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Response of soybean (G*lycine max* L.) that was applied by various liquid organic fertilizer in climate change at acid soil

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Abstract. Acidic soils are formed from rapid climate change. Acid soils have problems in it, among others; high levels of Al, Fe, and Mn and the unavailability of elements P and N for staple crops. Indonesia imports almost 70% of its domestic requirement. The purpose of this study was to determine the response of soybean plants that were given various types of liquid organic fertilizer (LOF) to climate change in acid soils. Experiments have been carried out in acid soil in the Kuranji area of Padang City. Materials needed include; Mutiara-1 seed. The lime and LOF trials were arranged in a completely randomized design (CRD), with 9 treatments namely; without calcification and without LOF (A); give lime equivalent to 1 x Exchangeable Al and without LOF (Control) (B); Crocober (C); Crocoberma (D); Crocoberderma (E); Titocroco (F); Titocrocoma (G); (H); Trichoderma harzianum (I). The observational data were analyzed statistically by using an F level of 5% significance level if the treatment had a significant effect, it was followed by a LSD test of 5% significance level. Observation parameters include; agronomic, pH soil. Experimental results established that given of dolomite lime can increase soil pH, Titocrocoma LOF accompanied by liming gives the best effect on soybean varieties Mutiara-1 at vegetative stadium, produces 3.45 Mg ha^{-1} forage dry weight equivalent to107,64 kg N ha^{-1} or 618,93 kg ha^{-1} crude protein.

1. Introduction

Climate change has the potential to affect changes in soil chemical properties and the dynamics of food crop growth. The extreme climate will make crop yields decline. moreover to disruption to water availability, the development of pests and diseases. In extreme wet rainy conditions and even very high puddles in a certain planting season, the plants fail to grow, and the same thing happens if the weather is very dry [19] tated that the rainy season in November-March has also shifted. Global climate changed has resulted in projecting to reduce food crop yields [1]. According to [28] continuous climate changed quickly will easily leach all nutrients, especially on dry land. The acid reaction is one of the characteristics of soil that has undergone intensive washing and is classified as sub-optimal land [21]. [4] reported that the rainfall throughout June is included in the Normal category which reaches 240 mm, [10] explained that it is classified in the Oldeman category it is classified as wet because of > 200 mm $month^{-1}$

The acid soil had become the largest agricultural land in Indonesia until now it is used as a development area for agricultural land. Acid soil has various other problems, among others; high levels of Al, Fe, and Mn and unavailability of P and N elements for staple plants. Some of them are

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classified as sub-optimal land, among others; Ultisol, Oxisol, part Inceptisol, Entisol, and Histosol. The soybean plant is a very popular product for the Indonesian people. [23] explained that of all Indonesia's soybean requirements, 70% was imported. Furthermore, he explained that farmers' soybean products were low and could still be improved if there were technological innovations, such as using superior seeds and needed liming and proper fertilization in that cultivation.

[2] has released a new superior variety Mutiara-1, with a potential yield of 4.1 Mg ha^{-1}. Varieties with high yield potential should be tried in West Sumatra on sub-optimal soil or Ultisols. The expectation is that soybean yields can achieve the target and even exceed the target. Therefore, this must be complemented by appropriate technological engineering than the farmer's method.

Currently, how many farmers have complained about the cost of farming costs that are already greater than the results they will reach. Therefore it is necessary to assist farmers by providing adequate understanding and technological innovation so that yields can increase. Lime application is important for soybean cultivation. Besides the application of lime, fertilizer application is also needed for optimal results. The use of *C.odorata* Liquid Organic Fertilizer (LOF) has been evidenced to save up to 50% of artificial fertilizers on various rice, corn, chili, onion, melon, cayenne, watermelon, and strawberry crops [11], [13], [14], [15], [16], but the soybean crops have not been evidenced.

However, LOF production engineering quality must continue to be improved. The enrichment of constituent raw materials is considered to improve these qualities, including the addition of *Tithonia diversifolia (T.diversifolia*), and *Trichoderma sp*. According to [22] the benefits of *Trichoderma sp*; as a bio fungicide are used to inhibit the growth and development of toxic fungi that can raise disease in plants. Therefore, it is necessary to study the effectiveness of these materials mixed together to become a quality LOF so as to increase the resistance of soybean plants in acid soils. The research objective was to determine the responsiveness of soybean plants given various types of LOF to climate change in acid soils.

