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Optimization Various ofLiquidsOrganic Fertilizers towards Nodulation, Root Weight and Yield of Groundnut (*Arachis hypogaea*, Linn) Organic Farming Systems

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Abstract : Human awareness of the dangers chemical fertilizers residues and use chemical pesticides encourage some people to consume healthy foods derived from organic farming. The purpose of this study is to determine the effectiveness ofLiquid Organic Fertilizers (LOF) to number of nodules, weight rootand yield of groundnut in East Kutai, to determine the correlation between observation variables. We used a randomized block design (RBD) in four levels of organic liquid fertilizers with concentration of 100ml/liter.water, i.e : L0 (Without LOF), L1 (*Leucaena* leaf LOF), L2 (*Gliricidia* leaf LOF), L3 (*Musa.P* knotLOF). Observations were made on number of nodules, root weight and pod dry weight. The results showed that *Leucaena* leaf LOF 100 ml/liter.water had better effectiveness in optimizingroot weight of 9,93 grams (36,70%) and increaseyield of Groundnutat 3,93 ton.ha^{-1} (21,11%) compared without no LOF. We found negative correlation between number of nodules and weight root towards dry pod weight, correlation is a very strong (0,94), together the number of nodules and weight root have effect to weight dry pod of groundnut by 89 % and 11 % influenced by other factors.
Keywords : Influence, Correlation, *Leucaena, Gliricidia, Musa.P, Groundnut*.

Introduction

Groundnut(*Arachis hypogaea* L) is the 13th most important food crop of the world, the world's 4th most important source of edible oil and 3rd most important source of vegetable protein. Its seeds contain high quality edible oil (50%), easily digestible protein (25%) and carbohydrate (20%). It has a total production 0f 36,1 million metric tons worldwide at an average productivity of 1,4 metric tons/ha. Globally, 50 % of groundnut produced is used for oil extaction, 37% for confectionery use and 12% for seed purpose. Its haulms (vegetatife plant part) also provide excellent hay for feeding livestock. It is grown in area of about 26 million hectares in more than 100 countries around the world under different agro-climatic conditions [(5,13)]. Groundnut provides food for direct human subsistence and it used in several other food products. Groundnut is a legume with high N requirement, which may be obtained from the soil or from biological N fixation (BNF) [(17)].

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Indonesia ranked 9th groundnut production of the world, with contribution of 2,17 % from the total area harvested of groundnut in the world. National productionin 2016 of groundnut decreased 7,43 %, also decreased total area harvested 6,61%, defisit 9,33% [12]. Groundnut production in East Kutai is still low at 1,17 ton.ha^{-1}[2]that value is far if compared to other regions with production of 2-3,5 ton.ha^{-1}. This indicates that the motivation of farmers to optimize groundnut production is still lacking, so it needs to be encouraged by various efforts to improve farmer's yield and welfare. One of these efforts is by means of OLF technology in the cultivation of peanuts in organic farming systems.

LOFtechnology is an action to improve the growing environment of plants, which is expected to support the improvement of the productivity of land and agricultural systems will be continued [14]. The advantages ofLOF compared to organic granuler fertilizers are that it is more readily available, does not damage the soil and plants, and has a binding solution so that if applied can be directly used by plants, besides it can be given through plant roots and leaves, the elements have been decomposed so that they are easily absorbed by plants [3]. LOF technology is part of organic farming that promises a healthier human life. The selling value of agricultural commodity products is relative higher compared to commodities conventional agricultural. Organic farming does not use artificial chemical fertilizers or chemical pesticides that can poison the soil and human health [16].

The purpose of these studiesare i.e : 1) to determine the most effective and efficient LOF in increasing nodulation, root weight and groundnut production, 2) to determine the correlation between observation variables.The hope research are i.e : 1) there is the most effective and efficient use ofLOF in increasenumber of nodules, root weight and yield of groundnut, 2) there is a strong correlation between the root variables on peanut production and so that farmers can apply it in the cultivation of organic groundnut.

