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Liquid Organic Fertilizer From Reduce Waste by Aerator and Bioinoculant Design

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ABSTRACT
The development of the potential of bioinoculants to reduce waste into liquid organic fertilizer (POC) with easy, cheap materials and abundant existence needs to be realized so that it can benefit the community. Waste treatment can prevent the occurrence of vectors and diseases and nourish the environment. The purpose of this research is to develop the potential of bioinoculants to reduce waste into liquid organic fertilizer (POC). The research method of this experiment goes through 2 stages, namely making bioinoculants containing waste degradation bacteria and making POC through the injection aerator and fermentation process. Bioinoculants contain bacteria: Actinomicetes; Lactobacillus sp; Nitrosomonas sp; Nictrobacter sp; Pseudomonas sp and Bacillus sp go through an aerobic process and feermentation for 2-3 months. POC raw materials: liquit materials (tofu waste, effluent biogas, cow urine and rabbit urine) and solid materials (leaf waste, rotten fruits, food scraps and other organic matter) ground with a mechanical box coper. The results of making POC mixing liquid materials and market waste based on the weight of the material with the addition of 1% bioinoculant then in a 2x24 hour injection aeraor and a fermentation period of 3-4 weeks the comparison of formula 1 is: C (8:2) replication 3 times yields an average (N: 4.3095%; P : 1.7373% ; K: 1.4944% and C/N ratio: 21.1904); D (7:3) yields (N: 4.2977%; P : 1.7514% ; K: 1.5813% and C/N ratio: 20.1701); and Formula 2 bioinoculant 2%. i.e. : G (9:1) yields (N: 4.7030%; P : 1.8551% ; K: 22.7471% and C/N ratio: 22.7471); H (8:2) (N: 4.8096%; P : 1.8344% ; K: 1.7128% and C/N ratio: 22.4420). Assessment of POC maturation results based on physical: smell, color, texture, pH, temperature, and chemistry: laboratory test results N, P, K, C/N ratio (Ministerial Regulation 261/2019). Innovative bioinoculation works that develop appropriate technologies that are easy, cheap, and useful with economic value to be more effective and efficient.

Keywords: Liquid waste, bioinoculant market waste, POC

INTRODUCTION

The manufacture of POC is influenced by the raw materials used, the aeration process, bioinoculant materials and the fermentation time. Organic liquid waste such as tofu waste, cow urine, rabbit urine, etc. often cause odor problems, aesthetic disturbances, environmental pollution, and invite disease vectors. The same thing also happens to organic waste that is not managed properly. Through appropriate technology, these materials can be used as POC raw materials that are beneficial to the community, have economic value, prevent diseases and maintain environmental health.

POC can be made from the following ingredients: straw, rice husks, banana plants, weeds, rotten vegetables, corn plant residues, and coconut coir. Materials from livestock include livestock manure, urine, wasted animal feed, biogas liquid can be processed into useful and useful. (Lesmana and Apriyani, 2019).

Fermnentor bacteria can help in the decay of organic waste to be shorter, easier and of better quality and Bioinoculant- 21

as a fermenter contains Total plate count (NA) bacteria; Actinomicetes; Phosphate solvent bacteria; Lactobacillus sp, Yast/kasmis, Salmonela SP and E.coli sp. (Mujino, Indrasvati & Suyant, 2021).

POC from fruits using EM4 bio activator has a great effect on the content of N, P, and K, because the more volume of EM4 bio activator, the higher the levels of N, P, and K will also be higher (Meriatna, Suryati and Fahri, 2018).

Aeration is the process of delivering oxygen into water or increasing the dissolved oxygen content in water. According to (Jasmidi, Zainuddin and Prastowo, 2018) Cow urine is aerated for 2 days and then fermented for 30 days to produce liquid fertilizer products that are produced with organic C levels: 1.22%, total N: 0.10%, P 0.09% and K 0.10%. With a 2 x 24 hour aeration process and fermentation (2 % EM4) for 14 days, biogas effluent materials: bovine urine (1:1) produces POC N level (1.47%); P (1.22%); K (4.51%) and C/n ratio (19.89) (Mujiyono, Sujangi & Suyanta B, 2021).

POC with biogas effluent raw materials: cow urine shows a physical condition of pH (6.9-8.4); characteristic smell of fermentation; The color of the blackish-brown texture is moldy and chemical in accordance with Ministerial Regulation No. 261/2019: the amount of N+P2O5+K2O is 2-6% while in this study it is obtained 8.66% (Sujangi, Susi Nurweni and Suyanto, 2021).