2. Methods

The experiment was carried out in Belimbing, Lalang Village, Kuranji District, Padang City, in April-July 2020. The materials required include; soybean seed variety Mutiara-1 , *C.odorata, T. diversifolia, Trichoderma sp.* All materials were obtained from the experimental location environment, while Trichoderma sp was obtained from the Laboratory of the Faculty of Agriculture, Tamansiswa University (Unitas) Padang. chemical analysis of N, P, and K nutrients of the plant will be carried out in the Unitas Padang laboratory and in the soil laboratory of the Faculty of Agriculture, Andalas University. The experiment was arranged in a completely randomized design (CRD), consisting of 9 combined treatments of lime and liquid fertilizer. Data generated were subjected to analysis of variance (ANOVA) at $P \leq 0.05$ using SPSS 20 for windows. When significant differences were observed treatment means were separated using the Least Significant Difference (LSD) according to [24]. Various types of liquid organic fertilizers with various ingredients, complete with the composition:

Table 1. The treatment of giving Liquid organic fertilizers (LOF) along with the composition of the ingredients

Number	Type of LOF and ingredients
0	- liming and - LOF
1	+ liming equivalent 1 x Exchangeable Al and - LOF
2	**Crocober** (30% *C.odorata* +10% cattle urine + 20% coconut fiber + 20% local micro organism from coconut water +20% manure)
3	**Crocoberma** (30% *C.odorata* +10% cattle urine + 20% coconut fiber + 20% micro organism from coconut water +20% manure + *Trichoderma*)
4	**Crocoberderma** (30% *C.odorata* +10% cattle urine + 20% coconut fiber + 20% micro organism from coconut water +20% manure + (2x *Trichoderma*)

IOP Conf. Series: Earth and Environmental Science **883** (2021) 012041 doi:10.1088/1755-1315/883/1/012041

5	**Titocroco** (30% *C.odorata* + 30% Tithonia + 10% coconut fiber + 10% local micro organism from coconut water +20% manure)
6	**Titocrocoma** (30% *C.odorata* + 30% Tithonia + 10% coconut fiber + 10% local micro organism from coconut water +20% manure + *Trichoderma*)
7	**Titocrocoderma** (30% *C.odorata* + 30% Tithonia + 10% coconut fiber + 10% local micro organism from coconut water +20% manure + (2x *Trichoderma*)
8	***Trichoderma*** dissolved in water (2 kg/20 L liquid) took 50ml/L applied

Implementation; Liquid fertilizer is made with the composition of raw materials that have been prepared based on treatment. The coconut fiber had been added to enrich the potassium nutrient in it [9]. All organic substance was finely chopped and then composted for 1 month, turning them every week so that oxygen can be penetrated. The compost was black and odorless and the biomass has crumbled. Then the material as much as 20 kg each was put into a container then coconut water was added. The addition of water was carried out as much as the solid material (1:1) specified in the container. Each dose of Trichoderma according to the treatment was put into the liquid fertilizer container then 2.5 kg of brown sugar was added, then fermented for 1 month. In order for fermentation to run properly, an aerator was used and equipped with a gas exhaust hose to avoid too high gas pressure.

Soybeans were planted at a spacing of 20 x 15 cm with 2 seeds per hole, in each plot the size of 200 cm x 200 cm. Soil reacted with acid and was given lime equal to 1 x Exchangeable Al , 2 weeks before planting. Liquid organic fertilizer was given starting 2 weeks after planting (MST). Subsequent applications were carried out by spraying evenly every 2 weeks with the same dose, namely 50 ml L^{-1} of water. Spraying was stopped after the plants entered the flower primordia phase. At this time, LOF was applied only 3 times. Urea, SP36, and KCl are still given but the dose was 50% of the recommended by BPTP West Sumatera, given the whole initial planting.

Observation parameters, among others; determination of pH of liquid organic fertilizers, plant height, number of branches and nodules, fresh and dry weight of stover of crops, length of primary roots, number of secondary branches of roots, and fresh and dry weight of roots, initial soil pH and 43 days after planting (dap) in the rhizosphere.

3. Results and discussion

3.1 Soil chemical analysis

The results of soil chemical analysis before the experiment was carried out are presented in Table 2. The chemical reaction of the soil before the treatment (initial soil pH) was considered acidic, therefore if it was to be planted with soybeans it needs to lime. The value of the cation exchange capacity was also classified as moderate, the exchangable-Mg level was also low. The content of other elements was classified as moderate, but the phosphorus content in the soil was very high. This was because the soil used in this experiment was former rice fields. This also proved that the high levels of phosphorus in the soil were thought to be due to the intensive use of phosphate fertilizers and that there were a lot of P deposits in the soil.

