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The Differences Duration Of Activators To Composting Cabbage (Brasicca Oleracea) At Panorama Market Of Bengkulu City

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***Abstract*-Panorama Market is one of the most significant contributor to organic waste in Bengkulu City, such as vegetable waste of cabbage *(Brasicca Oleracea)*. It was referring to Law on Waste Management No. 18/2008, the utilization of organic waste into compost is an effective way of reducing the amount of waste generation from the source. A process to speed up composting without causing unpleasant odors can use activators like EM4 and MOL Tape. The purpose of this research was to know the difference of activators of composting duration of cabbage *(Brasicca oleracea)* waste. The type of research was analytic with experimental research design while research design was posted test only with control group design. The result of one way ANOVA statistic test followed by bon bonferroni test found that there was a difference of composting duration with a various activator (p = 0,000). The fastest activator of composting duration was MOL tape (p = 0,000). It was suggested to market traders to sort vegetable waste based on the vegetable type to facilitate in further management. It was also suggested for further research to increase the volume of cabbage waste.**

Keywords: activator, composting duration

I. INTRODUCTION

One of the most significant waste contributors to life is the traditional market. The composition of market waste is the more dominant organic waste. Plastic waste is less than the waste from the housing, especially if the waste comes from the vegetable market or fruit market; the waste will be the more organic waste. Due to the large amount of waste in this traditional market is often found the amount of waste generated from the activity in the market, this should be a severe concern for sellers, market managers and the community, where waste generation generated every day will disrupt health, cleanliness and polluting the environment (Ramadhani, 2014).

Referring to Law No. 18 the Year 2008 on Waste Management, one effective way to reduce the amount of waste generation from its source is the re-utilization of organic waste into compost, where the use of chemical fertilizers can damage the original condition of the soil. One form of market waste management that has been done is to process the organic waste market into compost, where it has been implemented by Bunder Market located in Sragen regency, Central Java province. Bunder Market has even been selected as one of the National Healthy Market at the national level from the Ministry of Health of the Republic of Indonesia. Besides, Sragen Regency becomes a national pilot project area for processing market waste into compost.

One of the processes that can speed up composting without causing unpleasant aroma is to use an activator. Research Light et al. (2011) states that composting can be accelerated by using effective bacteria microorganism (EM4). Natural composting will take a relatively long time of about 2-3 months and even 6-12 months. Composting can take place more quickly by fermentation using the help of microorganisms (Subandriyo, 2012). The activator products on the market are mostly EM4.

Local microorganisms (MOL) are one of the activators that can help speed up the composting process and are useful in increasing the compost nutrients. Research Wibowo (2011) using local microorganisms tape and EM4 as activator making organic fertilizer mixture of sheep dung with the banana stem. This research made compost by mixing banana stem cuttings, sheep excrement, EM4, and MOL tape and then tested on kangkung plants and the result is that the compostable plants are higher and have more leaves than in non composted plants.

The volume of waste generated at Panorama Market of Bengkulu City each day amounted to 12 m3 / day. Based on observations at the Panorama Market in December 2016 looked so great the amount of waste generation of vegetables, especially the waste of cabbage that every day just thrown away and not used so that the environment becomes dirty and smelly. It was necessary to do some way of handling and management against such vegetable waste as compost material. This research aimed to know the different duration of activator composting cabbage (Brasicca Oleracea) Pasar Panorama

of Bengkulu City. Activators have been used in this research were EM4 and MOL tape.

II. METHOD

The type of this research was analytical with exact experimental research design whereas the research design was posted test only with control group design that was to know the difference of activator addition (EM4 and MOL tape) to the time of compost garbage vegetables composting market. The preliminary survey was conducted in February 2017 by observing the remnants of vegetable rubbish strewn and piling up around the vegetable sellers. Early research by making mol tape and molasses to activate EM4. After the tape mole was cooked and ready to be used then the vegetable waste was processed into compost with the addition of the activator. The composting process was observed, and the temperature and pH measurements were obtained until the time of compost was obtained by looking at the characteristics of the mature compost.

III. RESULTS

The result of temperature measurement, pH and time of composting with a treatment of MOL tape activator, EM4 and control are presented in table and narrative form with univariate analysis and bivariate analysis.

