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CHEMICAL CHARACTERISTICS OF INCEPTISOL SOIL WITH UREA AND GOAT MANURE FERTILIZER

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ABSTRACT

The application of organic fertilizers can improve soil fertility specifically on Inceptisol soils which are quite extensive but have problems with relatively low nitrogen nutrients so that the effort to overcome this is through the addition of organic matter into the soil through organic fertilization or with inorganic fertilizers. The purpose of this study was to determine the effect of the application of goat and urea fertilizer on the chemical properties of inceptisols from Rantau Selatan. This research was carried out at the Agrotechnology Practice Field, Faculty of Science and Technology, Labuhanbatu Rantau Prapat University in February May to 2021. This study used a factorial Randomized Block Design (RAK) with 2 factors, namely factor 1 urea with 4 levels, namely: U0 = 100 kg urea /ha (0 g urea/5 kg weight of oven dry soil or BTKO), U1= 100 kg urea/ha (0.25 g urea/5 kg BTKO), U2= 200 kg urea/ha (0.50 g urea/ha) 5 kg BTKO), U3 = 300 kg urea/ha (0.75 g urea/5 kg BTKO) and factor 2, the factor of giving goat manure with 3 levels, namely: K0 = 0 tons N/ha (0 goat manure/ 5 kg of oven dry soil weight), K1 = 10 tons N/ha (25 g Fertilizer, Goat Cage/5 kg BTKO), K2 = 20 tons N/ha (50 g Fertilizer, Goat Cage/5 kg BTKO), K3 = 30 tons N/ha (75 g Fertilizer, Goat Cage/5 kg BTKO). The results of the research application of goat manure increased the N-total dose of Urea: 0.25g and goat manure: 75g on Inceptisol soil while the interaction of urea and goat manure application increased the total N-total with Urea dose: 0.25g and goat manure: 75g) South Coast Inceptisol soil
Keywords : Inceptisol, Inorganic Fertilizer, Organic Fertilizer, Nutrients

INTRODUCTION

The fertilization improvement can be done by giving organic matter. Manure is one of the organic source materials available widely to farmers (Oktabriana, 2018). Applying manure can reduce and increase the use of chemical fertilizers, it will contribute nutrients to plants and also increase nutrient uptake by plants (Walida et al., 2020).

Nitrogen plays a role in plant vegetative growth (Fadhillah and Harahap, 2020). However, nitrogen in the soil is easy to lose because of leaching, evaporation, and used by plants. (Patti et al., 2018). It will disturb the ability of roots to absorb water and N nutrients in the soil that supports plant growth (Oesman et al., 2020). The way to increase the efficiency of inorganic fertilizer is to add organic fertilizer into the soil because the organic has a role in recovery physical, chemical, and soil biology (Harahap et al., 2020a). In increasing corn productivity, fertilizer has an important role especially, macronutrients N, P, K needed by plants in large quantities (Fi'liyah et al., 2016). There are two types of fertilizer use inorganic and organic fertilizers. Compound fertilizer is inorganic that always used for plants. (Harahap et al., 2021b)

Besides that, giving manure can also recover the nature of the soil. It means that the soil capacity to hold water, the density of the soil mass, and the total porosity (Sufardi I, 2012) improve the soil stability aggregates (Swanda et al., 2015) and increase the soil humus content (Priambodo et al., 2019) a condition desired by plants. (Oktabriana, 2018), the application of urea fertilizer can reduce soil pH while Sudirja et al., (2017), found that manure application can increase soil pH while Triyanto et al., (2020), state that the application of N fertilizer in The form NH4NO3 can reduce soil pH significantly, but the decrease in pH decreases with increasing doses of manure given. Organic matter is the main N source in the soil and plays a significant role in the process of improving soil's physical, chemical, and biological. Soil N content is usually categorized as an indicator to determine the dose of Urea fertilization (Asukura et al., 2018). The function of nitrogen in the soil is to improve the vegetative growth of plants. Plants that grow on enough N soil are greener. N soil's fewer symptoms, plants grow small or stunted with limited root growth and yellow leaves (Liao et al., 2020).

Keep on the use of inorganic fertilizers will accelerate the depletion organic substances, damage the balance nutrients in the soil so that causing various plant diseases (Harahap et al., 2020b). Therefore, the use of inorganic fertilizers should be reduced by alternative uses of organic fertilizers, either singly or in combination with inorganic fertilizers (Adnan et al., 2015).

Inceptisols are the main agricultural land in Indonesia with wide distribution, which is around 70.52 million ha (37.5%) so that it has the potential to cultivate food crops, especially rice, corn, and soybeans if managed properly and appropriately (Wiwik and Husnain, 2018).

