



Combined Effect of Organic Fertilizer and Vermicast for Organic Onion (*Allium cepa* L.) Production in Fully Converted Organic Area

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ABSTRACT

A field experiment was conducted to evaluate the influence of organic fertilizer application in the production of organic onion. The study was conducted in a fully converted organic field at CLSU RM-CARES using the following treatments; for treatment 1 was the control or no fertilizer, treatment 2 was the organic fertilizer of 8 t/ha applied before transplanting, treatment 3 was the vermicast of 8 t/ha applied before transplanting, treatment 4 was combined organic fertilizer and vermicast at the same rate of 4 t/ha applied before transplanting, and the treatment 5 was combined organic fertilizer of 4 t/ha and vermicast of 4 t/ha, half of each fertilizer material was applied before transplanting and another half was applied 30 days after transplanting. Results revealed that combined organic fertilizer and vermicast application as bio-fertilizer had no influence on the diameter size and weight of individual bulb after harvest. However, application of combined organic fertilizer and vermicast at the rate of 4 t/ha each of fertilizer materials applied before transplanting significantly increased the production of marketable bulb, yield per plot and computed yield per hectare. On the other hand, nitrogen and phosphorus uptake of onion was observed a comparable result to all organic fertilizers applied. Moreover, plants fertilized with combined organic fertilizer and vermicast at the same rate of 4 t/ha each of fertilizer materials applied before transplanting significantly obtained the highest potassium uptake with 2.36 t/ha. Follow up studies on the effect on growth and yield of combined fertilizer material should be conducted to confirm and further explain our findings.

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Introduction

Onion (*Allium cepa* L.) of the family Alliaceae, is one of the most important commercial vegetable crops cultivated extensively in the Philippines. Onion bulb is a rich source of minerals like phosphorus, calcium and carbohydrates. It also contains protein and vitamin C and is being used in several ways as fresh, frozen and dehydrated bulbs. Onion contains medicinal value like anticancer agent which was shown to prevent cancer in animals (Bagali et al., 2012).

Conventional onion production requires too much application of inorganic fertilizer and pesticides to obtain maximum yield and to protect the crops from insect pest infestation. Due to increasing price of agricultural inputs particularly fertilizers and pesticides; small farmers cannot cope with the situation. On the other hand, it has recently been found out that these harmful chemicals cause damage to the human immune system, thereby reducing the overall resistance of the body. Some farmers have already switched to organic onion cultivation. The reduced amount of toxins that are taken in by the consumer leads to increased and higher degree of immunity and stamina for the consumer as compared to normally grown onions.

The steady depletion of native soil fertility and the occurrence of multiple nutrient deficiencies in onion field had led to the identification of nutrient management as a key factor limiting sustainable onion production (Sharma et al., 2003, Ngullie et al., 2011).

As cited by Lopez et al. (2014) large amount of chemical fertilizers are used for crop production particularly in onion production and continued use of chemical fertilizer led to serious nutrient imbalances and soil degradation. Alternative production practices with low production cost and environmentally acceptable organic inputs must be developed to lessen the use of chemicals, which among others will require the use of organic fertilizer and other organic inputs.

The promoting effect of potassium fertilizer on the onion yield may be due to that potassium is involved in maintenance of ionic balance in cells and it bounds ionically to the enzyme pyruvate kinase, which is essential in respiration of carbohydrate metabolic. The yield response to adequate phosphorus and potassium fertilizer could be attributed to response of all tested growth features of onion plant (Aisha et al., 2007).

As sited by Jayathilake et al. (2003) an adequate and uniform supply of nitrogen is essential for plant growth, bulb

yield and good quality. A major constraint in increasing crop yield is the supply of nutrients particularly the nitrogen. On the other hand, with the adoption of improved technology for obtaining higher yield per unit area, the requirement of the nutrients has increased by many folds. Continuous use of inorganic fertilizers has resulted in deficiency of micronutrients, imbalance in soil physico-chemical properties and unsustainable crop production. Use of organic manures in combination with chemical fertilizers in an appropriate proportion improves the soil health for sustainable production. Therefore, integrated nutrient management is a viable strategy for advocating judicious and efficient use of chemical fertilizers with addition of organic and bio-fertilizers.

