Jurnal Biotik. P-ISSN: 2337-9812, E-ISSN: 2549-1768
Vol. 12, No.1 Ed. April 2024, Page: 23-32

EFFECT THE RICE HUSK ASH ON P-AVAILABLE AND P-UPTAKE OF THE CORN (*Zea mays* L.) ON ULTISOL

[1]Wulan Maghfirah, [2]Ilyas Ilyas and [3*]Yusnizar Yusnizar

[1,2,3]Soil Science Department of Agriculture Faculty, Syiah Kuala University, Banda Aceh, Aceh, Indonesia

*Email: nizaribr17@usk.ac.id

DOI: 10.22373/biotik.v12i1.20091

ABSTRAK

Ultisol dapat dimanfaatkan untuk ditanami tanaman pangan karena sebaran tanahnya cukup luas, akan tetapi hal tersebut harus dilakukan dengan pengelolaan tanah dan tanaman yang tepat. Salah satu tanaman pangan yang dapat ditanam pada lahan ini adalah tanaman jagung. Produksi jagung Aceh tahun 2017 sebesar 387.470 ton, sedangkan produksi jagung tahun 2018 sebesar 347.735 on yang dalam hal ini mengalami penurunan. Penelitian ini bertujuan untuk mengetahui pengaruh pemberian abu sekam padi terhadap sifat kimia tanah, pertumbuhan tanaman, serta serapan P tanaman jagung (*Zea mays* L.) pada Ultisol. Penelitian menggunakan rancangan acak kelompok non faktorial, dengan 4 perlakuan dan 5 ulangan sehingga terdapat 20 unit satuan percobaan. Susunan perlakuannya yaitu kontrol, abu sekam padi 10 t ha^{-1}, abu sekam padi 20 t ha^{-1}, abu sekam padi 30 t ha^{-1}. Parameter yang diamati adalah sifat kimia tanah (pH tanah, P-total, dan P-tersedia), serapan P tanaman jagung, dan pertumbuhan tanaman jagung yaitu berat brangkasan kering. Pengamatan sifat kimia tanah (pH tanah, P-total, dan P-tersedia), serapan P tanaman jagung dan berat berangkasan kering diukur pada 45 hari setelah tanam (HST). Hasil penelitian menunjukkan bahwa abu sekam padi berpengaruh nyata terhadap berat brangkasan kering, namun berpengaruh tidak nyata terhadap sifat kimia tanah (pH tanah, P-total, dan P-tersedia) serta serapan P tanaman jagung. Perlakuan dengan pemberian abu sekam padi 20 t ha^{-1} memberikan pengaruh terbaik terhadap pertumbuhan dalam hal ini berat kering tanaman jagung.

Kata Kunci: Ultisol, abu sekam padi, sifat kimia tanah, ketersediaan P, serapan P, berat kering tanaman.

ABSTRACT

Ultisol can be used to plant food crops because the land spread is quite wide, but this must be done with proper soil and plant management [1]. One of the food crops that can be planted on this land is corn. According to [2], Aceh's corn production in 2017 was 387,470 tons, while corn production in 2018 was 347,735 tons, which in this case experienced a decline. This research aims to determine the effect of applied og the rice husk ash on soil chemical properties, plant grow, and P-uptake of the corn plants (*Zea mays* L.) in Ultisol. The research used a non-factorial randomized block design, with 4 treatments and 5 replications so that there were 20 experimental units. The treatment composition was control, 10 t ha^{-1} the rice husk ash, 20 t ha^{-1} the rice husk ash, and 30 t ha^{-1} the rice husk ash. The parameters observed were soil chemical properties (pH of soil, P-total, and P-available), P-uptake, and plant growth namely dry weight. Observations of soil chemical properties (pH of soil, P-total, and P-available), corn plant P-uptake, and dry weight were measured 45 days after planting (DAP). The results showed that the rice husk ash had a significant effect on dry weight, but had no significant effect on soil chemical properties (pH of soil, P-total, and P-available) and P-uptake of corn plants. Treatment with 20 t ha^{-1} of the rice husk ash gave the best effect on the growth; dry weight of the corn plants.

Keywords: Ultisol, rice husk ash, soil chemical properties, P-available, P-uptake, dry weight.