The problem faced by Inceptisols is the chemical soil. The chemical soil is not good as seen from the C-organic and low N of the soil (Nazimah et al., 2020) generally Inceptisols have less fertile soil, including the pH of the soil that is slightly acidic, medium organic-C content, and low NPK nutrients (Yuniarti et al., 2020). Generally, this soil has an acidic to slightly acidic soil reaction (pH 4.6-5.5) and a fairly high clay content that can poison plants, while the levels of organic, soil P, and other macronutrients are low (Furoq et al., 2016). Meanwhile, the nutrients available in the soil are decided by the properties of the soil, such as soil reaction (pH), Al and Fe oxides levels, Ca level, organic levels, texture, and land management.

To solve the problems is by adding the organic into the soil through organic fertilization. This activity provides optimal results depending on several factors, including the dose and use of fertilizer type (Harahap and Walida, 2019). The fertilization type and dose are widely used to assess the response of plants to fertilization actions (Susanti et al., 2020). Organic fertilizers are widely known to the public now and even become a government program to increase fertility and crop production (Hartatik et al., 2015). According to Putra et al., (2015), the application of urea fertilizer at a dose (300 kg/ha) had a significant effect on increasing the height of corn plants on Inceptisol Kwala Bekala soil.

The interaction between urea fertilizer application and goat fertilizer at doses (100 kg/ha and 30 tons /ha) had a significant effect on increasing headers

dry weight and uptake N of maize on Inceptisol Kwala Bekala soil, while application of goat fertilizer at a dose (30 tons/ha) significantly increased uptake-N, dry Organic-C weight headers, dry root weight, and corn height plant on Inceptisol Kwala Bekala soil. According to Zulkifli et al., (2020), there was an increase in leaf area, headers wet weight, root dry weight, shoot dry weight, total dry weight, and eggplant fruit/plant weight along with an increase in the dose goats fertilizer up to 20 tons/ha each; 23.27%; 35.85%; 17.64%; 16.55%; 16.66%; and 17.18% compared to control.

In Inceptisol soil, it is necessary to provide organic so that this soil can be used for plant cultivation and maintain nutrient balance through fertilization (Fadhlina et al., 2017). In general, the management carried out is the use of high inorganic fertilizers, but it is not balanced with the provision of organic (Subiksa, 2018).

Based on the Minister of Agriculture No. 40 of 2007 states that the return of organic or the application of organic fertilizer combined with inorganic fertilizer to improve soil conditions and fertility. According to (Syofiani et al., 2020) showed that the Inceptisols chemical was not good as seen from the low amount of organic-C soil (1.88%) and low total soil N (0.15%) which could not guarantee the sustainability optimum seedling growth (Triadiawarman et al., 2020)

In general, fertility and Inceptisols chemical are relatively low, but efforts can still be made to improve with appropriate handling and technology, namely, apply balanced fertilization (Murdhiani, 2020) while according to Solfianti et al., (2021), to increase the organic-C content, total N, and alkaline cations in Inceptisol soil can be done through soil ameliorants apply such as organic application (compost, green manure, and others). Based on data from Farrasati et al., (2018), Inceptisol soils have low to high P-potential, acidic to slightly acidic soil pH (pH 4.6-5.5), and low to medium organic content. Therefore, Inceptisol soil has several obstacles to be developed in agricultural cultivation in Indonesia.

Research results Arabia et al., (2018), application of chicken manure and 150 kg/ha of SP-36 fertilizer can increase the available Inceptisol soil available-P and uptake-P can increase corn and corn plant growth. The use of chicken manure can reduce the use of SP-36 fertilizer on corn plants in Inceptisol soils.

According to Febrianna et al., (2018), high organic gifts can add essential nutrients and also can increase the nutrients available in plants' soil, especially nutrient N which has the main function for vegetative plant development such as leaf formation. According to Syawal et al., (2017), an increase in N plant uptake is associated with an increase in dry weight plant, recovery development in root plant, and availability of soil N (Luta et al., 2020). Through a balanced fertilization program, it is hoped that soil and plant productivity can be optimized, farmers' incomes increase, fertilization becomes more efficient and profitable, and avoids environmental pollution (Surya et al., 2019). This is important because nutrients are one of the factors that can determine plant productivity (Harahap et al., 2021).

The purpose of this study was to obtain the right dose of goat and urea fertilizer to improve the chemical characteristics of Inceptisol soil from Rantau Selatan.

MATERIALS AND METHODS

This research was carried out at the Agrotechnology Field Practice, Faculty of Science and Technology, Labuhanbatu Rantau Prapat University. Soil Analysis was carried out in the PT Socfindo Kebun Bangun Bandar laboratory, Dolok Masihul District, the research began in February to June 2021.

