Nitrogen Slow-Release Zeolite-Based Fertilizer on Rice Plants at Inceptisol Soil

Kharisun[1*]; Purwanto[2]; M Rifan[3]; Budi Prakoso[4]; Ratri Noorhidayah[5]; Afrina Handayani[6]

[1-5]Lecturer at the Faculty of Agriculture, Universitas Jenderal Soedirman, Indonesia
[6]Faculty of Agriculture, Universitas Jenderal Soedirman, Indonesia
*Corresponding Author

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Abstract— *Most of N fertilizer have low efficiency in paddy field due to it is easily lost through evaporation and runoff. Slow-release N fertilizer based on zeolite is potential N fertilizer in paddy field to to improve the efficiency of N fertilizer. Slow release N fertilizer based on zeolite is also potential to improve the growth and production of rice. This study aimed to determine the effect of slow-release fertilizer on the growth and production of rice plants on inceptisols and knowing the best dosage for rice plants in the inceptisols. This study used a Completely Randomized Block Design (RAKL) with 2 treatment factors and 3 replications. The first factor is the application of N fertilizers, namely original N fertilizer, 1% coating slow-release N fertilizer, and 3% coating slow-release N fertilizer. The second factor is the dose of N fertilizer namely 0 kg/ha (N0), 100 kg/ha (N1), and 200 kg/ha (N2). The research variables are leaf area, leaf area index, number of tillers, number of productive tillers, the greenness of leaves, density and width of stomatal openings, plant dry weight, net assimilation rate, plant growth rate, relative growth rate, nitrogen uptake, panicle length, number of grains per malai, moisture content of the harvested grain, grain weight of 1000 seeds, the weight of grain in clumps, grain weight per hectare, and agronomic efficiency. Data were analyzed using ANOVA, and if it is significantly different, then further tested using DMRT at a 5% level. The results showed that slow-release N fertilizer improves plant growth and production components better than original N fertilizer. Provision of slow release zeolite-based fertilizers coating 3% with a dose of N 200 kg/ha gives the best results for plant growth and production.*

Keywords— Rice, Nitrogen, zeolite, slow release.

I. INTRODUCTION

Nitrogen (N) is the main element needed by plants for growth. Nitrogen increases plant growth and production (Pan S et al., 2022). Nitrogen functions are a major component in forming proteins, nucleic acids, chlorophyll, and other organic compounds. Nitrogen also gives a green appearance to leaves as a component of chlorophyll, supports growth, increases plant height and the number of leaves, increases leaf size, increases seed size, and increases protein composition in seeds (Sumiyanah & Iman Sungkawa, 2018).

One of the problems of rice cultivation today is using fertilizer chemistry continuously with high doses, causing negative effects on the environment and reducing fertilization efficiency (Abdulrahman et al., 2008). The dosage of N fertilizer at the farm level is currently relatively high, reaching 400-600 kg urea/ha, especially in intensive rice fields in Java, which is above the national recommendation of 200-260 kg urea/ha (Triadiati et al., 2012).

Nikmah (2019) argues that the application of nitrogen (N) fertilizers in rice cultivation in Indonesia every year has increased. However, the ability of rice plants to absorb N is still low, around 30% -50%. The rest (50-70%) will be lost to the environment through evaporation and surface runoff (Coskun et al., 2017 Kharisun & Budiono, M.N, 2015). Even according to Oliveira et al. (1997), loss of N can reach 94% when urea is applied to soil covered with straw. N loss is caused by dispersion (Sommer et al., 2004), volatility NH3 (Li et al., 2017), and washed away by surface runoff (Cai et al., 2002).

The evaporation of gas from paddy fields is thought to be one of the contributors to the greenhouse effect (IPPC, 2013; Ye Yuan, 2019). Some gas emissions from fertilizing paddy soil are N2O (Wu et al., 2017) and CH4 (Shang et al., 2013). Nitrogen is a plant macronutrient that is very important for plant growth and production, and in most soils, monoculture cereals such as rice are deficient (Omara et al., 2019).