Materials and Methods

The study was carried out in January to May 2018, in Farmer's land, North Sangatta, East Kutai Regency, East Kalimantan. The material study used the seeds of " Elephant " variety groundnut (Appendix 1) obtained from Rantau Pulung farmers in East Kutai Regency, LOF*Leucocephala leaf, Gliricidia leaf and Musa Parasidiaca knot.* The tools used in this study was soil hoes , digital scales, crop scissors, plastic bags, and other supporting farming tools. We used non-factorial randomized block design as follows (Table 1).

Table 1. LOF Treatment

Code	LOF Treatment	Concentration (ml.liter.water^{-1})
L0	Without LOF	-
L1	*Leucaena leaf*	100
L2	*Gliricidia leaf*	100
L3	*Musa Parasidiaca knot*	100

Liquid organic fertilizer provided *Leucaena leaf, Gliricidia leaf and Musa Parasidiaca knot* were fermentated a month. Agriculture groundnut organic system aplied with low fertility soil. The quality of soil nutients and LOF are given in Table 2.

Table 2. Soil and LOF Nutrient

Soil and OLF Nutrient	pH H_2O	C (%)	N (%)	C/N	P	K
					----------Mg.100g^{-1}----------	
Before studied	-	1,02(**l**)	0,14 (**l**)	7,1 (**l**)	28,92 (**m**)	1,31(**vl**)
					---------- % ----------	
Without OLF (L0)	-	-	-	-	-	-
Leucocephala leaf (L1)	4,98	0,20	0,01	20,73	0,002	0,02
Gliricidia leaf (*L2*)	4,03	0,12	0,01	9,47	0,002	0,03
Musa Parasidiaca tuber (L3)	5,32	0,11	0,01	7,86	0,001	0,04

Eviati and Sulaeman, (2009). **m**=moderat, **l**=low, **vl**=very low

Experiments land consisted of 24 plots. Each block made of 1 m X 2 m. Groundnut planting made with space of 40 cm x 20 cm was repeated 6 (six) times so that there were 24 experimental plots. The observed parameters were number of nodules, weight root and yield of groundnut. Treatments were analyzed by F-Test and Test of LSD 5 % level(Hanafiah, 2014) followed by Effectiveness Test. We also analyzed the regression correlation with statiscial analysis by Microsoft Excel.

Results and Discussion

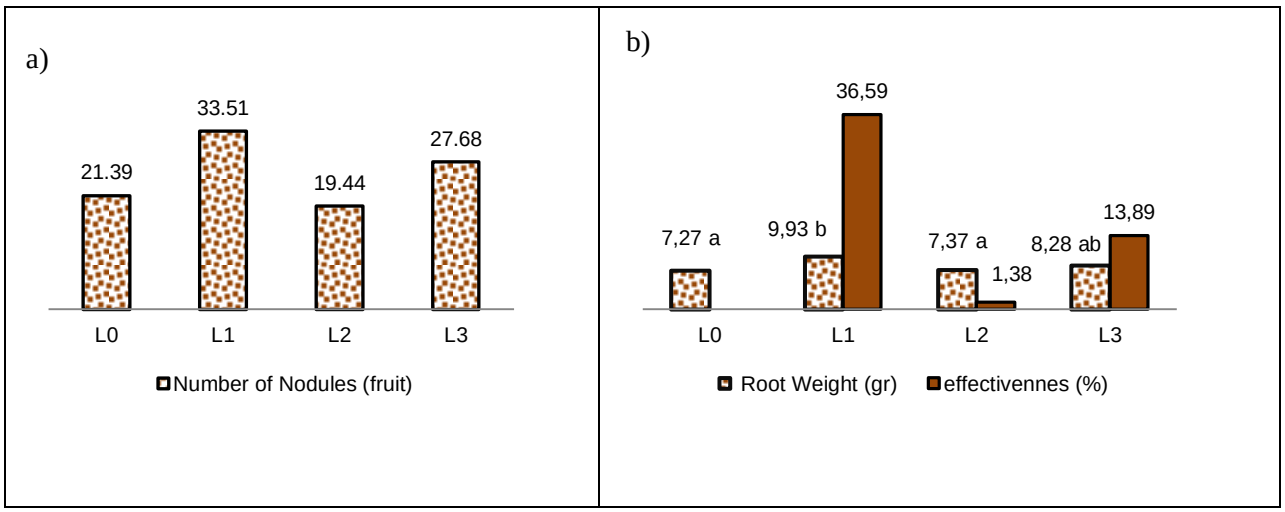
The research was conducted from January to May 2018. Harvesting was done once at the age of 110 DAP. This indicates that age period of pods groundnut was planted longer than the description "Elephant" variety groundnut (Appendix 1). This situation was thought to be due to the influence of LOFon groundnut plants which causes a longer harvest period.The development and production of groundnut plants will be optimal ifthe nutrients given are considered. Various LOF were applied to tested in order to determine the LOF that is most effective in increased root development and crop production. The LOF used in this study contains sufficient macro and micro nutrients, the advantages easily dissolve in water, quickly absorbed by plants, applied through roots and leaves. Micro elements can stimulate the formation of ATP, which plays an important role in absorb solar energy.