INTRODUCTION

Ultisol is soil that has experienced weathering at an advanced level, has clay deposits in the lower horizon. The Ultisol area is around 45,794,000 ha, which is 25% of the total land in Indonesia and is the dominant soil on the island of Sumatra [3]. Some of the obstacles to Ultisol include acid soil which has an average pH of <4.5, high Al saturation, base saturation <35%, nutrient availability and low organic matter content. Ultisol can be used to plant food crops because the land spread is quite wide, but this must be done with proper soil and plant management. Proper soil management will get optimal plant results [1]. One of the food crops that can be planted on this land is corn.

The corn is a cereal crop that can be found almost all over the world and can be developed because it has the main source of carbohydrates and protein after rice. In several regions in Indonesia, corn is also used as a staple food [4]. According to [2], Aceh's corn

production in 2017 was 387,470 tons, while corn production in 2018 was 347,735 tons, which in this case experienced a decline, along with the increase in population, the demand for corn also increased, while the production achieved by farmers decreased. The corn plants can grow and produce optimally by requiring sufficient nutrients during their growth.

The corn plants have a high need for phosphorus (P), a lack of phosphorus can cause stunted plant growth and low crop yields. The availability of P elements in acidic soils such as Ultisol is limited because most of the P is bound by metal elements such as Al and Fe so it cannot support plant growth. If there is a lack of P element availability in the soil, it will result in reduced P uptake by plants. The impact of P deficiency on plants can inhibit growth, fruit ripening and chlorophyll biosynthesis so that the color of the plant becomes dark and growth is less than optimal [5]. Phosphorus (P) is an essential macro nutrient that plants need in large quantities. Plants absorb phosphorus from the soil solution in the form of primary orthophosphate ions ($H_2PO_4^-$) and secondary orthophosphate ions (HPO_4^{2-}) [6]. Therefore, efforts are needed to increase the availability of P elements in the soil. Rice husk ash has been used in several studies as an alternative source of phosphorus to increase the availability of phosphorus in the soil.

Application of the rice husk ash can increase P-total and P-available in the soil [7]. The best results were obtained in the soil mixture treatment with 30% rice husk ash [7]. The rice husk ash had a significant effect on increasing the growth and yield of the corn plants with the best dose of 100 grams $plot^{-1}$ [8].

The rice husk ash is the result of burning rice waste which is completely burned. The Rice husk ash has several essential nutrients such as nitrogen (1%), phosphorus (0.2%), potassium (0.58%) and high levels of silica (87–97%), and others such as magnesium, iron and others are found in smaller quantities [9]. Applied the rice husk ash to the soil can help aerate the soil so that it will facilitate the movement of air and water in the soil and really help the plant root system in

absorbing nutrients [4]. One of the elements contained in the rice husk ash is the element silicate which is often associated with the availability of phosphorus. Silicates in the rice husk ash can reduce P sorption by soil components. P sorption is reduced because silicate is able to liberate P which is sorbed by soil components through the exchange of P anions with Si [10].

Based on this background, research on the effect of applied the rice husk ash on P-available and P-uptake of the corn (*Zea mays* L.) plants in Ultisol needs to be carried out to increase P-available and P-uptake of P in the soil so the plants can grow well.

RESEARCH METHOD

This research used a non-factorial randomized block design method of 4 treatments with 5 replications, so that in this research there were 20 experimental units with each polybag containing 15 kg of soil. This research was carried out at the Experimental Garden of the Faculty of Agriculture, Syiah Kuala University, Banda Aceh. Before carrying out this research, a preliminary analysis of the soil chemical properties was carried out. The CEC and base saturation were carried out at *Balai Pengkajian Teknologi Pertanian* (BPTP) Aceh. Analysis of pH of soil, P-total and P-available were carried out at the Soil Chemistry Laboratory, Faculty of Agriculture, Syiah Kuala University. Analysis Plant P uptake was carried out at the Soil and Plant Chemistry Laboratory, Faculty of Agriculture, Syiah Kuala University.

RESULTS AND DISCUSSION

Characteristics of Soil Chemical Properties

The results of analysis of soil chemical properties were carried out at the Soil Chemistry Laboratory, Faculty of Agriculture, Syiah Kuala University and Balai Pengkajian Teknologi Pertanian (BPTP) Aceh showed in Table 1.