One of the things needed for nitrogen fertilizers is fertilization technology with low solubility but can provide sufficient nutrients for plants. Nitrogen technology Slow-release fertilizer is a fertilizer technology with low nutrient solubility and can provide nutrients gradually over a long period. The low nutrient release will enable nutrient absorption with high efficiency and nutrient loss due to the washing. Fertilizer NZEO-SR-Plus is a slow-release nitrogen fertilizer that uses natural zeolite as the main ingredient and is enriched with Si and humic acid, rice husk and clay minerals (montmorillonite) as binders and nano-zeolite coating and humic materials. The presence of nano-zeolite coating and humic materials can increase the soil's physical, chemical and biological fertility, especially on marginal soils. The coating is a layer applied to the surface (Ngguna et al., 2020).

Humic acid can stimulate and activate physiological and biological processes in living organisms in the soil, which makes humic acid act as a soil conditioner. The humic acid given to the urea fertilizer acts as a coating which helps protect the nitrogen elements from possible evaporation and dissolves with surface runoff. This is shown when N fertilizers such as urea are given humic acid, properties volatile (volatile) of urea fertilizer appear to be reduced. NH2 from urea fertilizer changes into ammonium ion (NH4+).

Zeolite is an aluminosilicate mineral in three-dimensional crystals with a nano-sized pore channel structure resulting in a very large surface area. In NZEO SR Plus fertilizer, zeolite will bind NH4+, released from the hydrolysis of N fertilizers such as urea. NH4+ ions are adsorbed on the negatively charged lattice in the nano-sized, making them inaccessible to microbes. The adsorbed ions can be released slowly and controlled through the cation exchange mechanism. According to Suwardi (2020), applying nitrogen fertilizer without adding zeolite facilitates high N leaching and volatilization, making it unavailable to plants (Suwardi, 2000). N fertilizer based on zeolite can work as a slow-release fertilizer (Kharisun et al. 2017).

Using nitrogen fertilizers released in a controlled manner using zeolite can increase nitrogen uptake efficiency and reduce the loss of nitrogen gas through ammonia evaporation and denitrification (Cabezas et al., 2005; Achmed O.H. et al., 2010; Palanivel P et al. 2015). Slowrelease N fertilizer based on zeolite and humic acid is expected to overcome the efficiency of nitrogen fertilizers and can increase sub-optimal soil fertility. This study aims to determine the effect of slow-release fertilizer (NZEO-SRPlus) on the growth and production of IR64 rice plants and determine the best dose for I.R. 64 rice plants in soil inceptisol, Karangsari, Cirebon.

II. RESEARCH METHODS

The research was conducted in the rice fields of Karangsari Village, Cirebon Regency, Indonesia from September 2020 to February 2021. The research was conducted in paddy fields with the Inceptisol soil type and IR 64 rice plants. The experimental plots were 4 meters x 5 meters with a spacing of 25 cm x 25 cm.

The experiment used a Completely Randomized Block Design (RAKL) which consisted of 2 treatment factors: the type of fertilizer and the dose of N fertilizers. The types of fertilizer consisted of original N fertilizer with 46 % N content (P1), slow release N zeolite-based fertilizer (NZEO SR Plus) with 20 % N content and coating of 1% of zeolite (P2), and NZEO SR Plus with 20 % N content and coating of 3% of zeolite (P3). The dose of N consists of 0 kg/ha (N0), 100 kg N/ha (N1), and 200 kg N/ha (N2). There were 9 treatment combinations and 3 replications, so there were 27 experimental units.

Variables observed were leaf area, leaf area index, plant dry weight, number of tillers, green leaves, opening width and stomata density, number of productive tillers, panicle length, number of grains per malai, grain moisture content, the weight of 1000 seeds, grain weight per hill, net assimilation rate, plant growth rate, relative growth rate, nitrogen uptake, grain weight per hectare, and agronomic efficiency. The data obtained were analyzed statistically using the F-test analysis at an error level of 5%. If the results of the ANOVA show differences between the treatments, proceed with further testing using the DMRT (Duncan's Multiple Range Test) $\propto$ 5%.

III. RESULTS AND DISCUSSION

3.1 The general condition of research location:

The research area is located at an altitude of 10 m above sea level with the soil type in Inceptisols with Soil fertility status is shown in Table 1. The average air temperature is 28℃-

32℃ with humidity of 80%. The estimated air temperature in the morning is 24℃-27℃ and during the day 29℃-32℃.

