

# The Effectiveness of the Addition of EM4 and Molasses in Increasing Levels of N, P and K in Environmentally Friendly Liquid Fertilizers Made From Banana Pseudostem

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## ABSTRACT

According to the statistics agency in 2017, banana production had the largest portion in Indonesia. Furthermore, banana production increased from 6.28 million tons to 7.04 million tons. Consequently, this tremendous production lead to an increasing of pseudostem waste. Through a research-based community service program, empowerment of farmers, especially banana farmers, is carried out. One of area who farmers have been cultivating in East Java is in Pasuruan, namely Gondang Wetan village. This research examines the manufacture of environmentally friendly organic fertilizer using banana midrib as the main ingredient. Fertilizers are produced by using decomposers (EM4) as microbial decomposers. Moreover, fertilizers are distinguished in several variations in relation to the amount of preparation material. The fertilizer produced was further tested at the CV Nurti Techno Laboratory. As a results, the 12<sup>th</sup> sample (100 ml rice water: 100 gr banana pseudostem: EM4 3.0 ml: 3.0 ml mollase) has the highest composition of N (Nitrogen), P (Posphate), and K (Kalium), i.e. 0.076%, 0.32% and 0.47%, respectively.

**Keywords:** *Component, banana pseudostem, environmentally friendly organic fertilizer, NPK levels*

## 1. INTRODUCTION

Indonesia is a tropical country and the country that is located along the equator, therefore almost all plants can grow in the region of Indonesia. As an agrarian country, agriculture in Indonesia produces a variety of export commodity plants. For instance, the production of banana fruit rose from 6.28 million tons to 7.04 million tons, from 2016 to 2017 respectively [1] [2]. The increase leads to the ascent of banana pseudostem waste. The advancement of technology also attracts

scientists conduct research to explore the utility of banana pseudostem in various purposes, e.g. health [3] [4] [5] [6] [7], feed [8] [9], planting media [10] [11] [12], textile [13] [14] and organic fertilizer [15] [16]

The predominant content of banana stem is Nitrogen, which contributes to create vegetative parts of banana, especially root, pseudostem and leaves. The banana pseudostem is also used as a photosynthetic stimulant to stimulate the development of microorganisms in the soil [17]. The content of nitrogen in the banana pseudostem can be utilised as a base material of fertiliser production.

In this paper, we deploy banana pseudostem as a base material of environmentally friendly fertiliser. The fertilizer is created by using Effective Microorganism 4 (EM4) as a microbe decomposer. Fertiliser will be varied in several variations according to the number of compositions of the constituent material. Furthermore, fertilisers is carried out further testing to measure the level of Nitrogen (N), Phosphat (P), and K (Kalium). This is because N, P, and K are the essential parts of fertiliser.

## 2. METHODS

Recently, the needs of banana production rise all the time. One of areas of banana cultivation in East Java, located in Pasuruan is in Gondang Wetan village (Figure 1).



Figure 1 Gondang Wetan Village.



Figure 2 Banana pseudostem waste.

The village is very fertile and has sufficient water, therefore it is suitable for banana cultivation. However, there is a consequence for this. This is because the harvest of banana is only once, therefore there are a lot of banana pseudostem waste. The using of this waste is not well known by farmers.

### 2.1. Sample Preparation

The manufacture of liquid organic fertilizer uses banana pseudostem waste as the main ingredient. To facilitate the fermentation process, the sample size is mulched by using a blender. The details of the manufacturing process can be seen in Figure 3.