This research intended to determine the efficacy of combined organic fertilizers and vermicast that improved the growth and yield of onion to help farmers lessen the use of chemicals which among others that will require the use of organic fertilizer and other organic inputs. The study focused on the evaluation of the yield performance of onion content uptake was also evaluated after application of combined organic fertilizer and vermicast throughout the experiment.

Materials and Methods

This was conducted at RM-CARES Field Demo Farm for field experiment and at RM-CARES Microbial Laboratory for the laboratory activities in Central Luzon State University, Science City of Muñoz, Nueva Ecija, Philippines from November 04, 2016 to March 26, 2017.

Prior to the setting up of the experiment, soil sampling and analysis were done for macronutrient and texture analysis.

A single factor experiment arranged in a Randomized Complete Block Design (RCBD) with five treatments replicated four times was used in this study. An area of 504 square meter was divided into four equal blocks of 120m² representing the replications. Each block was further subdivided into five equal plots of 4m x 4m (16m²). A distance of one meter was provided in between blocks and 0.5 meter in between plots.

Five treatments were evaluated in this study: T1=control (no fertilizer); T2=organic fertilizer alone of 8 t/ha applied before transplanting; T3=vermicast alone of 8 t/ha applied before transplanting; T4=organic fertilizer and vermicast of the same rate of 4 t/ha applied before transplanting; and T5=organic fertilizer of 4 t/ha and vermicast of 4 t/ha half of each fertilizer materials applied before transplanting and another half of each fertilizer materials at 30 days after transplanting.

A 35 days old seedling of Onion Improved Red Express variety were transplanted in prepared plots with planting distance of 15 x 15 cm in between rows and hills.

Organic fertilizer produced by RM-CARES at Central Luzon State University was used as organic fertilizer in this study. It had a chemical analysis of 4.73% N, 1.20% P₂O₅, 0.39% K₂O and 25.13% organic carbon with a moisture content of 35%. Also vermicast produced by the center was used as another organic fertilizer. It had a guaranteed analysis of 3.36% N, 0.84% P₂O₅, and 0.84% K₂O. The recommended rate of both organic fertilizer was 8t/ha.

In terms of cultural management practices, first irrigation was done one week after transplanting. Succeeding irrigation of the experimental plots was done at weekly interval and

terminated 10 days before harvesting of onion bulbs. Spot weeding was done one week after transplanting. Succeeding weeding operations was done whenever

necessary throughout the duration of the study to keep the area clean and to avoid onion and weed competition for light, water and nutrients. All weeding activities were done by hand pulling. Aside from those practices, insect pest management is also practiced. Likewise, infection by diseases was monitored and symptoms manifested by the crop were described.

Five sample plants outside the harvested area were randomly harvested to measure below and above ground biomass within the sampling areas for analysis of the plant tissue on total N using Kjeldahl method, P in Vanadomolybdate method and K using Flame Photometer method.

All data gathered were analyzed using Randomized Complete Block Design (RCBD). A comparison among treatment means was done using Duncan's Multiple Range Test (DMRT) at 5% level of significance.

Results and Discussion

Agro-Climatic Condition

The area where the field experiment was conducted was within Type 1 climate based on the Modified Coronas Climate Classification, this type has two pronounced seasons, dry from November to April and wet during the rest of the year. Maximum rain period is from June to September.

Climatic data such as rainfall, temperature and relative humidity were obtained from the production of seedlings up to harvesting (November 04, 2016 to March 26, 2017) at the Philippine Astronomic Geophysical Astronomical Services Administration (PAG-ASA) Station, CLSU, Science City of Muñoz, Nueva Ecija. Based on the data gathered, the total monthly rainfall during the conduct of the study ranged from 6.7 to 57.2mm, whereas, the relative humidity ranged from 74 to 76%, there was no heavy rains incidence during the study for the crop not to damage during bulb formation. On the other hand, mean monthly temperature ranged from minimum of 21.5 to 23.5°C to maximum of 30.0 to 31.6°C provided a conducive condition for the growth and development of onion.