TABLE 1
STATUS OF INCEPTICOLS FERTILITY IN THE RESEARCH AREA

Analysis	Unit	Results	Dignity
H_2O pH	-	6.3	slightly acid
pH KCl	-	5.22	Acid
DHL	ds/cm	0.118	very low
Redox potential	Mv	130	Average
CEC	cmol(+)/kg	18.68	Average
C-Organic	%	0.11	very low
N-Available	ppm	21	High
P-Available	ppm	1675.95	very high
K-Available	cmol(+)/kg	1.43	very high
N-Total	%	0.22	Average
P-Total	ppm	1739.42	very high
K-Total	$cmol_{K2O}$ _	5.21	very low
Si-Available	%	0.059	very low

Source: Result of analysis, soil laboratory, Agriculture, Unsoed

Based on Table 1, the inceptisol soil has pH-$_{KCl}$ and pH-$_{H2O}$ of 5.22 and 6.3 respectively. The pH-$_{H2O}$ is greater than the pH-$_{KCl}$. This shows that the soil is negatively charged, meaning the soil is able to hold the cations that plants exchange. The status of C-organic and Si content is classified as very low. The availability of Si in soil is very low due to the desilication process so that the Si contained in the top layer of soil is leached into the bottom layer. The electrical conductivity (DHL) is also classified as very low. The redox potential is included in the medium category. Soil redox potential indicates the rate of oxidation and reduction reactions in the soil. The cation exchange capacity (CEC) on the research land is included in the medium category. The available N content in the land is high and the total N content in the land is moderate. The content of available P and total P in the land is very high. This is due to acidic condition of soil which is more easily to dissolve the P in soil. The available K content is very high while the total K is very low. This is due to the condition of flooding in rice field will increase the availability of Fe 2+ and Mn2+ to replace K adsorbed by clay so that K is released into the soil solution. According to Prasetyo et al., (2004) flooding will reduce the redox potential (Eh) of the soil thereby increasing the solubility of Fe^{2+} and Mn^{2+}.

3.2 Treatment of various type of fertilizers and doses of N on the growth and production of rice:

TABLE 2
EFFECT OF TYPE OF SLOW-RELEASE N AND DOSES OF N ON LEAF AREA, LEAF AREA INDEX, NUMBER OF TILLERS, AND PLANT DRY WEIGHT

Treatment	Number of Saplings	Number of Saplings	Number of Saplings	Dry Weight	Dry Weight	Dry Weight
	4 mst	6 mst	8 mst	4 mst	6 mst	8 mst
Fertilizer Type						
Original N Fertilizer	19.57 a	27.17 a	20.80 a	1.11 a	2.63 a	2.15 b
NZEO SR Plus Coating 1% .	20.15 a	27.08 a	20.68 a	1.17 a	2.28 b	2.40 a
NZEO SR Plus Coating 3% .	19.75 a	25.68 b	20.04 a	1.12 ab	2.36 b	2.36 ab
Dose N						
0 kg/ha	19.08 b	25.80 b	20.02 b	1.00 b	2.04 b	2.21 b
100 kg/ha	19. 80 ab	26.82 ab	19.53 b	1.21 a	2.23 b	2.14 b
200 kg/ha	20.60 a	27.33 a	21.97 a	1.19 a	3.01 a	2.71 a
Treatment	Leaf area	Leaf area	Leaf area	LAI	LAI	LAI
	4 ms	6 ms	8 ms	4 ms	6 mst	8 mst
Fertelizer Type						
Original N Fertilizer	1647.91 b	3982.17 a	2871.07 a	3.92 a	5,82 a	4,34 a
NZEO SR Plus Coating 1%	1865.04 a	4392.75 a	3025.84 a	3.98 a	6.08 a	4.68 a
NZEO SR Plus Coating 3%	1871.26 a	4189.02 a	3120.32 a	3.05 b	5.67 a	4.45 a
Dosis N						
0 kg/ha	1739.45 b	4053.35 a	2937.32 a	3.35 b	5.85 a	4.54 ab
100 kg/ha	1739.63b	4245.03 a	2879.14 a	3.79a	5.88 a	4.25 b
200 kg/ha	1905.12a	4265.56 a	3120.15 a	3.81 a	5.85 a	4.67 a

Note: Numbers followed by the same letters in the same column and treatment are not significantly different according to DMRT 5%.