Table 1. Results of Analysis of Soil Chemical Properties

No	Aspects of Soil Chemical Properties Analysis	Value	Criteria
1	pH H_2O	5,92	Slightly acid
2	P-total (mg 100 g^{-1})	9,65	Very low
3	P-available (ppm)	6,43	Low
4	CEC (me 100 g^{-1})	8,00	Low
5	Base saturation (%)	13,63	Very low

Table 1 showed that the Ultisol soil in Neuheun Village, Mesjid Raya District, Aceh Besar Regency has a slightly acid pH H_2O is 5.92, the P-total, P-available, cation exchange capacity (CEC) and base saturation are classified as low criteria to very low. Ultisol has an acidic pH so it can affect the nutrients in the soil. According to [11] soil pH has an important role, namely it is related to the absorption of nutrient elements by plants and base saturation. Acid soil has low base saturation and absorption of nutrients. The nutrient content of Ultisol is low, the CEC is low and has a base saturation of less than <35% at a depth of 1.8 m. Base saturation <50% in the soil can be categorized as infertile soil [12].

Characteristics of the Rice Husk Ash

The results obtained during the analysis of the rice husk ash carried out at *Balai Standardisasi* dan *Pelayanan Jasa Industri* (BSPJI) showed in Table 2.

Table 2. Results of the Rice Husk Ash Analysis

No.	Aspects of Analysis of The Rice Husk Ash	Value
1	SiO_2 (%)	93,96
2	P_2O_5 (%)	0,39

Effect of Application of the Rice Husk Ash on Changes in Soil Chemical Properties

pH of Soil

The results of variance analysis showed that the application of the rice husk ash has no significant effect on pH of soil, this is thought to be because the decomposition of the rice husk ash has not been long enough, which means that the Si element in the rice husk ash has not released many OH^- anions. Silicates have the ability to release OH^- anions which can neutralize soil acidity. If the silicate from the rice husk ash cannot be decomposed properly then

it will not be able to increase the pH of soil significantly. In line with research by [13] stated that the husk ash contains silicates which are able to release OH^- anions in solution so that they can increase the pH.

The application of the rice husk ash has not been able to increase P-total in the soil, allegedly because the Si element in the rice husk ash can only release metal elements which absorb P in the soil, the Si element cannot supply the P element in the soil therefore P-total content in the soil still in very low criteria. In line with research by [14] stated that the rice husk ash contains silicate elements which can release P elements absorbed by soil components and prevent P fixation through anion exchange between P and Si [14].

P-total

Average of P-total due to the application of the rice husk ash showed in Table 4.

Table 4. Average of P-total due to application of the rice husk ash

Treatment	P-total (mg 100 g^{-1})	Criteria
A (0 ton ha^{-1})	11,21	Very low
B (10 ton ha^{-1})	11,24	Very low
C (20 ton ha^{-1})	12,70	Very low
D (30 ton ha^{-1})	11,38	Very low
$BNJ_{0,05}$	-	

The results of variance analysis show that the application of the rice husk ash has no significant effect on P-total of soil. The initial soil analysis content of P-total has very low criteria so that application of the rice husk ash has not been able to increase P-total of soil. The low of Ptotal in the soil is thought to be because the source of the P element in Ultisol can come from the weathering of low phosphorus minerals, so P-total of soil are also low. This was stated by [12] that P deficiency in Ultisol can be caused by weathering of the soil parent material or mineral sources of P which are generally already low.

Application of the rice husk ash has not been able to increase P-total in the soil, allegedly because Si element in the rice husk ash can only release metal elements which absorb P in the soil, Si element cannot supply P element in the soil therefore P-total in

the soil still in very low criteria. The rice husk ash contains silicate elements which can release P elements absorbed by soil components and prevent P fixation through anion exchange between P and Si [14].

P-available

Average of P-available of soil due to application of the rice husk ash showed in Table 5.

Table 5. Average of P-available due to application of the rice husk ash

Treatment	P-available (ppm)	Criteria
A (0 ton ha^{-1})	6,53	Very low
B (10 ton ha^{-1})	6,55	Very low
C (10 ton ha^{-1})	7,32	Very low
D (10 ton ha^{-1})	7,04	Very low
$BNJ_{0,05}$	-	

The results of variance analysis show that the application of the rice husk ash has no significant effect on P-available in the soil. It is suspected that application of the rice husk ash has not been able to increase P-available significantly. The rice husk ash in this study contained high silicate elements but P element content in the soil was very low. Silicates function as a substitute for P elements that are absorbed in the soil, silicates are only able to release P to the soil so that P-available is still in very low criteria. In accordance with the statement of Ilyas (2000), added that the rice husk ash contains a high source of silicate which can release adsorbed P elements, because silicate is one of the potential determinant anions that can compete to occupy the complex of adsorption [13]. This competitive naturally can be exploited to increase the availability of phosphorus.