This study used a factorial randomized block design (RAK) with 2 treatment factors, namely: This study used a factorial randomized block design (RAK) with 2 factors, namely factor 1 urea with 4 levels, namely: U0 = 100 kg urea/ha (0 g urea /5 kg weight of oven dry soil or BTKO), U1= 100 kg urea/ha (0.25 g urea/5 kg BTKO), U2= 200 kg urea/ha (0.50 g urea/5 kg BTKO), U3 = 300 kg urea/ha (0.75 g urea/5 kg BTKO) and

factor 2, the factor of giving goat fertilizer with 3 levels, namely: K0 = 0 tons N/ha (0 goat manure/5 kg oven dry soil weight), K1 = 10 tons N/ha (25 g Fertilizer, Goat Cage/5 kg BTKO), K2 = 20 tons N/ha (50 g Fertilizer, Goat Cage/5 kg BTKO), K3 = 30 tons N/ha (75 g Fertilizer, Goat Cage/5 kg BTKO).

The research started with taking soil samples. The method used in this study is a free grid survey method at the semi-detail level survey (observation density of 1 sample per 100 meters). The implementation soil sampling is 5 point samples with distance 100 meters. It used a random method with an area determined as presented in Figure 2. Soil sampling use soil hoe/soil drill at a depth of 0 - 20 cm as ± 1 kg of each soil sampling. So that each soil sampling recorded based on the results of cordinate GPS (Rauf and Harahap, 2019) and is presented in Figure 2.

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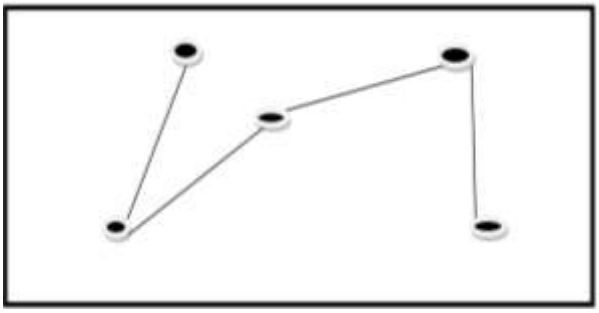

Gambar 2. Soil samplling side point at research location

Observation parameters include pH H_2O with the electrometric method, determination of total-N soil with the Kjehldal method, organic-C soil using Wakley and Black method

RESULTS AND DISCUSSION

Results

Inceptisol soil chemical analysis from Rantau Selatan District, namely pH, Organic-C, Total-N Soil was carried out after incubation at the end plants vegetative period. That is corn as an indicator (*Zea Mays* L)

Soil pH

The results of the variance show that the application of urea fertilizer and the application of goat fertilizer are presented in Table 1,

Significant on pH soil while interaction between urea fertilizer and goat fertilizer is not significant on soil pH. The average result of the significance of urea fertilizer, goat fertilizer toward pH soil is presented in Table 1. The results of the average difference test for the effect of a single application of urea fertilizer, sometimes goat fertilizer on soil pH are presented in Table 1.

From the results, the mean difference test in Table 1, it is known that the application of Urea fertilizer at the level of

U1 (0.25 g Urea) significantly increased soil pH compared to U2 (0.50 g Urea) which increased from (4.75) to (5 ,52) but when compared with U0 (0 g Urea) it was not significant.

Tabel 1.The effect of application urea, goat firtilizer toward Soil pH

Treatment	U0	U1	U2	U3	Average
K0	4,22 tn	4,42 tn	5,14 tn	5,32 tn	4,78c
K1	4,80 tn	4,82 tn	4,94 tn	5,34 tn	4,98b
K2	4,85 tn	4,94 tn	4,45 tn	5,45 tn	4,92b
K3	5,12 tn	5,38 tn	5,98 tn	5,95 tn	5,61a
Average	4,75c	4,89c	5,13b	5,52a	

Noted: the value followed by the same letters is not significat different at 5 % level according to the DMRT test

Organic-C Soil

The results of the variance show that the application of urea and goat fertilizer presented in Table 2. Table 2 shows that the application of urea fertilizer and the interaction of urea fertilizer with goat fertilizer has no significant effect on soil Organic-C. The application of Goat fertilizer has a significant effect on Soil Organic-C. The mean result of the different test has effect goat fertilizer on Organic-C soil application is presented in Table 2.

Table 2. The effect of goat firtilizer application toward Organic-C

Treatment	U0	U1	U2	U3	Average
K0	3,22 tn	3,42 tn	4,14 tn	4,32 tn	3,78 c
K1	3,60 tn	3,82 tn	3,94 tn	4,34 tn	3,93 b
K2	3,85 tn	3,64 tn	3,45 tn	4,85 tn	3,95 b
K3	4,12 tn	4,38 tn	4,98 tn	4,96 tn	4,61a
Average	3,70 tn	3,82 tn	4,13 tn	4,62 tn	

Noted: the value followed by the same letters is not significat different at 5 % level according to the DMRT test

From the results in Table 2, the application of goat fertilizer has effects in increasing C-Organic for each level where the highest C-Organic is in treatment K2 (4.12%), and the lowest is K0 (3.22%).

