

RESEARCH ARTICLE

THE DYNAMICS OF PH, EC AND REDOX OF POND SOIL AFTER APPLICATION OF HUMIC ACID.

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Abstract

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Key words:- Agent, Humic Acid, Ph,Pond Soil.

One role of humic acid is a buffer agent to control the stability of the soil reaction. A field experiment with the applications of humic acid with doses 0 and 6 kg/ha of shrimp pond soil are added 2 weeks before seed stocking. Seedsare stocked with a density of 1000 fries per hectare. The experimental results indicate that administration of humic acids alter the pH, EC, and Redox of soil and water. Average of water pH value before and after experiment each are 7.51 and 7.16. Soil pH, EC and redox values before and after the administration of humate each are 7.51 and 7.48, -22.83 and -5.00, and 129.67 and 63.33 ppm. Average shrimp weight of 2 months 10 days old is 16.46 with a range of 14.8 - 18.9 g or equivalent of size 50-60. These conditions are suitable for fish or shrimp.

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Introduction:-

Pond soil fertility decline is caused by the cultivation waste, seawater intrusion, and management fault. Pond soil fertility need to be improved to stabilize the pH, content, potential redox, salinity, c-organic, and porosity, so that the production of fish/shrimp is also increased.

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The dynamics of these characteristics will affect the quality of the pond. The quality and quantity of buffer determine the success of pond improvement, in addition to soil character and good management through soil reversal, drying, Addition of fertilization will ensure the growth of flora and fauna (plankton). Drying will neutralize excess metals (Fe^{3+,} Al⁺³) and organic materials from prior cultivation waste. Application of buffer will stabilized soil reaction until certain pH. Washing also requires a high cost and can't work properly without a good drainage system. The provision of good quality water is absolutely necessary, with the pH characteristics of 7.5-8.0, and EC of 0.3-0.9 mS/cm. This condition can be achieved by the replacement of water through irrigation from riverand aerator administration once every two weeks.

Humic Acid (HA) generated from the biodegradation of dead organic matter, is a complex mixture of different acids containing carboxyl and phenolic groups so that it functionally behaves as a dibasic acid or sometimes as tribasic acid. Humic acid pK1 value of about 4 is used to protonation of carboxyl groups and approximately 8 to

Corresponding Author:- Munawar Ali. Address:- Department of Environment, Faculty of Civil and Environmental Engineering, Universitas Pembangunan Nasional "Veteran" East Java, Indonesia. protonation phenolic groups. Humic acid can form complexes with ions creating humic colloids. Typical humic substances that has aromatic core with phenolic pattern and carboxylate substituents are linked together. Another important characteristic is the charge density. The presence of the carboxylic and phenolic groups give HA abilities to form complexes with ions such as Mg2+, Ca2+, Fe2+ and Fe³⁺.

Each type of pond soil has different characteristics compared to each other. Humic Acid application of 0- $400 \text{ ml} / 0.12\text{m}^2$ (100 ml = 880mg/kg of soil) in one month of incubation has changed pH, cations, and pond soil structures varied among the samples. Pond soil with pH of approximately 9 (Soil 1) need up to 6 g/kg dose of humic acid. Humic acid characteristics of used compost are 60-156 me/100g of CEC, 20-30% C-organic, pH of approximately 6.0, brownish black color, and slow dissolve in water (Ali and Mindari, 2015). HA application dose up to 400 ml/0.12 m² actually decrease soil pH, ion exchange, and bulk density. This study difference with previous ones are determined by HA source, soil texture, and added nutrition. Doses range of HA used are 1-4 g/kg (Khaled and Wafy, 2011) and2 g/kg (Turan et al, 2011; Celik et al, 2011). The addition of K⁺ in HA increase the proportion of K in colloid so that the cation balance directed to the increasing ratio of K/Na and K/Mg (Goudarzi and Pakniyat, 2008). In conjunction with the release of H⁺-HA, mono cation solubility and adsorption in humic acid is causing a separation of particles or easily mixing particles that add macro and micro pore spacesin soil. Changes in soil porosity affects the flow of water, air and nutrients fixing pond soil fertility structure.