The entire climatic occurrences were within the preferred condition in which onion grew and developed properly.

Yield Performance

The performance of onion as affected by types of organic fertilizer application is shown in Table 1. Onion plants fertilized with combined organic fertilizer and vermicast at the same rate of 4t/ha applied before transplanting significantly produced the highest computed yield per hectare with a mean of 19.64 t/ha. This yield was 38.70% higher than the yield obtained from the control plants (no fertilizer) with a mean of 14.16 t/ha.

Noticeably, onion plants fertilized with combined organic fertilizer and vermicast at the same rate of 4t/ha applied in split method, half of each fertilizer material applied before transplanting and another half applied at 30 day after transplanting as well as those plants fertilized with pure vermicast at the rate of 8t/ha applied before transplanting significantly produced comparable from plants fertilized with pure organic fertilizer of 8 t/ha applied before transplanting.

Interestingly, the highest yield of 19.64 t/ha obtained from this study was almost the same with the potential yield of the variety which ranged from 20-25 t/ha when grown and fertilized with inorganic fertilizer materials as reported by Allied Botanical Corporation (Undated).

Table 1. Computed yield per hectare (t/ha) of onion as influenced by types of organic fertilizer.

Treatment	Computed Yield (t/ha)
T1-Control (no fertilizer)	14.16 ^c
T2-Organic fertilizer alone (8 t/ha) applied before transplanting	16.25 ^{bc}
T3-Vermicast alone (8 t/ha) applied before transplanting	18.97 ^{ab}
T4-Organic fertilizer (4 t/ha) and Vermicast (4 t/ha) applied before transplanting	19.64 ^a
T5-Organic fertilizer (4 t/ha) and Vermicast (4 t/ha) half of each fertilizer applied before transplanting and another half applied at 30 DAT	19.05 ^{ab}

Means followed by a common letter are not significantly different at 5% level by DMRT

Based on the result of the study, the increase in yield of onion could be attributed to the addition of nutrients to the soil through application of organic fertilizer and vermicast coupled with favorable climatic condition in the experimental area throughout the duration of the study. It is interesting to note that the experimental area has been fully converted to organic production area for almost seven years since 2010. It is probable that continuous application of organic fertilizer for the last seven years had already improved the structure of the soil and possibly increased its fertility status. Hence, addition of combined organic fertilizer and vermicast provided additional nutrients for the growth and development of onion to increase the yield.

The yield of onion per hectare was significantly affected by application of organic fertilizer and vermicast applied before transplanting or in split application at planting and at 30 DAT.

Nutrient Uptake of Onion (t/ha)

Fertilizer application significantly influenced the nutrient uptake of onion. On the other hand, significantly comparable result on the nitrogen uptake was observed on plants applied in any organic fertilizer (organic fertilizer alone or combined organic fertilizer) as compared to plants with no fertilizer (Table 2). There was no significant result on phosphorus uptake at harvest. However, highly significant result was observed for potassium uptake on plants fertilized with combined organic fertilizer and vermicast at the same rate of 4 t/ha applied before transplanting with 2.36 t/ha, but this was significantly comparable to all plants applied in any organic fertilizer materials (organic fertilizer alone or combined organic fertilizer and vermicast) at harvest.

Table 2. Nutrient uptake (t/ha) of onion per hectare at harvest as influenced by types of organic fertilizer.

