Effect of Zeolite and Manure Against Some Physical Properties of Soil Ultisols and Entisols on Planting Soybean (*Glycine Max* L. Merrill)

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ABSTRACT

Utilizing Ultisols and Entisols to increase of the production of soy bean requires the improvement of the soil quality, such as by adding zeolite and manure. The aim of the research was to Determine the effects of zeolite and manure on soil physical properties of Entisols and Ultisols, and to examine the growth and production of soybean. The treatment consisted of three factors (soil, zeolite, and manure), ie, two types of soil (Ultisols and Entisols), 3 phases of zeolite doses (0 tons / ha, 2 tons / ha, 4 tons / ha), and 3 phases of cow manure doses (0 tons / ha, 20 tons / ha, 30 tons / ha). The experiment was designed using a randomized block and each treatment was repeated for three times that resulted in 54 experimental units. Variables observed included physical soil properties, the growth and soybean production. The results Showed that: 1) increasing doses of zeolite up to 4 tons / ha and manure up to 30 tons / ha had no effect on the bulk density, particle density, soil porosity of Ultisols and Entisols, sticky limit, roll limit, and the boundary changed the color. However, increasing doses of zeolite was Able to Increase the value of liquid limit and increasing doses of manure could reduce the plasticity index, and 2) zeolite Independently was not influential in promoting growth and crop production, while increasing the doses of manure could increase of pod fresh weight, dry weight and number of pods of soybean pods.

Key words: zelite, manure, soil, soybean

INTRODUCTION

Ultisol in Indonesia has a distribution which covers 45.794 million ha, or about 25% of the total land area of Indonesia (Subagyo et *al*. 2004 in Prasetyo and Suriadikarta, 2006). Ultisols included in marginal soils and is generally not handled properly. Utilization of the land faces a number of constraints on the physical and chemical properties of soil. The physical properties of the soil are generally ugly, that has a very low permeability soil, poor drainage, the macro pore spaces so small that very low soil aeration. Ultisols nature generally ugly and less support for the development of agriculture as bad aeration, which is less stable aggregate stability, infiltration and permeability slow and hold the power (water holding capacity) is low.

Constraints on the chemical nature Ultisols is the reaction of acid soils, the Commission is low, kekahatan macro nutrients N, P, K, S, Ca and Mg, kekahatan of micronutrients Zn, Cu, B and Mo, low base saturation, and saturation Aluminum highly high and poison plants. In most plants, the effect of excess Aluminum mainly on root growth. The first visible symptom of excess aluminum among others shortened and narrowed root, root brown with branch number decreased (Russell, 1988).

Additionally reportedly swollen roots, stunted growth and even can suffer serious damage. In plant tissue concentrations of Al is high (Al^{3+}) will affect the metabolism of phosphate by forming a complex compound of the Al-phosphate which is relatively stable (Matsumoto and Morimura, 1980 in Uexküll, 1986) as well as affect the activity of enzymes

phosphokinase and ATPase (Mengel and Kirkby, 1987). According Radjagukguk (1983) each plant has a critical value of the saturation of aluminum, but until now the critical value of the saturation of the aluminum plant is still very limited.

Entisols is a land that little or no profile development (without pedogenik process) as a result of short-time formation. Entisols is mineral soil that does not have horizons that characterize pedogenik. This land is dominated by sand so weak aggregate stability. The texture and organic matter content is determined by the deposition source material. Entisol have physical and chemical properties that are less good for plant growth. This land is generally textured sand so loose structure, aeration porosity and permeability big quick so poor water holding capacity.

In Entisols nutrient content depends on the parent material. Elements of P and K in the soil which is still in a fresh state can not be absorbed by the plant would cause the plant can not produce optimally and also experienced kekukarangan Entisol nutrient N. N nutrient content because the content of the sand lost a lot dominant causing pelindihan , Entisols aerasinya having a nice sandy texture that will cause the oxidation of organic material increases. Therefore, it needs to be improved physical and chemical properties Entisols land to be used for farming business, such as by the zeolite and the addition of organic matter.

