THE SLOW RELEASE NITROGEN FERTILIZER APPLIED IN SUGARCANE (*Saccharum officinarum*)

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ABSTRACT

The continuous application of chemical fertilizer mainly nitrogen has bad influence to soil. On the other hand the expensive price of fertilizer should be solved by maximized affect to plant productivity. The ordinary Nitrogen fertilizer has bad influence to soil water with high nitrogen content around the plantation mainly. The Slow release Nitrogen Fertilizer has possibility to reduce the production cost of plant and more environmentally friendly.

This Research was conducted in order to find out the influence of Slow Release Nitrogen Fertilizer and Nitrogen Fertilizer for sugarcane plant as the raw materials of green energy bioethanol. The Sugarcane plant needs fertilizer in order to improve plant productivity. The chemical fertilizer usually not circumctance friendly but the slow release chemical fertlilizer may be have something different. The application of slow release chemical fertilizer may be better for soil fertility The application of slow release nitrogen fertilizer in sugarcane plant seemed better rather than Quick release Nitogen fertilizer in Yellow – Red Podzolic Soil in Negara Bumi Ilir, Center of Lampung, Indonesia.. Results of a field experiment with sugarcane showed that the treatment of urea with slow release nitrogen fertilizer (coated nitrogen fertilizer) increased its efficiency by preventing N losses, resulting in significantly higher cane yields. In one of the years, sulphur-coated urea at 300 kg N/ha gave higher total sugar content in the juice and significantly more commercial cane sugar (CCS) than uncoated urea.

Keywords : Sugarcane, Nitrogen Fertilizer, Slow release Fertilizer.sulphur coated urea.

1.INTRODUCTION

Sugar cane is a potential source of large amounts of natural fibres which has not yet been adequately exploited. 7]LynneWong Sak Hoi, Increase of productivity of agricultural crops should be achieved by the using of mineral fertilizers so as not to contribute to global environment pollution. [5]

The Use of slow release N fertilizer may be an effective management practice to improve crop performance while reducing environmental N losses under the different soil moisture conditions which may be experienced due to spatial variation in agricultural fields or because of annual variations in climate. The variation of the processing parameters which altering the pellet porosity are significant in the release of nitrogen but minor for potassium release. [3]

However, the extra cost of this N source (approx. 10 percent more of ordinary N urea) must first be evaluated relative to its potential benefits observed under field conditions before it can be recommended to farmers. An additional important outcome of this research will be information that can be used to improve N fertilizer recommendations based on predicted N loss due to annual or spatial variation in soil moisture conditions.

The land with the mineral (sandy) soils typically have very low soil Organic Matter (OM) contents, so the soil-N supply from native soil OM can be expected to be very low, and crop availability of this N supply will likely be diminished by soil-N movement during rainfall events.

There is no fertilizer is recommended for sugarcane grown on muck soils. On organic soil , N deficiencies are rarely seen in sugarcane. A deficiency may appear if organic N cannot be mineralized under unfavourable conditions, such as flood.

It is also widely recognized that the sandy soils cropped to sugarcane are variable in terms of native soil OM contents, cation exchange capacities (CEC), and to some degree, soil pH. These factors affect native soil-N supply, and can vary considerably across adjacent 20-acre fields, and even within any given 20-acre field block. Regardless of this variability, the native soil OM and CEC for any of these sandy soils is considered low. Nitrate pollution in ground water has become a serious problem worldwide; one of its causes is known to be the excessive use of nitrogen fertilizers in agricultural production. Using water containing nitratenitrogen concentrations above the standards of the World Health Organization's (WHO) (10 mg/L) leads to agricultural products becoming unsuitable for human consumption, particularly for infants ("blue baby disease").. One possibility to solve the nitrate-nitrogen pollution of

subsurface it necessary to applied controlledrelease N-fertilizer to sugarcane. Nowadays Indonesia is doing the research of some alternative of biofuel production which renewable of raw materials and circumstance kindly. There are many kind of excellence biomass as raw materials in Indonesia such as cassava, corn, sweet potato, sweet sorghum, sugarcane and etc. There are many kind of Sugarcane variety (*saccharum officinarum*) in Indonesia which suitable with the regional agroclimate. The sheer size of the agricultural sector implies that changes affecting agriculture have large aggregate effects. Thus, it seems reasonable that agricultural productivity growth should have significant effects on macro variables, including economic growth.[11]. There are Theoretical arguments and empirical evidence for the hypothesis that agricultural productivity improvements lead to economic growth in developing countries [4].

