an unavoidable practice to enhance sustainable agriculture, this is because, the physical, chemical and biological properties of soil is generally improved by the addition of organic manures which in turn enhances crop productivity and maintains the quality of crop produce. Although, in comparison to inorganic fertilizers, organic manures contain smaller quantities of plant nutrients. The use of inorganic fertilizer to increase yield has been found to be effective as a short-term solution but demands consistent use on a long-term basis (Maheswarappa, et al, 1999).

Rabbit manure can be used as alternative fertilizer to different crops. Fresh rabbit manure is approximately 2 percent nitrogen, 1 percent phosphorus and 1 percent potassium. It does not burn plants. Moreover, rabbit manure has four times more nutrients than cow or horse manure and is twice as rich as chicken manure. Cow, horse and chicken manure are considered "hot" and need to be composted (well-rotted) to use as fertilizers (https: //www.canr. msu. edu). According to deep free permaculture. com (nd), rabbit manure has the following 3-4.8 %N, 1.5-2.8 %P, 1-1.3 %K, medium release speed.

Rabbit manure can be used as fresh and composted using African night crawler. Vermicomposting is a process that uses earthworms to transform organic residues into a secondary product named vermicompost, which can be used as a fertilizer for crop production (Dominguez, 2004). Vermicomposting is therefore an interesting solution for both recycling the increasing amount of organic waste and reducing the use of fertilizers (Blouin, et al., 2019).

Vermicompost constitutes a source of plant macro-and micronutrients. Although some of these nutrients are present in inorganic forms and are readily available to plants, most are released gradually through mineralization of the organic matter, thus constituting a slow-release fertilizer that supplies the plant with a gradual and constant source of nutrients (Chaoui et al., 2003). However, agricultural producers often claim that crop yields are much lower with this type of fertilizer than with inorganic fertilizers. This is generally attributed to the fact that the amount of nutrients provided by organic fertilizers is very unreliable in comparison with those supplied by inorganic fertilizers (Trewavas, 2001). Furthermore, most of the benefits oforganic fertilizers on soil fertility have mainly been

reported to be long-term effects, so that repeated applications over several years are necessary to achieve the desired steady state thatwill guarantee crop productivity.

Positive effects of vermicompost include stimulated seed germination in several plant species such as green gram (Karmegam et al.1999), tomato plants (Atiyeh et al.2000b; Zaller 2007), petunia (Arancon et al.2008) and pine trees (Lazcano et al., 2010a). Vermicompost also has a positive effect on vegetative growth, stimulating shoot and root development (Edwards et al., 2004). Vermicompost produced significant improvements in the growth and yield of sweet corn, as also reported by Atiyeh et al. (2000b), Arancon et al. (2004b) and Singh et al. (2008).

Likewise, a study was conducted by Marigmen and Magarro (2009) onvermicompost used in tomato, eggplant, and bell pepper in Occidental Mindoro condition that gives higher yield compared with conventional fertilizer. Further, Declaro-Ruedas and Ruedas (2013) applied vermicompostin the Yellow Granex' onion, which obtained higher growth and yield response. The paper recommends to utilize other source of vermicompost. Similarly, the proponents also engage in rabbitry wherein, rabbit manure is one of its by-products. Thus, this study was conducted using different forms of rabbit manure in onion production. Lastly, this study is under the institutional Bulb Crops Project presented last 2019 RDE Proposal Presentation.

Onion was the test crop used in this study. Farmers in Magsaysay, Occidental Mindoro grow onions as second crop after rice. Onions typically reach their peak from March to May after which the rains return and rice is again planted. Onion industry is one of the good-income generating ventures of the province. However, it is still beset with several problems on production such as pests and diseases and drought (Calitang and Orfiano, 2011); increasing price of farm inputs; non-availability of appropriate post-harvest facilities; unstable price of the product, and absence of quality control measures (Ruedas and Ruedas, 2012). Based on the agricultural production statistics, the MIMAROPA Region ranked second as garlic producing region with 18% share to the total national production; and ranked third as an onion producing region with 10% share to the total national production (BAS, 2009).

2. Objectives

The following were the objectives of the study:

1) Determine growth response of onion applied with different forms of rabbit manure, in terms of:
   a) Number of leaves; and
   b) Length of roots.
2) Determine the yield response of onion applied with different forms of rabbit manure, in terms of:
   a) Size of bulb;
   b) Fresh weight of bulb; and
   c) Dry weight of bulb.
3) Determine the significant difference on the growth and yield performance of onion applied with different forms of rabbit manure.