Zeolites are a group of compounds of various types of alumino silicate mineral hydrated cations mainly alkali and alkaline earth metals. Zeolite has the function, among others restore the lost soil nutrients, storing and binding nutrients, loosening the soil, improves aeration soil, fertilizer saving, absorb heavy metals (Usman, 2009).

Manure is an organic fertilizer that is very useful in agriculture. Organic fertilizer is fertilizer derived from a variety of organic materials, both of garbage (waste) or the rest of the vegetation and the activity of animals (livestock). The organic material is one pembenah ground. According Gratitude (2005), the role of organic matter to improve soil physical fertility, including reducing plasticity, viscosity and improve soil aeration. Simatupang (2005) says that the manure role in improving soil properties, especially the soil structure so as to increase the permeability of the soil.

Demolon and Henin (1932) in Baver (1972) states that the colloidal organic materials are more effective than clay as the cause of the formation of a stable aggregate with sand. According Mowidu (2001) in Jamie (2011), giving 20 tons / ha to 30 tonnes / ha of organic matter significantly in increasing the total porosity, the number of pores is useful, the amount of pore storage moisture and steadiness of the aggregate as well as lowering the density of the particles, the density of lumps and permeability , Low and Piper (1973) in Sugito et al. (1995) state manure as much as 75 tonnes / ha per year for 6 consecutive years may increase 4% porosity of the soil, the air volume of 14.5% of land in the state of field capacity and 33.3% of organic material and lower soil density as much as 3%.

Problems in the use of materials that will be able to repair the properties of the soil (soil ameliorant material) and increase the production of a plant is the selection of the type and exact determination of the amount of material. Provision of soil types ameliorant done by selecting the

source material that is relatively easy to obtain, for example, zeolites and manure.

Based on the above, the objectives of this study are:

1. Knowing the influence of zeolite and manure on some physical properties of soil Entisols and Ultisols
2. Knowing the influence of zeolite and manure on the growth and production of soybean crops in the ground Entisols and Ultisols.

RESEARCH METHODS

The study was conducted by field trials polybags at the Faculty of Agriculture UnSoed. Analysis of soil samples carried out in the Laboratory of Soil Science, Faculty of Agriculture, University of General Sudirman. The research was conducted in November 2010 until April 2011.

Materials used in the research are two types of land, that Ultisols of Mount Tugel Banyumas and Entisols of Pegalongan Banyumas, zeolite, manure and soybean seeds as an indicator plant. Equipment used in the study include scale, sieve, spray equipment, laboratory equipment (pH meter, porcelain dish, Casagrande, a spray bottle, dab, wooden boards, scales electrical and supporting equipment), glassware (pipettes, beakers, etc. etc.), as well as stationery.

The treatment in the experiment consists of three factors: soil type, zeolite and fertilizers cages, each two (2) types of soil (T1: Ultisols and T2: Entisols), three (3) the standard dose of zeolite (Z0: 0 ton / ha, Z1: 2 tons / ha, and Z2: 4 tons / ha), and three (3) dose level of cow manure (P0: 0 ton / ha, P1: 20 tons / ha, and P2: 30 tons / ha). The experiment was designed using a randomized block design (RAK). Each combination treatment was repeated three times, in order to obtain 54 experimental units.

Variables observed variable soil physical properties, ie density content (BJI), density of particles (BJP), porosity, liquid limit (BC), the limit of adhesion (BL), boundary breakers (BG), boundary changes color (BBW) , the maximum water supply (PAM), though the term (JO), plasticity index (IP), and variable growth and yield in terms of height, weight of wet pods, pod dry weight and number of pods.

Data were analyzed using the F test (Fisher), if significantly different then continued by Duncan Multiple Range Test (DMRT) with a confidence level of 95% ($\alpha = 5\%$).