Table 2 shows that application of type of fertilizer on agronomic characters varies, 5 of 12 variables provide a significant improvement. While the effect of fertilizer dosage on agronomic characters provides 8 of 12 variables in a significant improvement.

TABLE 3
EFFECT OF VARIOUS FERTILIZERS AND N DOSES ON LEAF GREENNESS, OPENING WIDTH AND STOMATA DENSITY, NAR, PGR, AND RGR

Treatment	Green Leaf (Unit)	Stomata Opening Width (µs)	Stomatal Density (mm^2)	NAR (g/dm^2 / week)	PGR (g/cm^2 / week)	RGR (g/g/week)
Kind of Fertilizer						
Original N Fertilizer	37.64 a	5,67 a	122.40a	0.23a	0.86a	1.05a
NZEO SR Plus Coating 1%	37.24 a	5.67 a	125,19 a	0.25 a	0,87 a	1.07 a
NZEO SR Plus Coating 3%	37.70 a	5.00b	129.27 a	0.27 a	0.88 a	1.08 a
Dose N						
0 kg/ha	37.76 a	5.11 a	134.49 a	0.25b	0.88 a	1.08 b
100 kg/ha	36.27 b	5.78 a	115.04 b	0.19 c	0.83 b	1.00 c
200 kg/ha	38.53 a	5.44 a	127.34 ab	0.32a	0.91a	1.13 a

Note: Numbers followed by the same letters in the same column and treatment are not significantly different according to DMRT 5%. NAR; Net Assimilation Rate, PGR = Plant Growth Rate, RGR = Relative Growth Rate

Table 3 shows that application of type of fertilizer on physiological characters only provides, 1 of 12 variables in a significant improvement (wide of stomata opening). While the effect of fertilizer dosage on physiological character provides, 5 of 12 variables in a significant improvement.

TABLE 4
INTERACTION OF FERTILIZER TYPES AND DOSES OF N ON GREENNESS OF LEAVES

Kind of fertilizer	N dose		
	0 kg/ha	100 kg/ha	200 kg/ha
Original N Fertilizer	38.14 aA	37.47aA	37.30bA
NZEO SR Plus coating 1%	37.94 aA	35.68bB	38.08bA
NZEO SR Plus coating 3%	37.22 aB	35.67 bC	40.20 aA

Note: Numbers followed by the same lowercase letters in the same column/same uppercase letter in the same row are not significantly different according to DMRT 5%

TABLE 5
INTERACTION OF FERTILIZER TYPES AND DOSES OF N ON DRY WEIGHT DOSES 8 WAP

Kind of fertilizer	N dose		
	0 kg/ha	100 kg/ha	200 kg/ha
Original Fertilizer	1.92 bB	2.16 aB	2.38b
NZEO SR Plus Coating 1%	2.71 aA	1.90 bB	2.60 bA
NZEO SR Plus Coating 3%	2.02 bC	2.35aB	3.17 aA

Note: Numbers followed by the same lowercase letters in the same column/same uppercase letters in the same row are not significantly different according to DMRT 5%

Tables 4 and 5. Show that there are interactions between application type of fertilizers and fertilizer dosage on the greenness of leaves and dry weight of plant 8 WAP. Both Tables show that the best combination of treatment is N slow-release fertilizer with the fertilizer dosage of 200 kg/ha.

3.3 Treatment of various types of fertilizers and doses of N on the yield components of rice:

TABLE 6
EFFECT TYPES OF SLOW-RELEASE FERTILIZERS AND DOSES OF N ON THE YIELD COMPONENTS OF RICE

Treatment	Productive chicks	Panicle length (cm)	Grains per panicle	Moisture content of harvested grain (%)	Nitrogen content (g)	Weight of 1000 seeds (g)	Grain weight per clump (g)	Weight of grain (ton/ha)	agronomic efficiency
Kind of fertilizer									
Original N Fertilizer	17.00 a.	25.80b	139.57b	16.51a	0.07b	26.62 ab	43.52 a	7.15 b	2.59a
NZEO SRPlus *coating* 1%	17.02a	26.60 a	157.71a	16.36 a	0.07 ab	26.15 b	41.36 b	7,09 b	2,50 a
NZEO SR Plus *coating* 3%	16.04 a	25.84 b	151.64 a	16.44 a	0.09 a	26.94 a	43.94 a	7.65 a	2.69 a
Dose N									
0 kg/ha	16.48 a	26.22 a	146,53a	16.66 b	0.05 c	26,00 a	42.82 a	6.93 b	-
100 kg/ha	16.35a	26.60 a	150.22a	16.25a	0.08b	26.79a	43.11 a	7.47 a	3.01a
200 kg/ha	17.22 a	26.00 a	152.17 a	16.40 ab	0.10a	26.91 a	43.34 a	7.46 a	2.17 b