The levels of N, P, and K from biogas waste as liquid fertilizer were 0.07 percent, 0.29 percent, and 3.21 percent, respectively; Meanwhile, the solid waste of cattle is 1.64 percent, 0.99 percent, and 4.38 percent respectively (Budi Surono, 2013). In addition, it also contains various elements needed by plants such as P, Mg, Ca, K, Cu and Zn, proteins, cellulose, lignin, and others that cannot be replaced by chemical fertilizers.(Featured on Aniana, Muryanto, 2014). Biogas material The manure of 2 cows is obtained 20 kg and mixed with 40 lt of water in a day, put in a 1900 lt digester and in 24 days produces 0.93 m3 of biogas which is enough for the daily cooking needs of households and 60 lt slurry every day and these materials have the potential to be raw materials for liquid organic fertilizer (POC). (Mujiyono, Trimawan Heru Wiyono, Benny Suwant, (2021).

Meanwhile, one 6-month-old cow is able to produce more than 10 lt/hr of cow urine (Muzino & Suzangi, 2019). The nutrient content in cow urine is 1.00% nitrogen, 0.50% phosphorus, 1.50% potassium, and 92% water. After fermentation, macronutrients increased, namely nitrogen 2.7%, phosphorus 2.4%, potassium 3.8% and carbon to 3.8% (Ramadhani et al., 2020). Strong smelling cow urine can prevent the arrival of various plant pests but also has a positive effect on the vegetative growth of corn plants (Scoriza, 2016). Urine with its distinctive smell can prevent the arrival of various plant pests. Therefore, cow urine can also function as pest control (Citra Aryana, Muryanto, 2014). The cow urine contains element N; P; K consecutively is 1 %; 0.5 % and 1.5 % (Budi Surono, 2013). According to (Jasmidi, Zainuddin and Prastowo, 2018) Cow urine is aerated for 2 days and then fermented for 30 days to produce liquid fertilizer products produced with organic C levels: 1.22%, total N: 0.10%, P 0.09% and K 0.10%. A Rabbit can produce more than 0.2 lt of urine per day (Ummi Sholikhah, Illia Seldon Magfiroh, Wahyu Indra Duwi Fanata 2018). The content in rabbit urine mixed with feces is 2.2% nitrogen, 8.7% phosphorus, 2.3% potassium, 3.6 sulfur, 1.26% calcium and 4.0% magnesium. Rabbit urine can be used as an organic liquid fertilizer that is very beneficial for plants. Liquid fertilizer is easier for plants to use because the elements in it are easily decomposed so that the benefits are felt faster (Rosniawaty, Sudirja, and Afrianto 2015). Rabbit manure and urine have a higher content of N, P, K elements (2.72%, 1.1%, and 0.5%) compared to other

livestock manure and urine such as horses, buffaloes, cows, sheep, pigs and chickens (Suryawaty, Dartius, M.S and Beny Wahyu Putra, 2018). By using a 24-hour cascade aerator process and 14-day fermentation, biogas waste and bovine urine (1: 1) produced N (1.47 %); P (1.22 %); K (4.51%) and C/N ratio (19.49). (Mujiono, Sujangi, Benny Suwant; (2021).

The importance of selecting available raw materials (liquid waste and market waste), cheap and easy, adequate injection aerator design, the creation of new variants of bioinoculants that are suitable and the accuracy of fermentation detention time require appropriate technology with research: design of aerators and bioinoculants to reduce waste into liquid organic fertilizer. Objective: to make POC with liquid waste materials and market waste using bioinoculants and an aerator injection process in accordance with Ministerial Regulation No. 261/2019. Special objectives: 1) to make bioinoculants that contain waste degradation bacteria, 2) to make POC meet quality standards through the injection aerator and fermentation process 3). analyze bioinoculants and POCs. With this research, in addition to producing superior waste treatment products that have economic value, it is also useful for overcoming environmental pollution from liquid waste and market waste and creating environmental health.

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The introduction contains the background, a brief and relevant literature review, and the purpose of the research. The writer must state the purpose of the work at the end of the introductory section. Before the goal, the author must provide an adequate background and a very brief literature survey.