LOF effectiveness onthe Number of Nodules and Weight Root

Rhizosphere is a soil ecology that is important for the interaction of plants and microbial or symbiotic nitrogen-fixing bacteria including the *Cyanobacteria* of the *Rhizobium* genera. Microbes that grow ideally in the rhizosphere are able to protect the roots from pathogenic attacks [(18)]. The wider the root range affects the fixation of N, it also increases plant tolerance to dryness [(6)].

The results F-Test (Fig.1a) show thatLOFtreatment hadn't significant effect on the number of nodules. LOFhadn't effect on the number of nodules so that nodule formation rates are relatively the same because there is no competition for sunlight and routine growth in all treatments. Adequate sun radiation, loose soil due to the adequacy of O_2 and CO_2, the formation of nodules takes place well, that nodule formation is influenced by environmental factors such as sun radiation intensity, CO_2 and O_2 concentrations and carbohydrate concentrations in plants[(8)].

In addition, the internal factors of the experimental land had been planted with groundnut, so the land was suspected to contain *Rhizobium* bacteria and could be used as a source of inoculant in all experimental plots. This fact was reinforced[(1)],that Rhizobium which was inoculated one season and two seasons ago was proved to be still effective, but the number was decreased over time the bacteria were in the soil without soybean legumes.



Description : L0=without LOF, L1= *Leucaena leaf* , L2=*Gliricidia leaf* , L3=*Musa Parasidiaca knot*. Numbers followed by the same letters in the treatment were not significantly different at test of LSD5% level.

Fig 1. Effectivennes Various of LOFto Number of Nodules (a) and Root Weight (b).

The results F-Test (Fig 1b) show that LOF treatment had a significant effect on the root weight of groundnut plants. Test of LSD 5% level results showed that the *Leucaena*LOF had the highest root weight of 9,93 gr.plant^{-1}. This value was significant different than without LOF and *Gliricidia*leaf, but it was not significant different from *Musa*knotLOF. This indicates that the *Leucaena* LOFismore effective36,59% in increase root weight than without LOF.Application of organic material in the form of 50 % NPK anorganic + 50 % soil amendment (T4), 50 % NPK organic and 50 % soil amendment (T5) that root number and root nodules differed significantly (P<0,05) level from control[13].