2.METHOD

The slow release nitrogen fertilizer is the fertilizer which able to supply Nitrogen to plant along time since application day until harvesting time. It also familiarly with nitrogen coated fertilizer that coated with phosphorus. aldehyde and etc. In this research was used two variety of sugarcane. GMP and Kidang Kencana Variety.

2.1Quick-Release

Quick-release nitrogen in fertilizers is useful because the nutrients are immediately available to plants. This water-soluble nitrogen (WSN) becomes available when it is dissolved in water, either through irrigation or rainfall, when it is applied. There are several benefits of quick-release fertilizers - nutrients are immediately available to plants and they stimulate quick shoot growth and greening.

On the down side, they rapidly deteriorate from the soil through the leaching of nitrates; they last only two to four weeks; and if they are over applied they can cause burning to the grass plant.

2.2Slow-Release

There are several benefits of slow-release nitrogen in fertilizers. They provide more uniform grass growth. They are less likely to burn the lawn or other plants. They can last 6 to 8 weeks or longer so they don't need to be applied as frequently as fertilizers with quick-release nitrogen.

On the downside, nutrients are not immediately available to plants. They are generally more expensive per pound than quick-release fertilizers. They may not work as well in cold soil. They require heavier irrigation during periods of high temperatures and too much irrigation may speed-up the release of nutrients.

There are two types of slow-release fertilizers.

2.3.Slowly-Soluble or Coated Fertilizer

The other types of slow-release fertilizers are those that are slowly-soluble or coated. Slowly-soluble fertilizers and coated fertilizers (typically in pellet form) depend on soil moisture and temperature to release nutrients.

Though coated fertilizers may not be listed with WIN on the product label, they are slow-release. The entire nutrient content may be included within the fertilizer particle, providing slow-release (controlled release) for the entire product. Nutrients are released over a period of time, some lasting up to 12 months, so fewer applications are needed. They provide good color without excessive leaf growth, but nutrients may not be available when the plant needs them.

3.RESULT AND DISCUSSION

3.1. The Slow Releasse Nitrogen Fertilizer Applied In Two Variety of Sugarcane (GMP and Kidang Kencana Variety)

The Plant growth, weigh of stalks, total sugar content in 3 month old until 7 month old was showed in fig 1 until fig 8.

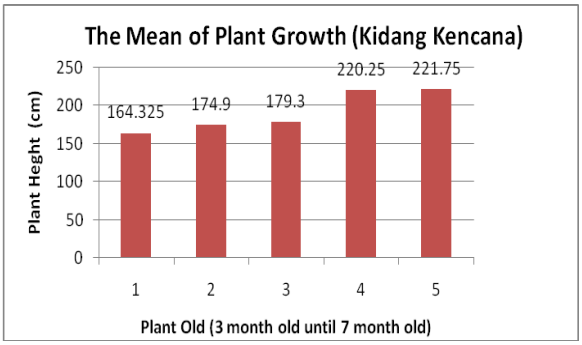

Fig 1. The Mean plant growth of Kidang Kencana Variety

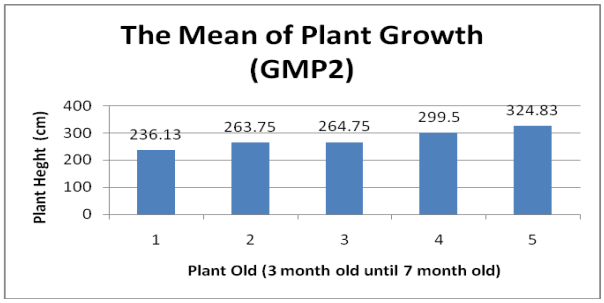

Fig 2. The Mean plant growth of GMP2 variety

The mean plant growth since 3 month until 7 month showed that GMP 2 was higher rather than Kidang Kencana as illustrated in Fig. 1. GMP 2 seemed more suitable rather than Kidang kencana by Slow release nitrogen fertilizer.