It aims to record existing solutions/methods, to show which are the best from previous research, to show the main limitations of previous research, to show what the authors are trying to achieve (to solve the limitations), and to show the scientific benefits or novelties of this paper. Avoid detailed literature surveys or summary results. To refer to relevant data or literature in the text, write the numbers only in order, without parentheses, and use superscripts after the full point (.), for example, the GlobalWebIndex report shows that since the COVID-19 pandemic, the main activity of college students at home has been using social media (52%), and the average usage per day is 2 hours and 41 minutes.

RESEARCH METHOD

The research method of this experiment goes through 2 stages: 1) making bioinoculants containing waste degradation bacteria, 2) making POC meet quality standards. The latest research on the fermentation method of bioinoculant materials, the design of injection aerator and the fermentation of POC materials using bioinoculants and producing POC products containing bioinoculant bacteria that fertilize the soil.

The manufacture of bioinoculants from rumen from the stomach of cows, goats, chicken intestines, leached, microbact, starbio, saniters, EM4, leri water, coconut water, fermented milk, shrimp paste, rotten banana husks) which are anaerobically processed for 3-4 months will then be checked for the bacterial content of the fermenter until it is ready for use.

POC raw materials: liquit materials (tofu waste, biogas effluent, cow urine and rabbit urine) and market waste/solid materials (leaf waste, rotten fruits, food scraps and other organic materials) that are ground with mechanical box copers become more fine. Mixing liquit and solid materials based on the weight of the material with a ratio of formula (1),

namely: C (8:2) and D (7:3) then to speed up the POC process, 1% bioinoculant is added each, in a 2x24 hour injection aerar and a fermentation period of 3-4 weeks. For formula (2), namely: G (9:1) and H (8:2) with the same method; the above will obtain quality standard results. based on physical: smell, color, texture, pH, temperature, and chemistry: laboratory test results N, P, K, C/N ratio (Ministerial Regulation 261/2019).

RESULT AND DISCUSSION

Table 1. Results of Chemical Testing of Liquid Organic Fertilizer

No	For In the the	Prosentase Bioinoculan	Sample formula type with liquit (LQ) and market similarity (PS) comparison	Replicati on to	Rate in %							
					N total	Rata-rata N total	P2O5	Rata-rata P2O5	K2O	Rata-rata K2O	C/N race	Rata-rata C/N racing
a	***b***	***c***	***d***	***and***	***f***	***g***	***i***	***j***	***towards***	***l***	***m***	***n***
1	C	**1%**	LQ:SP= 8:2.	1	4,1822	4,3095	1,6339	1,7373	1,3872	1,4944	23,0200	21,1904
2			LQ:SP= 8:2.	2	4,3192		1,9071		1,4779		20,8066	
3			LQ:SP= 8:2.	3	4,4271		1,6706		1,6182		19,7446	
4	D	**1%**	LQ:SP= 7:3	1	4,4081	4,2977	1,7118	1,7514	1,5989	1,5813	20,1203	20,1701
5			LQ:SP= 7:3	2	4,2018		1,6609		1,5555		18,5845	
6			LQ:SP= 7:3	3	4,2833		1,8814		1,5894		21,8056	
7	G	**2%**	LQ:SP= 9:1.	1	4,7781	4,7030	1,9881	1,8551	1,6447	1,6268	22,2116	22,7471
8			LQ:SP= 9:1.	2	4,8078		1,8844		1,6733		21,6188	
9			LQ:SP= 9:1.	3	4,5231		1,6927		1,5623		24,4110	
10	H	**2%**	LQ:SP= 8:2	1	4,9008	4,8096	1,9338	1,8344	1,7847	1,7128	24,5725	22,4420
11			LQ:SP= 8:2	2	4,7991		1,9033		1,6319		21,8517	
12			LQ:SP= 8:2	3	4,7288		1,6662		1,7218		20,9018	