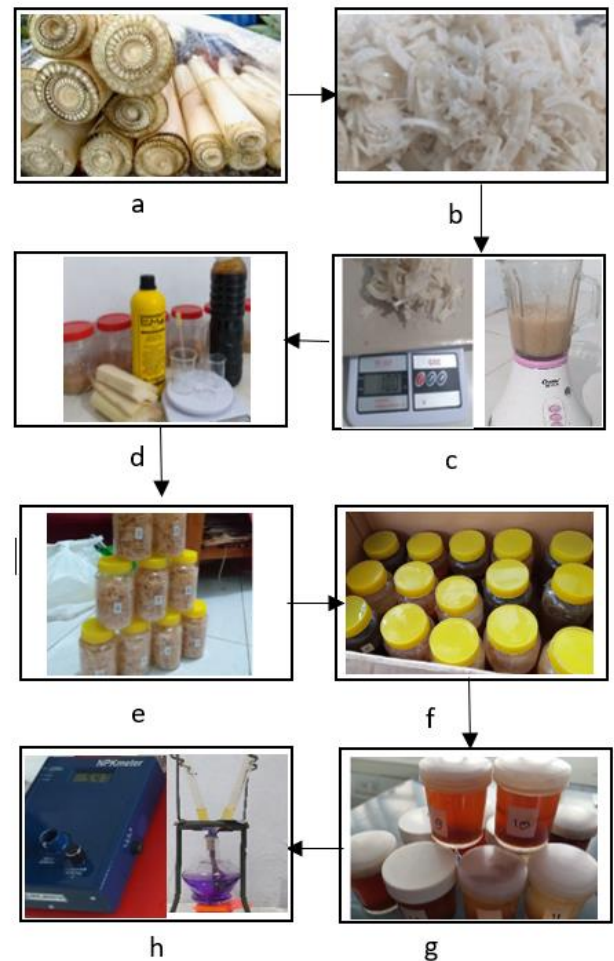


Figure 3 The manufacturing process of liquid organic fertiliser (a) Banana pseudostem; (b) Peeling banana pseudostem; (c) Blender; (d) Adding EM4, mollase and water; (e) Sample variations; (f) Fermentation; (g) Filtering sample; (h) Testing and analysing sample

A few of research on fertiliser that has been performed did not determine appropriate compositions of ingredient and also the content of fertiliser was not examined. Therefore, this paper made a sample of 12 fertilizer variations. The sample variations can be seen in table 1 below.

**Table 1.** The sample variations and composition

Sample	Composition			
	Water	Banana pseudostem	EM4	Mollase
1	100 ml	100 gr	0.5 ml	2.0 ml
2	100 ml	100 gr	1.0 ml	2.0 ml
3	100 ml	100 gr	1.5 ml	2.0 ml
4	100 ml	100 gr	2.0 ml	2.0 ml
5	100 ml	100 gr	2.5 ml	2.0 ml
6	100 ml	100 gr	2.0 ml	0.5 ml
7	100 ml	100 gr	2.0 ml	1.0 ml
8	100 ml	100 gr	2.0 ml	1.5 ml
9	100 ml	100 gr	2.0 ml	2.0 ml
10	100 ml	100 gr	2.0 ml	2.5 ml
11	100 ml	100 gr	3.0 ml	3.0 ml
12	100 ml rice water	100 gr	3.0 ml	3.0 ml

### 3. RESULTS AND DISCUSSION

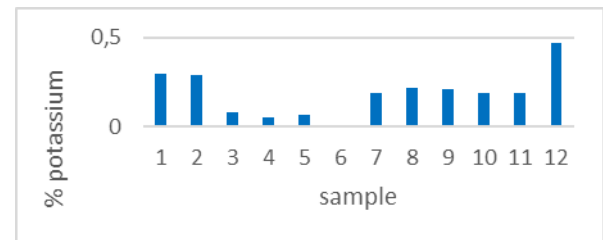
Fertilisers in the form of mineral and water are essential nutrients needed by plants in the process of growth, development and reproduction. The nutrients needed by plants are absorbed through the roots, stems and leaves. Therefore, these nutrients have various functions that support one another and become one of the important components to increase agricultural productivity.