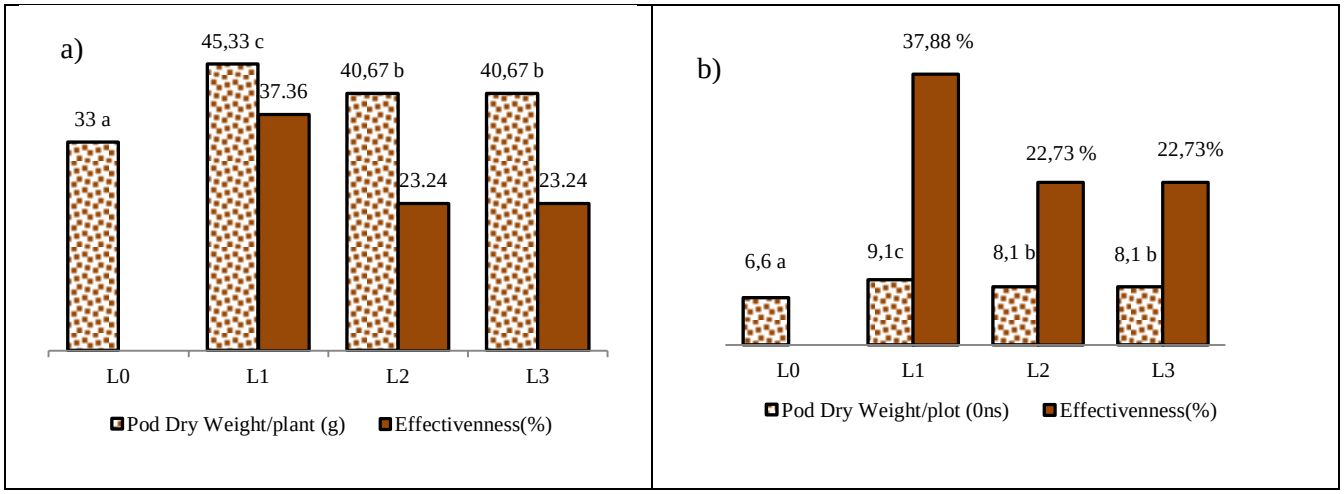
Organic input do no only provide nutrients but also add to the most important constituent of the soil humus, which provides excellent substrate for plant growth. This could be attributed to the fact that the nutrients in the organic fertilizer were released gradually through the process of mineralization [15,11,13], maintaining optimal soil levels over prolonged periods of time. Some of the organic subsrances released during the mineralization may act as chelates that help in the absorption of essential ions and other micro-nutrients [10].

The *Leucaena* LOF had the highest root weight.This is related to nodules, more nodules were produced for increased microbial activities, which resulted in improved vegetative growth. The *Leucaena*LOF is one of organic materials with C organic(0,20 %) and C/N ratio (20,73) higher from other LOF.Organic matter add carbon into the soil, provides substrate for microbial activity. The turnover result from the decomposition of organic materials improves C and N mineralization rates and enzyme activities, which affect nutrient cycling and availability to the plants [15,13].Organic matter could have formed complex (or chelate), preventing the precipitation of phosphate, reduced the P-sorption capacity of the soil, ehanced`P availability, improved P-recovery or resulted in better utilization by plants [10,13].

LOF Effectiveness to Yield of Groundnut

The results F-Test (Fig.2) show that LOF treatment had a significant effect on pod dry weight.plant^{-1} and plot^{-1}. Test ofLSD 5% level results show that the *Leucaena* LOF had the dry pod weight of 45,33 gr.plant^{-1} and 9,1 ons.plot^{-1}. This value was significant different than without LOF and other LOF. This indicates that the *Leucaena*LOF is more effective 37,36 % inincreasepod dry weight.plant^{-1} and 37,88% pod dry weight.plot^{-1}than without LOF.So that increase dry pod weight 3,63 ton.ha^{-1} or more effective 37,50% than without LOF.

Seed yields from pods 60% then dry seed production obtained 2,18 ton.ha^{-1}. Seed production in the profile description (Appendix 1) is larger in the production of groundnut given *Leucaena*LOF, the organic method of groundnut farm is able to optimize production of 21,11% compared to conventional agriculture. This indicated that*Leucaena*LOF is one of organic materials that ability increased produced of groundnut.The *Leucaena*LOF application has significant and more effective on groundnut yield. This is due to higher C organic content than others LOF. High C organic has an impact on the high value of C/N ratio (20,73) so that nutrient mineralization occurs.