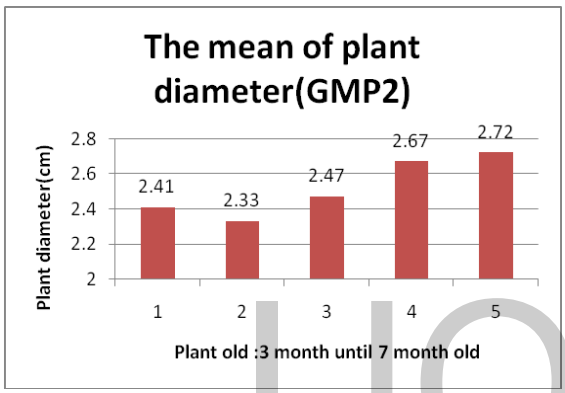

Fig 3. The Mean of plant diameter of GMP2 variety

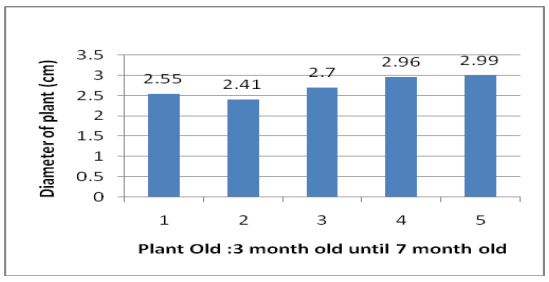

Fig 4. The Mean of plant diameter of Kidang Kencana Variety

Kidang Kencana seemed had better diameter size of stem rather than GMP 2 in the application of Slow Release Nitrogen Fertilizer. In 4 month old of plant ,the hot weather and no rainfall decreased the diameter of plant (fig 3 and fig 4).

The total sugar V1P1 in 6 month old is the bigest indicated that Kidang Kencana suitable with uncoated nitrogen fertilizer. V1P2 showed lower total sugar than V1P1 and indicated that coated nitrogen fertilizer 300 kg/hectar seemed suitable for Kidang Kencana. GMP 2 seemed suitable with 200 kg/ha and 100 kg/ha coated nitrogen fertilizer.

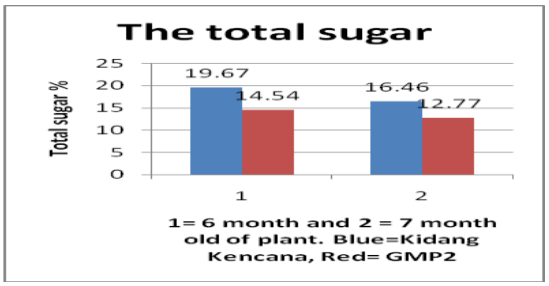

Fig 5. The mean Total sugar of Kidang Kencana and GMP 2 in 6 month and 7 month old

Kidang Kencana seemed had better total sugar rather than GMP2 in the application of Slow Release Nitrogen Fertilizer. Kidang Kencana more suitable rather than GMP2 by the application of slow release Nitrogen fertilizer.(fig3, fig 4 and fig 5.).

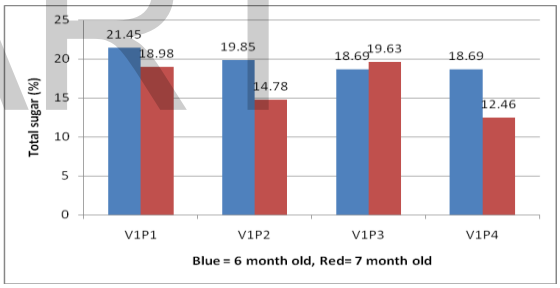

Fig 6. The Total Sugar of Kidang Kencana in 6 month and 7 month old

The total sugar of Kidang Kencana and GMP 2 is better in six month old of plant rather in 7 month old of plant. The highest total sugar was obtain by 300 kg/ha nitogen fertilizer and 300 kg /ha slow release nitrogen fertilizer respectively (fig 5.6.7).