RESULTS AND DISCUSSION

1. Effect of Zeolite and Manure Treatment Against Variable Land

Results of analysis of variance effect of the zeolite and manure to the soil physical properties of some of the variables are presented in Table 1. Table 1, zeolite and manure treatment has no effect on BJI, BJP and porosity of the soil. This ni allegedly addition of zeolite and manure has not been able to loosen the soil or ground conditions have not been able to make more nests. In this case the comparison between future land with a unit volume of soil does not change much with the addition zeolite and manure. Sarief (1989) states the contents of the soil density was influenced by tillage, organic matter, compaction by agricultural tools, texture, structure and soil water content.

Table 1. Results of analysis of variance some physical properties of soil by treating the zeolite and manure

Name variable	Effect independe			interaction effect			
	Z	P	T	Z + P	P + T	Z + T	Z + P + T
BJI	tn	tn	tn	tn	tn	tn	tn
BJP	tn	tn	tn	tn	tn	tn	tn
Porosity	tn	tn	tn	tn	tn	tn	tn
BC	**sn**	tn	**sn**	tn	tn	tn	**n**
BL	tn	tn	**sn**	tn	tn	tn	tn
BG	tn	tn	**sn**	tn	tn	**n**	tn
BBW	**n**	tn	**sn**	tn	tn	tn	tn

Description: BJI: heavy types of contents, BJP: density of particles, BC: liquid limit, BL: limit of adhesion, BG: limit rolls, BBW: boundary changes color, Z: Zeolite, P: manure, T: land, tn: unreal, n: real, sn: a very real

According to Wijaya (2009) in Irvan (2010), one of the factors that affect BJI, the BJP and the porosity of the soil is soil texture. The soil texture is one of the characteristics of the soil that is not easily changed by the agronomic treatment, so that the performance of zeolite and manure are not able to change significantly towards BJI, BJP and porosity.

Less stable soil structure and low content of organic matter in the soil can affect the value of BJI, BJP and porosity of the soil. Less stable structure can be easily dispersed result in soil that can clog the soil pores and cause soil becomes denser and add weight or time period ground so with increasing land value BJI becomes higher and reduced pore space. Hardjowigeno (2002) mentions BJI an indication of soil density. The more dense a higher ground BJI, which means more and more difficult to pass on the water.

Based on Table 1, it appears that the liquid limit (BC) is influenced by the interaction between the zeolite, manure and soil types. Zeolites and manure does not affect the adhesion limit (BL), but the BL is affected by soil type. Limit rolls (BG) is influenced by the interaction between the zeolite and the type of soil. Boundary changes color (BBW) is influenced both by the zeolite and the type of soil. This indicates that the zeolites are generally able to increase the ability of soil to absorb water. Estiaty (2001) stated that the mineral zeolite, a mineral that is special because it is very unique crystal structure that has the properties as an absorber, a separator and a catalyst.

BC Ultisols value higher than the value of BC on the ground Entisols (Table 2). In Ultisols, giving zeolite with a dose of 2 tons / ha turns its BC value is much higher, at 70.18% compared to the soil Entisols, ranging from 47.04% to 48.46%. In general, the BC Ultisols higher than the value of the land Entisols BC.

Giving zeolite was able to increase the value of BC (Table 3). Based on Table 3, the provision of zeolite 2 tonnes / ha can increase the value of BC land, significantly different from the controls but the administration of 2 tons / ha zeolite is not significantly different from the provision of 4 tons / ha. This means that the provision of zeolite 2 tons / ha have been able to donate the amount of water that can be sequestered in the soil of approximately 3.21%.

Corrector ground zeolite containing alkali and alkaline earth cations one of which is Ca2 + can stabilize soil aggregates. According Estiaty (2011), the addition of zeolite to the growing media will increase the number of bases K, Na, Ca and Mg and increase soil CEC, despite the growing medium has been used by the plants during their growing years. Besides zeolite contains elements of macro and micro nutrients, can improve soil aggregation thereby increasing the air pores ground.