Hypothesis

There is no significant difference on the growth and yield performance of onion applied with different forms of rabbit manure.

3. Materials and Methods

Time and Place of the Study

This study was conducted in SitioCabag, Brgy. Poblacion, Magsaysay, Occidental Mindoro from December 24, 2020 to April 2020.

Experimental Layout

The Randomized Complete Block Design (RCBD) was used in this study. The field was divided into units to account for any variation in the field. Treatments were then assigned at random to the subjects in the blocks-once in each block (Washington State University, 2000). The test plant received the same cultural management except for the experimental treatments. This was based on previous use of chemical fertilizers in the area based on soil type, which is 6 bags of chemical fertilizer/ha for clay soil and the recommended organic fertilizer per hectare is 20-100 bags (Adorada, 2000).

Block 1	Block 2	Block 3
T1 R1	T2 R2	T3 R3
T2 R1	T3 R2	T2 R3
T3 R1	T1 R2	T1 R3

Figure 2: Experimental Layout

Legend:
T1 = commercial fertilizer
T2 = rabbit manure (fresh)
T3 = rabbit vermicompost
Number of treatments = 3
Number of replications = 3
Number of plants = 900
Distance planting = 15 x 15 cm (Malixi, 1981)

Cultural Practices and Management

The Philippine National Standard for onion production was followed. The same care and management practices was used to each replication to produce healthy onions. The treatment varies in the use of rabbit vermicompost.

Land preparation: This study utilized maximum tillage method of land preparation. It is usually practiced in the lowland rice fields after the harvest of rice. Rice straw, rice hull, and weeds are cut closed to the ground. Canals was constructed around the paddies to ensure no standing water after heavy rain or irrigation.

Sowing of Seeds: Bulb onion seeds was sowed in beds and transplanted at 25-35 days after sowing. For the transplanting method while in direct planting method, seeds was directly sowed to the growing areas.

Distance of Planting: The distances of planting was 15 centimetres (cm) x 15 cm.

Weeding: Weed eradication was done through chemical method and physical method by hand pulling

Fertilization: Bulb onions have similar nutritional requirements to other alliums, removing about 130 kg of nitrogen (urea), 30 kg of phosphorus (16-0-20) and 60 kg of potassium (0-0-60) per hectare. The treatments were added as basal application.

Pest and Disease Management: Insecticide was used to control thrips. Downy mildew (*Peronosphora destructor*) and Purple Blotch (*Alternariaporri*) are the major leaf diseases. These diseases can be controlled using fungicide at 0.2% for treating the downy mildew. Bulb rot is caused by *Fusarium sp*. regular spraying of fungicide gives effective control. Avoid planting in a hard to drained area or the low lying areas.

Irrigation: Watering is very critical during the vegetative and bulbing stages of the growth of bulb onion. The plants must be watered 10-15 days based on the wetness of soil. Flooding irrigation will be the utilized. Watering frequency is reduced once the bulb is near to maturity. Watering has to be stopped completely one week prior to harvesting.

Harvesting: Harvesting period must not coincide with the wet to minimize bulb rot. The bulbs are harvested 12-14weeks after planting. Mature bulbs are ready for harvesting when the tops fall over and the leaves dried up. The uprooted onion was left in the field to sun dry. Leaves are cut off about 2.5 cm from the bulb.

Sorting and Storage: The bulbs was classified according to its size in diameter (Small, Medium, Large and Jumbo), removed the damage bulb and put in the red bags and piled not more than 5 stacks. The bulb onion was stored in a clean cool, dry place with good ventilation.

Statistical Analysis

The analysis of variance (ANOVA) at 5% level of significance using the Microsoft Excel software was used in analysing and interpreting the data gathered. This was used to determine the significant difference among the means of two or more groups (Freedman et al., 2007).

4. Results and Discussion

Growth Response of Red Pinoy Onion

Number of leaves

The number of fully grown functional leaves were counted in each of the ten plants and average was taken as number of leaves per plant at all crop growth stages. The Red Pinoy onion that were applied with fresh rabbit manure got the highest number of leaves of 7.11 as compared to the onion that are applied with rabbit vermicompost of 6.36 and commercial fertilizer 6.49.

Rabbit manure can be directly applied to the crops because it is considered as “cold” manure and it will only take about 3 – 5 days for the manure to completely breakdown, settling at the bottom. Rabbit manure contained 20% C organic matter, 1.3% Nnutrient; P 2.18%; Mg 1.88%; K 0.2%; and pH 5.6 [9]. Manure (animal manure) has been widely used to increase soil fertility and soil physical properties (Soelaeman & Haryati, 2012).