	Nutrient Uptake (t/ha)		
	N	P	K
T1-Control (no fertilizer)	1.96 ^b	0.52 ^a	1.93 ^b
T2-Organic fertilizer alone (8 t/ha) applied before transplanting	2.23 ^{ab}	0.54 ^a	2.17 ^{ab}
T3-Vermicast alone (8 t/ha) applied before transplanting	2.45 ^a	0.54 ^a	2.24 ^{ab}
T4-Organic fertilizer (4 t/ha) and Vermicast (4 t/ha) applied before transplanting	2.44 ^a	0.59 ^a	2.36 ^a
T5-Organic fertilizer (4 t/ha) and Vermicast (4 t/ha) half of each fertilizer applied before transplanting and another half at 30 DAT	2.42 ^a	0.53 ^a	2.19 ^{ab}

Means followed by a common letter are not significantly different at 5% level by DMRT

Result of the study shows that the higher the nutrient uptake, coupled with favorable climatic condition in the experimental area throughout the duration of the study was influenced the growth and development of onion and obtained much bigger in bulb size and heavier in weight. Addition of combined organic fertilizer and vermicast noticeably provided increases the nutrients of the soil were increased the yield of onion.

Conclusion

Based on the significant findings of the study, it is concluded that the use of organic fertilizer and vermicast applied before transplanting could improve the yield and quality of organic onion. The application of combined organic fertilizer and vermicast at the same rate of 4 t/ha significantly produced higher percentage of marketable bulbs, higher yield per plot and computed yield per hectare.

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References

- Aganon, C.P. 2002. Soil and Crop Management on the Production of Peri-Urban Vegetable. Central Luzon State University, Science City of Muñoz, Nueva Ecija, Philippines
- Aisha, A.H., Rizk, F.A., Shaheem, A.M., and Abdel-Mouty, M.M. 2007. Onion Plant Growth, Bulbs Yield and its Physical and Chemical Properties as Affected by Organic and Natural Fertilization. *Research Journal of Agriculture and Biological Sciences*, 3(5): 380-388, 2007, INSInet Publication
- Bagali, A.N., Patil, H.B., Chimmad, V.P., Patil, P.L., and Patil, R.V. 2012. Effect of inorganics and Organics on Growth and Yield of Onion (*Allium cepa* L.)*Karnataka J. Agric. Sci., 25 (1): (112-115)
- Galindez, J.L., Porciuncula, F.L., Pascua, M.P., and Claus, S.M. 2014. Going Organic-Based in Onion Production: Testing and Promotion via S&T Based Demo Farms in Two Selected Onion Growing Municipalities in Nueva Ecija. (Progress Report: August 2014 – August 2015).
- Jayathilake, P.K.S., Reddy, I.P., Srihari, D., Reddy, K.R., and Neeraja, G. 2003. Integrated Nutrient Management in Onion (*Allium cepa* L.). *Tropical Agricultural Research* Vol. 15:1-9 (2003)
- Lopez, LLM.A., Aganon, C.P., and Juico, P.P. 2014. Isolation of *Trichoderma* spp. From Carabao Manure and Evaluation of its Beneficial Uses. *International Journal of Scientific & Technology Research*. Volume 3: Issue 8, August 2014 ISSN 2277-8616190
- Nasreen, S. and Hossain, A.K.M. 2004. Nutrient Uptake and Yield of Onions as Influenced by Chemical Fertilizer and Organic Manure. *J. Agricultural Research* 38(3): 164-170
- Ngullie, E., Singh, V.B., Singh, A.K., and Singh, H. 2011. Fertilizing for Sustainable Onion Production Systems. *Better Crops/Vol. 95* (2011, No. 1)
- Onion Planting – Retrieved on July 07, 2016 at <http://aggie-horticulture.tamu.edu/archives/parsons/publications/onions/ONIONGRO.html>.
- Onion Production – Retrieved on July 07, 2016 at <http://extension.psu.edu/business/ag-alternatives/horticulture/vegetables/onion-production>
- Sharma, R.P., Datt, N., and Sharma, P.K. 2003. Combined application of Nitrogen, Phosphorus, Potassium and Farmyard Manure in Onion under High Hills, Dry Temperature Conditions of North-Western Himalayas. *Indian J. Agricultural Sciences*, 73:4:225-227