Table 2. Effect of zeolite and manure to the liquid limit (BC) Ultisols and Entisols

No.	Treatment	BC (%)	
1	T1Z0P0	64.98	e
2	T1Z0P1	66.12	ef
3	T1Z0P2	67.12	ef
4	T1Z1P0	70.18	f
5	T1Z1P1	68.71	ef
6	T1Z1P2	65.48	ef
7	T1Z2P0	67.51	ef
8	T1Z2P1	65.69	ef
9	T1Z2P2	68.64	ef
10	T2Z0P0	40.62	a
11	T2Z0P1	46.14	bcd
12	T2Z0P2	42.80	a B C
13	T2Z1P0	48.46	d
14	T2Z1P1	47.04	CD
15	T2Z1P2	47.13	CD
16	T2Z2P0	48.32	d
17	T2Z2P1	47.43	d
18	T2Z2P2	42.30	ab

Description: T1: Ultisols, T2: ground Entisols, Z0: without zeolite, Z1: 2 tons / ha zeolite and Z2: 4 tons / ha zeolite, P0: without manure, P: 20 ton / ha manure, P2: 30 tons / ha of manure. Figures followed by the same letter are not significantly different.

Table 3. Effect of zeolite dose independent of the BC

No.	Treatment	Zeolite dose (tonnes / ha)	BC (%)	
1	Z0	0	54.63	b
2	Z1	2	57.84	a
3	Z2	4	56.65	a

Description: Z0: without zeolite, Z1: 2 tons / ha zeolite and Z2: 4 tons / ha zeolite. Figures followed by the same letter are not significantly different.

According Mumpton (1983) in Nurhayati et al. (2006), the zeolite is a material that can improve the soil stabilizing reaction on acid soils and improve the physical properties of soil, improve water holding capabilities and can hold nutrients and release it slowly.

Zeolite also affects the roll limit (BG), both on land and soil Ultisols Entisols. Based on Table 4, administration of 2 tons / ha been able to increase both the value BG Ultisols and Entisols ground, but the provision of 2 tons / ha zeolite does not differ with the provision of 4 tons / ha zeolite. Effect of zeolite against BG influenced by soil type.

Table 4. Effect of zeolite to limit roll (BG) on Ultisols and Entisols

No.	Treatment	BG (%)	
1	T1Z0	22.23	b
2	T1Z1	31.17	d
3	T1Z2	32.78	d
4	T2Z0	15.75	a
5	T2Z1	27.25	c
6	T2Z2	25.79	bc

Description: T1: Ultisols, T2: Entisols land, Z0: without zeolite, Z1: 2 tons / ha zeolite and Z2: 4 tons / ha zeolite. Figures followed by the same letter are not significantly different.

Related to BBW, it kind of soil has a dominant influence. In Ultisols with high clay content more able to absorb water compared to the more coarse-textured soils. Likewise with zeolite treatment, although the administration of 2 tons / ha to 4 tons / ha is not significantly different, but the provision of a zeolite can improve the water sorption BBW status (Table 5). This means that the provision of zeolite 2 tons / ha is already quite capable of contributing role in increasing the water content in the soil limits the lowest water can still be absorbed by plants.

Table 5. Zeolite independent influence on BBW

No.	Treatment	Dose (Ton / ha)	BBW (%)
1	Z0	0	13.32 b
2	Z1	2	19.04 a
3	Z2	4	17.20 a

Description: Z0: without zeolite, Z1: 2 tons / ha zeolite and Z2: 4 tons / ha zeolite. Figures followed by the same letter are not significantly different.

2. Effect of zeolite and manure treatment against maximum water supply (PAM), the plasticity index (IP), and if the term (JO) at Ultisols and Entisols

The maximum water supply (PAM), the plasticity index (IP), and if the term (JO) is determined by the type of soil (Table 6). Zeolite does not affect PAM, IP and JO, but manure affect the IP.

