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LEACHING OF NITROGEN FOR LIME APPLICATION AND NPK SLOW DECOMPOSE FERTILIZER OF CORN *(Zea mays sacchararata Sturt)* GROWTH IN PEATLANDS

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ABSTRACT

Utilization of peat as agricultural land faced the problem of low soil fertility. Low soil fertility made nitrogen being leached easily. One solution to overcome Nitrogen leaching and efficiency fertilizer raising used dolomite and slow decompose fertilizers. This study aims to determine the effect of dolomite on Nitrogen element leaching in several types of NPK slow decompose applied for corn cultivation in peatland and determine the best dolomite dosage and NPK slow decompose with minimum Nitrogen leaching to optimum sweet corn plant growth in peatland. This research was conducted from August to October 2018 in the Experimental Garden Technical Implementation Unit and Soil Laboratory, Faculty of Agriculture, University of Riau. This research used experimentally and completely randomized design (CRD) factorial. The first factor is dolomite which consists of 4 levels (0 tons.ha^{-1}, 2.5 tons.ha^{-1}, 5 tons.ha^{-1}, dan 7.5 tons.ha^{-1}). The second is NPK slow decompose which consists of 4 levels (NPK single pearl, NPK 13: 6: 27: 4 + 0,65B Mahkota B, NPK 13: 6: 27: 4 + 0,65B Compound Plus Hi-Kay and NPK 13: 8: 27: 4 MgO Ztick). The results showed the administration of dolomite 23.55 g per tube and NPK slow decomposed could reduce Nitrogen leaching, improve physiology and growth of sweet corn plants. Provision of interaction between dolomite 5 ton.ha-1 with NPK slow decomposition (30.25 N, 3.72 P, 12.56 g per tube) produces the best interaction that can reduce the proportion of Nitrogen leaching and it can affects the increasing of plant growth.

Keywords *: Dolomite, Peat, slow decomposed NPK, Nitrogen leaching*

INTRODUCTION

The potential for peatlands in Indonesia is large enough to be used as an area for agricultural extension. The area of peatland in Indonesia about 14.93 million ha, and can be found in Papua, Kalimantan and Sumatra (Ritung et al., 2015). Riau is one of the provinces has large peatlands. The area of peatland in Riau is 3.573 million ha (Kementan, 2020).

Utilization of peatland for plant cultivation faced several obstacles, namely low fertility of peat soil characterized by low soil pH (acid), the number and availability of nutrients N, P low, levels of bases (K, Ca, Mg, and Na) and alkaline saturation. low nutrient leaching (leaching of nutrients) for example Nitrogen nutrients (Sasli, 2011). In addition, the high soil porosity can lead to high leaching of the elements as well. Nitrogen is a nutrient that is highly leached in peat soils. The results of research by Razzaque and Hanafi (2007) showed that the loss of N in peatland ranges from 55-66% of the N applied.

The efforts to overcome some of the constraints of soil chemical, such as pH, levels of bases (Ca, Mg, Na and K) and low base saturation can be done by liming. According to Sasli (2011) giving ameliorants such as lime (calcite or dolomite), or ash can increase soil pH, the number and availability of bases and base saturation. However, the application of ameliorants such as lime must be appropriate, because applying lime or ash in high dose can cause high nutrient leaching. The application of lime can improve soil fertility in increasing the activity of nitrifying bacteria where ammonium is transformed into nitrate, so it cannot be absorbed by soil colloids. As a result, nitrogen leaching is very high which results in low nitrogen nutrient uptake by plants. In addition, increasing the dose of lime can increase the solubility of humic compounds (Sukron et al., 2011). Humic compounds in peatland are organic colloids are very important relate to leached the nutrient. It becomes problem in nutrient supply. In this connection, it is necessary to find the right amount of lime in the sense that it can improve the chemical properties of peatland but with relatively low nutrient leaching and colloids.

One solution to overcome leaching and increase the efficiency of high fertilization is to use a slow-degradation fertilizer. Slowly decomposing fertilizers are fertilizers that are able to control nutrients that are easily lost due to water solubility, volatility and denitrification (Trankel, 1997). The results of Suwardi's (1991) research show that giving NPK slow decompose can save fertilization which is usually done by farmers three times in one planting season, just once. In this way can save fertilizer and labor. It cause NPK technology is slow to decompose, it can release nutrients gradually according to plant needs, minimize nutrient loss, thereby increasing the efficiency of fertilizer use, providing nutrients for a longer period of time, reducing the frequency of fertilizer application, and minimizing toxicity (Subbarao et al., 2006).