P-Uptake in Corn Plants

Average of P-uptake due to application of the rice husk ash are showed in Table 6.

Table 6. Average of P-uptake Due to Application of the Rice Husk Ash

Treatment	P-uptake (%)	Criteria
A (0 ton ha^{-1})	0,43	High
B (10 ton ha^{-1})	0,44	High
C (20 ton ha^{-1})	0,43	High
D (30 ton ha^{-1})	0,38	Medium
$BNJ_{0,05}$	-	

Base the results of variance analysis, it can be seen that the application of rice husk ash has no significant effect on P-uptake in corn plants. The results of the analysis in the treatment of 0, 10, 20 tons ha^{-1} of the rice husk ash showed high criteria,

but the treatment of 30 tons of ha^{-1} of the rice husk ash showed moderate criteria. Decreasing P-uptake criteria are thought to be because P-available results obtained are also low, therefore the phosphorus element cannot be absorbed properly by plants. The lower P-available in the soil so the plants will absorb less P and vice versa, in line with research by [15] stated that P-available in the soil is quite high and has a real effect so that P element can be absorbed by the plant. Phosphorus is absorbed by plants in the form of primary ($H_2PO_4^-$) and secondary (HPO_4^2) monophosphate or phosphate ions, so that more P-available in the soil, the more P will be absorbed by the roots [6];[16].

Dry Weight

Average of dry weight of the due to application of the rice husk ash showed in Table 7.

Table 7. Average of Dry Weight Due to Application of the Rice Husk Ash

Treatement	Dry Weight (g)
A (0 ton ha^{-1})	4,80 a
B (10 ton ha^{-1})	19,40 b
C (20 ton ha^{-1})	20,40 bc
D (30 ton ha^{-1})	29,00 c
$BNJ_{0,05}$	4,94

Note: Numbers in the same column and followed by the same letter show no significant difference in the BNJ 0.05 follow-up test

Based on the results of variance analysis, it showed that the rice husk ash treatment has significant effect dry weight of cor plants. The results on dry weight showed that 0 ton ha^{-1} treatment was significantly different from the 10 ton ha^{-1}, 20 ton ha^{-1} and 30 ton ha^{-1} treatments. It is suspected that the results of the dry weight of corn plant had a significant effect. The weight of the dry to increase. This is in line with [17], the increase dry weight after being in the oven was caused by an increase plant weight. Increased photosynthate formation influences an increase in plant dry weight because 90% of plant dry matter comes from photosynthesis [18].

CONCLUSION

The application of rice husk ash had a significant effect on dry weight. The application of rice husk ash had no significant effect on chemical properties (pH of soil, P-total, and P-available). Treatment with 20 t ha^{-1} of rice husk ash gave the best effect on growth of corn plants.

REFERENCE

[1]Prasetyo, B.H & Suriadikarta, D.A. 2006. Karakteristik, Potensi dan Teknologi Pengelolaan Tanah Ultisol Untuk Pengembangan Pertanian Lahan Kering di Indonesia. *Jurnal Litbang Pertanian*. 25 (2).

[2]Badan Pusat Statistik. Aceh. 2018. *Kajian Konsumsi Bahan Pokok 2018*. https://distanbun.acehprov.go.id/media/2020.02/LAKIP_2018_Distanbun.pdf. Diakses tanggal: 18 Juli 2023.

[3]Harahap, F.S., Walida, H., Harahap, D.A., Wicaksono, M., & Hasibuan, R. 2020. Pemberian Abu Sekam Padi dan Kompos Jerami Terhadap Sifat Kimia Tanah Ultisol pada Tanaman Jagung Manis. *Jurnal Tanah dan Sumberdaya Lahan Hara*. 7 (2): 12–18.

[4]Harahap, F.S. & Walida, H. 2019. Pemberian Abu Sekam Padi dan Jerami Padi untuk Pertumbuhan serta Serapan Tanaman Jagung Manis (Zea mays L.) pada Tanah Ultisol di Kecamatan Rantau Selatan. *Jurnal Agroplasma*. 6 (2): 12–18.

