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The Effect of the Application of Several Types of Green Fertilizer and the Incubation Period on Several Chemical Aspects of Ultisol Soil Fertility

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Abstract

Ultisol is a soil that has a low level of soil fertility. This is caused by many factors, including: acidic pH, high Al-dd, low available P content in Ultisol soil because P ions in the soil are bound by Al and Fe oxides and Cation Exchange Capacity (CEC) in Ultisol soil is classified as This low level causes the cations in the soil in the form of K+, NH4+, Ca++ and others to be easily leachated as a result, the soil is poor in nutrients. the provision of organic matter, namely with green manure, is defined as young forage and can be used as an addition to N and other elements or plant remains that are returned to the soil. Incubation is intended so that the reaction of organic matter and soil can run well, therefore incubation treatment is very important so that later nutrients can be available to plants. The research method used is verification by conducting experiments. The experiment was carried out at the screen house of Nanerang Village, Cililin District, West Bandung Regency and carried out from January 2020 - March 2020. The materials used in this experiment were Titonia diversifolia, Gricilidiasepium and Chromolaena odorata obtained from the land around the garden, the incubation period was carried out for 2 weeks, 3 weeks and 4 weeks. The interaction between the type of green manure and the incubation period significantly affected the pH (H2O) and C/N ratio in ultisol soils. In the treatment of green manure Gricilidiasepium and the incubation period of the 3rd week showed the highest results. The interaction that had a significant effect occurred in the observation of the C/N ratio where the treatment of green manure Titonia diversifolia and the incubation period of the 4th week gave the highest yield. The independent effect of green manure treatment showed a significantly different effect on total N, organic C, available P, but had no significant effect on humic acid. And the incubation period independent effect test showed a significant effect on total N, available P, organic C, and acid. humate. The independent effect test of the incubation period showed a significant effect on total N, available P, organic C, and humic acid. . Incubation period of green manure which gives optimum yield for ultisol soil at weeks 3 and 4.

Keywords: Green Manure, Incubation Period, Chemical Aspect, Ultisol

Abstract

Ultisol merupakan tanah yang memiliki tingkat kesuburan tanah yang rendah. Hal ini disebabkan oleh banyak faktor, diantaranya : pH yang bersifat masam, Al-dd yang tinggi, kandungan P-tersedia dalam tanah Ultisol yang rendah karena ion P dalam tanah diikat oleh oksida Al dan Fe serta Kapasitas Tukar Kation (KTK) dalam tanah Ultisol tergolong rendah hal ini menyebabkan kation-kation dalam tanah berupa K+, NH4+, Ca++ dan lain-lain mudah terlindi akibatnya tanah miskin akan unsur hara. pemberian bahan organik

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yaitu dengan pupuk hijau diartikan sebagai hijauan muda dan dapat sebagai penambah N dan unsur-unsur lain atau sisa–sisa tanaman yang dikembalikan ke tanah. Inkubasi ditujukan agar reaksi bahan organik dan tanah dapat bejalan dengan baik, oleh karena itu perlakuan inkubasi sangat perlu diperhatikan agar nantinya unsur hara dapat tersedia bagi tanaman. metode penelitian yang digunakan bersifat verifikatif dengan melakukan percobaan. Percobaan dilakukan di screen house Desa Nangerang Kecamatan Cililin, Kabupaten Bandung Barat dan dilaksanakan dari bulan Januari 2020 – Maret 2020. Bahan yang digunakan dalam percobaan ini adalah Titonia diversifolia, Gricilidia sepium dan Chromolaena odorata diperoleh dari lahan sekitar kebun, masa inkubasi yang dilakukan selama 2 minggu, 3 minggu dan 4 minggu. Interaksi antara jenis pupuk hijau dan masa inkubasi berpengaruh nyata terhadap pH (H2O) dan C/N rasio pada tanah ultisol. Pada perlakuan pemberian pupuk hijau Gricilidia sepium dan masa inkubasi minggu ke-3 menunjukan hasil yang tertinggi. interaksi yang berpengaruh nyata terjadi pada pengamatan C/N rasio dimana pada perlakuan pemberian pupuk hijau Titonia diversifolia dan masa inkubasi minggu ke-4 memberikan hasil yang tertinggi. Efek mandiri perlakuan jenis pupuk hijau menunjukkan pengaruh berbeda nyata terhadap N total, C-organik, P tersedia, tetapi tidak berpengaruh nyata terhadap asam humat.Dan uji efek mandiri masa inkubasi menunjukan berpengaruh nyata terhadap N total, P tersedia, C-organik, dan asam humat. uji efek mandiri masa inkubasi menunjukan berpengaruh nyata terhadap N total, P tersedia, C-organik, dan asam humat. . Masa inkubasi pupuk hijau yang memberikan hasil yang optimum untuk tanah ultisol pada minggu ke 3 dan ke 4.

