Available at : https://ejournal.unib.ac.id/index.php/terrajournal
DOI : https://doi.org/10.31186/terra.5.2.58-64 ISSN 2621-0207

TERRA
Journal of Land Restoration

The Effect of Humic Acid and Micro Compound Fertilizer on Soil Microorganism Population and Upland Rice Yield in Coastal Land

Nova Angelina Sibagariang[1*], Yudhi Harini Bertham[1], Heru Widiyono[1], Anandyawati[1], Kartika Utami[1]

[1]*Soil Science Department, University of Bengkulu, Bengkulu, Indonesia*

Corresponding Author : snovaangelina@gmail.com

ABSTRACT

This study aims to determine the effect of humic acid and micro compound fertilizer on soil microbial populations and yields of Inpago10 varieties of upland rice in coastal areas. This research was conducted from August to December 2021 in Beringin Jaya village, Muara Bangkahulu District, and analysis of soil and plant samples at the Soil Science Laboratory, Faculty of Agriculture, University of Bengkulu. This study was prepared using a randomized complete block design (RCBD) with 2 factors.The first factor is the dose of humic acid which consists of 3 levels, namely 0 L ha^{-1}, 8 L ha^{-1}, and 16 L ha^{-1}. The second factor is a compound micro fertilizer consisting of 2 levels, namely 0 g ha^{-1} and 70 g ha^{-1}. Each treatment was repeated 4 times, resulting in 24 experimental units. Observation variables include C-organic (%), respiration, total microbial population, pH KCl, pH H_2O, plant height (cm), the number of grains per panicle, plant dry weight (g), root dry weight (g), and weight per plot (g/plot). The Data were analyzed using variance analysis and extended with DMRT at the level of 5%. The results showed that the application of humic acid was able to stimulate the population of soil microorganisms by 38.91% and the addition of micro compound fertilizer was able to increase the yield of weight per plot by 26.69%.

Keywords: *upland rice, coastal land, humic acid, micro fertilizer*

INTRODUCTION

Indonesia is an archipelago country that has a coastal land area of 1,060,000 ha and a coastline of 95,161 km spread across various regions in Indonesia (Lasabuda, 2013). Bengkulu province is one of the regions that has a fairly extensive coastal area. Coastal land is a sandy-textured soil condition, has no structure, high salt content, and low nutrient content, causing plant growth to be disrupted (Bertham *et al.,* 2016). In general, the problem that is often encountered in coastal land is the ability to store and absorb water is very low, so the media quickly lose water (Rahmat *et al.,* 2020).

Therefore, coastal lands need special attention to increase the availability of nutrients for plants. Some researchers have succeeded in cultivating plants on coastal land, namely soybeans (Nusantara *et al.,* 2019) and upland rice (Bertham *et al.,* 2020).

The results of several studies show that coastal land has the potential to be developed as agricultural cultivation land if using the right strategies and technologies. One of the efforts that can be done to improve the nature of coastal land is the addition of humic acid. Humic acid is the result of the decomposition process that has carboxyl (- COOH) and phenolic (-OH) groups that play a role in overhauling soil properties. Mindari *et al.* (2018) stated that humic acid can stimulate soil microorganisms in increasing soil moisture, as well as chelating heavy metals. Humic acid also can increase the availability of nutrients for plants (Hermanto *et al.,* 2013). The addition of humic acid can stimulate the activities of microorganisms that play an important role in helping the decomposition process and the release of nutrients needed by plants (Tangapo *et al.,* 2018). Microorganisms in the soil help in the formation of stable soil structures and aggregates (Yulianti, 2010).

Rice (*Oryza sativa* L.) is the main food ingredient of Indonesian citizens. However, the need for rice increases as the population increases. On the one hand, population growth raises problems in the demand for land to meet the needs of settlements which leads to the conversion of agricultural land to non-agricultural. Septanti & Saptana (2019) stated that this has the potential to threaten farmers ' livelihoods and food availability in the future. Upland rice is a plant cultivated in dry land. In general, upland rice is planted once a year at the beginning of the rainy season. Cultivation on dry land is an alternative to supporting the development of food self-sufficiency. However, dry land conditions are at risk of experiencing drought stress, affecting the growth and yield of upland rice.