Note: Numbers followed by the same letters in the same column and treatment are not significantly different according to DMRT 5%

Table 6. shows that application of type of fertilizer on component of yield of rice provide 6 of 9 variables in a significant improvement. While the effect of fertilizer dosage on component of yield of rice provide 4 of 9 variables in a significant improvement.

TABLE 7
INTERACTION OF FERTILIZER TYPES AND DOSES OF N ON PLANT NITROGEN UPTAKE (%)

Kind of fertilizer	N dose		
	0 kg/ha	100 kg/ha	200 kg/ha
Original N Fertilizer	2,48 aC	3.61 aB	3.21 cB
NZEO SR Plus coating 1%	2.08 bB	3.65 aA	3.54 bA
NZEO SR Plus coating 1%	2.09 bB	3.80 aA	3.88 aA

Note: Numbers followed by the same lowercase letters in the same column/same uppercase letter in the same row are not significantly different according to DMRT 5%

TABLE 8
INTERACTION OF FERTILIZER TYPES AND N DOSAGE ON GRAIN WEIGHT FOR HA

Kind of fertilizer	N dose		
	0 kg/ha	100 kg/ha	200 kg/ha
Original Fertilizer	6,74 bB	7.51 aA	7.20 bA
NZEO SR Plus *coating* 1%	6.86 aB	7,52aA	6,81bB
NZEO SR Plus *coating* 3%	7,20 aB	7,38aB	8.36 aA

Note: Numbers followed by the same lowercase letters in the same column/same uppercase letter in the same row are not significantly different according to DMRT 5%

Tables 7 and 8. Shows that there are interactions between application type of fertilizers and fertilizer dosage on plant nitrogen uptake and grain weight per ha (ton). Both Tables show that the best combination of treatment is N slow-release fertilizer coating 3 % and the fertilizer dosage of 200 kg/ha.

IV. DISCUSSION

Fertilizer slow release NZEOSR Plus increased 11 out of 27 total variables that observed the growth and yield of rice plants. Besides that, NZEOSR Plus fertilizer can also increase plant growth and production better than original N fertilizer fertilizer. This is because NZEO SR Plus fertilizer has slow-release properties that can control N nutrient release according to plant needs.

According to Suwardi & Wijaya (2013), slow-release effectively increases nutrient availability with the regular release. Zeolite minerals can increase the efficiency of N fertilizers such as urea. NH4+ and K+ cations in the soil solution will be bound to the zeolite framework and slowly released around the root area to be absorbed by plants (Sastiono, 2004).

Humic acid has a negative charge that comes from the dissociation of H ions from functional groups, so it has a very high cation exchange capacity (more than 200 meq 100 g-1) to bind, absorb and exchange cations to prevent nutrient loss (Suwardi & Darmawan, 2009).

Increasing the dose of N can increase the growth and yield of rice plants due to the adequacy of N nutrients in the soil for plant growth nutrition. The function of N nutrients is very important, especially in the formation of protein compounds in plants (Ibrahim & Kasno 2008), the formation of chlorophyll, protoplasm, proteins, and nucleic acids, photosynthetic activity, metabolic processes and respiration N elements to increase the growth and development of living tissue (Brady & Weil, 2002).

The interaction between NZEO SRPlus Coating fertilizer and nitrogen dosage indicates a strong influence between the type of fertilizer and dosage. This is presumably due to the nature of the element nitrogen, which is easily lost, requiring additional ingredients to minimize nitrogen loss after being added to the land. Zeolite and humic acid in NZEO-SR Plus fertilizer can control the release of nitrogen into the soil as long as the nitrogen availability is still high so that the nitrogen content in the solution remains stable and saves fertilizer that must be added.