There are several types of NPK slow decompose fertilizer, such as NPK Mahkota B (13: 6: 27: 4 + 0.65B), NPK Hi-Kay Plus (13: 6: 27: 4 + 0.65B) and NPK Ztick (13: 8: 27: 4 MgO). Physically, fertilizer coatings are prepared from a variety of materials can reduce the dissolution rate. NPK fertilizer is type NPK Mahkota B (13: 6: 27: 4 + 0.65B) has raw material N

(Urea / ZA / DAP); P (DAP / RP); K (MOP) with a wax / oil (MFO) coating. NPK Compound Hi-Kay Plus (13: 6: 27: 4 + 0.65B) has raw material N (Urea / DAP / MAP); P (CIRP / Reaktive / DAP); K (MOP). NPK Ztick (13: 8: 27: 4 MgO) is a special complete compound fertilizer formulated to contain primary and secondary macro nutrients, essential micro elements and in the form of stems, wrapped in materials made from organic matter (Department of Agriculture, 2006). However, it is not yet known which species are effective and how efficient they are on peatland planted sweet corn. Which type of the best of NPK slow-decompose for increasing plant growth and productivity as well as suppressing the leaching of nutrients, especially Nitrogen. Therefore, it is necessary to conduct research to examine the correlation between N loss and plant growth, so it is necessary to use maize as an indicator.

This study aims to determine the effect of dolomite application on nitrogen leaching in several types of NPK slow-decompose applied to sweet corn cultivation on peatland and to determine the best dose of dolomite and NPK slow-decompose types able nitrogen leaching with minimal to optimum growth of sweet corn on peatland.

MATERIALS AND METHODS

This research was conducted in the experimental garden greenhouse, Faculty of Agriculture, Riau University, Bina Widya Campus Km 12.5, Simpang Baru, Tampan, Pekanbaru in altitude of 10 m above sea level. The screen house conditions have an average temperature of 30-400C and light intensity of 1694 lux .

The materials used in this study were samples of peatland type ombrogen sapric layer taken from oil palm plantations in Mandau area, Siak, belonging to First Resources (FR), sweet corn seeds of Bonanza F1 varieties, lime (dolomite), N, P and K fertilizers. single (Urea, TSP, KCl), NPK slow-decompose fertilizers, (NPK Mahkota B, NPK Hi-Kay Plus, NPK Ztick), liquid organic fertilizers (NASA), water and chemicals was used to analysis in the laboratory. The tools were used are ovens, AAS, analytical scales, plastic bags, rubber, PVC pipes, gauze filters, hoes, sprayers, mortar pestles, measuring cups, glas beakers, erlenmeyers, test tubes, film bottles, shakers, basins and stationery.

This research is factorial experiment 4 x 4 repeated 3 times using factorial Completely Randomized Design (CRD). The first factor is the provision of dolomite which consists of 4 levels, namely: D0: 0 ton.ha-1, D1: 2.5 ton.ha-1 or (7.85 g per tube), D2: 5 ton.ha-1 or (15.70 g per tube), D3: 7.5 ton.ha-1 or (23.55 g per tube). The second factor is NPK0: N, P, K single pearl (Recommendation), NPK1: NPK (13: 6: 27: 4 + 0.65B) Crown B or (6.05 gram N equivalent), NPK2: NPK (13: 6: 27: 4 + 0.65B) Hi-Kay Plus or (6.05 gram N equivalent), NPK3: NPK (13: 8: 27: 4 MgO) Ztick or (6.05 gram N equivalent).

Initial Peat Soil Chemical Properties

The chemical properties of the peatland in the research location before being treated are presented in Table.1

Soil chemical properties	Unit	Value	Status*
pH H_2O		4.04	Very sour
C organic	%	56.90	Very high
organic matter	%	98.09	Very high
N total	%	0.22	Moderate
C/N		35.39	Very high
P potential (HCl 25%)	%	0.0098	Very low
K- total (HCl 25%)	%	0.34	Very low
Ca-dd	me 100 g^{-1}	4.50	Low
K-dd	me 100 g^{-1}	0.28	Low
Mg-dd	me 100 g^{-1}	0.24	Very low
Na-dd	me 100 g^{-1}	0.77	Moderate
CEC	me 100 g^{-1}	48.03	Very high
Base Saturation	%	12.05	Low

Information * = Status of chemical properties refers to the Soil Research Center (2005).

Based on the data in Table 1, it stated that peatland was used is classified as less fertile. It is characterized by chemical properties, namely very acidic soil reactions, very high C / N, very low potential P and very low K. Other characteristics are low Ca-dd and K-dd, very low Mg-dd and low base saturation.