Table 2. Initial chemical soil analysis at Ultisol Kuranji, Padang City, West Sumatera

Soil Characteristic	Unit	Nutrient content in the soil	
		Value	Classification
pH (KCl)		4,18	-
pH (H2O)		4,66	acid
Nitrogen	%	0,278	moderate
Fospor (P)	ppm	21,175	Very high
KTK	Cmol kg^{-1}	19,55	moderate
Na	Cmol kg^{-1}	0,376	low

Ca-dd	Cmol kg^{-1}	0,327	Very low
Mg-dd	Cmol kg^{-1}	0,619	low
K-dd	Cmol kg^{-1}	0,502	moderate
Exchangeable Al	Cmol kg^{-1}	1,591	-
H-dd	Cmol kg^{-1}	0,53	-
C-organic	%	2,682	moderate
C/N		9,647	low
Organic Matter	%	4,624	

Note: Criteria for soil chemical properties based on [25]

Producing healthy soybeans with high production really requires proper treatment, including maintaining adequate nutrition and disturbances from pests and plant diseases and expanding the planting area [17], [29] explained that acid mineral soils had sufficient potential for the development of soybean crops in the future. The problem of various acid mineral soils such as Ultisols is that the content of Al and Fe is quite high and the soil pH is low. Some nutrient content is also low, especially base saturation. If this soil to be used for the cultivation of food crops, especially soybeans, it needs special treatment, by liming. Based on the chemical reaction conditions of the less fertile soil in general, liming was carried out. This experiment carried out liming equal to 1 x Exchangeable Al with dolomite $(CaMg\,(CO_3)_2$. Producing healthy soybeans with high production really requires proper treatment, including maintaining adequate nutrition and disturbances from pests and plant diseases and expanding the planting area [22] explained that acid mineral soils have sufficient potential for the development of soybean crops in the future. The problem of various acid mineral soils such as Ultisols is that the content of Al and Fe is quite high and the soil pH is low. Some nutrient content is also low, especially base saturation.

3.2 Liquid organic fertilizer pH

The chemical reactions (pH) of liquid organic fertilizer (LOF) of various ingredients are presented in Table 3. pH of Liquid organic fertilizer was determined after the LOF was harvested and will be applied to soybean crops. From the results of the analysis, it can be explained that in general, the LOF reaction was slightly alkaline to alkaline, while the *Trichoderma* solution reacted slightly acidic. In the types LOF of Crocober, Crocoberderma to Titocrocoderma, they contained more diverse microorganisms than the LOF which only come from *Trichoderma sp* fermentation. It was proven that liquid fertilizers containing various types of microorganisms can increase higher the pH than only Trichoderma liquid fertilizer. However, this study did not identify the types of microorganisms contained in the LOF. It will be hoped that future research will be carried out to analyze the types of microorganisms contained in it. [27] indicated that *Trichoderma sp* requires a growth medium with an optimal pH of 3-7, between very acidic to neutral.

Table 3. Reaction (pH) of various LOF with ingredients at 2 months after fermentation

Number	Type of fertilizers	Average of pH	Criteria*)
0	- Liming and - LOF	-	-
1	+ liming equivalent 1 x Exchangeable Al and – LOF	-	-
2	**Crocober**	7,635	rather alkaline
3	**Crocoberma**	8,120	rather alkaline
4	**Crocoberderma**	8,610	alkaline
5	**Titocroco**	8,685	alkaline
6	**Titocrocoma**	8,630	alkaline
7	**Titocrocoderma**	8,665	alkaline
8	***Trichoderma***	6,495	rather acid

*) Reference [25]

The Minister of Agriculture Regulation No. 70/ PERMENTAN/SR.140/10/2011 determined that regarding organic fertilizers, biological fertilizers, and soil repairers, that the pH of LOF range from 4 - 9. In terms of pH, LOF was very suitable as fertilizer that was sprayed on plants as a provider of nutrients for plants. The content of the LOF raw material comes from various shrubs of *C.odorata*. *T. diversifolia* which are added with manure, fermented coconut water, and coconut fiber. All of these materials contain nutrients that are very useful for plants. [12] had succeeded in proving the positive effect of providing liquid organic fertilizer from *C.odorata* on the production of cayenne pepper plants; black rice and Cisokan rice. The provision of liquid fertilizer from *Tithonia diversifolia* had also been proven by [18], which can be higher the yield of upland rice on Ultisol soil by 13.33% than to those not given LOF. Liquid organic fertilizers did not have a negative effect on the environment and food crops. Therefore, the use of LOF must be developed in the management as well as taking care of plant nutrition. The selection of ingredients for LOF must be careful because the wrong composition and the incorporation of useless materials will have a low effect and will not increase the yield of food crops. [20] had proven that the composition of *C.odorata* + coconut fiber + manure + urine + local microorganism) was able to exchange the use of artificial fertilizers up to 50% in lowland rice plants.