Table 6. Results of analysis of variance influence of zeolite and manure treatment to PAM, IP and JO

Name variable	Effect independe			interaction effect			
	Z	P	T	Z + P	P + T	Z + T	Z + P + T
PAM	tn	tn	**sn**	tn	tn	tn	tn
IP	tn	**n**	**sn**	tn	tn	tn	tn
JO	tn	tn	**sn**	tn	tn	tn	tn

Description: Z: Zeolite, P: manure, T: land, tn: unreal, n: real, sn: a very real

PAM is a clue the amount of water available in the soil. Hardjowigeno (2002) suggests differences in water content in the flow limit (BC) with a water content in the boundary change color (BBW) is the amount of water available to plants. The heavier a land, then PAM will be higher. The results showed that PAM Ultisols amounted to 47.36% and PAM for soil Entisols of 32.31%.

Hardjowigeno (2002) states that of clay soils generally have a high plasticity index while sandy soils have a low plasticity index. The results showed that the IP Ultisols (34.34%) was higher than the ground IP Entisol (21.29%). Sutedjo (1991) reported that high soil moisture content, soil moisture and high viscosity value means the land flowing, thickens, and dropped slowly into a sticky, tough and soft.

Based on Table 7, IP decreases with increasing doses of manure. Manure 30 tons / ha can lower soil plasticity index from 31.04% to 24.79%. The organic material is one of the factors that affect the value of the IP land (soil firmness). The results showed that the higher the organic matter then the IP value will decrease. Judge et al. (1986) suggested that soil plasticity decreases due to the decomposition of manure. According Gratitude (2005), organic matter to improve soil physical fertility, reduce the plasticity and stickiness and improve soil aeration.

Table 7. Effect of manure on IP

No.	Treatment	Dose (Ton / ha)	IP (%)
1	P0	0	31.04 a
2	P1	20	27,61ab
3	P2	30	24.79 b

Description: P0: without manure, P1: 20 ton / ha manure, P2: 30 tons / ha of manure. Figures followed by the same letter are not significantly different.

JO is the difference between BL and BG, the higher JO then the processing is done. Hardjowigeno (2002) if the soil with lower term is processed soils more difficult than if the soil with a high term. The results showed that PAM Ultisols amounted to 29.38% and PAM for soil Entisols of 18.31%.

3. Effect of Zeolite and Manure Treatment Of Multiple Variables Plant

Results of analysis of variance effect of the zeolite and manure to plant some variables observed in experiments are presented in Table 8. The results showed that the different types of soil turned out to increasing doses of manure effect on plant height. In Ultisols, plant height is increasing with increasing doses of manure, while on the ground turned out to be the addition of the above Entisols 20 ton / ha of plant height decreases (Table 9).

It is suspected genotype interactions with the environment. Genotype by environment interactions indicated differences in the test responses in different environments (Muhadjir,

1998, in Saraswati et al., (2006). Based on Table 9 is known that the best treatment is Ultisols by manure 30 tons / ha, whereas the soil Entisols manure up to 30 tonnes / ha had no effect on plant height. Gratitude and Istina (2006) states that the real effect of organic fertilizer on plant growth began to look at the dosage 20 ton / ha.

Table 8. F test results influence zeolite and doses of manure on the growth and yield

variable Observation	Effect independent			interaction effect			
	Z	P	T	Z + P	P + T	Z + T	Z + P + T
High plant	tn	**sn**	**sn**	tn	**sn**	tn	tn
Wet weight of pods	tn	**sn**	**sn**	tn	tn	tn	tn
dry weight pod	tn	**sn**	**sn**	tn	tn	tn	tn
total pod	tn	**n**	**sn**	tn	**N**	tn	tn

Description: Z: zeolite dose, P: dose of manure, T: soil type, tn: unreal, n: real, sn: a very real

Table 9. Effect of manure and soil interaction on plant height

Type of soil	dose Fertilizer Cage			Average
	P0	P1	P2	
T1	74,83bcd	102,00a	110,83a	95.89
T2	95,58abc	98,67ab	87,50abc	93.92
Average	85.21	100.34	99.17	

Description: T1: Ultisols, T2: Entisols, P0: without manure, P1: 20 ton / ha manure, P2: 30 tons / ha of manure. Figures followed by the same letter are not significantly different.