The peatland samples were used for Mandau oil palm plantation, Siak, which has very acidic soil reaction. The peatland used is ombrogen peat which is composed of organic matter, plant debris and rotting plant tissue. Ombrogenic peat usually has low bearing capacity, very low pH and soil fertility. This is consistent with several research reports on peatland. High acidity in tropical peatland caused by poor drainage conditions and the occurrence of hydrolysis of organic acids (Dariah et al., 2014). Noor (2001) also states that the decomposed organic material has reactive groups such as carboxylates (-COOH) and phenolics (C6H4OH) which dominate the exchange complex and are weak acids so that they can dissociate and produce large amounts of H + ions.

The peatland used in this study has very high C / N. The C / N content ratio shows the decomposition rate of organic matter in the soil. The C / N ratio indicates the size or size of the accumulated carbon. The higher the C / N ratio value, the more carbon can be accumulated so that the level of peatland decomposition is low. Peatland management causes soil microbiological activity and the rate of decomposition increases (Barchia, 2006). According to Fahmi and Radjagukguk (2013), high C / N causes most of the N element to be taken up by microorganisms as a source of energy in the process of weathering or changing organic matter, so that nutrient availability for plants will decrease. An overhaul is said to be perfect if the C / N ratio is less than 20 (Murayama and Abu Bakr, 1996). Therefore, to meet the optimum need for N plants, N fertilization is needed. One of the widely used sources of N fertilizer is urea.

Basic cations (Ca-dd, K-dd and Mg-dd) in peatlands are classified as low. This is due to organic compounds and very high cation exchange capacity (CEC). According to Ratmini (2012) organic acids contain carboxyl and phenolic groups, where the carboxyl and phenolic functional groups are the source of negative charges. Peatlands are characterized very high CEC, but very low percentage of base saturation (KB) can make it difficult to absorb nutrients, especially bases needed by plants. The low holding power of base cations causes nutrients to dissolve easily, especially nitrogen, so it needs several times fertilization with low doses. Nitrogen is absorbed by plants in the form of ammonium and nitrate. Ammonium has positive mutation can bind to soil colloids negatively charged so that it is not easily dissolved (leached), but nitrate cannot bind to soil colloids so it is easily leached and results in low fertilization efficiency (Lingga, 2005).

Chemical Properties of Peat Soil after being treated

Peat soil pH

The results of variance showed the main effect of giving dolomite and NPK slow decompose, as well as the interaction between dolomite and NPK slow decompose have significant effect on the pH of the peatland in observations 2, 4, and 10 MST. The results of Tukey's further test at the 5% level are shown in Table 4.2.

Table 2. The pH value of peat soil treated with dolomite and NPK is slow to decompose

Dolomit (ton.ha^{-1})	NPK Fertilizer (gram / plant)				Average
	NPK0	NPK1	NPK2	NPK3	
	----------------------Week 2 ----------------------				
0	4.40i	5.48f	5.42f	5.07gh	5.09c
2,5	4.76h	5.62ef	5.43f	6.50a	5.58b
5,0	5.39fg	6.14bc	5.60ef	6.38ab	5.87a
7,5	5.72def	5.98cd	5.87cde	6.15bc	5.93a
Average	5.07d	5.80b	5.58c	6.02a	
	----------------------Week 4 ----------------------				
0	4.51g	6.09cde	5.80de	5.81de	5.55c
2,5	5.43f	5.92cde	5.82de	6.65a	5.95b
5,0	5.74ef	6.55ab	5.82de	6.25cd	6.06a
7,5	6.03cde	6.19bc	6.19bc	6.10cd	6.13a
Average	5.42c	6.18a	5.91b	6.18a	
	----------------------Week 10 --------------------				
0	4.14g	5.54ab	5.25bcde	5.26abcde	5.05c
2,5	4.89f	5.37abcde	5.24bcde	5.60a	5.27ab
5,0	5.19cdef	5.50abc	5.27abcde	5.47abcde	5.39a
7,5	5.49abcd	5.14def	5.14def	5.14def	5.22b
Average	4.92c	5.38a	5.22b	5.37a	

The numbers followed by the same lowercase letter are not significantly different according to the Tukey test at 5% level