Physical Quality Observation Result (Color, Texture, Odor)

a. A result of Observation of Compost with MOL Tape Activator

On the 3rd day the compost was opened, the essential ingredients of composting cabbages were already yellow and began to rot and smell of acid. The texture was still mainly in the form of cow litter that has not been destroyed. Observations on the 7th day, compost using MOL activator already looked blackish brown, and the base of cabbage was not visible (smashed / dilute) and smelly. It happened to all composter using MOL Tape activator because the bacteria presented in the activator began to decompose organic matter. On the 14th day the compost using MOL activator was blackish brown and had not issued a foul odor, and the texture was not dilute (solid) but still moist (not dry). On the 17th day the compost using the MOL activator was brownish black and had not issued a foul odor, and the texture was dry when pressed then the compost crumbs (destroyed) indicated the compost was ripe.

b. Result of Observation of Compost with Active EM4 Activator

On the 3rd day the compost was opened, the essential ingredients of composting cabbages were already yellow and began to rot and smell of acid. The texture was still mainly in the form of cow litter that had not been destroyed. Observations on day 7, the compost using EM4 activator was brownish, and some of the essential ingredients of cabbage had been smashed and smelly. It happened to all composers that had used active EM4 activators because the bacteria presented in the activator begin to decompose organic matter. On the 14th day the compost using EM4 activator was blackish brown, and the base of cabbage had been crushed dilute) and foul-smelling. On the 21st day the compost that used the EM4 activator was black and had not issued a foul odor and the texture was not dilute (solid) but still moist (not yet dry). On the 22nd day, the compost using EM4 activator was black, and it had not issued a foul odor, and the texture was dry when pressed then the compost crumbs (destroyed) indicates the compost was ripe.

c. Results of Compost Observation without Treatment (Control)

On the 3rd day of the compost was opened, the essential ingredients of composting cabbages were already yellow and began to rot and slightly acidic. The texture was still mainly in the form of cow litter that had not been destroyed. Observations on the 7th day, the essential ingredients of compost that were cauliflower brownish and a little garbage of cabbage begin to rot and slightly smelly. The texture was still mainly in the form of cow litter that had not been destroyed. On the 14th day, the essential ingredients of compost were mostly blackish brown and started to rot and smell bad. The texture in the form of garbage had been destroyed/dilute. It happened to the entire composter control because the bacteria presented in the activator begin to decompose organic matter. On the 21st day, the compost base was black and rotting and foul-smelling. The texture in the form of garbage was still diluted. On the 28th day of compost without using the activator (control) was black and had not issued a bad smell and texture was not dilute (solid) but still moist (not dry). On the 29th day, the compost using EM4 activator was black and had not put out the stench, and the texture is dry when pressed then the compost crumbs (destroyed) indicated the compost was ripe.

The result of pH and Temperature Measurement on the Composting Process

Table 1. Average pH table by Activator Type

Average day to day	Activator																	
	MOL Tape						EM4						Control					
	1	2	3	4	5	Average	1	2	3	4	5	Average	1	2	3	4	5	Average
3	6.5	6.5	6.4	6.5	6.6	6.5	6.5	6.5	6.5	6.5	6.5	6.5	6.7	6.8	6.7	6.7	6.8	6.7
7	6.4	6.4	6.3	6.4	6.5	6.4	6.4	6.4	6.4	6.4	6.4	6.4	6.7	6.8	6.7	6.7	6.8	6.7
14	6.7	6.7	6.7	6.7	6.7	6.7	6.7	6.7	6.7	6.5	6.5	6.6	6.7	6.8	6.7	6.8	6.8	6.7
21	6.9	6.9	6.9	6.9	6.9	6.9	6.8	6.8	6.9	6.6	6.6	6.7	6.8	6.9	6.8	6.9	6.9	6.8
28	6.9	6.9	6.9	6.9	6.9	6.9	6.8	6.8	6.9	6.6	6.6	6.7	6.8	6.9	6.8	6.9	6.9	6.8

Table 1 showed the average pH based on the activator type MOL tape, EM4 and without the activator (control). The average pH of compost with MOL tape activator on day 3 was 6.5, at day seven was 6.4, at day 14 was 6.7, on day 21 was 6.9 and average pH on day 28 is 6.9. The average pH of compost with EM4 activator on day 3 was 6.5, at day seven was 6.4, at day 14 was 6.6, on day 21 was 6.7 and the average pH on day 28 was 6.7. Average pH of compost without activator (control) on day 3 was 6.7, at day seven was 6.7, at day 14 was 6.7, on day 21 was 6.8 and average pH on a day to- 28 was 6.8.

