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DYNAMICS OF SOIL N-MINERAL BY REPEATEDLY GIVING LABELED ^{15}N PLANT RESIDUE

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ABSTRACT
This study aims the dynamics of the mineral plant residues. The research was conducted in three stages; Stage 1. Planting soybean and rice plants labeled ^{15}N with 4 concentrations of 15N, namely: 0 mM (N_0), 0.625 mM (N_1), 2.5 mM (N_2), and 10 mM (N_3) given in the form of urea, $CO(^{15}NH_2)^2$ with aconcentration of 10% atomic excess in a 5 kg plastic pot. Stage 2.Experiment with adding plant residues with the first ^{15}N label on the unwashed condition and Stage 3. Experiment with adding the second ^{15}N-labeled plant residue on the unwashed condition. Each stage use a factorial Completely Randomized Design (CRD). The results showed that soybean and rice residues gave the dynamics of mineral N in the soil with the same pattern, which increased with increasingconcentration of ^{15}N given. The N_3T_1 treatment (concentration ^{15}N 10 mN soybean residue) showed the highest nitrate, ammonium, and microbial biomass N content, respectively, at 330.28 mg kg^{-1}; 231.29 mg kg^{-1}, and 376.39 mg kg^{-1} during a 14-week incubation. The repetition of adding new soybean residues increased the content of nitrate, ammonium, and microbial biomass N by 26.65%, 21.99%, and 67.24%, respectively, while the repetition of adding rice straw residue increased the content of nitrate, ammonium, andmicrobial biomass N by 38.49%, 45.48% and 11.41% respectively.

Keywords:
^{15}N; soybean residue; rice straw; nitrate; ammonium; microbial biomass N

INTRODUCTION

Plant residues are used as a source of organic matter as well as a source of nutrients for plants. The input of plant residues into the soil has different effects on plant growth depending on the rate of decomposition and mineralization of the plant residues. The rate of mineralization of plant residues is a function of the quality of the residue itself. High residue quality (high N content, low lignin, and polyphenol content) will mineralize quickly and can provide nutrients fairly quickly but often exceeds plant needs at the beginning of the growth period so that it is easily washed off. On the other hand, low-quality residues (low N content, high lignin, and polyphenol content) will experience slow mineralization and little can be absorbed by plants. In general, farmers provide the organic matter in their fields of varying quality because they utilize plant residues available around their area.

Organic matter quality is defined as the chemical composition of plant residues and is a critical factor in influencing mineralization and nutrient release. The N content or C/N ratio of plant residue organic matter is generally stated as an important factor affecting the rate of mineralization and the release of organic matter nutrients (Chen, 2006). Several researchers reported that the lignin content of organic matter affects the rate of mineralization of organic matter more than the N content, the higher the lignin content the weaker the effect of N on the mineralization process and the greater the amount of N retained in plant residues during the mineralization process (Kaleeem Abbasi et al., 2015). The quality of various organic matter, especially the N content, will determine the amount of N released into the soil. Nitrogen itself is one of the most important nutrients for plant growth, and N fertilization is the most important energy input in plant cultivation systems (Whitmore et al., 2000; Zentner et al., 2003). Considering that the element N easily changes from one form to another depending on the mineralization and nitrification processes which are also influenced by environmental conditions such as temperature, humidity (Rathke et al., 2006), soil properties (pH, texture, organic matter content). and the quality of the organic matter itself; C:N ratio, lignin, polyphenols and particle size (Myrold, 2011; Van Kessel and Reeves, 2002; Stadler et al., 2006).

Various research results show that the addition of organic matter continuously to the soil is an easy way to maintain soil health, because it can provide additional sources of nutrients for biota and stimulate the availability of nutrients. However, the application of organic matter that is widely used is not able to increase plant production optimally, due to the low amount of nutrients provided in a short time, as well as the low level of synchronization between the time of nutrient release and the plant's need for nutrients. The results of several studies show that organic matter derived from legume crop residues only releases about 20-45% of the nutrients contained in it, in one annual crop cycle of this amount only about 20-30% can be utilized by plants (Handayanto et al.,1997). The efficiency of using low N is mostly due to the loss of N by evaporation, through leaching and retention of N organic matter by soil organic matter (BOT).

Nitrogen is one of the most important nutrients for plant growth, and N fertilization is the most important energy input in plant cultivation systems (Whitmore et.al., 2000; Zentner et al., 2003). In order to optimize the efficiency of N use by plants, knowledge of the pattern of N release, plant N accumulation and N mineralization in the soil is needed to prevent loss from the ecosystem.

The quality of plant residues can be manipulated in various ways, one of which is the application of N fertilizer with various concentrations of ^{15}N so that plant residues that vary in content of ^{15}N will be obtained even in the same plant species. Quality manipulation was carried out on two different types of plants, namely rice plants and soybean plants which were then applied to the soil and the rate of mineralization was measured. The selection of rice and soybean plants with the consideration that both have different qualities where rice plants are included in low quality while soybean plants are included in high quality groups.

The aims of this study were: 1. To obtain plant residues containing different concentrations of ^{15}N in the same plant species. 2. Testing the dynamics of the mineral N of plant residues containing different concentrations of ^{15}N when applied to the soil repeatedly. The method for measuring the amount of N mineralization in the soil can be done by the unwashed incubation method, where this method was chosen with several considerations, namely; can be mixed directly with the soil so that there is direct contact of residue and soil, there is no leaching of nutrients, the water content is controlled and no elements are absorbed by plants so that the amount of N elements that are clearly released will be obtained.

There is little information about N mineralization, long-term advantages and disadvantages with repeated addition of organic matter, it is necessary to conduct research to determine the dynamics of soil N minerals with repeated addition of new organic matter to soil organic matter (BOT). In-depth understanding of the dynamics of soil N mineral content due to the addition of comprehensive organic matter, especially nitrogen mineralization, is still very low compared to carbon and the factors that contribute to the occurrence of nitrogen mineralization.