Micro-nutrient components (Fe, Mn, B, Cu, and Zn) are essential nutrients needed by plants in small quantities. Although absorbed in small amounts but has an important role in the process of plant metabolism, especially in helping the work of enzymes. The addition of micronutrients can improve plant growth (Widayat *et al.,* 2020). In addition, Fauziah *et al.* (2018) added that the elements Zn and Cu play a role in the formation of auxin hormones, energy production, and protein synthesis. A lack of micronutrients will cause enzyme work to be disrupted and excess micronutrients will cause poisoning in plants.

MATERIALS AND METHODS

This research has been carried out from August to December 2021 in Beringin Raya village, Muara Bangkahulu District, and in the Soil Science Laboratory of the Faculty of Agriculture, University of Bengkulu. This study used a 2-factor randomized complete block design (RCBD). The first factor is humic acid 3 doses of 0 L ha^{-1}, 8 L ha^{-1}, and 16 L ha^{-1}. The second factor is the compound micro fertilizer 2 doses of 0 g ha^{-1} and 70 g ha^{-1}. So, from these two factors, the can 6 combination treatments were repeated 4times, so that in the can 24 unit experiment. Then, make a map with a size of 1.5 m x 3 m, the distance on the map is 50 cm, while the distance on the repeat is 100 cm, and the planting distance is 30 cm x 30. Apply humic acid by spraying evenly on the soil surface. Application is carried out 2 days before planting. Planting was done by inserting as many as 2 seeds into the planting hole, and inserting biological fertilizer inoculants (azotobacter, phosphate solvent bacteria, K solvent bacteria, and FMA) as many as 2.5 grams of inoculants into the planting hole (Nusantara *et al.,*2012). Next, apply compound micro fertilizers by spraying evenly on the leaf surface. Application is done as much as 2 times when upland rice plants enter the final vegetative phase of 55 days. Applying basic inorganic fertilizer at planting, fertilizer is given at 25% of the recommended dose of 90 kg ha^{-1} urea (22.5 g ha^{-1}), 45 kg ha^{-1} SP36 (11.25% g ha^{-1}) and 45 kg ha^{-1} KCl (11.25 g ha^{-1}). During the research, plant maintenance was carried out in the form of embroidery, watering, weeding, closing plant roots, and controlling plant pests and diseases. Harvesting is carried out in two stages, namely the vegetative and generative phases**.**

RESULTS AND DISCUSSION

The research was conducted on coastal land located in Beringin Raya village, Muara Bangkahulu District, Bengkulu City. The soil in the study site was classified as marginal with problems of sandy soil texture, high evaporation, nutrient levels (N = 0.12%, P = 6.23 ppm, and K = 0.28 me 100^{-1}), CEC 5.21 me 100^{-1}, and pH rather sour. This is based on data from Class I Climatology station Baii Island-Bengkulu climatic conditions during the study that the average amount of rainfall in August, September, October, November, and December is 13.62 – 26.68 mm per month with an average air temperature of 26.74- 27.67 ^{o}C.

Upland rice plants planted at the research site are Inpago 10 varieties. The percentage of plant growth power seen in the second week after planting reaches 75%, so the embroidery is done. In the vegetative phase, plants are attacked by grasshoppers and caterpillars. Then, manual and chemical control is carried out using insecticides with the active ingredient Profenofos. In the generative phase rice plants were attacked by Sparrow pests, so the installation of bird nets around the research area.

The results of variance analysis (Table 1) showed that the interaction between humic acid and micro fertilizer had a significant effect on the C-organic content (%) and the number of grains per panicle. Administration of humic acid significantly affects the levels of C-organic (%), respiration, microorganism population, the number of grains per panicle, and weight per plot. While the application of micro compound fertilizer significantly affects the dry weight of plants, the number of grains per panicle, and the yield per plot.