Table 2. Average Temperature by Activators Type (℃)

Average day to day	Activator																	
	MOL Tape						EM4						Control					
	1	2	3	4	5	Average	1	2	3	4	5	Average	1	2	3	4	5	Average
3	28	28	28	28	29	28.2	28	28	28	28	28	28	28	28	27	27	27	27.4
7	32	33	32	32	32	32.2	31	30	31	30	31	30.6	29	28	28	28	28	28.2
14	27	27	28	28	28	27.6	30	30	30	30	30	30	29	29	29	29	29	29
21	26	26	27	27	27	26.6	27	27	27	27	27	27	28	28	27	27	27	27.4
28	26	26	27	27	27	26.6	26	26	26	26	27	26.2	26	26	26	26	26	26

Table 2 showed the average temperature based on the type of activator MOL tape, EM4 and without activator (control). The average temperature of compost with MOL tape activator on day 3 was 28.2, at day seven was 32.2, at day 14 was 27.6, on day 21 was 26.6 and the average temperature on day 28 is 26.6. The average temperature of the compost with the EM4 activator on the 3rd day was 28, on the 7th day was 30.6, the 14th day was 30, on the 21st day was 27 and the average temperature on the 28th day was 26.2. The average temperature of the compost without activator (control) on the 3rd day was 27.4, on the 7th day was 28.2, on the 14th day was 29, the 21st day was 27.4 and the average temperature on the day to- 28 was 26.

Differences in Duration of Compost Formations

Bivariate analysis with One Way ANOVA test was used to know the different duration of composting, then continued with Bonferroni test to know the difference duration between treatments. The result of one way ANOVA test of different duration of compost formation could be seen in table 3 below.

Table 3. One Way ANOVA Test Result Difference of Compost Time Formation

Treatment Variables	Mean	SD	95 % CI	*p value*
MOL Tape	17,00	0,707	16,12-17,88	0,000
EM4	22, 40	1,140	20,98-23,82	
Control	29,00	1,581	27,04-30,96	

Table 3 showed that the average time of compost was formed by the addition of a 17 day MOL tape activator, with the addition of a 22 day EM4 activator and without the addition of a 29-day activator (control) with p = 0.000. To know the difference of time of composting between treatments, bonferroni test. Bonferroni test results could be seen in table 4 below.

Table 4. Bonferroni Test Results Differences in Time of Compost Formation

Variabel Perlakuan	Variabel Perlakuan	Rata-Rata Beda	*p value*
MOL tape	EM4	5,400	0,000
	Kontrol	12,000	
EM4	Kontrol	6,600	

The average difference of composting duration among treatments was five days duration in compost using MOL tape activator with compost using EM4 activator, 12 days in compost using MOL tape activator with compost without activator (control) and seven days in compost using EM4 activator with compost without activator (control).

IV. DISCUSSION

Physical Observation Result of Compost (Color, Texture, Odor)

The results of physical observation of compost of cauliflower can be seen from the color, texture, and odor from day to day changes. This indicates the presence of bacteria in the decomposition process, as described by Gaur (1986) that the composting process will occur decomposition of organic materials by microbial activity, that is, microbes will take water, oxygen, and nutrients from organic materials which will then decompose and release of CO2 and O2. Compost that has been mature can be seen from the following characteristics (SNI 19-7030-2004): black / brown compost color; good compost smells odorless, but smells like the smell of the soil or the smell of the forest humus; and when held and clenched, the compost will agglomerate, when pressed softly, the compost lump will break easily.

In compost with EM4 activator showing good physical characteristics of compost, where the color was blackish brown, moist, and the material is no longer visible. For compost without activator also showed a blackish brown color while for compost with MOL tape activator showing the different brown color.

The odor in the maturity of the compost group that uses the activator was relatively odorless rather than the smell on the maturity of the compost group that does not use the activator. The odor differences in the two groups using the activator and not using the activator may occur due to the influence of activator used.