In plants 4 WAP, the average leaf area was the widest in the treatment with NZEO SR Plus 3% fertilizer at a dose of N 200 kg/ha. The average leaf area was 2071.12 cm2. The presence of zeolite, montmorillonite and humic acid in NZEO SR Plus fertilizer is thought to slow N solubility so that the availability of N around is guaranteed to root.

At 6 and 8 wp, nitrogen elements began to be lost by using metabolic processes, evaporation and washing, so the role of applying NZEO SR Plus fertilizer began to be seen according to its natural releases of nutrients slowly. At 8 weeks, the best leaf area was treated with 3% NZEO SR Plus Coating fertilizer with a dose of N 200 kg/ha.

At the beginning of plant growth, nitrogen application can increase leaf area because nitrogen availability in the soil is still sufficient. Then the availability of N will decrease due to leaching and evaporation. Nitrogen plays a role in vegetative growth as the main element of protein formation for plant cell division so that the number of leaves, leaf area and leaf thickness increases (Porter et al., 1990).

The NZEO SRPlus Coating 3% fertilizer treatment affected the leaf area index of 4 mst with a leaf index value of 3.98 and at a dose of N 200 kg/ha producing the highest value is 3.81. The dose of N affected the leaf area index of 8 mst, and at a dose of 200 kg/ha, the leaf index was 4.67.

The leaf area index value increased until the age of 6 WAP, and then it decreased. This is because around the age of 6 WAP, there is a vegetative peak, and after that, the plants have started to enter a generative period so that nutrients will be more focused on panicle formation. The critical point LAI or LAI needed to absorb 95% of the solar radiation absorbed by the plant canopy ranges from 4-6. The critical point of LAI during generative growth is a prerequisite for obtaining maximum yields (Bachrain, 2005).

At 6 most plants, original N fertilizer fertilizer at a dose of N 200 kg/ha gave the best results, namely 27.86 tillers. Fertilizer NZEO SRPlus Coating, 3% with a dose of N 200 kg/ha, increased the number of tillers by 8 mst, namely 22.4 tillers. The number of tillers indicates the growth of healthy or diseased rice plants. However, genetically the plant variety determines the number of tillers, and the role of N is very important in growing the number of tillers (Dara et al., 2017). Usman Made (2010) states that nitrogen nutrients greatly determine the development of plant meristem cells. With the availability of sufficient nitrogen, plants will form vegetative parts quickly.

NZEO SRPlus Coating Fertilizer 3% with a dose of N 200 kg/ha gave the best green leaf yield of 40.20. This is because the greenness of the leaves is influenced by the availability of nitrogen with the addition of slow-release fertilizer at a fertilizer dose of 200 kg/ha, which will cause sufficient nitrogen availability so that the greenness of the leaves is high. This follows the opinion of Dwidjoseputro (1984). Plants need the nutrient N for shoot growth and green leaf coloring (chlorophyll). The N content in the soil can affect the amount of chlorophyll in the leaves so that the leaves turn green.

The NZEO SRPlus Coating 1% fertilizer treatment increased the width of the stomata opening by 5.66 µm2. Stomata are important organs in the process of photosynthesis and also transpiration in plants. Stomata function as a place for exchanging CO2 in the leaves for the process of photosynthesis and as a place for water evaporation in the process of transpiration (Arista et al., 2015).

NZEO SRPlus Coating Fertilizer 1% at a dose of 200 kg/ha gave the best results at a 4-wm dry weight of 1.45 (g). NZEO SRPlus Coating Fertilizer 3% with a dose of N 200 kg/ha gave the best results at 8 mst plant dry weight, namely 3.17 (g).

According to Putri et al. (2017), plant growth and development are shown by increasing the size and number of cells. Plants absorb nutrients for photosynthesis so that they produce photosynthesis. Photosynthate will be distributed and stored in the vegetative organs of plants, such as roots, stems and leaves, as food reserves. It is this storage of food reserves that will affect the wet weight and dry weight of plants.

Fertilizer NZEO SR Plus coating 1% with a dose of N 0 kg/ha (control) gave the best net assimilation rate of 0.39 g/dm2/week. The net assimilation rate shows the accumulation rate of the dry weight of material per unit of leaf area per unit of time. The value of the net assimilation rate indicates the efficiency of leaf photosynthesis in a cultivated plant community. The highest net assimilation rate value occurred in plants whose leaves were still exposed to sunlight (Aliinfallible et al., 2016).