The percentage increase in soil organic C - the content of (30.45%) given a humic acid dose of 16 L ha^{-1} is higher, compared to that given a humic acid dose of 8 L ha^{-1} of (26.90%) (Table 2). This is because humic acid applied before planting can stimulate and activate the activity of microorganisms in the soil. The presence of C-organics in the soil is a source of energy for microorganisms. In line with Afandi *et al.* (2015) if (C) is a source of nutrients, then the availability of C-organic in the soil can revive the activity of microorganisms. In addition, Fadhli (2021) added that the increase in soil C-Organic is influenced by the decomposition process of soil microorganisms. Based on the results of Santi's research (2016) the addition of humic acid helps in increasing soil C- organic levels by 0.5% to 1.0 %. However, the application of compound micro fertilizers did not show an increase in soil C-organic levels (%), this is because micro fertilizers were applied on the 55th day after planting so it did not affect increasing C - organic (%).

Table 1. Summary of analysis variance

Variables	F value			
	Hiumic acid	Mikro fertilizer	Interaction	CV (%)
C-organik	12.01**	2.94ns	5.0*	8.59
Soil respiration	14.12**	0.29ns	0.95ns	18.38
Total microorganism	9.47*	1.85ns	0.44ns	14.91
pH H20	1.77ns	3.17ns	0.47ns	5.12
pH KCl	0.73ns	1.13ns	0.73ns	5.97
Plant height	1.92ns	2.78ns	0.15ns	7.76
Number of spikelets per panicle	9.55**	48.61**	7.36**	10.68
Biomass dry weight	1.63ns	6.10*	0.70ns	33.26
Root dry weight	0.36ns	1.07ns	3.58ns	33.10
Yield per plot	9.47**	13.14**	1.81ns	15.90

Note : ** = highly signicant ; * = significant ; ns = non-signicant

Table 2. The effect of humic acid and micro compound fertilizer on C organic

Dosage micro fertilizer	Humic acid dosage		
	0	8	16
0	1,97b	2,50a	2,57a
	A	A	A
70	2,07b	2,48a	2,08b
	A	A	A

Note : Number followed the same capital letter in the column (vertically) and the same lowercase letter in the row (horizontally) are the same different is not real at DMRT 5%

The number of spikelets per panicleshowed a real difference in each treatment. The application of a humic acid dose of 16 L ha^{-1} and given a compound micro fertilizers dose of 70 g ha^{-1} increased the number of grains per panicle higher by 63.94 % (Table 3). This is because humic acid applied 2 days before planting can improve soil fertility status both in physical, chemical, and biological properties of the soil. With increasing soil fertility, nutrient uptake will increase so that plant growth is optimal. In addition, Heil (2005) stated that the influence of humic acids directly helps in improvingmetabolism in plants, such as increasing the process of plant photosynthesis. Shaaban *et al.* (2009) stated the addition of humic acid can also reduce the use of inorganic fertilizersin the soil by 25 %, and also able to increase the weight of stalks and seeds in rice plants.

In addition, compound micro fertilizers given on the 55th day after planting can be optimally absorbed by the upland rice plant, so that it can carry out metabolic processes that are utilized in flowering and grain formation. In line with Husin *et al.* (2014) that micronutrients contained in micro fertilizers can spur the process of photosynthesis which is utilized by plants in the growth and production of results. In addition, Pratama *et al.* (2017) stated that the provision of micronutrients such as B plays an important role in the formation of seeds resulting from the photosynthesis process. In Romlan *et al.* (2021) that the Fe micronutrients contained in compound micro fertilizers help in the formation of chlorophyll and protein constituents which are utilized by upland rice plants in the formation of flowers, fruits, and seeds. Based on the results of research by Rozen *et al.* (2017) that Zn and Mn nutrients can increase production by 3.8 – 15 %. This issupported also, at the time of application of micro compound fertilizer through the leaves so that it is quickly utilized by plants (Praba *etal.,*2018).