The objective of this study were to assess the potential of humic acid (organomineral buffer) in effectively controlling pond soil fertility indicated by volume weight change, density, porosity, soil pH, and redox potential. Humic acid can provide oxygen, hydrogen and carbon that is sufficient for the development of micro and macro soil fauna.

Materials and Methods:-

The research is conducted in the pondsbelong to village farmers in Kalanganyar, Sedati, Sidoarjo, from August to November 2016. The land is located at a height of 0-5 meters above sea level with slope of 0-2%. Suitabilityclass of the pond is considered S2 with the main indicators that must be addressed are the soil pH, salinity, and C-organic content. The study arranged according to RAL with humic acid doses of 0 and 6 kg/ha. Indicators of growth and production of ponds are shrimp, while health the indicatorsarechanges of 1) Physical characteristics (soil structure), 2) Soil Chemical characteristics (pH, EC, Redox), 3) Biological characteristics includingweight of shrimp.

The second phase is the application of humate to pond soil. Humate is prepared by compost extraction with 0.1 N NaOH in a ratio of 1:10 for 24 hours of intermittent stirring. After stirring, humate is filtered and liquids are separated by adding sulfuric acid to a pH of 2. Humic acid is applied when ponds dried and 2-4 weeks before sowing the seed batches intended toneutralize acidity / alkalinity (pH, EC), redox potential (Eh, assess the solubility of elements), chelate Fe, and loosen soil structure. If the pH is low (<5) then there is a need to improve the humic acid to a pH of 7-8 and vice versa if the pH is high (>9) then the soil pH needs to be lowered using humic acid to 7-8. Ca saturation needs to be adjusted until they reached approximately 60%. Soil samples were collected after 2 weeks of application of humate and after shrimp harvest. Sampling was performed on 5 points of each plot, taken by drilling soil wereused to chemical and physical analysis. Soil observation parameters include: 1) The pond chemical and water characteristicscomprise: redox, pH, EC, 2) Physical characteristics of soil including bulk density. 3) Biological characteristics includingshrimp weight, length and size.

Data were analyzed with multiple linear method to determine the determinants of soil chemical characteristics of the results shrimp.

Results and Discussion:-

Soil samples were taken at a depth of 0-20cm both intact and disturbed ground. Soil samples were dried at room temperature. Results of analysis of soil physical and chemical characteristics of the pond are more detailed in the next section. Soil subsamples were weighed 100 g and then placed into a plastic bottle and added 200 ml of water. A mixture of soil and water is shaken to form a soil paste in approximately 30 minutes. The device pH meter was immersed in the soil paste and the numbers shown on the device are noted. Soil characteristic measurement data is shown in Table 1.

#of sample	Soil Weight	Ring	Solids	BV	BJ	Porosity	Soil pH
_	_	Volume	Volume			-	-
1	86.41	89.02	32.87	0.97	2.63	0.37	7.2
2	97.69	89.02	35.60	1.10	2.74	0.40	7.3
3	85.20	89.02	35.20	0.96	2.42	0.40	7.2
4	99.10	89.02	36.10	1.11	2.75	0.41	7.2
5	95.10	89.02	35.70	1.07	2.66	0.40	7.2
Amount	463.50	445.10	175.47	5.21	13.20	1.97	
Average	92.70	89.02	35.09	1.04	2.64	0.39	

Table 1:-Analysis BV and BJ and the pH of the soil embankment

The average weight of pond soil volume = m/v = 92.7 / 117.29 = 0.79,

where m = weight of soil = 86.41 and V = total volume = area x height = π r2 xt = (22/7) x 2.5² x 6 = 117.29.