The usage of coconut fiber was indeed appropriate in making LOF because its potassium content is quite high. Apart from agriculture, coconut fiber was also used as a storage for K_2CO_3. This was agreed by [9] from the results of studies on the use of catalysts using coconut fiber ash, palm bunch ash, and K_2CO_3 to convert castor oil into biodiesel with methanol as solvent. Biodiesel was made by converting unrefined castor oil, using a catalyst, through a transesterification reaction. The catalysts were annealed at temperatures of 500, 600, 800, and 900^o C for 10 hours. The reaction was carried out in a three-neck flask at a constant temperature of 60^o C for 3 hours. The results showed the use of a coco ash catalyst without annealing and with annealing at 800^{o}C gave the highest biodiesel yield (87.05 and 87.97%) with low soap content (0.23-0.26%). The characteristics of the biodiesel produced from the use of these catalysts complied with the quality requirements set by Indonesian and International Standards so that these catalysts were suitable for use as commercial K_2CO_3 catalysts.

[22] explained that the benefits of *Trichoderma sp*; as a bio fungicide which is used to inhibit the growth and development of toxic fungi that can cause disease in plants. Examples of these pathogenic fungi include the fungus *Rhizoctonia solani, Sclerotium rolfsii, Rigdiforus lignosus*, *Fusarium moniliform*, and also *Fusarium oxysporum. Trichoderma sp*. also can be used as a decomposer in the manufacture of organic fertilizers. Apart from being a decomposing organism, Trichoderma sp can also function as biological agents and growth stimulators in plants. This fungus also had the ability to increase the production of healthy roots and increase the depth of roots below the soil surface so that it can increase the rate of growth and development of plants.

3.3 Soil pH and development of agronomy

Soybean plants reaching the age of 43 days after planting (dap) were presented in Table 4 and Figure 1. There was a lot of information that can be conveyed regarding this treatment. Plant growth on soils that were not given lime nor given LOF looked stunted. If the soil was given lime equivalent to 1 x Exchangeable Al, the growth was better than it did not apply lime, and there was a significant difference. It was proven that plants need lime for better growth. There was a higher of 47.06% in height plant, 45.17% in the number of branches, and 85.41% by weight of fresh stover of the Mutiara-1 soybean plant which was given lime than to those that were not given lime.

IOP Conf. Series: Earth and Environmental Science **883** (2021) 012041 doi:10.1088/1755-1315/883/1/012041

Table 4. Effect of lime and LOF on changes in soil pH and the shoot of the Mutiara-1 soybean plants at 43 dap

Treatments	Soil pH	Plant height	number of plant branches	Fresh weight of shoot
		cm	piece	g/clump
Inisal Soil chemical	4,66			
- Liming and - LOF	4,63 c	44,00 c	3,83 c	43,33 d
+ liming equivalent (1 x Exchangeable Al)	***5,18***	***64,71***	***5,56***	***80,34***
(+ liming and -LOF)	5,00 abc	58,83 b	5,16 a	68,40 cd
Crocober	5,23 ab	63,16 ab	5,50 ab	74,40 bc
Crocoberma	**5,33 a**	**68,50 a**	**6,20 a**	75,56 bc
Crocoberderma	5,25 ab	62,16 ab	5,33 ab	90,26 ab
Titocroco	4,95 bc	63,50 ab	5,66 ab	63,93 cd
Titocrocoma	5,18 ab	68,33 a	4,50 b	**90,80 a**
Titocrocoderma	5,23 ab	**68,50 a**	**6,36 a**	**102,70 a**
Trichoderma	5,28 ab	67,16 a	5,73 ab	76,63 bc
CV (%)	3,07	5,19	11,04	14,42
LSD at 5%	0,37	5,58	1,02	18,86
P-value	0,018	14,4 x 10^{-5}	0,00045	0,000038

Note: The number followed by the same supersript in each column is significantly different according to the LSD at 5% significance level.

The treatment of soil treated with lime equivalent to 1 x Exchangeable Al, giving LOF also had various impacts on soil pH. The lowest soil chemical reaction (pH) was in the experimental plot that was not given lime or the LOF application. Soil given dolomite lime equivalent to 1 x Exchangeable Al increased by 0.52 from the initial pH of only 4.66 to 5.18 during the generative phase of plant growth. Soils that were calcified with the application of various types of LOF on soybean plants, it was found that the soil pH of the rhizosphere also experienced various changes. Giving Crocoberma LOF gave the highest soil pH impact of 5.33. The soil was treated with lime, without LOF application resulted higher in the soil pH reached 5, than soils was unlimed and not applied LOF was only 4.63.