Table 3. The effect of humic acid and micro compound fertilizer on the number of grains per panicle

Dosage micro fertilizer	Humic acid dosage		
	0	8	16
0	95,90c	113,31a	104b
	B	B	B
70	121,10b	133,97b	170,5a
	A	A	A

Note : Number followed the same capital letter in the column (vertically) and the same lowercase letter in the row (horizontally) are the same different is not real at DMRT 5%

The application of humic acid at a dose of 8 L ha^{-1} and 16 L ha^{-1} was able to increase the respiration rate of the soil (Table 4). This is because humic acid can increasethe availability of nutrients in the metabolic process, one of which is used for cell division in plant root organs. Good root growth will produce exudate containing organic acids that are favored by microorganisms so that the rate of soil respiration increases. In line with Asmara *et al.* (2021) that the height of respiration is influenced by the number of microorganisms in the soil. In addition, Kurniawati & Priyadi (2021) added that the amount of microbial activity produces high CO2 so the higher the respiration, the greater the activity of microorganisms.

The application of humic acid at a dose of 8 L ha^{-1} and 16 L ha^{-1} can increase the total population of microorganisms. This isbecause the addition of humic acids to the soilhelps in providing a source of nutrients toincrease soil biological activity so that the number of soil microorganism populations increases. According to Priyadi *et al.* (2018) stated that the activity of microorganisms is directly proportional to the total number of microorganisms in the soil so the higher the total number of microbes, the higher the activity of microorganisms. On the other hand, the addition of humic acid showed high levels of C-organic (%) soil, in line with Purbalisa *et al.* (2020) state that microorganisms can multiply well in soils thatcontain a lot of carbon.

Humic acid applied showed no significant effect on pH KCl and pH H_2O (Table 4). However, compared to the initial soil pH, the soil pH is rather sour. This is because humic acids contain organic compounds that tend to lower the pH of the soil. In line with Nikiyuluw *et al.* (2018), humic acids produce active groups such ascarboxyl (-COOH) and phenol (-OH) that predominate and act as weak acids thatdissociate and produce H+ ions so that soilpH decreases. Wang *et al.* (2008) stated a decrease in pH due to the dissociation of protons from the hydroxyl of humic acids. In addition, a decrease in soil pH is suspected when a humic acid application is incubated for 2 days before planting. According to Winarso *et al.* (2009) decreased soil pH is dueto the length of incubation.

Table 4. Effect of humic acid on soil properties

Humic acid dosage (L ha^{-1})	Soil respiration (mg m^{-2} day^{-1})	Microbial population CFU g^{-1}	pH H20	pH KCl
0	388.57b	776.00b	4.80	4.41
8	634.5a	941.16a	4.91	4.48
16	592.72a	1078a	5.03	4.57

Note: Numbers followed by same letter in the same co-

Humic acid administration had no significant effect on plant height, plant dryweight, and root dry weight. This is because humic acid is an organic compound that helps restore conditions in the soil not in plants. In line with Subowo (2010) that organic matter plays a role in restoring soil structure, increasing soil absorption, and increasing soil biological activity. In addition, supported by the results of the field there is interference from environmental factors (rainfall) which causes some of the upland rice plants to collapse it affects the process of plant photosynthesis. In line with, Nazirah & Damanik (2015) the rate of plant growth is also influenced by environmental factors suchas rainfall, temperature, and others.

Humic acid applied at doses of 8 L ha^{-1} and 16 L ha^{-1} was able to increase the weight per plot (g $plot^{-1}$) (Table 5). This is because humic acid can increase nutrition for plants, especially P nutrients. P nutrients play an important role in the formation of grains (Ruhaimah *et al.,* 2009). In addition, Suwardi and Wijaya (2013) in their research, the administration of humic acid doses of 5-15 L ha^{-1} was able to increase crop production by15-33 %. This is by the results obtained in thetreatment of humic acid of 3283.16 g $plot^{-1}$ increased approximately 37.48 % of the treatment without humic acid is 2388.61 g $plot^{-1}$.

Table 5. Effect of humic acid on rice growth and yield

Humic acid dosage (L ha^{-1})	Plant height (cm)	Plant dry weight (g)	Root dry weight (g)	Weight per plot (g $plot^{-1}$)
0	96.75	53.27	14.67	2388.61b
8	104.37	58.57	14.97	3283.16a
16	101.37	70.13	13.09	3284.21a

Note: Numbers followed by same letter in the same colomn are not signicantly

Plant height is one of the parameters used to determine vegetative growth in plants.In (Table 6) the difference in plant height between the dose of 0 g ha^{-1} (98.16 cm) witha dose of 70 g ha^{-1} (103.5 cm). But in general, the micro fertilizer dose treatment didnot show a marked difference in plant height. This is because the micro fertilizers applied through the leaves have a temporary supply ofnutrients so that the liquid attached to the surface of the leaves runs out then the nutrientsupply stops. The speed of loss of this fluid is influenced by environmental factors such as the intensity of sunlight, temperature, and rainfall. In line with Idawanni & Ferayanti (2021), plant height growth is influenced by genetic factors and also the appropriate growing environment for plants.