The bacteria in the activator was beneficial to the process of fermentation of organic materials into compost and sped up the process so that the results are more perfect. The maturity of the compost in the group using the resultant activator was more optimal. Globally there were five groups of bacteria contained in the activator of photosynthetic bacteria, Lactobacillus sp., Streptomycetes sp., Yeast (yeast) and Actinomycetes.

Compost with MOL tape activator on day 7 was brownish black with a crumbling/smelly texture and foul smelling. On the 14th day, the compost was blackish brown, odorless, and the texture was not dilute (stable) but still moist. On the 17th day the compost had matured, it was characterized by black compost, odorless, crumb / crushed and dry texture.

Compost with EM4 activator on the 7th day was brownish, just some crumbled cabbage and foul-smelling garbage. On the 14th day the color of blackish brown compost, cauliflower had been crushed / smelly and foul-smelling. On the 21st day the compost was black, odorless, the texture was not dilute (stable) but still moist, and on the 22nd day the compost had matured, it was marked with black compost, odorless, crumb / crushed and dry texture.

Compost without activator (control) on the 7th day brownish, just a little rotten garbage and foul-smelling garbage. On the 14th day, the compost was blackish brown, most of the cabbage starts to rot. On the 21st day, the compost was black, the cauliflower was crushed / smelly and smells rotten. On the 28th day, the compost was black, and the texture was not watered (stable) but still moist and odorless. On the 29th day the compost had matured, it was marked with black compost, odorless, crumb / crushed and dry texture.

A result of Measurement of Temperature and pH at Composting Process

This research was a composting Aerob. Several factors need to be controlled in the composting decomposition process such as compost material size, temperature, and pH (Suryati, 2014). The size of the compost material is minimized by cutting or chopping the compost base to accelerate the decomposition process. The compost particles will affect the porosity as well as the surface area of contact between the microbes and the compost material. The ideal size of raw material cuts is about 2-4 cm. Cuts that are too small cause the pile to become, so there is no air circulation inside.

Temperature

Microbial activity can generate heat in the composting process. Increased temperature is related to oxygen consumption. The higher the temperature, the more oxygen consumption and the faster the decomposition process occurs. Temperature increases can occur quickly on the compost pile. Temperatures ranging from 30-600C indicate rapid composting activity. However, temperatures higher than 600C will kill some microbes, only thermophilic microbes will survive.

The temperature factor is very influential to the composting process because it is related to the type of microorganisms involved (Ali, 2010). This suggests that the active microbes are mesophilic microbes, i.e., microbes that can live at temperatures between 20-35 ℃. The mesophilic microbial activity in the decomposition process will produce heat by removing CO2 and taking O2 in the compost pile until it reaches its maximum temperature (Isroi, 2009).

The temperature of the decomposition material will increase as a result of biological activity. Temperatures ranging from 60 ℃ and 70 ℃ are optimum conditions of life of certain microorganisms and killing undesirable pathogens, with the aim of obtaining sufficient hygienic levels of compost, if possible the temperature should be maintained continuously for two weeks. Temperature changes during the composting process can also be affected by stirring of compost generation, the stirring that is often done causes the pile to cool down (Sutanto, 2002) quickly.

In this research, the optimum temperature obtained was 32 ℃. Temperatures in the outer environment can also affect the temperature at the composting pit. Therefore, the compost pit is closed not too tightly to keep the temperature optimal. The same thing is expressed by Andika (2011) that the temperature in the aerobic composting process was influenced by the air that is maintained so as not to enter the compost container and does not cause the growth of pathogenic bacteria that affect human health such as Pneumonia disease where infectious diseases or inflammation in lung organ caused by bacteria, viruses, fungi or parasites in which the pulmonary alveolus (alveoli) absorbs oxygen from the atmosphere into "inflame" and filled with fluid, in addition to pneumonia disease that can be caused by the fungus (spore) of the composting process is a transmitted Histoplasmosis disease through the air spores and when people breathe will enter the lungs. People who are particularly at risk for histoplasmosis are workers who come into contact with bird or bat droppings, such as farmers. Most people affected by histoplasmosis are unaware that they are infected because they never show signs and symptoms. However, histoplasmosis can be severe for some people, especially infants and people with less immune systems.

pH

The magnitude of pH (acidity degree) during the composting process takes place ranges from 6.5 to 7.5. In the composting process, the pH change will take place when composting is successful, and the pH will change to or near neutral (7.0).