Keywords: Pupuk Hijau,Masa Inkubasi ,Aspek Kimia, Ultisol

1. Introduction

Ultisol is a type of soil in Indonesia which has an area of 45,794,000 ha or around 25% of Indonesia's total land area. The widest distribution is in Kalimantan (21,938,000 ha), followed by Sumatra (9,469,000 ha), Maluku and Papua (8,859,000 ha), Sulawesi (4,303,000 ha), Java (1,172,000 ha), and Nusa Tenggara with an area of (53,000 ha)(Prasetyo & Suriadikarta, 2006). This land can be found in various reliefs, from flat to mountainous.

The main problem with ultisol soil is low organic matter content because the decomposition process is fast, resulting in low nutrient content because the base leaching process takes a long time and occurs intensively (Prasetyo & Suriadikarta, 2006). Judging from its wide distribution, Ultisol soil has great potential to be used as agricultural cultivation land. However, Ultisol soil is soil that has a low level of soil fertility. This is caused by many factors, including: acidic pH, high Al-DD, low P-available content in Ultisol soil because P ions in the soil are bound by Al and Fe oxides and Cation Exchange Capacity (CEC) in Ultisol soil. relatively low, this causes cations in the soil in the form of K+, NH4+, Ca++ and others to be easily leached as a result of which the soil is poor in nutrients.

Providing organic material has an important role in increasing soil fertility. The addition of organic matter is one effort that can be used to overcome the problem of nutrients in the soil. Organic materials in the decomposition process will release organic acids which can bind Al and form complex compounds, so that Al becomes insoluble.

Providing organic material is one way to speed up the soil amelioration process (Tan, 2010).

One way of providing organic materials is byGreen manure is defined as young forage and can increase N and other elements or plant residues which are returned to the soil. This green manure can be used as a substitute for manure, if the amount of manure is small and the soil really needs organic fertilizer.The incubation period really determines the maturity of a fertilizer, if the incubation period is not sufficient, then the resulting fertilizer will not be of good quality when used (Fathini et al., 2014). Incubation is intended so that the reaction of organic matter and soil can run well, therefore incubation treatment really needs to be paid attention to so that nutrients can be available to plants.

2. Materials and Methods

The research method used is verification by conducting experiments. The experiment was carried out at the screen house in Nangerang Village, Cililin District, West Bandung Regency with an altitude of 850 m above sea level, and was carried out from January 2020 – March 2020.

The materials used in this experiment were Titonia diversifolia, Gricilidiasepium and Chromolaena odorata obtained from land around the garden, the incubation period was 2 weeks, 3 weeks and 4 weeks.The equipment used is a hoe, fork, raffia thread, bamboo stake, knife, machete, measuring tape, bucket, emrat, writing utensils and scales.

The research used a Factorial Randomized Block Design (RAK) which consisted of 2 factors, namely the first factor was the type of green fertilizer (B) in 3 levels with 3 replications. Factor I: organic material (B) with a dose of 10g/pot equivalent to 20tons/ha, namely : b1 (Titonia diversifolia), b2 (Gricilidia sepium), b3 (Chromolaena odorata), and the second factor is the incubation period of 3 levels. Factor II: incubation time (I), namely: i2, (2 weeks incubation), i2 (incubation 3 weeks), i4 (4 weeks incubation).