There is an interaction effect between 2.5 ton.ha-1 dolomite and NPK3 species, and between 5.0 ton.ha-1 dolomite and NPK1 at 2 MST observations. At 4 MST there was an interaction effect between 2.5 ton.ha-1 dolomite and NPK1 species, between 7.5 ton.ha-1 dolomite with NPK1, NPK2 dolomite and 5.0 ton.ha-1 dolomite with NPK1 types. Likewise, at 10 MST observations there was an interaction effect between dolomite 2.5 g ton.ha-1 and NPK3 species. Increasing the dose of dolomite from 0 to 2.5 tonnes.ha-1 in the NPK3 type resulted significantly increasing soil pH and the highest compared to NPK1 and NPK2 and there was tendency for same pattern to soil pH after dolomite application and NPK slow decompose at 2.4 and 10 MST (Table 2). It thought due to the influence of the interaction between dolomite and NPK, slow decompose can improve soil fertility by increasing the pH of the peatland. Dolomite provides supply of OH- to soil solution can reacts with H + to become water and causes the H + level to decrease so the soil pH increases. Application of NPK slow decompose fertilizer has effect on increasing the pH of the peatland. According to Winarso (2005), soil pH has a strong influence on nutrient availability, the increasing soil pH, the more soil nutrient availability increases. pH affects nutrient absorption by plants (Heriansyah, 2019).

Peatland Electrical Conductivity

The results of variance showed the main effect of giving dolomite and NPK slow decompose, and interaction between dolomite and NPK slow decompose had significant effect on electrical conductivity in observations 2 and 4 MST. Meanwhile, dolomite administration and interaction between dolomite and NPK slow decompose had no significant effect, however, NPK was given significant effect on the electrical conductivity at 10 MST observations (Attachment 5.4-5.6). Tukey's further test results at the 5% level are shown in Table 4.3.

Table 3. Electrical Conductivity (dS / m) of 10 cm peat soil treated with dolomite and NPK slow decompose fertilizer

Dolomit (ton.ha^{-1})	NPK Fertilizer (g / plant)				Average
	NPK0	NPK1	NPK2	NPK3	
	--------------------------Week 2 ----------------------				
0	0.52e	4.30bcd	4.27bcd	4.25bcd	3.30b
2,5	0.54e	4.14d	4.48ab	4.19cd	3.33b
5,0	0.63e	4.44ab	4.27bcd	4.40abc	3.438a
7,5	0.47e	4.43ab	4.29bcd	4.54a	3.434a
Average	0.54b	4.32a	4.33a	4.34a	
	--------------------------Week 4 ---------------------				
0	0.50g	3.98bcd	3.44ef	3.67de	2.89cb
2,5	0.41g	3.55ef	3.31f	3.95bcd	2.80c
5,0	0.40g	4.41a	3.24f	3.69cde	2.93b
7,5	0.39g	4.34a	4.00cd	4.03b	3.19a
Average	0.42d	4.07a	3.49c	3.83b	
	--------------------------Week 10 -------------------				
0	0.51a	2.85a	3.15a	3.10a	2.40a
2,5	0.55a	2.95a	3.19a	2.68a	2.34a
5,0	0.533a	2.75a	3.00a	2.71a	2.25a
7,5	0.44a	3.40a	3.33a	3.04a	2.55a
Average	0.50c	2.99b	3.17a	2.88b	

The numbers followed by the same lowercase letter are not significantly different according to the Tukey test at 5% level

There is an interaction effect between 7.5 ton.ha-1 dolomite with NPK3 and NPK1 types, between 2.5 ton.ha-1 dolomite and NPK2 species and between 5.0 ton.ha-1 dolomite and NPK1 species at 2 MST observations . At 4 MST there is an interaction effect between 5.0 and 7.5 ton.ha-1 dolomite with NPK1 types, also between 7.5 ton.ha-1 dolomite with NPK1 and NPK2 types and between 2.5 ton.ha-dolomite 1 with the NPK2 type at 10 MST observations. Increasing the dolomite dose from 0 to 7.5 tonnes.ha-1 with the NPK3 type resulted in a significant increase in electrical conductivity (DHL) and the highest compared to NPK1 and NPK2 types at 2 MST, while the 4 and 10 MST observations were between 7.5 dolomite doses ton.ha-1 with NPK1 and NPK2 types produced DHL which increased significantly and was the highest compared to NPK3 types (Table 4.3). It thought due to influence of interaction between dolomite and NPK slow decompose can increase availability of nutrients, such as N, P, K and Ca, Mg. High levels of nutrients, especially Ca and Mg cations, can increase electrical conductivity of peatlands (Brotowijaya et al, 1995).

Ammonium, Nitrate and Proportion of Leached Nitrogen

The results of variance showed the main effect of dolomite and NPK slow decompose significantly affected ammonium, leached nitrate and leached nitrogen proportion, while the interaction between dolomite and NPK slowl decompose had no significant effect on ammonium and leached nitrate except for proportion of leached nitrogen. The results of Tukey's further test at the 5% real level are shown in Table 4.