There were also indications that liming which raises soil pH increases the general growth of soybean plants. *Trichoderma sp* added to any type of LOF can increase the pH of the soybean plant rhizosphere. From table 4, it was also proven that the addition of tithonia to the raw material of *C.odorata* LOF can reduce the pH of the soybean rhizosphere. The highest plants were those given LOF Crocoberma and Titocrocoderma. The same pattern also occurred in the formation of the number of plant branches. The plant's fresh weight was higher than the Titocrocoderma LOF treatment. There had been a higher of 16.44% plant height, 23.25% number of branches, and 50.15% weight of stover in plants given LOF than to those not given LOF.

Figure 1. Soybean plants applied with LOF at 43 dap

The Titocrocoderma LOF was a mixture of *C.odorata* which is added with Tithonia and coconut husk and *Trichoderma sp*. All complete ingredients were contained in it, thus producing nutrients that meet the growing needs of soybean plants. The positive impact started on height, the number of branches, and fresh shoot weight per clump. However, several other types of fertilizers also have the same positive impact as this type. Likewise, it was unless great if pure *Trichoderma* which was fermented and then applied as LOF was still insignificant with other ingredients. This showed that *Trichoderma sp* was able to provide useful nutrients for soybean plants.

The application of lime and LOF affected the length of the primary roots, the number of nodules, and the fresh weight of the roots (Table 5) and (Figure 1). The highest fresh root weight was influenced by Titocrocoderma LOF although other types of fertilizers were able to significantly increase the primary root length, the number of root branches, and root nodules. The highest root weight resulted in the highest shoot weight (Table 4). It turns out that the LOF effect was not only able to affect the top of the plant but also the root of the soybean plant. Adequate nutrition from LOF Titocrocoderma because there was a mixture of *C.odorata* and *T. diversifolia* raw materials, while the other ingredients contain *Trichoderma sp*.

Plants treated with lime showed a significant increase in primary root length, a number of nodules, and root fresh more weight than to those not given lime. Crops that were without liming will grow unhealthy and morphologically the leaves will also appear more yellow, than those given lime even though they are not given LOF. The impact of liming on crops had been explained by many experts, among others [3], [5], [8], [26], stated that lime application could reduce the excessive availability of Al, Fe and other microelements, and increase the availability of P, Ca, Mg and K elements. They also reported liming on acidic soils can increase nutrient uptake, especially phosphorus nutrients.

Table 5. The effect of lime and LOF application on the root development of soybean plant at 43 dap

Number	Treatments	Primary root length (cm)	Number of root branches / plant (numbers)	Number of Root nodules (grain)	fresh Root weight (g/clump)
0	- Liming and - LOF	9,16 ^{c}	28,67	9,33 ^{c}	6,56 ^{c}
	+ liming equivalent (1 x Exchangeable Al)	***12,58***	***26,29***	***25,83***	***8,38***
1	(+ liming and -LOF)	12,66 ^{abc}	23,00	17,66 ^{bc}	7,46 ^{bc}
2	**Crocober**	**15,66** ^{a}	31,00	14,33 ^{bc}	8,40 ^{ab}
3	**Crocoberma**	11,00 ^{bc}	27,00	19,00 ^{bc}	8,06 ^{abc}
4	**Crocoberderma**	**13,33** ^{a}	29,00	**52,00** ^{a}	7,73 ^{bc}
5	**Titocroco**	10,16 ^{bc}	23,00	16,00 ^{bc}	8,46 ^{ab}
6	**Titocrocoma**	13,00 ^{ab}	26,66	**46,33** ^{a}	8,66 ^{ab}
7	**Titocrocoderma**	11,33 ^{bc}	28,66	20,66 ^{b}	**9,50** ^{a}
8	***Trichoderma***	13,50 ^{ab}	22,00	20,66 ^{b}	8,76 ^{ab}
	CV (%)	17,22	16,37	19,19	10,78
	LSD 5%	3,61		7,90	1,51
	P-value	0028	0,171	$23x\ 10^{-12}$	0,023

Note: The number followed by the same superscript in each column is significantly different according to the DMRT at 5% significance level.