NZEO SRPlus Coating Fertilizer 3% with a dose of N 200 kg/ha gave the best results on growth rate (LPT), which was 0.96 cm2/week. Nitrogen plays an important role in forming photosynthetic tools, namely chlorophyll and the enzyme RuBP carboxylase, which function in the fixation of CO to be reduced to sugar. The high and efficient photosynthesis rate allows hoarding to occur in biomass plant dryness and is measured by increasing the value of LPT (Lakitan, 2007).

NZEO SR plus Fertilizer SR plus Coating 3% with a dose of N 200 kg/ha gave the best results relative to the growth rate with a yield of 1.21 g/week. Relative growth rate (LPR) is an increase in plant dry weight in a certain time interval (Gardner, 1991). LPR is determined by the shape of the leaf canopy (Horie, 2001; Yoshida, 1981).

Fertilizer NZEO SRPlus Coating, 1% with a dose of N 200 kg/ha, gave the best results for the number of productive tillers, namely 17.73. The number of productive tillers describes the tillers that produce panicles. Nitrogen plays a role in the formation of the number of productive tillers. The higher the nitrogen content, the more productive tillers increase (Winarso, 2005). Fertilizer NZEO SRPlus Coating, 1% with a dose of N 200 kg/ha, gives the best results on the number of grains per malai, namely 167.6 points. The high and low number of grains per panicle can be determined by the productivity level of rice plants (Azalika et al., 2018). Using fertilizers with zeolite and humate coatings effectively increases the availability and absorption of nutrients in plants to increase the number of grains per malai. Aina & Jumadi (2018) said that nitrogen affects the quality and quantity of corn kernels.

The NZEO SRPlus Coating 3% fertilizer treatment with a dose of N 200 kg/ha gave the best results for nitrogen uptake, namely 3.88%. The soil's adequacy of the N nutrient will allow it to absorb the nutrient according to its needs. According to Mengel et al. (2001), when the macronutrients in the soil increase, the amount of uptake by plants will increase. This follows the opinion of Suminarti (2010) that there is a close relationship between the level of soil nutrient availability and the level of N uptake by plants.

Fertilizer NZEO SRPlus Coating, 1% with a dose of N 200 kg/ha, gave the lowest yield of grain moisture content, namely 16.10%. According to Wibowo (2010), grain moisture content can be used to predict grain storage after harvest. Rice generally has a grain moisture content at harvest of about 25%. The lower the grain moisture content indicates the cooking process grain is maximum.

NZEO SRPlus Coating 3% fertilizer gave the highest 1000 seed weight yield of 26.46 g, and the N dose of 200 kg/ha gave the highest 1000 seed weight yield of 26.42 g. The weight of 1000 seeds indicates the quality of the grain. The higher the weight of 1000 seeds, the higher the quality of the grain. NZEO SRPlus Fertilizer can increase the weight of 1000 seeds because the fertilizer can increase the availability of Nutrients in a controlled manner. According to Haryati & Anna (2016), nutrients absorbed from the soil by plants will be accumulated into protein to form seeds of maximum size and weight.

Fertilizer NZEO SR Plus Coating, 3% with a dose of N 200 kg/ha, gives yields per hectare the highest was 8.58 tons/ha. These results indicate that the fertilizer can increase production better than original N fertilizer fertilizer. According to Sarief (1990) and Aisyah (1990), using N fertilizer with zeolite can increase the efficiency of N fertilizer use and grain yield.

Fertilizer treatment with NZEO SRPlus Coating 1% at a dose of 100 kg/ha. Provides agronomic efficiency of 2.87. According to Schulze & Caldwell (1995) and Zheng (2007), applying N fertilizer with the appropriate dose will increase the efficient use of nitrogen. However, the application of excessive doses will reduce plant growth.

V. CONCLUSION

Application of slow-release zeolite-based N fertilizer (NZEO-SRPlus) is better than original N fertilizer in increasing plant growth and production components (agronomic and physiologic kharacteristic. Provision of fertilizers NZEO SR Plus coating 3% with a dose of 200 kg N/ha gives the best results for plant growth and production.

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