Table 1.Table of Treatment Types of Green Manure and Incubation Time

Types of Green Manure(B)	Incubation Time		
	I1(2 weeks)	I2 (3 weeks)	I3(4 weeks)
b1	b1I1	b1I2	b1I3
b2	b2I1	b2I2	b2I3
b3	b3I1	b3I2	b3I3

Table 2. Operational Independent Variables and Dependent Variables

No.	Variable Type	Sub Variable	Variable Indicator
1.	Independent Variable Treatment	1. Types of green manure (b)	b1= Titonia diversifolia, b2= Gricilidiasepium, b3= Chromolaena odorata
		2. Incubation Time (i)	i2= 2 weeks, i3= 3 weeks, i4= 4 weeks
2.	Variable Bound Response	1. Chemical Aspects of Ultisol Soil Fertility	1. pH(H2O) 2. C-Organic 3. N-Total 4. C/N Ratio 5. P-Total

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6. Humic Acid

Table 3. Variety Analysis

Diversity Source	Degrees of Freedom	Sum of Squares	Middle Square	F count	F table
Ex/Deuteronomy (r)	r-1=2	JKU	CEC	KTK/KTG	3.98
Treatment (t)	bk-1=11	JKP	ID card	KTP/KTG	2.82
Green Manure (B)	b-1=3	JK(b)	KT(b)	KT(b)/KTG	5.59
Incubation Period (I)	k-1=2	JK(I)	KT(k)	KT(k)/KTG	3.98
Interaction (BI)	(b-1)(k-1)=6	JK (BI)	KT(bk)	KT(bk)/KTG	3.09
Error	(bk-1)(r-1)=30	JK is wrong	KTG	-	-
Total	bkr-1=35	JKT		-	-

Source: Fitri et al., 2014 and Herdiyanto. 2013.
Information: DB = Degrees of Freedom, KT = Middle Square, JK = Sum of Squares, Fhit= F Calculate F.05= F 5% Rate Table.

3. Results and Discussion

pH (H2O)

The results of observations and statistical analysis of pH (H2O) showed that there was an interaction between the type of green fertilizer and the incubation period on pH (H2O) in ultisol soil.

Table 4.Effect of Green Manure Type and Incubation Period on pH (H2O)

Treatment (Types of Green Manure)	Incubation Period (week 2)		
	i2	i3	i4
b1(*Titonia diversifolia*)	4.73 b B	4.80 ab B	4.67 a AB
b2(*Gricilidiasepium*)	4.80 b B	4.83 b B	4.63 a A
b3(*Chromolaena odorata*)	4.63 a A	4.63 ab B	4.80 b B

Note: The average numbers followed by the same lowercase letters (vertical direction) and capital letters (horizontal direction) are not significantly different according to Duncan's Multiple Range Test at the 5% significance level.

Table 4 shows the influence of the type of green manure at each level of the incubation period. It shows that at all levels the type of green manure has a significant effect on the incubation period, the highest results were obtained at levels i3 and i4. Optimum results at level b2 type of green manure. At all levels of green manure types, the incubation period had no significant effect on pH (H2O). The effect of each level of green manure type on all levels of the incubation period showed that all levels of green manure types had a real influence on pH (H2O), the highest results were obtained from levels of green manure types b1, b2, and b3.

N Total

The results of observations and statistical results on total N showed that there was no interaction between the type of green manure and the incubation period on the total N of ultisol soil.

Table 5.Effect of Green Manure Type and Incubation Period on Total N

Treatment	Average
Green Manure	
b1(*Titonia diversifolia*)	0.11 a
b2 (*Gricilidiasepium*)	0.12 b
b3 (*Chromolaena odorata*)	0.12 b
Incubation Period	
i2 (2 weeks)	0.11 a
i3 (3 weeks)	0.12 b
i4 (4 weeks)	0.12 ab

Note: The average numbers followed by the same lowercase letters (vertical direction) and capital letters (horizontal direction) are not significantly different according to Duncan's Multiple Range Test at the 5% significance level.

The results of observations and statistical analysis of Total N showed that there was no interaction between the type of green manure and the incubation period on Total N in ultisol soil for all observations. However, the type of green manure and incubation period showed significantly different effects on total N. The b2 and b3 types of green manure have higher yields than the b1 type of green manure. In the results of the independent follow-up test, the incubation period showed a real influence on Total N. The incubation period of i3 and i4 showed a higher Total N than i2.

C-organic

The results of observations and statistical results on C-organic showed that there was no interaction between the type of green fertilizer and the incubation period for C-organic in ultisol soil.