Utilization of ^{15}N trace elements is widely used in qualitative and quantitative studies of the process of N transformation in soil and plants. As a trace element ^{15}N is used to determine the presence and distribution of N relative to the addition of ^{15}N, whereas in isotope dilution studies, the addition of ^{15}N to the terminal product and the accompanying dilution of ^{15}N content in natural abundance N is monitored and calculated. The technology used to analyze ^{15}N is widely used using a mass spectrophotometer and emission spectrophotometer. An emission spectrophotometer is used when the ^{15}N atom percent content in the soil and plant samples is greater than 0.1% atom. While the mass spectrophotometer is used at ^{15}N content in samples that are less than 0.1% atoms, for example to analyze ^{15}N natural abundance.

METHOD

The research was carried out from February to July 2020 in a greenhouse and integrated laboratory of the Faculty of Agriculture, Islamic University of Malang. Soil analysis was carried out at the Soil Chemistry Laboratory, Department of Soil, Faculty of Agriculture, Universitas Brawijaya. The research was carried out in 3 stages as follows:

Stage 1. Planting Residues of Soybean (Glycine max) and Rice (Oryza sativa) labeled ^{15}N

Experiment 1 was aimed at obtaining rice and soybean residues containing ^{15}N. The difference in concentration of ^{15}N and different types of plants is intended to obtain plant residues that have different qualities even within the same plant species. Soybean (T_1) Wilis variety and rice (T_2) IR 64 variety were grown for 8 weeks in a nutrient solution containing 4 different concentrations of ^{15}N, namely: 0 mM (N_0), 0.625 mM (N_1), 2.5 mM (N_2) and 10 mM (N_3) given in the form of urea, $CO(^{15}NH_2)_2$ with a concentration of 10% excess atoms in a 5 kg plastic pot. The growing medium used was 3 kg of sterile quartz sand which was obtained by washing the quartz sand thoroughly with a 3% HCL solution. To prevent nodulation in soybean plants, soybean seeds and pots were previously soaked for 3 days with a disinfectant containing 1% sodium hypochlorite to be free from rhizobia. The volume of nutrient solution used is 50 - 400 ml per pot per day and then as needed. Other nutrients, namely Ca, K, P, Mg, Cl, Fe, Mn, Zn, B, Mo, and Co were also provided in the form of a solution that had been prepared by the method of Hammer et al. (1978), Experiments were arranged in a simple completely randomized design. Rice and soybean plants have trimmed all parts of the plant on the planting medium at the age of 8 weeks after planting. The biomass (head) of soybean and rice plants was then dried at 60^o for 48 hours, then the quality parameters were analyzed including %^{15}N atom excess, %^{15}N natural abundance, C content, N content, lignin content, and polyphenol content. The content of ^{15}N atom excess and ^{15}N natural abundance was measured using the Micromass 622 (UK) mass spectrometer at the National Nuclear Energy Agency (BATAN) Friday market Jakarta, the C content was determined by the Walkley and Black method, the total N content was determined by the Kjeldahl method (Keeney and Nelson, 1982), the polyphenol content was measured by the Folin-Denis method (Anderson and Ingram, 1993), and the lignin content was determined by the acid-detergent lignin method (Goering and Van Soest, 1970). The data obtained for each observation parameter were analyzed for variance (ANOVA) or the F test = 0.05 and 0.01 followed by the 5% tukey test. when there is a real effect.

Stage 2. Experiment with the addition of the first plant residue in the unwashed condition.

This experiment aims to study the dynamics of N mineralization from the first plant residue where the residue from the first stage of the experiment, namely soybean and rice plant residues (stage 1) is crushed and dried, weighed as much as 50 mg, and evenly composited with 100 g of soil then put into a plastic bottle. 50 ml and given ionized water equivalent to 70% field capacity. To maintain humidity every day maintained at these conditions by giving water, to prevent evaporation, the bottles are covered with aluminum foil. The top layer of Inceptisol (0-20 cm) was air-dried and sieved through a 2 mm diameter sieve. The soil has the following characteristics: clay soil texture, pH (H_20) 6.20, pH (KCl) 5.40, CEC 28.95 cmol kg^{-1} soil (NH_4OAc pH 7), C-organic content 1.91%, N content 0.20% (Kjeldahl), P content 22.16 mg kg^{-1} soil (Bray II), mineral N content 0.053 mg kg^{-1} soil, microbial biomass N content 0.0035 mg kg^{-1} soil, and Na^+, K^+, Mg^{2+} content 0.28; 0.5; 1.53 cmol kg^{-1} soil. Eight treatments (2 types of plant residues with 4 concentrations of supply N) were arranged in a completely randomized design with three replications. At weeks 1, 2, 4, 8, and 14, the soil mineral N content and microbial biomass N were measured. The N content of soil minerals (NH_4^+ and NO_3^-) was carried out using the Kjeldhal method. Microbial biomass N was measured by the chloroform fumigation method (Vance et al., 1987). The mineralization velocity constant N (kN, $week^{-1}$) was calculated by the calculation method used by Weider and Lang (1982). The data obtained for each observation parameter were analyzed for variance (ANOVA) or F test = 0.05 and 0.01 (Gomez and Gomez, 1995) if there is a significant effect, then the tukey test is 5%. The design used is a simple factorial design with 8 treatment combinations as follows; N_0T_1, N_1T_1, N_2T_1, N_3T_1, N_0T_2, N_1T_1, N_2T_1, N_3T_1.

Stage 3. Experiment with the addition of the second plant residue (repeated) in the unwashed condition.

This experiment used 100 g of residual soil from stage 2 media, divided into 2 parts of 50 g each with 1 part added with new plant residues (code +) and 1 part without adding new plant residues (code -). The next stage is the same as experiment stage 2.