The growth of longer plant roots was able to produce more nodules. Longer roots would make the range of roots in getting nutrients much wider too. This indicated that the nodule will develop more like the root length increases. Living root nodules depended on the plant nutrients it received from the roots. Therefore, for better root growth, it was certain that the nutrients that are circulated were much more rooted than the short roots. Giving Crocoberderma LOF was able to produce nodules of up to 52 pods, outperforming plants not given LOF which were only 17.66, or an increase of up to 3 times. The formation of root nodules increasingly affected the growth of soybean crops. According to [7], [8] stated that root nodules are the site of N fixation in plants, so the availability of N was largely determined by the presence of root nodules. If nitrogen was available and absorbed by plants, soybean plant growth will increase.

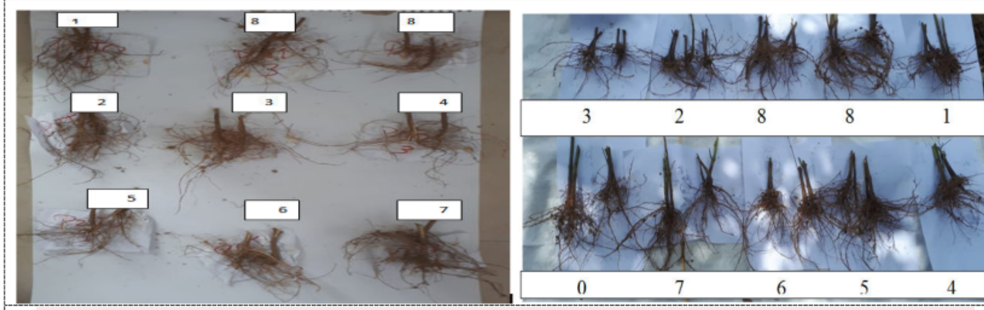

Figure 2. Roots of soybean crops 43 DAP after drying based on treatment at 43 DAP (left) and at harvest time (right) (numbers according to treatment can be seen in Table 5).

Figure 2, shows that the roots of soybean plants that were not given lime had fewer and shorter roots than those treated with lime. However, in the treatment given lime, the LOF application did not have a significant difference in root development [5], [26] reported that applying lime can increase nutrient availability in acid soil and reduce the detrimental effects of trace elements.

If calculated based on the dry matter weight of soybean plants, according to [6] with N content, while according to [27] conversion of N to crude protein in soybean plants by multiplying 5.75. So the nitrogen and protein content in the forage for soybeans was presented in Table 6. Soybean plants maintained up to 43 days after planting (dap), besides being able to grow, will produce pods that were useful for harvesting seeds. However, if you are not going to harvest the seeds, the soy forage will become a source of protein for ruminants.

3.4. The crude protein yield of the soybean plant

The highest crude protein content in soybean forage was found in the Titocrocoma LOF treatment which produced 618,93 kg ha^{-1} of crude protein. The higher the dry matter content in soybean crops, the higher the crude protein content. The crude protein content in soybean crops that were not given lime and not given LOF was only 192,53 kg ha-1, while those given lime but not given LOF increased by 52,07%. If the crude protein content was due to the effect of the same treatment with a lime even those added with the Titocrocoma LOF application, there was a higher 77,78% than those not given LOF.

Table 6. Effect of lime and LOF on transport of nutrients N and crude protein for soybean plants at 43 dap.

Treatments	Plant shoot per hectare			Crude protein (kg)
	Dry matter (mg ha^{-1})	N - plant (%)	N-uptake (kg)	
- Liming and - LOF	1,646 ^{c}	2,21 ^{b}	34,56 ^{c}	192,53
+ *liming equivalent* (*1 x Exchangeable Al*)				
(+ liming and -LOF)	2,598 ^{bc}	1,96 ^{c}	50,92 ^{b}	292,79
Crocober	2,828 ^{b}	3,33 ^{a}	93,324 ^{a}	541,49
Crocoberma	2,872 ^{b}	3,07 ^{ab}	88,17 ^{ab}	506,98

Crocoberderma	3,430 [ab]	2,91 [b]	99,81 [a]	573,93
Titocroco	2,430 [bc]	2,98 [ab]	72,41 [ab]	416,38
Titocrocoma	3,450 [ab]	3,12 [ab]	107,64 [a]	618,93
Titocrocoderma	3,902 [a]	2,32 [bc]	90,53 [ab]	520,53
Trichoderma	2,912 [b]	2,84 [b]	82,70 [ab]	475,53
CV (%)	14,42	7,46	18,59	-
LSD 5%	4,91	0,36	184,19	-
P -value	0,00004	0,00000067	0,00496	-

Note: The number followed by the same superscript in each column is significantly different according to the LSD at 5% significance level.