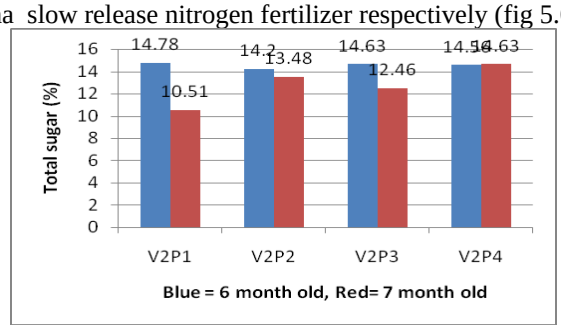

Fig 7. The Total Sugar of GMP2 in 6 month and 7 month old

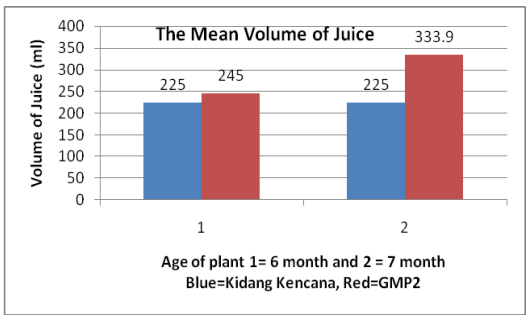

Fig 8. The Mean volume of juice of Kidang Kencana (Blue) and GMP2 (red)

GMP2 seemed had better volume of stem juice rather than Kidang kencana in the application of Slow Release Nitrogen Fertilizer

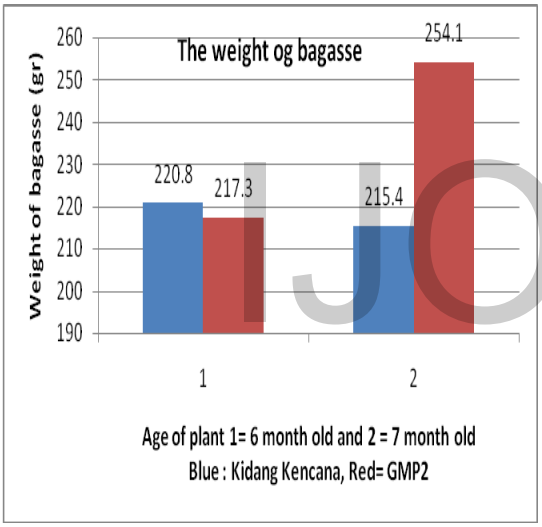

Fig.9.. The Weight of bagasse of Kidang Kencana variety (Blue) and GMP2 variety (red)

GMP2 seemed had better weight of baggase rather than Kidang Kencana in the application of Slow Release Nitrogen Fertilizer in 6 month and 7 month old of plant respectively. But Kidang kencana seemed had better weight of baggase rather than GMP 2 without the application of Slow Release Nitrogen Fertilizer.

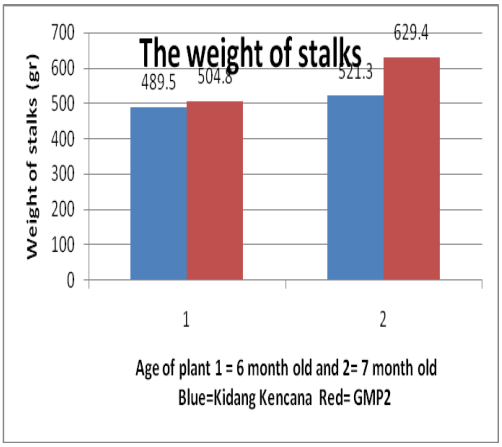

Fig 10. The Mean Weight of stalks of Kidang Kencana (Blue) and GMP2 (right)

GMP2 seemed had better weight of stalks rather than Kidang kencana in the application of Slow Release Nitrogen Fertilizer in 6 month and 7 month old of plant respectively. But Kidang kencana seemed had better weight of stalks rather than GMP 2 without the application of Slow Release Nitrogen Fertilizer.