Fertilisers that are being often used are inorganic fertilizers. Inorganic fertilisers are fertilisers that are produced in chemical factories, such as urea, phonska, rainbows and others. The benefits are quite high for development of plants. However, the use of inorganic fertilizers in a relatively long period of time generally has a deleterious impact on soil conditions. The soil hardens quickly, is less able to store water and the pH of the soil becomes acidic which in turn lowers plant productivity.

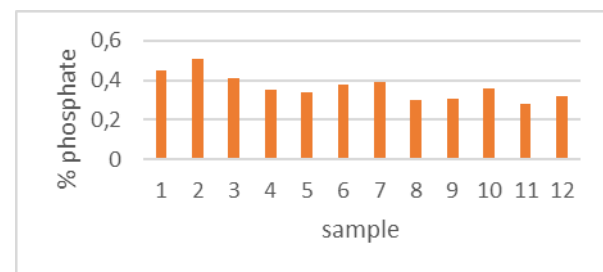
In improving physical, chemical and biological soil properties, additional fertilizer is needed, namely by using organic fertilizer. Organic fertilizer is fertilizer that consists mostly or entirely of organic material

derived from plants or animals. Organic fertilizer can be either solid or liquid. Liquid organic fertilizer which can be abbreviated POC (*pupuk organik cair*) can be used more easily because it can be directly absorbed by the soil. The application of liquid fertilizer can also be applied more evenly and its density can be easily adjusted according to the needs of the plants.

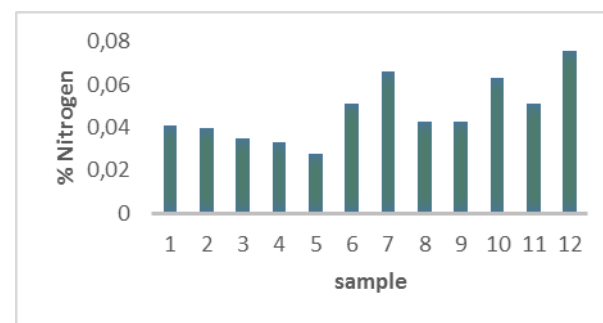
Based on the POC test results that have been made from banana pseudostem waste can be seen in Figure 4a, 4b and 4c. In Figure 4a, it can be seen that the highest potassium levels are found in sample 12, which is the composition of (100 ml rice water: 100 gr banana pseudostem: EM4 3.0 ml: 3.0 ml mollase). By comparing to other samples, the high levels of potassium are caused by the presence of rice water mixture.



(a)



(b)



(c)

**Figure 4** Graph of % level of (a) potassium; (b) phosphate; (c) nitrogen

The potassium (K) element behaves as an activator of various enzymes and helps form proteins, carbohydrates, and sugars and strengthens plant tissues and increases resistance to disease. In addition, a potassium level can be increased by adding cattle or cow dung [18] Element phosphorus (P) is employed to flow the energy into the whole plant, stimulate growth and development of roots and accelerate crop fertilization.

Figure 4b shows that the level of % phosphate is almost the same and independent of rice water supply. Moreover, the variation of molasses and EM4 is not significant to increase phosphate level. Compared to Figure 4c, the percentage of nitrogen is still very low, in the range of 0.04 - 0.08%. The N element is the main component of a protein whose effects are quickly tangible in plants and is useful to accelerate growth in general, especially in the vegetative phase. The results are in accordance with Agriculture Regulation No.28/Permentan/OT.140/2/2009 in the amount of <2% or <20000 ppm. Alternately, the provision of some concentrations of chicken manure compost can increase N in the soil because it has some N-binding microorganisms. Furthermore, chicken manure compost can increase P and K as well [19]. Next, the use of organic liquid fertilizer together with inorganic fertilizer N, P, and K with lowered doses did not reduce the growth of onion tuber plants [20], sweet corn [21], and potatoes [22].