According to the study of El-mogy, et al (2020), the effect of either mineral or organic fertiliser on soil fertility or the microbial community was also studied. Control plots were fertilised with recommended rates of mineral fertiliser (150: 45: 65 kg/ha NPK) and the other treatments were 15 t/ha compost, 10 t/ha rabbit manure, and 10 t/ha chicken manure. Our results indicated that all sources of organic fertiliser significantly increased total nitrogen, organic carbon, total fungi, and bacteria contents of soils compared with mineral fertiliser. Rabbit and chicken manure fertilisers resulted in a significant increase in yield. Compared with conventional fertiliser and other organic treatments, plots receiving rabbit manure showed a lower weight loss and microbial load on fresh lettuce head. Moreover, rabbit manure significantly reduced polyphenol oxidase and peroxidase activity. Hence, these results suggest that rabbit manure fertiliser could be an alternative to conventional production without significant reduction in yield and with low enzymatic browning and better storability.

Table 1 (a): Number of leaves.

Treatments	Size of bulb			Treatment Total (T)	Treatment Mean
	R1	R2	R3		
T1-Commercial	6.00	6.40	7.07	19.47	6.49
T2-Rabbit manure (fresh)	7.07	7.20	7.07	21.33	7.11
T 3-Rabbit Vermicompost	6.00	6.40	6.67	19.07	6.36
Replication Total (R)	19.07	20.00	20.80		
Grand Total				59.87	
Grand Mean					6.65

The results of statistical analysis revealed that there is no significant difference using the analysis of variance. A computed F-value 6.175 was obtained which is lower than critical value of 6.944272. This suggests that the different forms of rabbit manure such as the fresh and composted can be used as fertilizer.

Table 3 (b): Analysis of variance on the number of leaves of the onion.

Source of Variation	SS	df	MS	F	P-value	F crit
Treatment	0.975802	2	0.487901	6.175	0.059853	6.944272
Block	0.501728	2	0.250864	3.175	0.149362	6.944272
Error	0.316049	4	0.079012			
Total	1.79358	8				

Length of roots

Root length was measured by excavating onion in the soil and washing out roots, and then measure it using a ruler. The Red Pinoy onion that were applied with fresh rabbit manure got the longest root length of 4.83 as compared to the onion that is applied with rabbit vermicompost of 4.30 and commercial fertilizer 4.41.

Table 2 (a): Length of rootse

Treatments	Size of bulb			Treatment Total (T)	Treatment Mean
	R1	R2	R3		
T1-Commercial	4.20	4.20	4.83	13.23	4.41
T2-Rabbit manure (fresh)	5.00	4.73	4.77	14.50	4.83
T 3-Rabbit Vermicompost	4.47	4.23	4.20	12.90	4.30
Replication Total (R)	13.67	13.17	13.80		
Grand Total				40.633	
Grand Mean					4.51

The results of statistical analysis revealed that there is no significant difference using the analysis of variance. A computed F-value 3.465361was obtained which is lower than critical value of 6.944272. This suggests that the different forms of rabbit manure such as the fresh and composted can be used as fertilizer.

Table 2 (b): Analysis of variance on the length of roots of the onion

Source of Variation	SS	df	MS	F	P-value	F crit
Treatment	0.475756	2	0.237878	3.465361	0.133913	6.944272
Block	0.076289	2	0.038144	0.555681	0.612416	6.944272
Error	0.274578	4	0.068644			
Total	0.826622	8				

Yield response of Red Pinoy Onion

Size of bulb

The onions were graded based on their size. The Red Pinoy onion that were applied with commercial fertilizer (Treatment 1) and rabbit vermicompost registered the same diameter of 5.52 cm as compared to the onion that is directly applied with fresh rabbit manure with a bulb size of 6.02 cm. This holds true with the study of Ikrarwati et al (2021) that it is consistent with the response shown in the vegetative growth parameters, the level of rabbit manure upto 75% increased the ability of ultisol soil to produce onion bulbs. Meanwhile, the best yield of bulbs obtained from the treatment of 25% and 50% rabbit manure level.

For local market, the size of the bulb falls under the medium onion category with less than 6 cm diameter (Bautista, 2000) with a market price from Php40.00-43.00 per kilogram during the harvest season in April 2021.