The stalks weight in 6 month old of plant for Kidang Kencana more than 600 gram per plant equal to 120 ton per hectar by application of 300 kg/ha Nitrogen fertilizer. By the data of stalks weight , GMP2 seemed more suitable with the application of slow release nitrogen fertilizer mainly in 7 month old of plant.

The total sugar of Kidang Kencana and GMP 2 is better in six month old of plant rather in 7 month old of plant. The highest total sugar of Kidang Kencana was obtain by 300 kg/ha nitogen fertilizer and 300 kg /ha slow release nitrogen fertilizer respectively.

N deficiencies can readily occur in sugarcane grown on sandy soils such like Yellow Red Podzolic Soil in Negara Bumi Ilir. Multiple applications of N fertilizer are often required during the growing season to sustain adequate sugarcane production on mineral (sandy) soils, which lack the high organic N contents of muck soils. Failing to supply adequate N during critical growth periods can result in stunted plants, premature ripening, and reduced biomass and sugar yields. Nitrogen has the greatest influence on cane ripening of all the nutrient elements. Cane will store a higher percent of sucrose when N is limited 6 to 8 weeks prior to harvest. Although a late-season N deficiency can actually promote improved sugarcane ripening, this scenario is unlikely to be achievable on organic soils.

Instrumental analysis of vermicompost with the help of modern technologies provides essential information on its maturity, before it can be used for agricultural application. Nowadays, vermicompost is considered as a promising

organic alternative to chemical fertilizers in agriculture and horticulture [13].

Since N is a mobile nutrient, N-deficiency symptoms are first observed on older leaves (since N is mobilized from older tissues in favor of supporting growth in new tissue), although deficiency symptoms can eventually be seen over the entire plant. Leaf blades become uniformly pale-green to yellow, stalks become short and slende.

3.2. The Application of N with Environmentally friendly

There is a fundamental flaw in how we apply N fertilizer – we don't apply N as the crop needs it.
-In some cases, applying all N at preplant does not result in optimal use of N
-N is subject to environmental losses
Environmental losses of N
-Volatilization
-Denitrification
-Leaching
-Runoff

Why consider slow-release N

-Consider slow-release N when attempting to reduce environmental losses (Environmentally friendly).
-Slow-release fertilizer is becoming more cost effective (low input with high productivity).
-Consider your soil system and cropping system and evaluate which N losses may be occurring and hindering efficiency (N loss as least as possible).

These fertilizers also reduce environmental risks caused by soil nitrogen and help reduce irrigation water consumption while sustaining normal tomato growth and fruit yield, making their promotion extremely beneficial]12]. The technological innovations, which enhanced urban eco-efficiency, had a greater impact on eastern cities than on central and western cities. The higher was the administrative level of a city, the greater were the effects of invention patents on urban eco-efficiency. Moreover, the higher was the administrative level of a city, the smaller was the role that national high-technology industrial development zones NHTIDZs played in promoting urban eco-efficiency, which represented a case of diminishing marginal utility.]6]

The main application of the developed model is to predict the deterioration in Earth-to-Air Heat Exchanger (EAHE's) thermal performance as a function of the duration operation. This deterioration can be caused by soil thermal saturation where the nearby subsoil temperature becomes almost equal to the inlet air temperature resulting in minimum heat transfer between air and soil.]9]. Chemicals and Chemical Materials had the highest potential to save energy and reduce emissions. A panel regression indicated that the relationship between energy-environmental efficiency (EEE) and gross output was U-shaped for all industry, but had an inverted-U shape for heavy industry [8]. The efficient irrigation technology like drip irrigation is an important factor to drive sustainable sugarcane production in the future. Land-water-energy nexus management measures for improving sustainability of sugarcane production are also recommended [14].. The soil microbial size and microbial activity had a marginal effect on fertilizer mineralization.[10].