[5]Tambunan, A.S., Fauzi & Guchi, H., 2014. Efisiensi Pemupukan P terhadap Pertumbuhan dan Produksi Jagung (*Zea mays* L.) pada Tanah Andisol dan Ultisol. *Jurnal Online Agroekoteknologi*. 2 (2): 414–426.

[6]Ahmadi. 2019. *Pengaruh Pengukuran pH Tanah terhadap Pemberian Pupuk Sp 36.* http://cybex.pertanian.go.id/mobile/artikel/65395/Pengaruh-Pengukuran-Ph-Tanah-Terhadap-Pemberian-Pupuk-Sp-36/. Diakses tanggal: 18 Juli 2023.

[7]Khotimah, K. 2016. Peningkatan Ketersediaan Fosfor dalam Tanah akibat. Penambahan Abu Sekam Padi dan Analisisnya secara Potensiometri. *Skripsi*. Jurusan Kimia Fakultas Matematika dan Ilmu Pengetahuan Alam. Universitas Jember, Jawa Timur.

[8]Taufik, I., Ermawati, & Haryoko, W., 2022. Respon Jagung Manis (*Zea mays* var. *saccharata* Stur.) terhadap

Abu Sekam dan NPK. Jurnal Embrio. 14 (1): 1–17.

[9]Bakri, 2008. Komponen Kimia dan Fisik Abu Sekam Padi sebagai SCM untuk Pembuatan Komposit Semen. *Journal Perennial.* 5(1), pp. 9–14.

[10]Salehuddin, 1990. Pengaruh Pemberian Sekam Padi dan Fosfor Terhadap Kandungan Hara dan Produksi Kedelai Pada Tanah Podzolik Merah Kuning. *Tesis* Fakultas Pasca Sarjana Institut Pertanian Bogor. Bogor.

[11]Hardjowigeno, S., 2015. *Dasar-Dasar Ilmu Tanah.* Penerbit Akademika Pressindo: Jakarta. Pg. 288.

[12]Syahputra, E., Fauzi, & Razali. 2015. Karakteristik Sifat Kimia Sub Grup Tanah Ultisol di Beberapa Wilayah Sumatera Utara. *Jurnal Agroekoteknologi*. 4 (1): 1796–1803.

[13]Ilyas, Syekhfani & Prijono, S. 2000. Analisis Pemberian Limbah Pertanian Abu Sekam sebagai Sumber Silikat pada Andisol dan Oxisol terhadap Pelepasan Fosfor Terjerap dengan Teknik Perunut. *Risalah Pertemuan Ilmiah Penelitian dan Pengembangan Teknologi Isotop dan Radiasi. Malang*. Direktorat Jendral Pendidikan Tinggi Departemen Pendidikan dan Kebudayaan. 1991, Jakarta.

[14]Prasetyo, B.T., Darfis, I., & Fitri, R. 2008. Pengaruh Pemberian Abu Sekam sebagai Sumber Silika (Si) bagi Pertumbuhan dan Produksi Tanaman Padi (*Oryza sativa* L.). *J. Solum.* 5 (1): 43–49.

[15]Pane, M.A., Damanik, M.M.B. & Sitorus, B. 2014. Pemberian Bahan Organik Kompos Jerami dan Abu Sekam Padi dalam Memperbaiki Sifat Kimia Tanah Ultisol serta Pertumbuhan Tanaman Jagung. *Jurnal Online Agroekoteknologi*. 2 (4): 1426–1432.

[16]Aprilianda, D. 2012. Pengaruh Pupuk Majemuk NPK terhadap Pertumbuhan, Produksi dan Serapan Hara Jagung (*Zea mays* L.) pada Latosol Darmaga. *Skripsi*. Fakultas Pertanian Institut Pertanian Bogor, Bogor.

[17]Birowo, A. T., Prabowo, D., & Djojonegoro, P. 1992. *Perkebunan Gula*. Lembaga Pendidikan Perkebunan, Yogyakarta.

[18] Iriany, R. N. M., Yasin, H. G., & Asal, A. T. M. 2006. *Sejarah, Evolusi, dan Taksonomi Tanaman Jagung. Maos*, Balai Penelitian Tanaman Serealia.