In this experiment, it was proven that LOF containing *C.odorata* raw materials combined with *Thitonia* and *Trichoderm*a as a Titocrocoma LOF were able to produce nutrients that were better absorbed by the top of the crop and promote the formation of crude protein which is useful for producing pods if maintained until the physiologically mature phase or as a source of animal feed. for ruminants if the forage is harvested. [20] indicated that quality animal feed is if the crude fiber content is low and the crude protein was high. However, the most important thing that must be considered was that the source of forage to be used as animal feed must be economical. It still needs further study regarding the efficiency of using a ration by livestock which is known from the difference between the amount of crude protein from soybean forage was consumed and excreted by the body either through feces or urine. If you look at the high rainfall in West Sumatra, it had the potential to increase the development of pests and diseases in soybean plants, especially pod borer or fungal attack which will harm pod production, so forage for soybean had the potential to be used as a source of animal feed.

4. Conclusion

Experimental results established that given of dolomite lime can increase soil pH, Titocrocoma LOF accompanied by liming gave the best effect on soybean varieties Mutiara-1 at the vegetative stadium, produced 3.45 Mg ha^{-1} plant shoot or forage dry weight equivalent to107,64 kg N ha^{-1} or 618,93 kg ha^{-1} crude protein.

5. Acknowledgment

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References

[1] Atmaja T, Adi R F, and Pangan K 2018 Adaptasi perubahan iklim dan ketahanan pangan: telaah inisiatif dan kebijakan *Jurnal Hukum Lingkungan Indonesia* **5**(1) 60–68.

[2] BATAN 2018 *Kedelai Varietas Baru, Hasil pemulilaan Mutasi Radiasi*. Jakarta: Media Informasi Ilmu Penegtahan Teknologi Nuklir. Retrieved from http://drive.batan.go.id/kip/documents/leaflet2018/Kedelai Varietas Baru.pdf

[3] Bolan N S, Adriano D C, and Curtin D 2003 Soil A Cidification And Liming Interactions With Nutrient And Heavy Metal T Ransformation *Advance in Agronomy* **78**(2) 215–272.

[4] Damayanti R H, and Denata 2020 *Analisis Hujan Juni 2020 dan Prakiraan Hujan Agustus, September dan Oktober 2020*. Jakar. Retrieved from https://cdn.bmkg.go.id/web/Buletin_Hujan_Bulanan_Bmkg_Edisi_JULI_2020.pdf#viewer.action=download

[5] Fageria N K, and Baligar V C 2008 Ameliorating Soil Acidity of Tropical Oxisols by Liming For Sustainable Crop Production *Advance in Agronomy* **99**(8) 345–399. https://doi.org/10.1016/S0065-2113(08)00407-0

[6] Faozi K, Yudono P, Indradewa D, and Ma A 2019 Serapan Hara N , P , K dan Hasil Biji Kedelai (*Glycine max* L. Merrill) pada Pemberian Bokashi Pelepah Pisang pada Tanah Pasir Pantai Nutrient uptake of N , P , K and Soybean Seed Yield by Application of Bokashi made from Banana Stem in the Coastal Sand *Vegetalika* **8**(3) 177–191.

[7] Fatima Z, Zia M, and Chaudhary M F 2006 Effect of Rhizobium strains and phosphorus on growth of soybean (*Glycine max*) and survival of Rhizobium and P solubizing bacteria *Pak. J. Bot* **38**(2) 459–464.

[8] Heide B. Van Der 2004 Pengelolaan Kesuburan Lahan Kering Masam Untuk Tanaman Kedelai *Bulletin Palawija* **50**(7) 39–50.

[9] Husin H, Mahidin, and Marwan 2011 Studi Penggunaan Katalis Abu Sabut Kelapa , Abu Jarak Menjadi Biodiesel *Reaktor* **13**(4) 254–261.

[10] Ilmu Geografi.com. 2020. 5 Kategori Klasifikasi Iklim Oldeman (Paling Lengkap). https://ilmugeografi.com/ilmu-bumi/meteorologi/klasifikasi-iklim-oldeman, akses Agustus 2020.

[11] Jamilah 2017 Pengaruh Pupuk Organik Cair Asal *C.odorata* Terhadap Serapan Hara Kalium Dan Hasil Padi Ladang *Jurnal Bibiet* **1**(1) 17–26.

[12] Jamilah, Ben Kurniawan Z 2018 Pengaruh Pupuk Organik Cair Unitas Super Asal *Chromolaena odorata* Terhadap Pertumbuhan Dan Hasil Padi Hitam (*Oryza sativa* L.) *Jurnal Agroteknologi* **8**(2) 15–20.