Based on the most effective Nitrogen (N) content, it is at a concentration of 1% (4.2977% - 4.3095%), while at a concentration of 2% (4.7030% - 4.8096%). The destruction of organic matter in urine requires nitrogen (N). Nitrogen (N) fuses with microbes during the destruction of organic materials to make the urine fermentation process go perfectly (Muhammad Khoirul Huda, 2013). Goat manure contains a high amount of potassium, significantly increasing the nitrogen uptake of plants (Omari, 2018). According to Rismawati Rasyid, 2017 : The longer the aeration time used in rabbit urine, the higher the organic N value produced. This is suspected to be due to the activity of microorganisms from the decomposition process of organic matter which is able to increase the organic N content in biourine. Organic matter degraded by microorganisms, greatly affecting the organic N content in biourine (Yarsi, 2019). The nitrogen content (N) in POC effluent biogas with goat urine with a ratio of 1:1 was able to increase from 0.9% to 1.8%. (N Nurjannah, Nurfajriani Arfah, Nur Fitriani ,2018) Results Rinekso (2011)) deep Growling, dkk (2015), that cattle urine from Jatibarang that has been fermented for 15 days contains N 0.7%, with a C/N condition of 6.41 (Ministerial Regulation

70/2011: C/N ratio 15 – 25). According to Mujiyono, dkk (2021) The nutrient content in organic fertilizers produced from waste from the manufacture of biogas and cow urine is fairly complete, but the amount needs to be improved by adding other ingredients that contain macronutrients such as the addition of tofu pulp to increase carbon levels and goat urine to increase nitrogen levels.

Based on the content of P205, the most effective is at a concentration of 1% (1.7373% - 1.7514%), while at a concentration of 2% (1.8344% - 1.8551%). Rabbit manure is high in phosphorus (P). Rabbit manure has been identified to be able to improve soil nutrition, aeration, and water retention (Anila et al., 2019). Phosphorus is the most important nutrient for plants that has a role in cell division, stimulating early root growth, fruit ripening (Youssef et al., 2017), energy transport in cells, fruit formation and seed production (Kurniawan et al., 2017). There is a method to increase the level of nutrients (Nitrogen, Phosphorus, Potassium, Carbon) in organic fertilizers by using additives, namely Goat Urine, and Tofu Pulp. (N Nurjannah, Nurfajriani Arfah, Nur Fitriani ,2018). The POC formula of goat urine, molasses and tofu pulp produces goat urine producing phosphor (0.9 %) for 14 hr fermentation and this shows that goat urine is good for increase phosphor levels in liquid organic fertilizers. Rinekso (2011)) deep Growling, dkk (2015), cow urine from Jatibarang that has been fermented for 15 days contains a P of 0.16%.

Based on the K20 content, the most effective is at a concentration of 1% (1.4944% - 1.5813%), while at a concentration of 2% (1.6268% - 1.7128%). To increase the potassium content, rabbit urine can be added (Sopha et al., 2020). Potassium can increase plant resistance to pest and disease attacks (Pawar et al., 2019). If there is a deficiency of element K, the plant will experience symptoms of drought at the tips of the leaves and also affect the sweetness of the fruit (Abro et al., 2019). The manufacture of POC with the formula of 500 gr of vegetables and 5 lt of water with 350 ml of EM4 fermented for 25 days is able to produce Potassium of 0.85%. and this increase in potassium is due to microbial activity in decomposing organic matter (Erickson surgeons Ciboro, Edu Sun, Netti Herlina; 2013)

Based on the C/N ratio, the most effective ratio is at a concentration of 1% (20.1701% - 21.1904%), while at a concentration of 2% (22.4420% - 21.7471%). In principle, composting is to reduce the C/N ratio of organic matter equal to the C/N of soil (<20). The higher the C/N ratio of organic matter, the longer the composting or overhaul process of the material. The time it takes varies from 1 month to several years depending on the base material (Darma et al., 2020). (Ismayana et al., (2012) Changes in the C/N ratio are influenced by the organic carbon content of the material which tends to decrease and the change in nitrogen content which is relatively constant, so that the C/N ratio will decrease at the end of the aeration process.

Physical POC

According to Rasyid (2017) which states that the physical characteristic of liquid organic fertilizer that has been fully matured is that the smell of the forming material has disappeared Mujiyono, dkk (2021) stated that liquid organic fertilizer has a strong smell because it is made from livestock organic waste. The liquid produced by liquid organic fertilizer is brownish-yellow and does not have a strong odor. The POC produced is better if the fermentation process lasts for a long time. Molasses additives, 8 days cow urine fermentation no pungent odor (Muhammad Khoirul Huda, 2013). Results Rasyid (2017): The smell of the cow manure and water solution before being put in the digester has a pungent smell typical of cow manure. After 7 days of treatment, the smell is slightly reduced. Likewise, after 14 and 21 days of treatment, the typical smell of cow dung was decreasing. Thus, the

characteristic smell of cow dung will be reduced if the fermentation process in the digester is longer.