RESULT AND DISCUSSION

Soybean (Glycine max) and rice (Oryza sativa plant residue quality

The results of chemical analysis of soybean and rice residues showed varying quality depending on the concentration of ^{15}N applied as a fertilizer solution during growth (Table 1). The wet and dry biomass of rice residue was greater than that of soybean residue in all treatments with a ^{15}N concentration difference. The N content, %^{15}N-abundance content, and %^{15}N atomic excess increased with increasing ^{15}N concentration. The content of N, %15N-abundance, and %^{15}N atomic excess of soybean residue is greater than that of rice residue. The organic C content, lignin, polyphenols, C/N ratio, lignin/N ratio, polyphenol/N ratio, and (lignin+polyphenol)/N ratio decreased with increasing concentration of ^{15}N.

The results of the further test of 5% tukey (Table 1) the lowest C/N ratio in N_3T_1 treatment (6.41) and the highest in N_0T_2 (37.04), on the parameters of organic C content, polyphenol content, and C/N ratio N_3T_1 treatment was the treatment that had the lowest value compared to other treatment.

Table 1. Quality of soybean residue (T_1) and rice residue (T_2) after treatment with a concentration of ^{15}N

Treatment	C/N rasio	C (%)	N (%)	Lignin (%)	Polyphenols (%)	^{15}N-*abundance* (%)	^{15}N atom *excess* (%)	Polyphenols /N ratio	Lignin/N ratio	(Lignin+ Polyphenols)/ N ratio	Wet weight (mg kg-[1])	Dry weight (mg kg-[1])
N_0T_1	13.55bcd	36.85ab	2.72c	10.58b	5.98cd	0.37a	0.02a	2.20b	3.91a	6.09ab	7554.1a	2589.3a
N_1T_1	10.88abc	39.03ab	3.61d	9.96b	3.21a	1.29b	0.08a	0.89a	2.79a	3.65ab	10587.3b	3575.5bc
N_2T_1	8.63ab	32.25ab	3.78d	9.82b	2.94a	2.38c	0.75b	0.78a	2.61a	3.38ab	17853.2c	3856.8cd
N_3T_1	6.41a	31.58a	4.95e	6.28a	2.63a	4.34e	3.82f	0.53a	1.28a	1.80a	28923.4d	5749.2e
N_0T_2	37.04f	38.85ab	1.05a	23.54d	6.78d	0.37a	0.02a	6.46e	22.52c	28.88d	15150.2e	2910.3ab
N_1T_2	21.47e	35.46ab	1.70ab	18.76c	5.98cd	0.44a	1.10c	3.52c	11.26b	14.55c	23475.5f	4200.7d
N_2T_2	18.13de	35.08ab	1.94bc	5.34a	5.34bc	1.24b	2.19d	2.75b	2.76a	5.51ab	31625.1g	7975.3f
N_3T_2	15.94cde	32.38ab	2.04bc	4.24a	4.74b	3.14d	2.81e	2.32b	2.10a	4.40ab	47625.6h	10275.4g
Tukey's	5.79	6.98	0.88	2.84	0.95	0.32	0.34	0.67	3.35	3.71	572.97	714.95

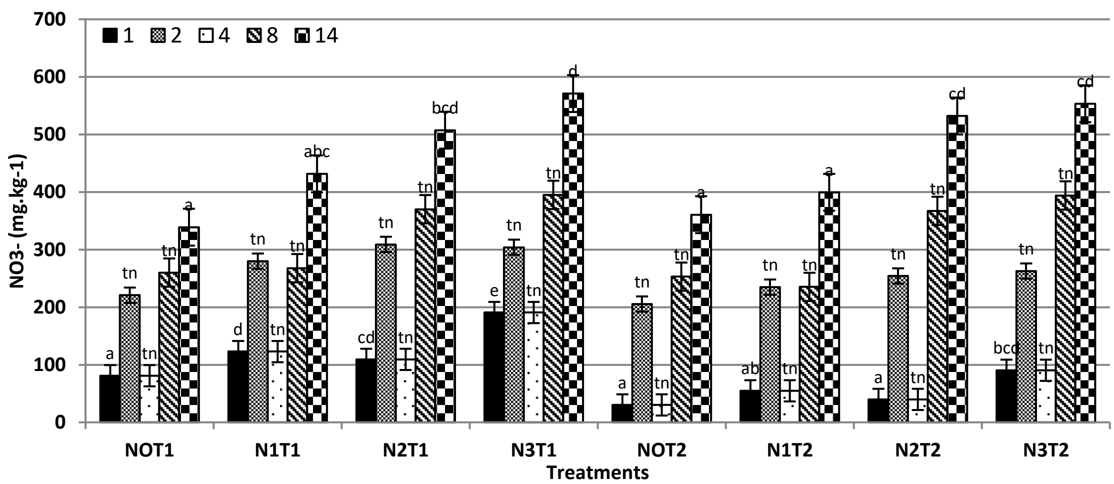
N_0 = concentration of 0 mM ^{15}N; N_1 concentration of 0.625 mM ^{15}N ; N_2 = concentration of 2.5 mM ^{15}N ; N_3 = concentration of 10 mM ^{15}N ; The same letter does not show a significant difference in the 5% Tukey tes

In the lignin parameter, the treatment of N_3T_1 was not significantly different from that of N_2T_2 and N_3T_2. The ^{15}N concentration treatment did not show a significant effect on soybean residues on polyphenol content except for N_0 concentration and the highest polyphenolic rice residue at N_2 concentration. At the same concentration, the polyphenol content of rice residue was higher than that of soybean residue. In both residues, the concentration of N_0 contained polyphenols, lignin, and the highest C/N ratio. %^{15}N-abundance and %^{15}N excess soybean residue were higher than rice residue, polyphenol/N ratio, lignin/N ratio, and (lignin+polyphenol)/N ratio soybean residue were lower than rice residue and decreased with increasing ^{15}N concentration treatment. The ^{15}N concentration treatment on soybean residue did not show a significant difference in the ratio of polyphenol/N and lignin/N, in rice residue the concentration of N_2 was not significantly different from the concentration of N_3.

Soil Nitrate (NO_3^-) Content

The first addition of plant residues with ^{15}N concentration treatment showed that the nitrate content released by soybean and rice straw residues showed the same pattern (Figure 1), in the second week it increased and decreased in the fourth week and then increased again in the eighth and fourteenth weeks of incubation.