Administration of NPK1 produced lower leachate ammonium than NPK2 and NPK3. Meanwhile, giving NPK1 and NPK3 resulted in different and lower leachate nitrate than NPK2. The application of NPK slow decompose resulted lower proportion of dissolved nitrogen than non-NPK slow degradation. NPK type treatment slow to decompose, NPK1 produces lower proportion of leached nitrogen than NPK2 and NPK3. This is due to the slow degradation nature of can cause low solubility, but can provide nutrients sustainably for a longer time. Thus, NPK slow decompose will retain the N content in the soil in the form of NH4 +. Availability can inhibit nitrification so as to maintain high NH4 + concentrations for a longer time in the field (Joseph and Prasad, 1993 in Prasad and Power, 1997).

Yoshida (1981) stated that NH4 + in soil is the main source of N in maize/corn, approximately 70% N is taken from the soil. Furthermore, it was stated that maize/corn was tolerant of high NH4 + concentrations, and in the early growth phase maize/corn preferred to absorb NH4 + than NO3-. Adequacy of N in the vegetative growth phase is important factor for plant growth. Nitrogen is absorbed by plants in the form of NO_3- and NH_4 + ions.

Table 4. Ammonium, Nitrate and Nitrogen Proportion leached from peatland fed by dolomite and NPK slow decompose fertilizer

Dolomit (ton.ha^{-1})	NPK Fertilizer (g / plant)				Average
	NPK0	NPK1	NPK2	NPK3	
	-------------------Ammonium (mg/l)----------------				
0	30.22a	61.60a	81.30a	71.90a	61.26a
2,5	19.64a	57.48a	65.97a	65.95a	52.2ab
5,0	25.56a	41.18a	63.40a	65.37a	48.87b
7,5	23.43a	53.70a	48.29a	61.34a	46.69b
Average	24.71c	53.49b	64.74a	66.14a	
	------------------------ Nitrat (mg/l) ----------------				
0	51.51a	58.22a	109.4a	70.06a	72.30a
2,5	37.78a	53.86a	88.8a	50.24a	57.67ab
5,0	37.30a	55.00a	72.5a	69.14a	58.48ab
7,5	29.85a	48.41a	61.35a	57.86a	49.36b
Average	39.10c	53.86bc	83.03a	61.82b	
	------------------ Proporsi Nitrogen (%)------------				
0	2.75a	0.853de	1.36cd	1.04de	1.50a
2,5	1.93bc	0.79de	1.10de	0.850de	1.17b
5,0	2.11b	0.68e	0.97de	0.98de	1.19b
7,5	1.79bc	0.72e	0.78de	0.87de	1.04b
Average	2.14a	0.76c	1.05b	0.93bc	

The numbers followed by the same lowercase letter are not significantly different according to the Tukey test at 5% level

The proportion slow-decomposed of non-NPK dissolved nitrogen was higher than the slow-decomposing type of NPK, where the nitrogen obtained from non-NPK slowly degraded was derived from urea. According to Alexander (1976), explaining that urea which is given to the soil will immediately hydrolyze in less than 1 week. N-urea is transformed into ammonium form at 10 0C. The conversion will be faster at high temperatures. The results of observations of soil temperature during the experiment were in the range of 24-29 0C, so the conversion of urea to ammonium would be even faster.

Growth Response

Plant height

The results of variance showed the main effect of giving dolomite had significant effect, while NPK slow decompose and interaction between dolomite and NPK was not significantly affected by the height of sweet corn plants. The results of Tukey's further test at the 5% real level are shown in Table 4.7.

Table 5. Plant height (cm) of sweet corn given dolomite and NPK slow decompose fertilizer

Dolomit (ton.ha^{-1})	NPK Fertilizer (g / plant)				Average
	NPK0	NPK1	NPK2	NPK3	
0	98.50a	96.33a	89.27a	84.67a	92.19b
2,5	142.00a	100.00a	139.00a	122.00a	125.75a
5,0	136.17a	112.83a	120.33a	89.00a	114.58ab
7,5	123.33a	113.00a	115.67a	155.67a	126.92a
Average	125.00a	105.54a	116.07a	112.83a	

The numbers followed by the same lowercase letter are not significantly different according to the Tukey test at 5% level

Increasing the dose of dolomite with NPK slow-decompose and non-NPK slow-decompose types resulted in the same high interaction of sweet corn plants, but there was tendency to increase plant height. Giving dose of 7.5 ton.ha-1 dolomite with NPK3 species produced the highest plant height compared to other treatments (Table 5). This is due to the slow degradation characteristics of NPK are available slowly so initial stage there is disturbance causes the plant to burn. In general, plant height growth without dolomite was lower than other treatments. This is due to the availability of nitrogen for growth of corn plants. Increasing the dolomite dosage from 2.5 to 7.5 tonnes.ha-1 resulted in significantly different plant heights in various types of NPK slow-decompose. The availability of N in the application of NPK is relatively available due to the addition of N fertilizer, which is a limiting factor for the growth of maize plants. The element N in sweet corn cultivation is used to stimulate the growth of roots, stems, leaves and plant height (Sirajuddin et al., 2010). Suryanti (2004) states that the availability of sufficient N nutrient causes plant metabolic activities to increase.