Total-N Soil

The result from the variance test shows that the application of urea fertilizer and goat fertilizer has a significant effect on soil total-N. While the interaction of urea fertilizer and goat fertilizer is not affected toward soil total-N. the application of goat fertilizer toward soil total-N is presented in Table 3

Table 3. The Effect of goat firtilizer application toward total-N Soil

Treatment	U0	U1	U2	U3	Average
K0	0,22 tn	0,44 tn	0,34 tn	0,62 tn	0,405 c
K1	0,60 tn	0,52 tn	0,64 tn	0,34 tn	0,525 c
K2	0,85 tn	0,64 tn	0,45 tn	0,85 tn	0,698 b
K3	0,12 tn	0,88 tn	1,29 tn	1,96 tn	1,062 a
Average	0,448 tn	0,620 tn	0,680 tn	0,942 tn	

Noted: the value followed by the same letters is not significat different at 5 % level according to the DMRT test

The difference mean test result in Table 3. It is known that the effect of the application goat fertilizer has a significant effect on the increased soil N-total for

each level where the highest soil N-total is found in K3 level (1.062 ppm) and the lowest at K0 (0.405 ppm).

DISCUSSION

Soil Acidity (pH)

The diversity analysis results in Table 1 show the use of urea and goat fertilizer has no significance to inceptisol soil acidity. It is because urea fertilizer is not reacted to the inceptisol soil so that goat fertilizer's giving will increase unreacted pH to the inceptisol soil slightly acidic. It is stated in (Istiqomah et al., 2020), clayey, the soil reaction is slightly acidic to slightly alkaline, the nutrient content and reserves are relatively medium, medium to high ground cation exchange capacity as according to the research Sebayang et al. ., (2021) state that the tillage treatment, goat and N fertilizers and their interactions has no significant effect on pH H2O. This is because although given additional fertilizer, goats fertilizer can increase pH soil but the dose has not been able to balance the dose of N fertilizer that is given according to the treatment, namely urea fertilizer 50 kg/ha, considering that urea is a fertilizer that reacts acidly so that it can increase soil acidity that given urea fertilizer. The increase occurred due to the application of urea and goat fertilizer to the inceptisol soil pH was still in the acid criteria according to the criteria soil characteristics from the Agricultural Research and Development Agency of the Ministry of Agriculture. (2012).

Organic-C Soil

The application of goat fertilizer had a significant effect on increasing Organic-C soil at the end of the vegetative period as shown in the results of the variance in Table 2 were the lowest Organic-C in the application of goats fertilizer at K2 (4.12%) and the lowest at K0 (3.22%).). However, the increase is still within the low criteria according to the soil characteristics criteria based on the Agricultural Research and Development Agency of the Ministry of Agriculture (2012).

The increased Organic-C content in the inceptisol soil is caused by the goat's fertilizer, which is an organic fertilizer that has a high Organic-C content so that it can provide Organic-C content for the inceptisol soil, so the activity of the microorganisms in the inceptisol soil increased. It is based on Rauf and Harahap, (2019) which states in the tropic area, the rate of weathering organic is very high so that turn over Organic-C into short then make low levels of organic soil.

Organic-C soil has the biggest important role to recover physical, chemical, and biological soils, organic (manure and/or green manure) needs to be added in large quantities.

Total-N Soil

From the results of variance in Table 3, it shows that the application of goat fertilizer has a significant effect on increasing the total-N soil until the end of the vegetative period of the plant because goat fertilizer has high N nutrients. According to (Ariyanti et al., 2018), states that goat fertilizers contain high total-N, organic matter, available-Ca, available-S, and high available-K, so it is hoped that the addition of goat fertilizer can increase fertility. Sufficient soil and nutrients are available to plants. Goat fertilizer has organic matter that is important to recovering the soil physically.

The application of urea fertilizer was not significantly different from the inceptisol total-N soil, it caused N nutrients in urea fertilizer available quickly and vise versa. because N nutrients were immobilized. According to Faqih et al., (2019) states that Urea is more quickly available to plants and can also be quickly lost due to evaporation and washing, while N itself is mobile.

CONCLUSION

1. Giving goat manure can increase N-Total, namely, 75 g goat firtilizer.
2. The urea application and goat fertilizer and urea with a dose of: 0.25 g urea and 75 g goat fertilizer, pH soil and C-Organic

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