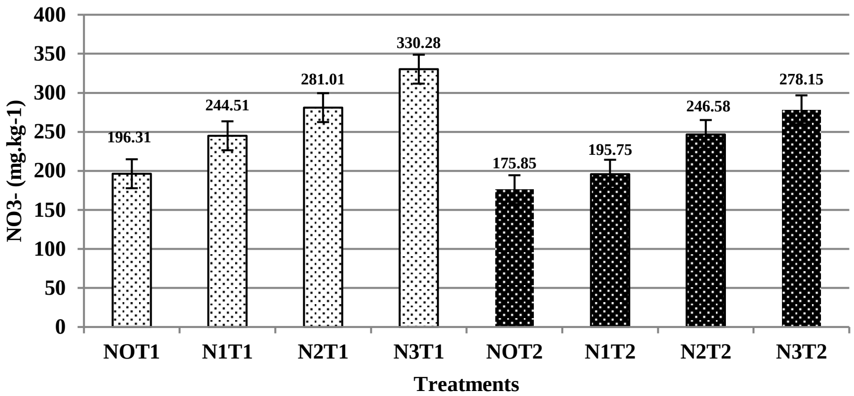
Figure 1. Soil Nitrate Content Various Treatments During Incubation (1 to 14 weeks)



The results of the analysis of variance showed that there was a very significant interaction effect ($P<0.01$) between the ^{15}N concentration difference treatment and the type of residue on the amount of nitrate at weeks 1 and 14 but at weeks 2, 4 and 8 there was no interaction where the difference in the concentration of ^{15}N and the type of residue had an effect. individually significant (Figure 1). The highest concentration of 10 mM gave the highest value as well as soybean plant residues which had a higher effect than rice straw residues.

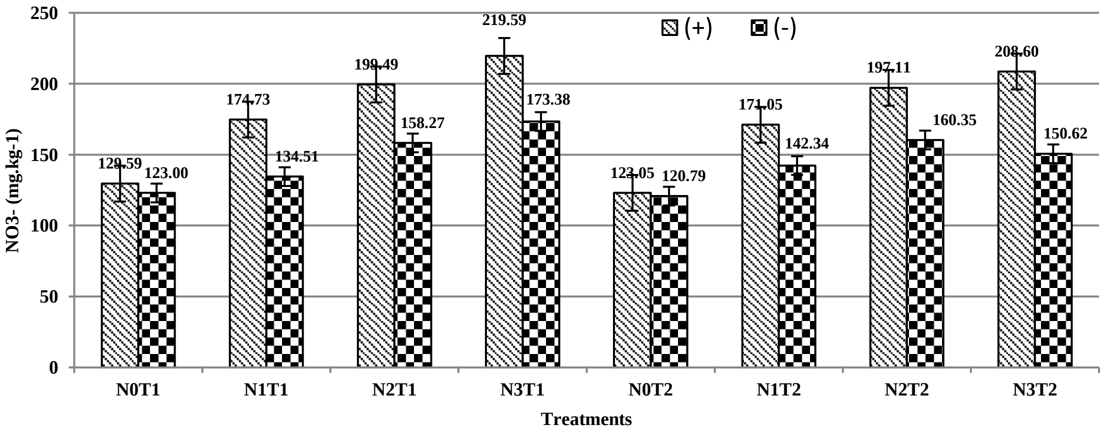
The nitrate content of soybean residue at various concentrations of ^{15}N during incubation was higher than that of rice straw residue (Figure 2) and showed the same pattern in both residues, which increased with an increasing concentration of ^{15}N. The highest nitrate content in the treatment of soybean residue with the highest concentration of 10 mN (N_3T_1) was 330.28 mg.kg^{-1} and the lowest treatment with rice straw residue with a concentration of 0 mN (N_0T_2) was 175.85 mg.kg^{-1}.

Figure 2. Average Nitrate Content During Incubation



The addition of (+) and without the addition of (-) plant residues in the soil medium of the remaining experimental phase 2 had a very significant interaction effect (P<0.01;) on the amount of nitrate at weeks 1 to 14 (Figure 3). The amount of nitrate treatment with the addition of new soybean residue (+) was higher than that of rice straw residue in all ^{15}N concentration treatments (Figure 3). The highest nitrate content was at the concentration of N_3 with the addition of new soybean residue ($N_3T_1^+$) of 219.59 mg. kg- and the lowest was at N_3 without the addition of new straw residue ($N_0T_2^-$) of 120.79 mg.kg-1 (Figure 3).

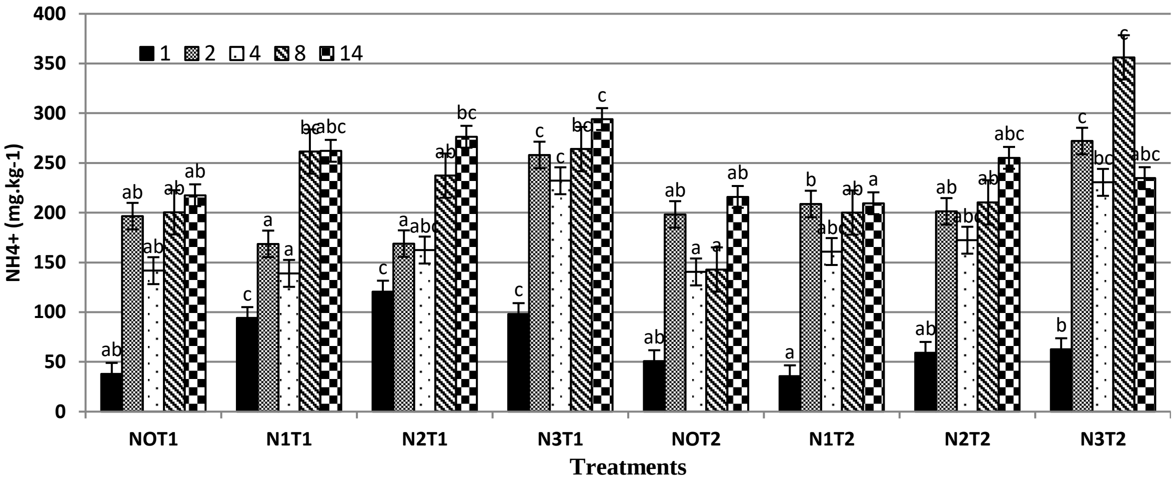
Figure 3. Nitrate Content With the addition of (+) and without the addition of (-) new residue