[13] Jamilah, Hamdani Nusri, Zahanis M E 2018 Penetapan Konsentrasi Pupuk Organik Cair Unitas Super Yang Tepat Pada Tanaman Cabai Rawit Lokal (*Capsicum frutescens* L.) *EnviroScienteae* **14**(1) 33–37.

[14] Jamilah, Ramdan Soleh W H 2017 Respon Tanaman Padi (*Oryza sativa* L.) Kabir 07 Terhadap Pupuk Organik Cair Crocober Plus Khusus Kota Padang dengan Iklim Af *Jurnal Solum* **14**(1) 18–26.

[15] Jamilah A D 2016 Potensi tanaman jagung yang dipangkas dan dipupuk kompos *C. odorata* sebagai model integrasi tanaman pangan dan peternakan. In *Seminar Nasional Dampak Perubahan Iklim Terhadap[Biodiversitas Pertanian Indonesia* (pp. 27–34). Payakumbuh, Sumatera Barat: Politani Pertanian Negeri Payakumbuh.

[16] Jamilah, Fadhila R, and Mulyani S 2017 Farm Analysis Of Rice Crop Trimmed Periodically. In *International Conference on Social, Humanities and Government Science (ICSHGS) 2017* (pp. 202–211). Palembang: Universitas Tamansiswa Palembang.

[17] Jamilah and Herman W 2018 K*arakteristik sifat fisika dan kimia tanah yang mendukung ketahanan pangan di Sumatera Barat*. Padang.

[18] Jamilah, Maradona C, Zahanis, and Ernita M 2014 Penetapan konsentrasi dan intreval pemberian pupuk organik cair asal sabut kelapa dan tithonia untuk meningkatkan hasil padi ladang (*Oryza sativa* L.). In P. P. N. Payakumbuh (Ed.), *Seminar Nasional Pebangunan Bio-Industri untuk Mewujudkan Kedaulatan Pangan Indonesia* (pp. 53–59). Payamkubuh: Politani Pertanian Negeri Payakumbuh.

[19] Khudori 2011 Sistem Pertanian Pangan Adaptif Perubahan Iklim *Pangan* **20**(2) 105–119.

[20] Munir J, Juniarti, and Srimulyani 2017 Mowing Rice Crop as Ratoon and Applying *Chromolaena odorata* Compost to Support Food Security *International Journal of Appled Engineering Reserach* **12**(21) 11738–11748.

[21] Nazir M, Syakur, and Muyassir 2017 Pemetaan Kemasaman Tanah dan Analisis Kebutuhan Kapur di Kecamatan Keumala Kabupaten Pidie *Jurnal Ilmiah Mahsiswa Pertanian Unsyiah* **21** 21–30.

[22] Rizal S, Susanti T D 2018 Peranan Jamur Trichoderma sp yang Diberikan terhadap Pertumbuhan Tanaman Kedelai (*Glycine max* L.) *Sainmatika* **15**(1) 23–29. https://doi.org/10.31851/sainmatika.v15i1.1759

[23] Satria 2015 *Produksi Kedelai Nasional Masih Rendah*. Jogyakarta.

[24] Steel R G D, Torrie J H 1980 Principles and Procedures of Statistics: A Biometrical

Approach *Biometrics* **37**(4) 859. https://doi.org/10.2307/2530180

[25] Tanah B P 2009 *Analisis Kimia tanah, Tanaman, air dan pupuk* (1st ed.). Bogor: Balai Penelitian Tanah, Bogor.

[26] Taufiq A, Kuntyastuti H, Prahoro C, and Wardani T 2007 Pemberian Kapur dan Pupuk Kandang pada Kedelai di Lahan Kering Masam *Penelitian Pertanian Tanaman Pangan* **26**(2) 78–85.

[27] Taufiq A, Manshuri A G 2005 Pemupukan dan Pengapuran pada Varietas Kedelai Toleran Lahan Masam di Lampung *Penelitian Pertanian Tanaman Pangan* **24**(3) 147–158.

[28] Notohadiprawiro T and Soeprapto S, Endang S 2006 Pengelolaan kesuburan tanah dan peningkatan efisiensi pemupukan 1. In *Ilmu Tanah* (pp. 1–19). Jogyakarta: Universitas Gadjah Mada.

[29] Thorik, Aqwamit 2018 Masalah Impor dan Hama Jadi Penyebab Banyaknya Petani di Jatim yang Enggan Menanam Kedelai. Tribun.com Jatim https://jatim.tribunnews.com /2018/11/05/masalah-impor-dan-hama-jadi-penyebab-banyaknya-petani-di-jatim-yang-enggan-menanam-kedelai.

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