CONCLUSION

The manufacture of bioinoculants can give rise to the bacteria Total plate count (NA); Actinomicetes; Phosphate solvent bacteria; Lactobacillus sp, Yast/kasmis, Salmonela SP and E.coli sp.

The most effective concentrations of NPK and C/N Ratio in the manufacture of POC with a concentration of 2% were N (4.7030% - 4.8096%), P (1.8344% - 1.8551%), K (1.6268% - 1.7128%), and C/N Ratio (22.4420% - 21.7471%).

REFERENCES

1. Abro, S.A., M. Fazal, G. Qadir, I. Shah, M. Gadehi, A. Solangi and A. Abro, 2019. Managing organic manures for carbon sequestration to improve soil health and sustained vegetable yield. Pak. J. Anal. Environ. Chem., 20: 54-59
2. Anila, M.A., V.K. Duraisamy and T. Arumugam, 2019. Effect of drip fertigated and soil drenched liquid organic manures on productivity and quality of tomato. Environ. Ecol., 37: 495-499.
3. Budi Surono, U. (2013) 'Production from Cow Waste and Utilization of Biogas Waste As Organic Fertilizer', Agros, 15(1), pp. 207–213.
4. Citra Aryana, Muryanto, S.P. (2014) 'Study on the Utilization of Biogas Waste (Slurry and Sludge) in Plant Seeds', Study on the Utilization of Biogas (Slurry and Sludge) in Coffee Plant Seedlings [Preprint], (National Food Seminar 2012). doi:10.1103/PhysRevA.45.2052.
5. Darma, S., Ramayana, S., Sadaruddin, & Suprianto, B. (2020). Investigation of organic C, N, P, K and C/N ratio of leaves of fruit plants for organic fertilizer. Journal of Moist Tropical Agroecotechnology, 3(1), 12–18.
6. Diniaty, D. et al. (2020) 'Techno-Economic Analysis of Waste Utilization as a Material for Making Liquid Organic Fertilizer (Case Study: Pasar Selasa Panam Pekanbaru', SPEKTRUM INDUSTRI, 18(1), pp. 83–94.
7. Farhana, D. and Wijaya, Y.R.P. (2021) 'Utilization of Tofu Liquid Waste as Liquid Organic Fertilizer for Various Plants in Lengkong Village, Langsa City', Pros. National Seminar. Improving the Quality of Education, 2(1), pp. 83–87.
8. Jasmidi, Zainuddin, M. and Prastowo, P. (2018) 'East Sukadamai Village Farmer Group', Community Service, 24(1), pp. 570–575.
9. Kurniawan, E., Ginting, Z., & Nurjannah, P. (2017). The Utilization of Goat Urine in the Making of Liquid Organic Fertilizer on the Quality of Macronutrients (NPK). Eddy Kurniawan Zainuddin Ginting Putri Nurjannah, 1(2407 – 1846), pp. 1-10. Faculty of Engineering. University of Muhammadiy. jurnal.umj.ac.id/index.php/semnastek.
10. Lesmana, R.Y. and Apriyani, N. (2019) 'Utilization of Leachate as Liquid Fertilizer from Household-Scale Organic Waste with the Addition of EM-4 Bioactivator', Environmental Engineering Scientific Media, 4(1), pp. 16–23. doi:10.33084/mitl.v4i1.649.
11. Marjenah et al., 2018, The Utilization of Fruit Peel Waste as Raw Materials for Making Liquid Organic Fertilizer: Journal of Tropical Forests, vol 1 issue 2, pages 120-127.