The soil pH of Pond slightly lower than pH suitability for cultivation because of of sewage sludge ponds previous. The order of pond soil micro nutrients after 5 weeks of humate application are Fe > Zn > Mn > Mo > Pb > Cd, while content of macro cation were Ca > Mg > K > NH4 > Na (Ali, and Mindari, 2015). The excess of Fe can be decreased by land oxidation other than using humate, so that the Fe is oxidized to become Fero. The higher of HA addition, it will further lower its alkaline content. According to Davis et al. (2004), the most important saline ions are Ca, Mg and K, not Na which is similar to what plant needed. The change of pond soil cationdepended on soil buffer. The addition of humate would exchange reactions between H to Na+, Ca+2, or Fe caused soil salinity reduced. The decrease of Na is due to K+ replacing them on the surface colloidal adsorption so that the proportion of K increases. Because of the three ions have same valences, they are determined by the ability to exchange cations affinity (Tan, 2003). Anion=anioon (H2PO-) wereadsorbed by the positive charge of HA will eventually be released into the soil solution if needed by plants or biota. Humic pH adjusted to 5 by the addition of KOH, forms K+ humate, which is easier to adsorb by colloids than NH4+ ion (Nursyamsi et al, 2009). The addition of an ion will exchange other ions in the same amount. The higher the dose of humic acid, causing a higher CEC value, because cations will increase on the mineral surface and between the minerals. Colloids not only absorbed ions, but also water, so the water reserves increased. HA absorb more of the absorbent used today (Pena-Méndez et al, 2005). Along with the release of humate H+ to the solution and the adsorption of mono cations and by the humic acid, causing the incorporation of loose particles or easing of solid particles adding soil pore space. Changes in soil porosity affect the flow of water and soil nutrients. Overall, the trend of changes in soil volume weight decreases with the increasing application of humic acid. Soil pond 1 is more response to administration of humic acid than other soil samples allegedly because ofstructure fault that need more repairs.

Application of humate 6 kg/hachanges the chemical characteristics of soil and water as shown in Table 2.

No.	pHair1	pHair2	pHtnh1	pHtnh2	Redoks1	Redoks2	EC1	EC2	shrimp weight
1	7:53	6.97	7:49	7:47	-42	-6	64 0	126	18.9
2	7.67	7:12	7.5	7:47	-19	-5	78 0	142	14.8
3	7:57	7:33	7:51	7:48	-27	-3	53 0	127	15:59
4	7.3	7:01	7:51	7:47	-19	-6	58 0	125	14:59
5	7.4	7.2	7.5	7:45	-14	-6	59 0	132	17.68
6	7:58	7.3	7:52	7:52	-16	-4	68 0	126	17.2

Table 2:- Chemical characteristics changes of ponds from application of humic acid and its effects on the growth of shrimp.

They affect Na and K exchange in real time, but does not significantly affect the Ca and Mg exchange. Although the HA dosage and type mostly only affect soil cations, but they are interacting with other cations. Soil macro cations is relatively higher than micro except Fe. Higher doses of HA reduce the content of Na, K, Ca, Mg, NH4, Mn, Mo, Zn, Pb and Cd. The Fe content of the pond soil is still not statistically significant. The Fe content is almost the same as the content of Ca, allagedly because Fe chelate may occur where a carboxyl functional group formed slightly more H2PO4-Fe-R. Dosage of HA and NPK up to 400 ml/0.12 m2 administered over 4 weeks after incubation lowered K, Na, Ca and Mg soil exchange. This condition is similar to that obtained by Çelik et al. (2010), Paksoy et al. (2010), Khaled and Fawy (2011) and Turan et al. (2011), where their application lowered salinity detected in Na decline.

The order of micro nutrient content of the pond soil for 4 weeks HA application is Fe> Zn> Mn> Mo> Pb> Cd as shown in Figure 13. Excess Fe can be reduced by oxidation through processing and liming, or with humate, so that the feo2 is oxidized or chelated to available form of R-Fe-OH. Humic acid has functional carboxylic and phenolic groups highly capable to neutralize the excess acid or alkaline because they are amphoteric. Carboxylic group is acidic, so the release of humate H+ will neutralize the pond's excess OH affecting the soil ph.

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