Number of Leaves

The results of variance showed that the main effect of giving dolomite had a significant effect, while NPK was slow to decompose and the interaction between dolomite and NPK was not significantly affected by the number of sweet corn leaves. The results of Tukey's further test at the 5% real level are shown in Table 4.8.

Table 6. The number of leaves (strands) of sweet corn given dolomite and NPK slow decompose fertilizer

Dolomit (ton.ha^{-1})	NPK Fertilizer (g / plant)				Average
	NPK0	NPK1	NPK2	NPK3	
0	13.00a	10.00a	9.00a	8.00a	10.00b
2,5	14.00a	12.00a	13.00a	13.33a	13.08a
5,0	13.66a	12.00a	13.00a	12.66a	12.83a
7,5	12.33a	11.00a	12.66a	14.33a	12.58a
Average	13.25a	11.25a	11.91a	12.08a	

The numbers followed by the same lowercase letter are not significantly different according to the Tukey test at 5% level

There is interaction effect between dolomite 2.5 ton.ha-1 with NPK0 and NPK1 types, but it does not significantly increase the number of leaves compared to other treatments except for dolomite 0 g per tube with NPK3 (Table 6). Its because increasing dose of dolomite cannot increasing availability of nutrients in the soil. The optimum number of leaves allows for more even distribution or distribution of light between leaves in all parts of the plant. The more leaves of the plant, the easier is for the leaves to get sunlight from various directions, so the rate of photosynthesis (Table 4.6) will be maximized. The better the rate of photosynthesis, the better the plant growth will be.

Male Flowers Appear

The results of variance showed the main effect of giving dolomite, NPK slow decompose and the interaction between dolomite and NPK slow decompose had significant effect on appearance of male flowers (Annex 5.16). The results of Tukey's further test at the 5% real level are shown in Table 4.9.

Table 7. The male flowers (HST) of sweet corn given dolomite and NPK slow decompose fertilizer

Dolomit (ton.ha^{-1})	NPK Fertilizer (g / plant)				Average
	NPK0	NPK1	NPK2	NPK3	
0	51.33a	52.00a	53.00a	53.33a	52.41a
2,5	46.66b	52.33a	51.00a	51.66a	50.41c
5,0	51.33a	50.33a	50.66a	52.00a	51.08bc
7,5	51.00a	51.66a	51.33a	52.33a	51.58ab
Average	50.08b	51.58a	51.0a	52.33a	

The numbers followed by the same lowercase letter are not significantly different according to the Tukey test at 5% level

Increasing dose of dolomite with NPK slow-decomposing types and non-NPK slow-decomposing species did not show result in significantly different interactions with male flower appearing except for dolomite and NPK0 (Table 7). Its because giving higher doses of dolomite can improve soil properties in providing nutrients. Giving dolomite is more influential in improving soil nutrient status than NPK slow decompose because dolomite can affect the availability of more nutrient amounts. Increasing soil N, P, and K nutrients play a role in accelerating the appearance of male flowers (Noza et al., 2014).

Flower appears female

The results of variance showed the main effect of giving dolomite had significant effect, while NPK slow decompose and the interaction between dolomite and NPK slow decompose had no significant effect on the appearance of female flowers. The results of Tukey's further test at the 5% real level are shown in Table 4.10.

Table 8. The female flowers (HST) of sweet corn given dolomite and NPK slow decompose fertilizer

Dolomit (ton.ha^{-1})	NPK Fertilizer (g / plant)				Average
	NPK0	NPK1	NPK2	NPK3	
0	55.33a	54.33a	55.66a	55.33a	55.16a
2,5	52.33a	55.33a	54.00a	54.00a	53.19b
5,0	54.33a	54.33a	53.66a	54.66a	54.25ab
7,5	53.33a	54.33a	54.00a	54.33a	54.00ab
Average	53.83a	54.58a	54.33a	54.58a	

The numbers followed by the same lowercase letter are not significantly different according to the Tukey test at 5% level

Increasing dose of dolomite with NPK slow-decomposing and non-NPK slow-decomposing types did not produce significant difference between appearance of female flowers except between 0 ton.ha-1 dolomite and NPK2 and between 2.5 ton.ha-1 dolomite and NPK0 (Table 8) . This is due to fact that dolomite with NPK slow decompose can improve soil chemical properties by increasing nutrient availability, by increasing pH (Table 4.2). The increase in pH can affect the availability of nutrients where the flowering period requires the role of macro nutrients, namely N, P and K. Corn flowering occurs in the generative phase and in this case the macro elements that play a greater role are Nitrogen (N) and Phosphorus (P). Elemental N is only needed in small amounts, while P is needed more for the formation of flowers. This was also expressed by Marschner (1986) in Marvelia et al. (2006), stated that the nutrient N plays a role in flowering, but the role of N is not as big as the role of P in the formation of flowers.