Soil Ammonium (NH_4^+) Content

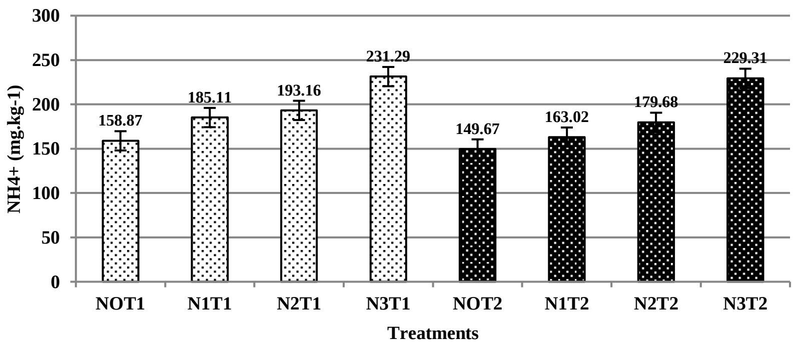
The first addition of plant residues with ^{15}N concentration treatment on the ammonium content of the soil showed the same pattern as the nitrate content whereas soybean and rice straw residues showed the same pattern (Figure 4), in the second week it increased, and decreased in the fourth week and then increased again in the fourth week. eighth and fourteenth during incubation observations. The results of the analysis of variance showed that there was a very significant interaction effect ($P<0.01$) between the different ^{15}N concentration treatments and the type of residue on the amount of ammonium at weeks 1 to 14 (Figure 4).

Figure 4. Soil Ammonium Content Various Treatments During Incubation (1 to 14 Weeks)



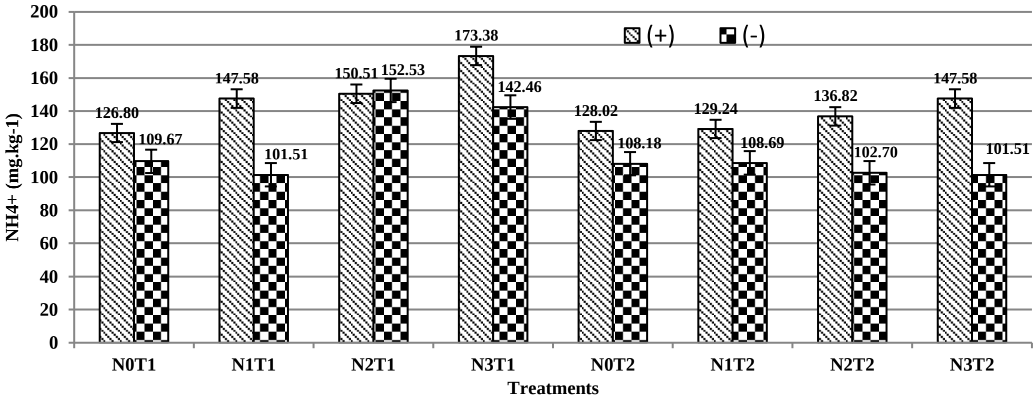
The average ammonium content of all treatments during incubation showed that soybean residue had a higher ammonium content than rice straw residue (Figure 5). The highest concentration of 10 mM gave the highest value for soybean plant residues (N_3T_1) and the effect was higher than rice straw residues when compared between ^{15}N concentrations at the same level. The higher the concentration of ^{15}N in the residue, the higher the ammonium content in the soil.

Figure 5. Average Ammonium Content During Incubation



The treatment of addition (+) and without the addition of (-) plant residues in the soil medium of the remaining experimental phase 2 had a very significant interaction effect ($P<0.01$;) on the amount of ammonium at weeks 1 to 14 (Figure 6). The amount of ammonium released by the treatment with the addition of new residue (+) in soybean residue media was higher than in rice straw residue in all treatments (Figure 6). The highest ammonium content was at the concentration of N_3 with the addition of new soybean residue ($N_3T_1^+$) of 173.38 mg. kg- and the lowest was at N_3 without the addition of new straw residue ($N_1T_1^-$) of 101.51 mg.kg^{-1}.

Figure 6. Ammonium Content With the addition of (+) and without the addition of (-) new residue.



Microbial Biomass N

The amount of microbial biomass N during incubation showed that soybean residue was higher than rice straw residue where the amount of microbial biomass N increased with an increasing concentration of ^{15}N in each residue (Table 2). The highest microbial biomass content of N during incubation occurred in the treatment with the highest concentration of soybean residue 10 mM (N_3T_1) at week 14, which was 564.14 $mg.kg^{-1}$, and the lowest in the treatment with the lowest concentration of soybean residue 0 mM (N_0T_1) at week 4 that is equal to 41.62 $mg.kg^{-1}$. The treatment of the ^{15}N concentration difference and the type of residue had a very significant effect ($P<0.01$) during incubation.