Description : L0=without LOF, L1= *Leucaena leaf* , L2=*Gliricidia leaf* , L3=*Musa Parasidiaca knot*. Numbers followed by the same letters in the treatment were not significantly different at test of LSD 5% level.

Fig 2. Effectivennes Various of Dry Pod Weight/plant (a) and Dry Pod Weight/plot^{-1} (b).

Correlation between Nodulation, Root Weight and Ground nut Production in various LOF

Multiple Regression analysis (Table 3) showed negative correlation between number of nodule and root weight to groundnut production on *Leucaenaleaf* LOF(L1) treatment. The more decreasing number of nodule and root weight, then the groundnut production will increase. Correlation coefficient of r = 0,94 means a very strong correlation. The cofficient of determination R^2 = 0,89 implied that the increase in pod dry weight affected by number of nodule and root weigh for 89 % while 11 % influenced by othe factor. Leucana LOF had significant effect to nodules and root weight, thus increased groundnut production (P<0,05).

Table 3. Multiple Regression Analysis between Nodules, Root Weights on Groundnut Production

X1	X2	Y	Persamaan	R^2	r	Sig
Without LOF						
Nodule of Number	Root Weight	PRO	$Y=37,98+0,330_{nn}-1,659_{rw}$	0,16	0,40	$0,77^{ns}$
LOF*Leucaena leaf*						
Nodule of Number	Root Weight	PRO	$Y=82,05-0,367*_{nn}-2,445*_{rw}$	0,89	0,94	$0,04^{*}$
LOF*Gliricidia leaf*						
Nodule of Number	Root Weight	PRO	$Y=62,651-0,0079_{nn}-2,963_{rw}$	0,54	0,73	$0,32^{ns}$
LOF*Musa Paradisiaca tuber*						
Nodule of Number	Root Weight	PRO	$Y=52,921-0,050_{nn}-1,311_{rw}$	0,16	0,40	$0,77^{ns}$

Description : OLF=Organic`Liquid Fertilizier, nn=number of nodules, rw=root weight, ns=non significant, * =significant

The increase in pod dry weight is influenced by the number of nodules and the weight of the root. The number of nodules and root weight is reduced because nutrients stored in roots and nodules are utilized by plant physiology to stimulate vegetative and generative growth. The nodules are mostly concentrated at the top of the root [(9)].

Conclusion

1. Application of *Leucaena leaf* LOF (L1) 100 ml. liter.water^{-1} has better effectiveness on optimizing root weight (36,70%) and production (21,11%) of groundnut plants than without LOF treatment.
2. There is a very strong correlation (r=0,94) between the number of nodules, root weight and dry pod weight per plant on *Leucaena leaf* LOF (L1), the effect of the number of nodules and root weight on yield of groundnut by 89 %.

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Appendix 1. Groundnut'sDescriptions of Elephant Varieties

Names of Varieties	: Elephants
Year	: 1950
Elder	: Schwarz-21 Spanish 18-38.
Potential Results	: 1,8 tons.ha^{-1}
Breeder	: Bogor Agricultural Engineering Research Center
Parent Number	: 61
Start Flowering	: 30 days
Old pod age	: 100 days
Plant Shape	: Upright
Rod Color	: Green
Leaf Color	: Green
Flower Color	: Yellow
Ginofora Color	: Purple
Seed Skin Color	: Pink
Weight of 100 seeds	: 53 grams
Fat Level	: 48%
Protein Level	: 29%
Soaking Seeds from Pods	: 60-70%
Disease Resistance	: Resistant to wilt, Sensitive to rust and Leaves.
Other properties	: Seed yield from pods 60-70%

Source: BB Biogen Bogor

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