12. Meriatna, Suryati and Fahri*, A. (2018) 'Effect of Fermentation Time and Bio Volume of EM 4 (Effective Microorganism) Activator on the Production of Liquid Organic Fertilizer (POC) from Fruit Waste', Journal of Chemical Technology Unimal, 1 (May), pp. 13–29.
13. Muhammad Khoirul Huda, L. and A. T. P. (2013). Preparation of Liquid Organic Fertilizer from Cow Urine with Molasses Additives Fermentation method. Journal of Chemical Information and Modeling, 53(9), 1689–1699.
14. Mujiyono, Indraswati, D. and Suyanto, B. (2021) 'The Potential of Bioinoculant-21 to Reduce Waste into Compost', final research report of PDUPT Surabaya Polytechnic, pp. 1–10.
15. Mujiyono, Sujangi and Suyanto, B. (2021) 'Development of Potential of Biogas Waste and Cow Urine for Organic Liquid Fertilizer', Aloha International Journal of Health Advancement (AIJHA) Volume 4 Number 3 , pp. 51–54.
16. Mujiono, ., Wiyono, T. heru and Suyanto, B. (2018) 'Final Report on Minimalist Biogas Design of Cow Manure on a Household Scale, PDUPT, Health Polytechnic of the Ministry of Health Surabaya'.
17. Nurjannah, N., Arfah, N. and Fitriani, N. (2018) Making Liquid Organic Fertilizer from Biogas Waste Journal of Chemical Process Engineering ISSN = 2303-3401 Vol.03, 03(01), pp. 43–46.
18. Omari, R.A., D.S. Bellingrath-Kimura, Y. Fujii, E. Sarkodee-Addo, K.A. Sarpong and Y. Oikawa, 2018. Nitrogen mineralization and microbial biomass dynamics in different tropical soils amended with contrasting organic r esources. Soil Syst., Vol. 2, No. 4. 10.3390/soilsystems2040063.
19. Pawar, A., N.B. More, V.M. Amrutsagar and B.D. Tamboli, 2019. Influence of organic residue recycling on crop yield, nutrient uptake and microbial and nutrient status of rabi sorghum (Sorghum bicolor L.) under dryland condition. Commun. Soil Sci. Plant Anal., 50: 435-443.
20. Ministerial Regulation 261/2019, minimum technical requirements for organic fertilizers, biological fertilizers and soil amendmentsrequirements of the Ministry of Agriculture, RI.
21. Ramadhani, D. et al. (2020) 'Feeding of Fermented Cow Urine with Growth and Yield of Okra (Abelmoschus esculantus (L .) Moench) Growth and Yield of Okra'.
22. Rismawati Rasyid, (2017). Quality of Liquid Fertilizer (Biourine) of Rabbits Produced Using Different Types of Decomposers and Aeration Process Duration. Hasanuddin University Repository, 1–31.
23. Rosniawaty, S., Sudirja, R. and Afrianto, H. (2015) 'Utilization of rabbit urine and cow urine as an alternative to liquid organic fertilizer in cocoa nursery (Theobroma cacao L.)', Cultivation, 14(1), pp. 32–36. doi:10.24198/cultivation.v14i1.12094.
24. Scoriza, R.N., M.D.O. Bianchi, M.E.F. Correia and M.A.D.A. Leal, 2016. Effect of castor cake and elephant grass composting on edaphic fauna. Cienc. Rural, 46: 1750-1755.
25. Sujangi, Susi Nurweni and Suyanto, B. (2021) 'Potential of Biogas Waste, Cow and Rabbit Urine for Liquid Organic Fertilizer (POC)', final

research report of PDUPT Surabaya Polytechnic, pp. 1–9.

26. Suryawaty, S., Dartius, D. and Putra, B.W. (2018) 'Rabbit Urine Liquid Organic Fertilizer and Oyster Mushroom Planting Media Waste Compost Affects the Growth and Production of Sweet Corn (Zea mays saccharata)', AGRIUM: Journal of Agricultural Sciences, 21(2), pp. 187–194. doi:10.30596/agrium.v21i2.1879.
27. Sopha, G. A., Efendi, A. M., & Liferdi, L. (2020). Enhancing Organic Tomato Yield and Quality by Liquid Organic Fertilizer.
28. Journal of Agronomy, 19(2), 106–112. https://doi.org/10.3923/ja.2020.106.112.
29. Ummi Sholikhah, Illia Seldon Magfiroh, Wahyu Indra Duwi Fanata (2018) 'Utilization of rabbit urine waste into liquid organic fertilizer (poc), AJIE - Asian Journal of Innovation and Entrepreneurship Volume. 03, Issue. 02, May 2018.
30. Yarsi, G., 2019. The effects of liquid worm fertilizer and liquid bat guano fertilizer on plant growth and yield in grafted tomato plants (Lycopersicon esculentum L.). Fresenius Environ. Bull., 28: 3740-3744.
31. Youssef, M.A. and M.A. Eissa, 2017. Comparison between organic and inorganic nutrition for tomato. J. Plant Nutr., 40: 1900-1907.