Root Volume

The results of variance showed the main effect of giving dolomite and NPK slow decompose and interaction of dolomite and NPK slow decompose had significant effect on the root volume of sweet corn at 4 WAP observations. However, the application of dolomite and NPK slow decompose had significant effect, while the interaction between dolomite and NPK slow decompose had no significant effect on the root volume of sweet corn at 5 and 10 MST observations. The results of Tukey's further test at the 5% real level are shown in Table 9.

Table 9. Root volume (ml) of sweet corn treated with dolomite and NPK slow decompose fertilizer

Dolomit (ton.ha^{-1})	NPK Fertilizer (g / plant)				Average
	NPK0	NPK1	NPK2	NPK3	
	----------------------Week 4 -----------------------				
0	16.67bc	11.66c	13.00c	14.00c	13.83b
2,5	39.66a	18.33bc	18.00bc	13.66c	22.41a
5,0	34.66ab	12.00c	18.66bc	13.66c	19.75ab
7,5	26.00abc	10.33c	23.00abc	13.66c	18.25ab
Average	29.25a	13.08b	18.16b	13.75b	
	-----------------------Week 5 -----------------------				
0	24.00a	21.00a	21.33a	23.00a	22.33b
2,5	66.33a	26.67a	32.33a	31.67a	39.25a
5,0	55.33a	23.33a	25.33a	23.67a	31.91ab
7,5	58.33a	24.67a	32.00a	34.67a	37.41a
Average	51.00a	25.33b	26.33b	28.25b	
	----------------------Week 10 -----------------------				
0	81.33a	65.33a	68.67a	74.00a	72.33b
2,5	140.67a	101.33a	95.67a	113.33a	112.75a
5,0	136.00a	106.00a	110.00a	112.00a	116.0a
7,5	136.67a	105.00a	137.33a	145.00a	131.0a
Average	123.66a	94.41b	102.91ab	111.08ab	

The numbers followed by the same lowercase letter are not significantly different according to the Tukey test at 5% level

There is interaction effect between 2.5 and 7.5 ton.ha-1 dolomite with NPK0 at 4 MST. At 5 MST there is interaction effect of increasing the dose between 2.5 to 7.5 ton.ha-1 dolomite and NPK0, between 2.5 ton.ha-1 dolomite with NPK2, NPK2 and NPK3 and between 7.5 ton.ha dolomite -1 with the types of NPK2 and NPK3. Likewise, at 10 MST there was interaction effect between 7.5 ton.ha-1 dolomite and NPK0 and between 7.5 ton.ha-1 dolomite with NPK2 and NPK3 (Table 9). Its because provision of dolomite and NPK slow decompose can improve the condition of the peatland by increasing the availability of nutrients in the peatland. Nutrient adequacy is very important for plant growth because it will affect the plant growth process, including root growth. Root growth includes lengthening and widening the roots which will be influenced by media and environmental factors. The planting medium factor is related to its carrying capacity for root growth as an organ that functions to absorb water and nutrients. Sinaga and Ma'ruf (2016) through their research concluded that giving N, P, and K nutrients to sweet corn plants increased root volume.

Plant Dry Weight

The results of variance showed the main effect of dolomite and NPK slow decompose fertilizer had significant effect, while the interaction of dolomite and NPK slow decompose had no significant effect on plant dry weight in 4 and 5 MST observations. Giving dolomite and giving NPK slow decompose and interaction of dolomite with NPK slowl decompose had significant effect on plant dry weight at 10 WAP observations. The results of Tukey's follow-up test at the 5% significance level are shown in Table 10.