#### 4. CONCLUSION

According to the research, we conclude that banana farmers in Pasuruan have a difficulty to understand the usefulness of the banana pseudostem. Furthermore, we would like to sum up based on the results as follows:

1. The largest N, P and K levels are on sample 12 with the composition of (rice water 100 ml: banana pseudostem 100 gr: EM4 3.0 ml: mollase 3.0 ml).
2. Levels of N, P and K obtained in sample 12 were (Potassium levels showed 0.47%, phosphate levels 0.32% and Nitrogen 0.076%.)
3. The maximum phosphate content was obtained in sample 2 with composition (100 ml water: 100 gr banana pseudostem: EM4 1.0 ml: 2.0 ml mollase) with a phosphate content of 0.52%.

#### ACKNOWLEDGMENT

The authors would like to thank the ITS university especially LPPM ITS (Lembaga Penelitian dan Pengabdian Masyarakat) and ITS for their support of the work reported in this article.

#### REFERENCES

- [1] Available:  
<https://jatim.bps.go.id/statictable/2018/11/06/1367/produksi-sayuran-dan-buah-buahan-tahunan-di-jawa-timur-ton-2008-2017.html>
- [2] Outlook Komoditas Pertanian Sub Sektor Hortikultura, Pusat data dan Sisem Informasi Pertanian kementerian Pertanian, 2016, ISSN : 1907-1507
- [3] K. P. Sampath Kumar<sup>1\*</sup>, Debjit Bhowmik<sup>2</sup>, S. Duraivel<sup>3</sup>, M. Umadevi<sup>4</sup>, "Traditional and Medicinal Uses of Banana", *Journal of Pharmacognosy and Phytochemistry*, ISSN 2278-4136, IC Journal No: 8192, Vol. 1 No. 3 2012, [www.phytojournal.com](http://www.phytojournal.com)
- [4] NJyothirmayi N allikarjuna Rao, "Banana medical Uses", *Journal of medical Science & Technology*, Volume 4, issue 2, May, 2015.
- [5] Nopitasari, *Pemanfaatan Pelepah Pisang sebagai Bahan Pembuat Hand Sanitizer dalam Bentuk Gel dengan Penambahan Alcohol dan Triclosan*, Program studi pendidikan biologi, Fakultas keguruan dan ilmu Pendidikan universitas Muhammadiyah Surakarta, 2018.
- [6] N. Galu, "Analisis ekstrak batang dan akar pisang kapok (Musa paradisiaca) dalam menghambat pertumbuhan candida albicans", *Skripsi, Fakultas kedokteran Gigi Universitas Hasanuddin Makassar*, 2016.
- [7] N. Lailatul, "Potensi Pelepah Daun Pisang Kapok Sebagai Hand Sanitizer Alami," *publikasi ilmiah, program studi Pendidikan biologi, fakultas keguruan dan ilmu Pendidikan Universitas Muhammadiyah Surakarta*, 2017.
- [8] I. Sutowo, T. Adelina Dan D. Febrina, "Kualitas Nutrisi Silase Limbah Pisang (Batang Dan