Table 6.Effect of Green Manure Type and Incubation Period on Organic C

Treatment	Average
Green Manure	
b1(*Titonia diversifolia*)	0.98 a
b2 (*Gricilidiasepium*)	1.01 b
b3 (*Chromolaena odorata*)	1.00 b
Incubation Period	
i2 (2 weeks)	0.96 a
i3 (3 weeks)	1.02 b
i4 (4 weeks)	1.00 b

Note: The average numbers followed by the same lowercase letters (vertical direction) and capital letters (horizontal direction) are not significantly different according to Duncan's Multiple Range Test at the 5% significance level.

In Table 6, the type of green manure shows a significantly different effect on organic C between b2 and b3 on b1. The b2 green manure type provides the largest C-organic yield compared to the b1 and b3 green manure types. The incubation periods i3 and i4 showed

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significantly different effects on C-organic b1. The i3 incubation period provided the largest C-organic results compared to other incubation periods.

C/N Ratio

Observation results and statistical results on the C/N ratio show that there is an interaction between the type of green manure and the incubation period on the C/N ratio.

Table 7.Effect of Green Manure Type and Incubation Period on C/N Ratio

Treatment (type of fertilizer)	Incubation Period (week 2)		
	i2	i3	i4
b1(*Titonia diversifolia*)	3.05 b B	2.89 ab A	4.83 a A
b2(*Gricilidiasepium*)	2.83 a A	2.89 a A	4.83 a A
b3(*Chromolaena odorata*)	2.83 a A	4.63 a A	4.83 a A

Note: The average numbers followed by the same lowercase letters (vertical direction) and capital letters (horizontal direction) are not significantly different according to Duncan's Multiple Range Test at the 5% significance level.

Table 7 shows the influence of the level of green manure type at each incubation period level, showing that at level i4 the type of green manure has a significant effect on the C/N ratio, the highest results were obtained at level b1. At the level of green manure types b2 and b3, all levels had no significant effect on the incubation period.

P is available

Observation results and statistical results on available P showed that there was no interaction between the type of green manure and the incubation period on available P in ultisol soil.

Table 8.Effect of Green Manure Type and Incubation Period on Available P

Treatment	Average
Green Manure	
b1(*Titonia diversifolia*)	0.27 ab
b2 (*Gricilidiasepium*)	0.24 a
b3 (*Chromolaena odorata*)	0.32 b
Incubation Period	
i2 (2 weeks)	0.24 a
i3 (3 weeks)	0.28 ab
i4 (4 weeks)	0.31 b

Note: The average numbers followed by the same lowercase letters (vertical direction) and capital letters (horizontal direction) are not significantly different according to Duncan's Multiple Range Test at the 5% significance level.

In Table 8 it can be seen that green manure treatment shows a real influence on available P. The B3 green fertilizer treatment provided higher available P compared to other types of fertilizer. The results of the independent follow-up test showed that the incubation period showed a real influence on P Available in all treatments. The i4 incubation period showed higher results than other incubation periods.

Humic acid

The results of observations and statistical results on humic acid showed that there was no interaction between the type of green manure during the incubation period and humic acid.

Table 9.Effect of Green Manure Type and Incubation Period on Humic Acid

Treatment	Average
Green Manure	
b1(*Titonia diversifolia*)	0.15 a
b2 (*Gricilidiasepium*)	0.16 a
b3 (*Chromolaena odorata*)	0.15 a
Incubation Period	
i2 (2 weeks)	0.14 a
i3 (3 weeks)	0.17 b
i4 (4 weeks)	0.15 ab

Note: The average numbers followed by the same lowercase letters (vertical direction) and capital letters (horizontal direction) are not significantly different according to Duncan's Multiple Range Test at the 5% significance level.

Seen from Table 9, the results of further tests on types of green manure show no significant different effect on humic acid. However, the incubation period showed a significantly different effect on humic acid. The i3 incubation period provided the largest humic acid yield compared to the i2 and i4 incubation periods.

4. Conclusion

Based on the results of the research and discussion of the effect of applying various types of green fertilizer and the incubation period on several aspects of ultisol soil chemistry, it can be concluded as follows: There is an interaction between the application of various types of green fertilizer and the incubation period in ultisol soil on pH (H2O) and C/N ratio . And there was no interaction with total N, available P, organic C and humic acid. The incubation period for green manure which provides optimum results for ultisol soil is in the 3rd and 4th weeks.

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