Table 3 (a): Size of bulb

Treatments	Size of bulb			Treatment Total (T)	Treatment Mean
	R1	R2	R3		
T1-Commercial	5.42	5.34	5.82	16.57	5.52
T2-Rabbit manure (fresh)	5.94	5.70	6.42	18.06	6.02
T 3-Rabbit Vermicompost	5.40	5.62	5.56	16.57	5.52
Replication Total (R)	16.75	16.66	17.80		
Grand Total				51.21	
Grand Mean					5.69

The results of statistical analysis revealed that there is no significant difference using the analysis of variance. A computed F-value 6.037486 was obtained which is lower than critical value of 6.944272. This suggests that the different forms of rabbit manure such as the fresh and composted can be used as fertilizer.

Table 3 (b): Analysis of variance on the size of bulb of the onion

Source of Variation	SS	df	MS	F	P-value	F crit
Treatment	0.486756	2	0.243378	6.037486	0.061918	6.944272
Block	0.265689	2	0.132844	3.29548	0.142643	6.944272
Error	0.161244	4	0.040311			
Total	0.913689	8				

Fresh weight of bulb

Fresh weight of bulb refers to the weight of the bulb at harvest. Result of the study shows that bulbs in Treatment 2 obtained the heaviest weight with a mean 1.80 kg as compared to Treatment 1 and 3 with mean weight of 1.6 kg and 1.46 kg, respectively.

Table 4 (a): Fresh weight of bulb

Treatments	Size of bulb			Treatment Total (T)	Treatment Mean
	R1	R2	R3		
T1-Commercial	1.40	1.60	1.80	4.80	1.60
T2-Rabbit manure (fresh)	1.80	1.60	2.00	5.40	1.80
T 3-Rabbit Vermicompost	1.30	1.60	1.50	4.40	1.46
Replication Total (R)	4.50	4.80	5.30		
Grand Total				14.60	
Grand Mean					1.62

The results of statistical analysis revealed that there is no significant difference using the analysis of variance. A computed F-value 3.454545was obtained which is lower than critical value of 6.944272. This suggests that the different forms of rabbit manure such as the fresh and composted can be used as fertilizer.

Table 4 (b): Analysis of variance on the fresh weight of bulb of the onion

Source of Variation	SS	df	MS	F	P-value	F crit
Treatment	0.168889	2	0.084444	3.454545	0.134444	6.944272
Block	0.108889	2	0.054444	2.227273	0.223841	6.944272
Error	0.097778	4	0.024444			
Total	0.375556	8				

Dry weight of bulbs

Dry weight refers to the weight of bulbs after curing for 6-10 days (Bautista, 2000). Treatment 2 obtained the heaviest weight with a mean 1.43 kg as compared to Treatment 1and 3, with mean weight of 1.36 and 1.16 kg. Curing reduces bulb weight. The acceptable weight loss of 3-5% is normal under ambient drying conditions and up to 10 % with artificial drying (Thompson, 1982). However, estimated loss in bulb onion crop is high and can reach 16-35% (Steppe, 1976).

Table 4 (a): Dry weight of bulb

Treatments	Size of bulb			Treatment Total (T)	Treatment Mean
	R1	R2	R3		
T1-Commercial	1.30	1.20	1.60	4.10	1.36
T2-Rabbit manure (fresh)	1.40	1.30	1.60	4.30	1.43
T 3-Rabbit Vermicompost	1.00	1.20	1.30	3.50	1.16
Replication Total (R)	3.70	3.70	4.50		
Grand Total				11.90	
Grand Mean					1.32

The results of statistical analysis revealed that there is no significant difference using the analysis of variance. A computed F-value 6.117647 was obtained which is lower than critical value of 6.944272. This suggests that the different forms of rabbit manure such as the fresh and composted can be used as fertilizer.

Table 4 (b): Analysis of variance on the dry weight of bulb of the onion.

Source of Variation	SS	df	MS	F	P-value	F crit
Treatment	0.115555556	2	0.057777778	6.117647059	0.060701533	6.94427191
Block	0.142222222	2	0.071111111	7.529411765	0.044048163	6.94427191
Error	0.037777778	4	0.009444444			
Total	0.295555556	8				

5. Conclusions

The study has the following conclusions:

1) The onion bulbs applied with the fresh rabbit manure got the highest growth response in terms of number of leaves and length of roots.
2) The onion bulbs applied with the fresh rabbit manure yields the highest response in terms of bulb size, fresh weight of bulbs; and dry weight of bulbs as compared to the other treatments.
3) There is no significant difference on the growth and yield response of bulb onion applied with different forms of rabbit manure.

6. Recommendation

The studies recommends the use of other forms of rabbit manure like foliar fertilizer and test its efficacy with other high value crops.

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