- Bonggol) Dan Level Molases Yang Berbeda Sebagai Pakan Alternatif Ternak Ruminansia,” *Jurnal Peternakan*, Vol. 13, No. 2, pp. 1829-8729, 2016.
- [9] N. Thiasari dan A. I. Setiyawan, “Complete feed batang pisang terfermentasi dengan level protein berbeda terhadap pencernaan bahan kering, pencernaan bahan organik dan TDN secara *in vitro*”, *Jurnal Ilmu-Ilmu Peternakan*, vol. 26, no. 2, pp. 67 – 72, ISSN: 0852-3681
- [10] Eva Setianingsih, “Growing Variety of Morning Glory (*Ipomoea reptans* L.) In Banana Pseudostem as a Pot with Different Media Composition,” *Jurnal Produksi Tanaman*, Vol. 4, No. 2, pp. 117-112, 2016.
- [11] A. A. U. Ningsih,” Pemanfaatan Pelepah Pisang (*Musa paradisiaca*) Untuk Media Penyemaian Hidroponik Pada Daya Tumbuh Tanaman Okra (*Abelmoschus esculentus*) Sebagai Bahan Ajar Perubahan Lingkungan Dan Daur Ulang Limbah Di Sma,” *Skripsi, program study Pendidikan biologi, fakultas keguruan dan ilmu Pendidikan universitas Muhammadiyah Surabaya*, 2016.
- [12] A. Fatah, *Pemanfaatan Pelepah Pisang (Musa paradisiaca) Untuk Media Penyemaian Hidroponik Pada Daya Tumbuh Tanaman Okra (Abelmoschus Esculentus) Sebagai Bahan Ajar Perubahan Lingkungan Dan Daur Ulang Limbah Di Sma*. Fakultas ilmu tarbiyah dan keguruan Universitas Islam Negeri Islam Raden fatah, Palembang, 2016.
- [13] Fauziati, ”Pemanfaatan dan Prospek pelepah Batang pisang kapok sebagai bahan baku mebel,” *Jurnal Riset teknologi Industri*, Vol 2 N0 4 desember 2008
- [14] Chairul Irawan\*), Dwita Ariyanti, Pradifta Hernanda,” Pemanfaatan Limbah Batang Pisang (*Musa* sp.) di Kalimantan Selatan sebagai Alternatif Bahan Baku Pembuatan Kertas”, *Seminar Nasional Teknoin 2013*, Yogyakarta, 16 November 2013
- [15] Jamal Basmal, “Teknologi Pembuatan Pupuk Organik Cair Kombinasi hidrolisat Rumput Laut *Sargassum* sp. dan Limbah Ikan,” *Squalen Vol. 5 No. 2, Agustus 2010*
- [16] Siratul Hati, “Pembuatan Pupuk Kompos Cair Dari Limbah Rumah Tangga Sebagai Penunjang Mata Kuliah Ekologi Dan Masalah Lingkungan”, Skripsi, mahasiswa Fakultas Tarbiyah dan keguruan prodi Pendidikan biologi, 2018.
- [17] Monica Dame Yanti Ambarita, Eva Sartini Bayu\*, Hot Setiado,” *Identification of morphological characteristic of banana (Musa spp.) in Deli Serdang district*”, *Jurnal Agroekoteknologi*, Vol.4. No.1, Desember 2015. (586) :1911- 1924, E-ISSN No. 2337- 6597
- [18] Sukamta, M. A. Shomat, A. Wisnujati,”Pengelolaan Limbah Ternak Sapi Menjadi Pupuk Organik Komersial di Dusun Kalipucang, Bangujiwo, Bantul, Yogyakarta,” *Jurnal Berdikari*, Vol .5, No. 1, 2017.
- [19] Riza Elsa Surya, Suyono,”composting effect of chicken mature toward C/N Ratio and available NPK Nutrient and soil cation exchange capacity”, *UNESA Journal of Chemistry* Vol. 2, No. 1, 2013.
- [20] Suwandi, G. A. Sopha, M. P. Yufdy, ”The Effectiveness of Organic Fertilizer, NPK and Biofertilizer Managements on Growth and Yields of Shallots,” *J. Hort.*, Vol. 25, No. 3, pp 208-221, 2015.
- [21] Jurhana, U. Made, and I. Madauna, “Pertumbuhan dan Hasil tanaman Jagung Manis (*Zea mays saccharate*) pada berbagai dosis Pupuk Organik,” *e-J. Agrotekbis*, vol. 5, no. 3, pp. 324-328, 2017.
- [22] H. Karamina, W. Fikrinda,”Aplication on liquid organic fertilizer on potato plant varieties of granola in the medium,” *Jurnal Kultivasi*, Vol. 15, no. 3, 2016.