Tabel 2. Microbial Biomass N after treatment with a concentration of ^{15}N

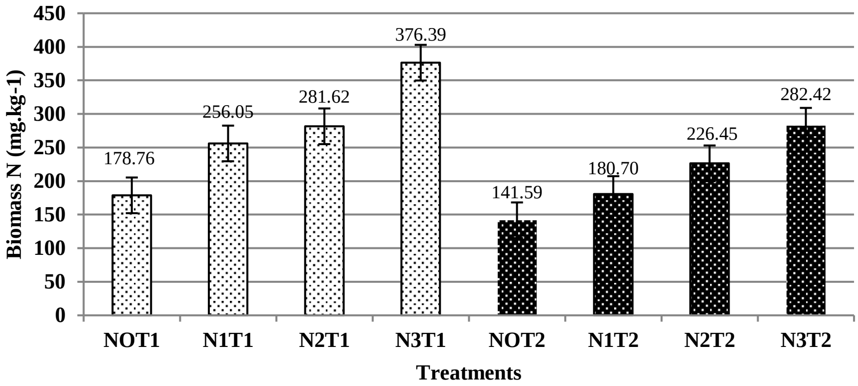
Treatments	Incubation Time (weeks)									
	1		2		4		8		14	
N_0T_1	90.79	bc	116.51	a	41.62	a	274.64	b	317.76	b
N_1T_1	162.25	d	299.55	bc	104.24	ab	296.84	b	352.72	bc
N_2T_1	181.83	d	323.88	c	133.98	b	340.85	c	376.39	c
N_3T_1	266.34	e	403.64	d	216.65	bc	381.50	d	564.14	e
N_0T_2	54.53	a	142.39	a	70.67	c	232.61	a	223.90	a
N_1T_2	58.78	a	164.33	a	74.80	d	262.20	ab	342.75	bc
N_2T_2	70.35	ab	250.23	b	90.12	e	377.53	cd	363.78	c
N_3T_2	98.06	c	260.64	bc	190.76	e	487.74	e	467.60	d
Tukey's	21.99		64.81		29.51		39.23		38.64	

N_0 = concentration of 0 mM ^{15}N; N_1 concentration of 0.625 mM ^{15}N ; N_2 = concentration of 2.5 mM ^{15}N ; N_3 = concentration of 10 mM ^{15}N ; The same letter does not show a significant difference in the 5% tukey tes`

The average content of microbial biomass N during incubation showed that soybean residue had higher microbial biomass N than rice straw residue in all ^{15}N concentrations (Figure 7) where the microbial biomass N content increased with increasing ^{15}N concentrations.

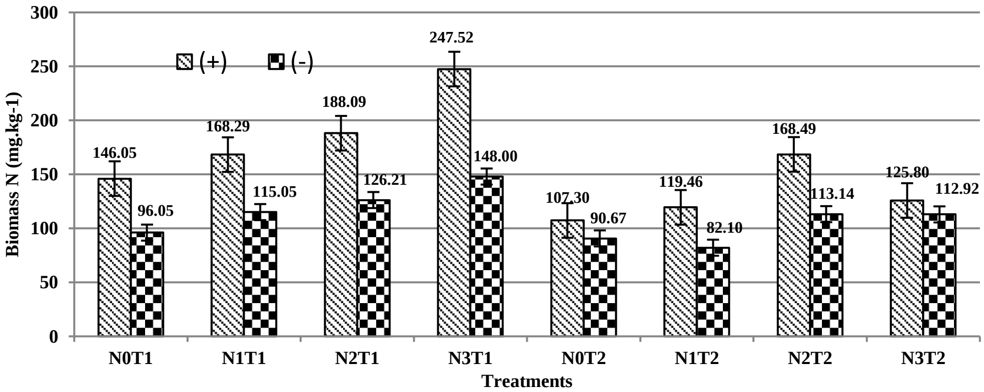
The treatment of addition (+) and without the addition of (-) plant residues in the soil media of the remaining experimental phase 2 had a very significant interaction effect ($P<0.01$;) on the microbial biomass N content at weeks 1 to 14 (Figure 8).

Figure 7. Average Content of Microbial Biomass N During Incubation



The amount of microbial biomass N in the soil with the addition of new soybean residue (+) was higher than that of rice straw residue in all treatments (Figure 8), the highest content was at the concentration of N_3 with the addition of new soybean residue ($N_3T_1^+$) of 247.52 mg. kg- and the lowest was at N_3 without the addition of new straw residue ($N_1T_1^-$) of 82.10 mg.kg^{-1}.

Figure 8. Microbial Biomass Content N The addition of (+) and without the addition of (-) new residue



Discussion

The addition of plant residues (organic matter) into the soil plays an important role to replace the loss of nutrients from the soil and can improve the biological and chemical properties of the soil (Goyal et al., 1999). Mineralization, decomposition, and nitrification are very important processes in the soil that are controlled by moisture, temperature, and quality of the organic matter (Silver and Miya, 2001; Nunez et al., 2001). In this study, the results of the analysis of the quality of rice and soybean residues varied after the treatment with different concentrations of ^{15}N where both residues showed an increase in N content, ^{15}N natural abundance, and ^{15}N atomic excess with an increase in ^{15}N concentration in the fertilizer solution given. On the other hand, the organic C content, lignin, polyphenols, C: N ratio, lignin: N ratio, polyphenol: N ratio, and (lignin+polyphenol): N ratio decreased with an increase in ^{15}N concentration in the given fertilizer solution. The difference in the amount of mineral N (nitrate and ammonium) in rice and soybean residues in addition to the quality parameters above is also due to the large diversity even though in the same plant species between organs plants this happens because of the growing conditions (Sariyildiz and Anderson, 2003). . Plant tissue morphology can play an important role (Annoussamy et al., 2000). The C/N parameter is the most widely used parameter to control the process of mineralization and N immobilization (Trinsoutrot et al., 2000), in addition to other factors such as N content (Cogle et al., 1989), polyphenols (Oglesby and Fownes, 1992; Chaves et al., 2005), and lignin (Hofman et al., 2009). The results of the analysis of variance showed that the quality of the observed plant residues was influenced by the ^{15}N concentration treatment and the type of residue together (interaction) which was very significant ($P<0.01$) except for the organic C content parameter, only the ^{15}N concentration treatment had an effect. However, on the content of lignin and polyphenols, the effect of the type of plant residue was stronger than the effect of ^{15}N concentration, polyphenols and lignin decreased when the N supply of the two plant residues was limited. An increase in the ^{15}N supply increased the N content but reduced the polyphenol and lignin content in both plant residues. Previous studies have found that plants produce the highest levels of polyphenols and lignin in their leaves when the N content is low (Gershenzon, 1993). N fertilization performed on a plant species showed a decrease in polyphenol production (Bryant et al., 1987).