The application of compound micro fertilizers had no significant effect on the dry weight of the roots (g). This is because the provision of micronutrients through the leaves is quickly absorbed and converted into nutrients needed by plants, so it is not distributed to plant roots.In line with Sanda & Sham (2018) that fertilizers applied through leaves are more quickly absorbed by plants and directly used in the photosynthesis process. In addition, Mandie *et al.* (2015) stated fertilization through leaves provides a rapid response in supporting the process of photosynthesis rate. Compound micro fertilizers applied through leaves were able to increase the dry weight of plants by 40.29% compared to those without compound micro fertilizers. This is because the application of micro nutrients through the leaves can be absorbed optimally in helping the metabolism and synthesis of proteins used by plants. Based on the results of research by Janket *et al.* (2018) that the provision of micro fertilizers such as (Zn, Cu, and Mn) can improve the dry weight biomass of plants. Kurniawan (2020) also suggested that the provision of micronutrients affects the dry weight of plants.

Table 6. Effect of dosage micro fertilizer on rice growth and yield

Dosage micro fertilizer ($g\ ha^{-1}$)	Plant height (cm)	Plant dry weight (g)	Root dry weight (g)	Weight per plot ($g\ plot^{-1}$)
0	98.16	50.21b	13.24	2633.80b
70	103.5	70.44a	15.25	3336.85a

Note: Numbers followed by same letter in the same

Table 6 shows the administration ofthe micronutrient compound dose of 70 g ha^{-1} was able to increase the weight per plot (g) by 26.69 %. This is because the micron utrients contained in compound micro fertilizers can be absorbed by plants in theprocess of protein and carbohydrate metabolism which affects the formation of fruits, flowers, and seeds. Praba *et al.* (2018) suggested that the application of micronutrients through the leaves can increase the production of the number of grains per clump, the percentage of grain content, and the weight of 1000 grains.

Micro compound fertilizer showed no significant effect on pH KCl, pH H_2O, respiration, and total microorganism population. This is because micro nutrients are given to increase the growth and yield of crop production. In addition, the application of micro fertilisers through the leaves is quickly absorbed and used by plants in the process of preparing enzymes and proteins for plant growth so that the nutrient supply does not reach the roots.

CONCLUSION

Based on the results of the study can be concluded as follows :

Administration of humic acid 8 L ha^{-1} was able to increase the population of microorganisms by 941.16 CFU g^{-1} and 16 L ha^{-1} was able to increase the population of microorganisms by1078.00 CFU g^{-1}. The application of compound microfertilizer 70 g ha $^{-1}$ was able to increase the yield weight per plot of upland rice by 3336.85 g $plot^{-1}$.

References

Afandi, F., Siswanto, B. & Nuraini, Y. (2015). Pengaruh pemberian berbagai jenis bahan organik terhadap sifat kimia tanah pada pertumbuhan dan produksi tanaman ubi jalar di Entisol Ngrangkah Pawon, Kediri. *Jurnal Tanah dan Sumberdaya Lahan*, 2(2), 237-244.

Asmara, A., Atmaja, I.W.D., Suwastika, A.A.N.G & Kusumadewi, A.A.I. (2021). Pengaruh ukuran biochar bambu dan dosis pupuk Urea terhadap efisiensi pupuk dan hasil tanaman sawi hijau (*Brassica juncea* L.) pada Tanah Berpasir. *AGROTROP*, 11(2), 157-166. DOI: https://doi.org/10.24843/AJoAS.2021.v11.i02.p05.