The results of this study indicated that the pH at the time of examination day 7 was relatively low/acid but on the examination day 17 to day 30 pH starting normal and close to soil pH that is between 6.5-7.5 on the activator MOL tape and EM-4 pH between 6.4-6.9. At control of pH composting between 6,7-6,9. This is because the microbes use organic acids that will cause the pH to rise, then organic acids are used other types of microbes to the degree of acidity back neutral (Maradhy, 2009).

The average final pH of the decomposition process of a vegetable waste of cabbage at all treatments was almost the same, i.e., about 6-7, the optimum pH for the composting process ranges from 6.5 to 7.5. Ideal aerobic decomposition pH between 6-8 because at that degree microbes could grow and hold their activities in decomposing organic leaf waste (Maradhy, 2009). The degree of acidity (pH) also acutely affects the composting process because pH is one of the critical factors for the growth of microorganisms involved in the composting process (Simamora, 2006).

The degree of acidity is too high will cause the consumption of oxygen will rise and will give wrong results for the environment. It can also cause the element of nitrogen in the compost to become ammonia (NH3). Conversely, in the acid state (low acidity degree) will cause some microorganisms to die (Juarnanai, 2005).

Bacteria prefer to have neutral pH; fungi develop well enough in a slightly acidic pH condition. Strong alkaline conditions will cause nitrogen loss; this is possible when added lime at the time of composting. Very acidic conditions at the beginning of the decomposition process show the decomposition process takes place without any increase in temperature. Usually, the pH is slightly down at the beginning of the composting process because of the activity of bacteria that produce acid. With the advent of other microorganisms from the decomposed material the pH of the material returns up after a few days, and the pH is in neutral condition when the compost is ripe (Sutanto, 2002).

In this study temperature and pH were controlled by daily measurements using a soil analyzer. If the pH is too acid (<5,5) it was increased by adding dolomite while the temperature was controlled by flipping through the compost material every day so that the temperature did not exceed the maximum composting temperature of 600C.

Differences in Time of Compost Formation

The duration of waste composting in this analysis was determined based on the weight loss of garbage up to 60% and looked at the soil-like compost-like physical features — depreciation of the weight of waste due to the decomposition process. The decomposition process will experience biological, physical and chemical events which in the process of decomposing aerobic waste requires microbial decomposers such as fungi, yeast and actinomycetes sp (Rinrin, 2002).

The process of waste decomposition was the result of microbial activity with biologic processes aerobic and anaerobic through several stages. In the first stage of the process occurred aerobically, the second resistance occurred anaerobic process because O2 had run out. In the third stage of methane gas-forming microorganisms would eat CO2, hydrogen and organic acids to form methane gas and other products. At this stage, microorganisms worked

slowly but efficiently using all the available material (Nurullita, 2003).

By the result of data analysis indicated that there was a different duration of compost formation to various activator used (p = 0,000). It was possible because each type of activator had different types of microorganisms. The more types of microorganisms in the activator the faster the composting time (Budiaman, 2010). Mol contained eight types of microorganisms and EM4 contains 4
types of microorganisms namely lactobacillus, photosynthetic bacteria, actinomycetes, and yeast (Hairani A, 2006).

Composting time with MOL tape activator was17 days, with EM4 activator was 22 days and control group was 29 days. The difference duration in composting with MOL tape activator compared with EM4 activator was five days; the difference duration of composting with MOL tape activator compared with control was 12 days. The difference duration in composting with EM4 activator when compared with control was six days. The color of the compost produced from the use of brown MOL tape activator, with EM4 activator black and brown color control black. It was similar to the research Kusuma (2013) which is showed that the longer composting time the compost color becomes darker.

V. CONCLUSION

It could be concluded that the duration of composting with MOL tape activator was 17 days, with activator EM4 was 22 days, and the compost without activator was 29 days. There was a difference in the duration of composting with various activators (p = 0,000). The fastest activator of composting time was MOL tape (p = 0,000). For further research should be added to the volume of waste for composting and adding research variables. Market traders should sort vegetable waste based on the vegetable type to facilitate further management.

REFERENCES

Budiaman, I gusti, 2010. *Pengaruh Jenis Starter, Volume Pelarut dan Aditif terhadap Pengolahan Sampah Organik Rumah Tangga Menjadi Pupuk Kompos Secara Anaerob*. UPN Veteran Yogyakarta.