Magna (1977) said that if the nutrient content in the soil is deficient, it will cause an increase in the activity of the phenylalanine ammonia-lyase enzyme which is an enzyme for polyphenol synthesis. In times of N deficiency, phenylalanine utilizes N to convert into more complex forms of phenolic compounds (Gershenzon, 1993). In addition, protein synthesis is slow in conditions of limited N so carbohydrates cannot be used for phenol synthesis.

The amount of N minerals (nitrate and ammonium) released was consistently higher in soybean residues than rice residues in all observations and treatments at ^{15}N concentrations, the amount of N minerals increased with increasing supply of ^{15}N in plant residues, this is in line with research conducted by Lemus et al. (2008) there was an increase in the amount of mineral N in the soil with the application of N fertilizer in the form of urea on grass-like plant media with various application doses. In this study, during observation (week 1 to week 14) the percentage increase in the amount of mineral N in week 1 was the highest and then decreased with increasing observation time (week 14) in both soybean residues and rice residues. When compared between residues, it can be seen that soybean residues experienced the highest percentage increase compared to rice residues. This shows that soybean residue is a high quality residue compared to rice residue. The N content of soybean residue was higher than that of rice residue and the content of polyphenol, lignin, lignin:N ratio, polyphenol:N ratio and ratio (lignin+polyphenol):N of soybean residue was lower than rice residue.

Soybean residues undergo mineralization faster than rice residues, the higher the concentration of ^{15}N in plant residues, the faster mineralization occurs. Regression analysis showed a significant relationship between N release rate (kN) and residual parameters such as N, polyphenols, lignin, C/N ratio, polyphenol:N, lignin:N, and (lignin+polyphenol):N which shows the importance of these parameters are used to predict the release of N from plant residues, because soil microbial activity and mineralization processes are influenced by the content of lignin, polyphenols and as significantly soluble as N and C in the added organic matter (Palm et al., 2001; Bolger et al., 2003). Several researchers Frankenberger and Abdelmagid (1985) said that the N mineralization of plant residues was controlled by the N content and the C/N ratio of the residue content. The critical value for N content is 1.75% and for the C/N ratio the critical value is 20 so that the mineralization of an organic material can proceed. If the C/N ratio is above 25, it will potentially increase the immobilization of N in the soil (Hadas et al., 1992; Sainju et al., 2005; Muhammad W, 2011). In this study, it was seen that all plant residues had N content greater than 1.75% and C/N ratio below 20 except for rice residues with concentrations of N0 and N1. Jansen and Kucey (1988) measured the N mineralization of wheat, legumes, rape with different nutritional treatments and found that the rate of decomposition and N mineralization varied between treatments. Tian et al. (1992) stated that the rate of N release from pruning from legumes varied significantly with the N content, lignin and polyphenolic pruning, where the N release increased with increasing N content and decreased with decreasing polyphenol and lignin content. Thippayarugs S. et al. (2008) found the highest coefficient (81.7%) between the N content and the amount of mineral N after incubation of 133 days, then in this study manipulated the residue quality parameters in one plant species so that there might be differences, for example in leaf morphology, lignin structure and different types of polyphenols. as between species. Mengel K. (1996) showed that the fresh leaves of some plants contain soluble substances similar to tannins (polyphenols) and cause protein to precipitate, thereby inhibiting the release of N in the form of complexes. So that the role of polyphenols in controlling N is not only inhibiting enzymes but also its ability to bind plant proteins. Plant residues with a high C/N ratio, lignin and polyphenols will release N slowly (Tian et al., 1992; Achakzai & Bangulzai, 2006). Fox et al. (1990) found that the ratio (lignin+polyphenol):N was a predictor of the rate of mineralization after a 12-weeks incubation period with the addition of plant residues from legume species.

The addition of plant residues into the soil can increase the amount of microbial biomass N (Muhammad W. et al., 2011). Increasing the concentration of ^{15}N in plant residues will increase soil microbial N biomass, this is in line with research conducted by Muhammad et al. (2011) where soil microbial biomass N and C increased in soil fertilized with sorghum, corn and sugarcane litter after 84 days of incubation. The difference in the concentration of N in the residue causes differences in the dynamics of microbial biomass N and C in the soil. The high microbial biomass N and C is influenced by microbial activity and mineralization process (Cayuela et al., 2009). The average microbial biomass N in the control was lower than in the soil with additional plant residues. The addition of plant residues increases the availability of N and microbial populations, and can accelerate the mineralization of low-quality plant residues (Tanahashi et al., 2004). Residual quality can change microbial activity and balance the process of mineralization and N immobilization (Gentile et al., 2009).

The microbial biomass N of soybean residue was always higher than that of rice residue during the 14-week incubation (Figure 7). Lovell et al. (1998) stated that the variation in the amount of microbial biomass N is the result of several complex factors, including; physical, chemical, biological and anthropogenic which mutually and subsequently affect the length and shortness of the presence of microorganisms, thereby affecting fluctuations in the microbial biomass content of N. Fontaine et al. (2003) found that a high supply of cellulose-containing substrates will increase microbial growth and can increase the total biomass by 350 to 700 mg C kg^{-1} and the highest increase occurs during cellulose decomposition. Vityakon P. and Dangthaisong N (2005) found a significant increase in the amount of microbial biomass N with increasing incubation time from 1 to 16 weeks in several legume residues L. leucocephala, S. grandiflora and S. obtuse. Contrary to the results of Lu Jun Li et al. (2010) where the addition of inorganic N fertilizer actually reduces microbial N biomass in arid and semi-arid soils.