Bertham, Y. H., Nusantara A.D., Murcitro, B.G. & Arifin, Z. (2020). Increased adaptability and growth of several varieties of upland rice through inoculation of biofertilizers and biocomposites in coastal areas. *Agrin,* 24(2), 185-194. DOI : 10.20884/1.agrin.2020.24.2.503

Bertham, Y. H., Nusantara, A.D. & Sukisno. (2016). Socialization and assistance of chili cultivation Biological Technology package in a coastal area of Bengkulu. *Dharma Raflesia UNIB*, 14 (2), 155-165. DOI: 10.33369/dr.v14i2.4309 .

Fadhli, R. 2021. Changes in the chemical properties of rice soil in Bener Meriah district by giving *Tithonia* compost and rice straw. *Journal of Real Research,* 3(1), 61-68.

Fauziah, F., Wulansari, R. & Rezamela, E. (2018). Pengaruh pemberian pupuk mikro Zn dan Cu serta pupuk tanah terhadap perkembangan *Empoasca sp*. pada areal tanaman teh. *Jurnal Agricultura*, 29(1), 26-34. DOI : https://doi.org/10.24198/agrikultura. v29i1.16923.

Heil, C. A. (2005). Effect of humic, fulvic, and hydrophilic acids on the growth, photosynthesis, and respiration of the dinoflagellate prorocentrum minimum (Pavillard) Schiller. *Harmful Algae*, 4, 603-618.

Hermanto, D., Dharmayani, N.K., Kurnianingsih, R. & Kamali, S. (2013). The effect of humic acid as a fertilizer complement the availability and uptake of nutrients in corn crops in dryland-District. Bayan-NTB.*Agricultural Science,* 16 (2), 28-41.

Husin, L., Manurung, G. & Khoiri, M. (2014).The use of compost and micro fertilizer in Palm Oil seeding (*Elaeis guineensis* J.) in peat medium. *Let Faperta*, 1(2), 1-9.

Idawanni & Ferayanti, F. (2021). Characteristics of growth and yield of three superior varieties of upland rice on dry land in Pidie Jaya Regency. *Journal of Research*, 8(1), 1-9.

Janket, A., Vorasoot, N., Kesmala, T. & Jogloy, S. (2018). The effect of zinc,copper, and manganese on dry matter yield and physiological traits of three cassava genotypes grown on soil micronutrient deficiencies. *Pakistan Journal of Botany,* 50(5), 1719-1725.

Kurniawan, F. (2020). Agronomiccharacter and production of cassava (*Manihot esculenta* C.) due to micronutrient fertilization. *Journal of Kelitbangan*, 8(1), 29-38.

Kurniawati, N. & Priyadi. (2021). Effect of fly ash and cow manure fertilizer application on microorganismpopulation in ultisol soil. *Agriprima*, *Journal ofApplied Agricultural Sciences*, 5 (1), 41–49. DOI: *10.25047/agriprima.v5i1.406*.

Lasabuda, R. (2013). Development of coastal and marine areas in the perspective of the archipelago of the Republic of Indonesia. *Platax Scientific Journal*, 1(2), 92-101. DOI: *10.35800/jip.1.2.2013.1251*.

Mandie, V., Simic, A. & Bijelic. (2015). Effect of foliar fertilization on soybean grain yield. *Husbandry Biotechnology*, 31(1), 1-12.

Minda, W., Sasson, P., Khasanah, U. & Pujiono. (2018). Rationalization of the role of biochar and Humate on soil Physico-chemical characteristics. *Journal of Folium*, 1(2), 34 – 42.

Nazirah, L. & Damanik, B.S.J. (2015). Growth and yield of three varieties of upland rice on fertilization treatment. *Journal of Floratek*, 10, 54-60

Nikiyuluw, V., Soplanit, R. & Siregar, A. (2018). The efficiency of giving water and compost to NPK mineralizationon regosol soil. *Journal of Agricultural Cultivation*, 14(2), 105-112. DOI: *https://doi.org/10.30598/jbdp. 2018. 14.2.105*.

Nusantara, A. D., Bertham, Y.H., Junedi, A., H. Pujiwati, H. & Hartal. (2019). Pemanfaatan mikroba untuk meningkatkan pertumbuhan dan hasil kedelai di tanah pesisir. *Jurnal Ilmu-Ilmu Pertanian Indonesia*, *21*(1), 37–43. DOI: https://*doi.org/10.31186/jipi.21.1.37-43*.