Table 10. Plant dry weight (g) of sweet corn treated with dolomite and NPK slow decompose fertilizer

Dolomit (ton.ha^{-1})	NPK Fertilizer (g / plant)				Average
	NPK0	NPK1	NPK2	NPK3	
	----------------------Week 4 -----------------------				
0	4.33a	2.56a	4.55a	8.14a	4.89b
2,5	21.76a	5.48a	13.05a	15.15a	13.86a
5,0	19.07a	10.63a	12.56a	16.65a	14.73a
7,5	20.46a	8.18a	15.27a	10.85a	13.69a
Average	16.40a	6.71b	11.36ab	12.70ab	
	---------------------- Week 5 -----------------------				
0	15.63a	19.11a	12.70a	17.04a	16.12c
2,5	39.18a	27.14a	21.15a	24.55a	28.00b
5,0	37.51a	25.36a	29.33a	42.63a	33.71ab
7,5	40.30a	32.86a	30.27a	57.40a	40.22a
Average	33.15a	26.12ab	23.36b	35.41a	
	---------------------- Week 10 -----------------------				
0	38.96g	51.78efg	49.04fg	56.04efg	48.95d
2,5	66.18cdef	57.14edf	61.49cdef	73.53abcd	64.58c
5,0	87.18a	65.36cdef	67.33bcde	75.97abc	73.96b
7,5	83.96ab	78.53abc	76.27abc	86.95a	81.43a
Average	69.07ab	63.20b	63.53b	73.12a	

The numbers followed by the same lowercase letter are not significantly different according to the Tukey test at 5% level

There is interaction effect between 2.5 and 7.5 ton.ha-1 dolomite with NPK0 at 4 MST. At 5 MST there is interaction effect of increasing the dose between 5.0 to 7.5 dolomite with NPK3, also between 5.0 and 7.5 ton.ha-1 dolomite with NPK0 and between 2.5 ton.ha-1 dolomite and NPK3 at 10 MST (Table 10). This is due to the application of dolomite and NPK slow to decompose, which can improve soil fertility by increasing pH (Table 4.2) and providing sufficient nutrient availability in peatland to help plant growth. Imam and Widyastuti (1992) stated the height and the low dry weight of the plant depends on the amount or at least of nutrient uptake during the plant growth process. In line with Dwijoseputro's (1986) opinion that the dry weight of a plant is influenced by optimal photosynthesis because the dry weight of a plant depends on the amount of accumulated carbohydrates in the plant body. The photosynthesis process will run well if the environmental conditions for growth are favorable.

Growth rate

The results of variance showed that the main effect of dolomite and NPK was slow to decompose and that the interaction between dolomite and NPK was significantly affected by the growth rate of sweet corn plants. The results of Tukey's further test at the 5% real level are shown in Table 11.

Table 11. The growth rate (g / day / plant) of sweet corn given dolomite and NPK slow decompose fertilizer

Dolomit (ton.ha^{-1})	NPK Fertilizer (g / plant)				Average
	NPK0	NPK1	NPK2	NPK3	
0	1.61b	2.36b	1.16b	1.27b	1.60b
2,5	2.49b	3.09b	1.15b	1.34b	1.02b
5,0	2.63b	2.10b	2.39b	3.71ab	2.71ab
7,5	2.83b	3.52ab	2.14b	6.65a	3.79a
Average	2.39ab	2.77ab	1.71b	3.24a	

The numbers followed by the same lowercase letter are not significantly different according to the Tukey test at 5% level

There is interaction effect between 7.5 ton.ha-1 dolomite and NPK1, between 5.0 and 7.5 ton.ha-1 dolomite and NPK3 (Table 11). Its because application of dolomite and NPK slow decompose can improve the soil fertility of the peat, thereby affecting the rate of plant growth, seen from data such as photosynthesis rate (Table 4.6) and plant dry weight (Table 4.13) in a time interval and in relation to the original weight. The difference in plant size occurs between plants of the same age even when planted in the same environment, but different treatments, in nature, nutrient absorption is strongly influenced by the environment (Heriansyah *et al,* 2020). Larger plants produce new, taller plants because they have photosynthetic active leaves and roots actively absorb more nutrients and water than smaller plants (Sitompul and Guritno, 1995), Nutrient absorption is also influenced by the availability of growth hormone in plants (Heriansyah & Indrawanis, 2020). The results of photosynthesis are translocated to all parts of the plant to support the growth rate in the generative and vegetative phases of the plant.

Conclusions

1. Giving dolomite 7.5 ton.ha-1 can reduce the proportion of leached nitrogen, increasing the physiology and growth of sweet corn plants such as plant height, leaves, root volume, plant dry weight and plant growth rate compared without dolomite.
2. Giving NPK slow decompose can reduce the proportion of dissolved nitrogen, increasing plant physiology such as chlorophyll content and plant growth such as plant dry weight compared without NPK slow decompose.
3. Having the interaction between 5 ton.ha-1 dolomite and NPK slowly decomposed resulted in different responses were able to suppress the proportion of leached nitrogen, thereby affecting the increase in plant growth.

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