The pattern of N release from plant residues is very important to understand to prevent the large loss of N from the environment (Rathke et al., 2006) considering that plant residues release N depending on the process of mineralization, nitrification, immobilization, and denitrification where these processes are influenced by conditions. environment (temperature, humidity), soil properties (pH, texture, organic matter content), and quality of plant residues; C/N ratio, lignin content, polyphenols, and particle size (Myrold 1998; Van Kessel and Reeves, 2002; Stadler et al., 2006). Mineralization of plant residues will release inorganic N and the process will reduce the inorganic N content of the soil when the given plant residue contains high amounts of C and ultimately can increase microbial activity and growth (Burger and Jackson, 2003; Habteselassie et al., 2006). The result of this research is that the addition of new residue (+) to the previous residual media has a significant effect on the amount of mineral N in the soil and soil biomass. In the parameters of the amount of mineral N and microbial biomass N, it is very clear that the additional treatment with new residues (+) has a significant effect, as can be seen by the greater amount of mineral N in the soil compared to the treatment without the addition of new residues (-). The dynamics of changes in the amount of mineral N and microbial biomass N are a consequence of the results of several processes that exist in the soil such as decomposition (Gallo et al., 2004; Liu et al., 2006), C and N fixation (Frey et al., 2004), the N cycle (Fisk and Schmidt, 1996) and the effect of the presence of plants (Bardgett et al., 2002). Zhang et al. (2008) the results of his research found an increase in the amount of microbial biomass N on the addition of urea 1 to 2 g $Nm^{-2}year^{-1}$ but then a decrease in the amount of microbial biomass N when the addition of urea was increased by 4 to 64 g $Nm^{-2}year^{-1}$. Nikiema P. et al. (2012) found an increase in the amount of microbial biomass C (20% - 50%) and microbial biomass N (38% - 80%) with the application of 3 kinds of ground cover crop residues compared to controls at a soil depth of 0-15 cm.

Increasing the amount of N in the soil is not only the amount of C needed by microbes but can reduce soil pH (Moura., et al, 2015). Mineralization and decomposition will produce organic acids that can lower soil pH). The microbial community is highly adaptive to changes in pH (Schimel and Weintraub, 2003; Wang et al., 2006; Kemmitt et al., 2006). A decrease in soil pH due to an increase in the amount of high N in the soil can have a major impact on the soil microbial community (Schimel and Weintraub, 2003; Wang et al., 2016; Kemmitt et al., 2006).

The results of the research by Cadish et al. (1998) that the addition of unlabeled Gliricidia repetitions before the second and third gave a positive priming effect previously with the application of ^{15}N labeled Gliricidia, on the other hand, the repetition of Peltoporum residues rich in lignin and polyphenols reduced the amount of N recovery and resulted in a negative priming effect which gave the advantage of improving soil structure, CEC, microclimate, controls erosion and increases soil organic matter content. The addition of Gliricidia and Leucaena plant residues increased the dry weight of maize plants in the three cycles. The addition of plant residues contributed to increasing microbial biomass by 9% (low-quality Calliandra and Peltoporum) and 19% (Leucaena) in the first cycle of harvest. Jenkinson et al. (1985) said ANI often occurs between labeled N and unlabeled N (soil N) which will affect the process of replacing soil N reserves (pool substitution) in addition to the loss of inorganic N in the soil, although leaching does not occur embolization and volatilization can occur. here so that it can often cause the N recovery calculated by the ^{15}N method to be lower than that calculated by the difference method. In line with the research of Cadist et al., (1998), Handayanto and Sholihah (2010), the recovery N of the ^{15}N method produces lower values than the difference method, the ^{15}N method provides an overview of the truth of the rate of mineralization of plant residues due to the effect of the ^{14}N substitution pool resulting in inaccuracies. agronomic measurement but the difference is very small influenced by the use of the measurement method. Vanlauwe et al. (1994) found a priming effect of 7-10% of the substrate easy to decompose corn residues on both the source of soil organic matter and the recalcitrant fraction (difficult to decompose) residue. This study found indirect evidence of priming effect and significant microbial biomass with repeated addition of residues. There is a substitution pool effect that occurs after the addition of new unlabeled soybean and rice residues are fully utilized by microbial biomass and stability in the soil. Handayanto et al. (1994) said that protein binding by polyphenols in Peltoporum can explain the negative priming effect of Peltoporum and Calliandra which is rich in polyphenols does not cause a priming effect. The main difference in residue quality between the two species is the higher lignin content and Peltoporum. Secondary products of lignin degradation together with microbial/protein and polyphenols inhibit soil organic matter which can stabilize ^{15}N in the soil. The addition of new soybean residues gave a positive priming effect with a maximum value of 3.63% and a negative priming effect with a maximum value of 9.74% for a period of 14 weeks. This negative effect is due to; 1. complex protein bonds with polyphenols from new rice residues, 2. Increased stabilization of ^{15}N organic matter in soil organic matter. Handayanto et al. (1997) also reported that the application of polyphenol-rich legume residues resulted in stronger N bonds with proteins causing more N to remain in the soil and less of which could be absorbed by plants in the short term. Grifffiths (1994) said that not only microorganisms themselves cause the priming effect but the interaction between soil microbes, soil fauna, and plants is one of the keys that play a role in the priming effect and the substrate released by soil fauna increases microbial activity so that the priming effect occurs.

The results showed that low quality residues (rice straw) had the potential to increase mineralization in the long term as seen from the dynamics of the amount of mineral N and microbial biomass N. The input of plant residues of different quality affected the magnitude of the different priming effects in the soil. Soybean residue is able to produce a positive priming effect (stimulation) whereas rice residue produces a negative priming effect (retardation) in the soil.

CONCLUSION

Soybean residues and rice residues gave the dynamics of mineral N in the soil with the same pattern, which increased with increasing concentration of ^{15}N given. The N_3T_1 treatment (concentration ^{15}N 10 mN soybean residue) showed the highest nitrate, ammonium and microbial biomass N content, respectively, at 330,28 mgkg^{-1}; 231,29 mgkg^{-1} and 376.39 mgkg^{-1} during a 14-week incubation. The repetition of adding new soybean residues can increase the content of nitrate, ammonium and microbial biomass N by 26.65%, 21.99% and 67.24%, respectively, while the repetition of adding rice straw residue increases the content of nitrate, ammonium and microbial biomass N, respectively. 38.49%, 45.48% and 11.41% respectively.

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