4.CONCLUSSION

The conclussion of a field experiment showed that the treatment of urea with slow release nitrogen fertilizer (coated nitrogen fertilizer) increased its efficiency by preventing N losses, resulting in significantly higher cane yields. In one of the years, slow release nitrogen felizer or sulphur-coated urea at 300 kg N/ha gave higher total sugar content in the juice and significantly more commercial cane sugar (CCS) than uncoated urea or Quick release urea. There is need to put in place pesticide residue monitoring programs and farmer education on commercial sugarcane production and safe pesticide use as ways of reducing pesticide exposure [15]..

5.REFERENCES

[1]... Amar Rouag et al.2018.Thermal design of Earth-to-Air Heat Exchanger. Part I a new transient semi-analytical model for determining soil temperature. Journal of Cleaner Production, Volume 182, 2018, pp. 538-544.

[2].Chengming Xiao et al. 2018. Sectoral energy-environmental efficiency and its influencing factors in China: Based on S-U-SBM model and panel regression model. Journal of Cleaner Production, Volume 182, 2018, pp. 545-552

[3]. Chandra Wahyu Purnomo, Andi Respito, Eva Pramuni Sitanggang ,Panut Mulyono 2018. Slow release fertilizer preparation from sugar cane industrial waste.Environmental Technology and Innovation vol 10 May 2018 pages 275=280.

[4]. **DouglasGollin. 2010. Chapter 73 . Agricultural Productivity and Economic Growth. Handbook of Agricultural Economics vol 4, 2010. pp 3825=3866**

[5].**EldarGugava[a]AvtandilKorokhashvili[b] 2017.Technologies for obtaining nitrogen fertilizers prolonged effect in wheat.Annals of agrarian science vol 16 issue 1, March 18 pages 22=26**

[6].. JiangxueZhang[a] et al. 2018. Do technological innovations promote urban green development?—A spatial econometric analysis of 105 cities in China. Journal of Cleaner Production, Volume 182, 2018, pp. 395-403.

[7].LynneWong Sak Hoi, Bice S.Martincigh 2013. Sugar cane plant fibres: Separation and characterization. Journal Industrial Crops and product vol 47 may 2013 pages1=12

[8]...Masuda, T., Katsuta, Y., Hiramatsu, K. and Sugahara, K. (2002): *Application of slow release fertilizer to sugarcane in spring planting.* Abstracts of the Annual Meeting, Japanese Society of Soil Science and Plant Nutrition, 48,123 (in Japanese).

[9].Matt Ruark, 2012. Advantages and disadvantages of controlled-release fertilizers. Dept. of Soil Science WI FFVC, 1/17/2012.

[10].Pierfrancesco NARDI et all, 2018. Nitrogen Release from Slow-Release Fertilizers in Soils with Different Microbial Activities. Journal International Pedosphere.Vol 28 issue 2 April 2018 :p :332-340

[11].. Prabhu Pingali and Robert Evenson.2010. Handbook of Agricultural Economics . Volume 4, Pages 1-3894 (2010)

[12]...Parashar, K. S.; Prasad, R.; Sharma, R. P.; Sharma, S. N.; *Singh, S. 1980. .Efficiency of urea, nitrification inhibitor treated urea and slow release nitrogen fertilizers for sugarcane.* Zeitschrift fur Pflanzenernahrung und Bodenkunde 1980 Vol. 143 No. 3 pp. 262-269

[13]..Sartaj Ahmad Bhat, Jaswinder Singh and Adarsh Pal Vig. 2017.Instrumental characterization of organic wastes for evaluation of vermicompost maturity. Journal of Analytical Science and Technology 2017 8:2

[14].Thapat Silalertruksa[ab] and Shabbir H.Gheewala[ab]. 2018. Land-water-energy nexus of sugarcane production in Thailand. Journal of cleaner production vol 182, 1 May 2018. p:521-528

[15].Trust Kasambala Donga[a] and Ole MartinEklo[ab].2018 Environmental load of pesticides used in conventional sugarcane production in Malawi. Crop Protection vol 108, June 2018, Page 71-77

[16]..YanmeiLi et al. 2017. Effects of two slow-release nitrogen fertilizers and irrigation on yield, quality, and water-fertilizer productivity of greenhouse tomato. Agricultural Water Management vol 186, 31 May 2017. Pages 139=146, Elsevier.

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