Based on the results of variance (Table 8), the treatment of manure independently affect the fresh weight of pods and pod dry weight. Pods wet weight, dry weight of pods and pod number increased with increasing doses of manure (Table 10). The addition of fertilizers cage 20 tons / ha can improve soybean pod wet weight of 44.17 g (control) to 55.61 g (26%) and a dose of 30 tons / ha can increase the wet weight of 44.17 g pods (control) to 66, 83g (52%).

Extra doses of manure at 20 t / ha and 30 ton / ha were able to improve significantly the dry weight of the pods that each of 22,17g (control) to 27.50 g (24 %) And 31.44 g (41.8%). This is because the manure is able to improve the physical properties of soil and provide nutrients needed by plants. Judge et al. (1986) suggest that in addition to add nutrients to the soil also can increase the humus, improving soil structure and encouraging nature of life soil microorganisms.

The best plant uptake will result in higher production compared with that plant uptake low. Fertilization with manure will increase the organic matter. Tisdale et al., (1990) in Umar and Istina (2003) states that the organic material in addition to reduce the reactivity of aluminum also has the ability to separate the phosphorus from aluminum and iron compounds so that phosphorus released.

Table 10. Effect of dose of manure to the wet weight of pods, pod dry weight and number of pods

No.	Dose Manure (Ton /	Wet Weight of Pods (G)	Dry Weight of Pods (G)	number of pods
1	0	44,17c	22,17c	163,39b
2	20	55,61b	27,50b	190,67ab
3	30	66,83a	31,44a	213,17a

Information : Figures followed by the same letter are not different real.

Table 11 shows that the different types of soil will give effect to the pod wet weight, dry weight of pods and pods. Production on the ground Entisols higher than Ultisols. This is because land is a land Entisols derived from fertile materials or materials is then deposited, so that the nutritional content of Entisol higher than Ultisols.

Table 11. The influence of the type of soil on the

wet weight of pods, pod dry weight and number of pods

No.	Type of soil	wet weight pod	dry weight pod	number of pods
1	Ultisols	36,33b	19,52b	132.56 b
2	Entisols	74,74a	34,56a	245.59 a

Description: The figure followed by the same letter are not significantly different.

Effect of increasing doses of manure on the number of pods is determined by differences in soil type. In Ultisols increasing doses of manure can improve significantly on the number of soybean pods. While on the ground Entisols increasing doses of manure does not increase the number of pods, although the number of pods on the ground Entisols higher than the number of pods on Ultisols (Table 12).

Table 12. Interaction manure and soil on the number of pods.

Type Soil	dose Fertilizer Cage			Average
	P0	P1	P2	
T1	46,67a	135,67bc	174,00cd	118.78
T2	255,33f	213,00ef	240,67ef	236.33
Average	151.00	174.34	207.34	

Description: T1: Ultisols, T2: Entisols, P0: without manure, P1: 20 ton / ha manure, P2: 30 tonnes / ha of manure. Figures followed by the same letter are not significantly different.

CONCLUSION

Increasing doses of zeolite to 4 t / ha and manure up to 30 tonnes / ha did not affect the weight of the types of content (BJI), density of particles (BJP), the porosity Ultisols and soil Entisols, the limit of adhesion (BL), boundary breakers (BG), and boundary changes color (BBW), but increasing doses of zeolite able to increase the value of the liquid limit (BC) and increasing doses of manure can lower the plasticity index (IP).

Zeolites independently no effect in promoting growth and crop production, while increasing doses of manure can increase the weight of the wet pod, pod dry weight and the number of soybean pods.

It is suggested that further research needs to be done to increase the dose per hectare in order to obtain the optimum dose to increase soybean production, particularly on marginal soils such as Ultisols.

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