Nusantara, A. D., Bertham, Y.H. & Mansur, I. (2012). Works with arbuscular mycorrhizal fungi. *Seamer Biotrop*. Bogor.

Praba, H., Harjoko, D. & Jonah, A. (2018). Micro and complete nutrient application through leaves in some Chinese hybrid rice varieties. *Journal of Agrosains*, 20(1), 7 – 12.

Priyadi, N., Kurniawati. & Nugroho, P.A. (2018). Aktivitas biologi tanah yang berasal dari perkebunan karet pada berbagai kondisi Kelengasan . *Journal of Enviscience*. 2(1), 10-15.

Purbalisa, W., Zulaehah, I., Paputri, D. & Revelation, S. (2020). Dynamics of carbonand microbes in soil treatment biochar compost plus. *Journal of Precipitation*. 17(2), 138-143.

Romlan, R.., Laia, V. & Nainggolan, T. (2021). The effect of potassium fertilizer and iron (Fe) micronutrientelements on the growth and production of peanuts. *Journal of Agrotechnics*, 5 (1), 68-82.

Rozen, Nalwida, Hakim, N. & Gusnidar. (2007). Application of microelements in rice paddy intensification given tithonia plus organic fertilizer on SRI method. *Journal of Solum,* 14 (1), 1-12.

Ruhaimah, R., Asmar, A. & Harianti, M. (2009). The residual effect of humic acid from rice straw composting process and water management in reducing iron toxicity (Fe) of new opening Paddy soil to rice production. *Journal of Solum*, 6(1) , 1-13.

Sanda, N. & Sham, N. (2018). The effectiveness of vermicompost organicfertilizer and liquid organic fertilizer on the growth and production of tomato plants (*Lycopersicum esculantum* M.). *Journal of Agrotek,* 2(1), 16-27.

Santi, L. (2016). The effect of humic acid on the growth of cocoa seedlings (*Theobroma cacao*) and the populationof microorganisms in the soil humic dystrudept. *Journal of Soil and Climate*, 40(2), 87-94.

Septanti, K. S., & Saptana. (2019). Potential utilization of local wisdom to withstand the conversion of rice fields to moonshine. *Agro Economic Research Forum,* 37(1), 59-75.

Shaaban, S. H. A., Manal, F.M. & .Afifi, M.H.M . (2009). Humic acid foliar application to minimize soil applied fertilization on surface-irrigated wheat. *World Journal of Agric Sci.*, 5(2), 207-2010.

Subowo, G. (2010). Strategy for the efficient use of organic materials for soil fertility and productivity through the empowerment of soil biological resources. *Journal of Land Resources* 4 (1), 13-25.

Suwardi & Wijaya, H. (2013). Increased production of food crops with the active ingredient humic acid with zeolite as a carrier. *Indonesian Journal of Agricultural Science*, 18(2), 79-84.

Tangapo, A., Astuti, D.I. & Aditiawati, P.. (2018). The Dynamics and diversity of cultivable rhizospheric and endophyticbacteria during the growth stages of cilembu sweet potato (*Ipomoea batatas* L.). *Agriculture and Natural Resources*, 52(4), 1-21.

Wang, Y, He, Y., Zhang, H. & .Zhou. C.L.D. (2008). Phosphate mobilization by citric, tartaric, and oxalic acids in a clay loam ultisol. *Soil Sci. Soc. Am. J.,* 72, 1263-126.

Widayat, D., Umiyati, U. & Riswandi, D. (2020). Effect of micro compound fertilizer on rubber plant breeding(*Hevea brasiliensis* L) on soil inception Jatinangor. *Journal of Agroswagati,* 8 (1), 16-20.

Winarso, S., Handayanto, E., Shaykhfani. & D. Sulistyanto. (2009). The effect of humic compounds on the activity of aluminum and phosphate typic Plaeudult Kentrong Banteng. *Agrivita*, 31(3), 214-222 .

Yulianti, T. (2010). Distribution of soil microbial population in BPTP Nai Bonet (NTT) in various planting patterns. pp: 277-282