Cahaya TS, Andhika dan Nugroho, A. 2011. Pembuatan Kompos dengan Menggunakan limbah Padat organik (Sampah sayuran dan Ampas tebu). *Skripsi*. Jurusan Teknik Kimia, Fakultas Teknik, Universitas Diponegoro.

Chandra, B. 2005. *Pengantar Kesehatan Lingkungan*. Jakarta : Buku Kedokteran EGC.

Habibi, L. 2008. *Pembuatan Pupuk Kompos Dari Limbah Rumah Tangga*. Titian Ilmu, Bandung.

Juarnani, N.2005. *Cara Cepat Membuat Kompos*. Agromedia Pustaka. Jakarta.

Maradhy, E. 2009. Aplikasi Campuran Kotoran Ternak dan Sedimen Mangrove Sebagai Aktivator pada Proses Dekomposisi Limbah Domestik. *Thesis*. Pasca Sarjana Universitas Hasanuddin Makassar.

Marzuki, Y. 2013. *Kubis Si Pencegah Kanker*. Dunia Sehat, Jakarta.

Mulyono, 2014. *Membuat Mol dan Kompos dari Sampah Rumah Tangga*. Jakarta: AgroMedia Pustaka.

Notoadmodjo, S. 2007. *Promosi Kesehatan dan Ilmu Perilaku*. Rineka Cipta. Jakarta.

Nurullita, U. 2012. Lama Waktu Pengomposan Sampah Rumah Tangga Berdasarkan Jenis Mikroorganisme Lokal (MOL) dan Teknik Pengomposan. Fakultas Kesehatan Masyarakat Universitas Muhammadiyah Semarang. *LPPM UNIMUS 2012*. ISBN : 978-602-18809-0-6

Ramadhani A dan Tarigan A. 2014. Studi Pengelolaan Sampah Pasar Kota Medan. *Jurnal*. Departemen Teknik Sipil, Universitas Sumatera Utara.

Setiawan, S. 2012. *Membuat Pupuk Kandang Secara Cepat*. Penebar Swadaya. Depok.

Simamora, S dan Salundik. 2006. *Meningkatkan Kualitas Kompos*. Agromedia Pustaka. Jakarta.

Subandriyo, Anggoro D, Hadiyanto. 2012. Optimasi Pengomposan Sampah Organik Rumah Tangga Menggunakan Kombinasi Aktivator EM4 dan MOL terhadap Rasio C/N. *Jurnal Ilmu Lingkungan* Vol 10 (2) : 70-75. *http://ejournal.undipac/index.php/ilmulingkungan*

Sumatera, Tarigan. 2013. Pembuatan Pupuk Organik Cair Dengan Memanfaatkan Limbah Padat Kubis (Brassica aleracege. L) dan Isi Rumen Sapi. *Thesis*. Universitas Sumatera Utara *www.repository.usu.ac.id/bitstream/123456789/27866/5/Chapter%20I.pdf*

Suryati, T. 2014. *Bebas Sampah Dari Rumah Tangga*. Jakarta : Agro Media Pustaka.

Susetya, D. 2014. *Panduan Lengkap Membuat Pupuk Organik Untuk Tanaman Pertanian dan Perkebunan*. Yogyakarta : Pustaka Baru Press.

Sutanto, R. 2002. *Penerapan Pertanian Organik*. Permasyarakatan dan Pengembangannya. Penerbit Kanisius. Yogyakarta.

Undang-Undang Republik Indonesia Nomor 18 Tahun 2008 tentang Pengelolaan Sampah. Jakarta : Sekretariat Negara.

Warsidi, E. 2008. *Mengolah Sampah Menjadi Kompos*. Mitra Utama: Bekasi.

Wibowo, LS. 2011. Taraf Penggunaan Mikroorganisme Lokal Tape sebagai Bioaktivator Pembuatan Pupuk Organik Campuran Kotoran Domba dengan Batang Pisang. *Skripsi*. Departemen Ilmu Produksi dan Teknologi Peternakan, Fakultas Peternakan, Institut Pertanian Bogor.

Yuliarti, I. 2009. *1001 Cara Menghasilkan Pupuk Organik*. Yogyakarta : Penerbit Andi