



Effect of Tithonia Compost (*Tithonia diversifolia*) and Phosphorus on the Growth and Yield of Peanuts

Edhi Turmudi*, Nanik Setyowati, and Rudi Saputra Hutabarat

Department of Crop Production, Faculty of Agriculture, University of Bengkulu
Jl. WR Supratman, Kandang Limun, Bengkulu 38120, Indonesia

ABSTRACT

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*Corresponding author:

E-mail:

edhi_turmudi@yahoo.com

This study aims to determine the effect of phosphorus dosage and tithonia compost on growth and peanut. The research had been conducted from November 2017 to March 2018 at Bentiring Pemai Village, Muara Bangkahulu Sub-District, Bengkulu City, Indonesia \pm 10 m above sea level using Completely Randomized Block Design, two factors. The experiment was replicated three times. The first factor was tithonia compost with 2 treatment levels namely 0 ton ha⁻¹ (control) and 20 ton ha⁻¹. The second factor was the dosage of phosphorus (SP-36) with 4 treatment levels, 25, 50, 75 and 100 kg ha⁻¹. The results showed no interaction between compost and phosphorus dosage treatment on the growth and yield of peanut crops. Tithonia compost at 20 ton ha⁻¹ increases the growth and yield of peanut crops. Application of tithonia compost patient 20 ton ha⁻¹ resulted in higher increase plant height, crop dry weight, pod weight and yield of peanut 53%, 58%, 67%, and 71% respectively, compared to that of control plants (not compost). Phosphorus dosage had no significant effect on the growth and yield of peanut.

INTRODUCTION

Peanuts (*Arachis hypogaea* L.) are the most important food crops of legumes after soybeans which have a strategic role in national food as a source of protein and vegetable oil. Soil beans contain 40-50% fat, 27% protein, carbohydrates and vitamins. Based on the Ministry of Agriculture's Center for Agricultural Data and Information Systems, (2016) in 2011-2015 Indonesia exported peanuts, which only reached an average of 3.39 thousand tons, while imports of peanuts were far greater, reaching an average of 235.81 thousand tons so that

peanut commodities need to be developed so that production increases.

Efforts are being made to increase the productivity of peanuts, among others, through fertilization. Fertilization which is the provision of nutrients in plants can also provide and replace nutrients that are used up in the process of growth, development, and production of a plant (Setyamidjaja, 1986). Fertilizers can be classified into two namely inorganic fertilizer and organic fertilizer. Inorganic fertilizers are fertilizers resulting from chemical, physical and or biological engineering processes and are industrial products or fertilizer manufacturing plants,

while organic fertilizers are composed of living matter material, such as weathering of the remains of plants, animals and humans. Organic fertilizers are good and natural soil enhancers compared to artificial and synthetic enhancers. Organic fertilizers are in the form of solid or liquid which is used to supply organic materials, improve the physical, chemical and biological properties of soil (Sutanto, 2002).

One type of organic fertilizer is compost. Compost is an organic fertilizer whose processing is broken down by microorganisms. As an organic fertilizer compost can also improve soil structure, increase the ability of the soil to absorb water and hold water and other nutrients. Natural compost takes a relatively long time, which is about 1-2 months or even 6-12 months. However, making compost with fermentation can take place faster with the help of microorganisms (Saptoadi, 2001).

Compost can be made from various sources including household waste, livestock waste, industrial waste, rice straw, dried leaves, legumes and weeds that are one of the related weeds that can be used as a compost source to meet plant nutrients needs. The results of Kurniansyah's research (2010) show that the addition of a link has a significant effect on plant height, number of leaves, and decreases the intensity of rust on soybean plants. This is probably due to the decomposition of the connecting leaves. The link can be used as a potential forage source to reduce the use of artificial fertilizers so as to reduce production costs. Paitan has nutrient content of 3.59% N, 0.34% P, and 2.29% K (Lestari, 2016). The part of the *Tithonia* plant that can be used as green manure is the stem and leaves. The Utilization of linkages as a source of nutrients can be in the form of fresh green fertilizer, liquid green fertilizer, or compost and mulch (Muhsanati *et al.*, 2008).

The role of compost includes improving the physical, chemical and biological properties of the soil. The benefits of organic matter physically improve the structure and increase the capacity of the soil to store water. Chemically increasing soil buffer against pH changes, increasing cation exchange capacity,

decreasing P fixation. Biologically, it is an energy source for soil microorganisms that play an important role in the process of decomposition and release of nutrients in soil ecosystems. Compost fertilizer has complete nutrient content but its availability is low, so it needs to be combined with inorganic fertilizers (Ding *et al.*, 2002).

Musnamar (2006) mention that inorganic fertilizers are widely used in increasing peanut production, one of which is phosphorus fertilizer. The P element is absorbed in the form of inorganic compounds that are water-soluble, for example, nucleic acid and chitin. Phosphorus absorbed by plants in fast inorganic ions turned into organic phosphorus compounds. This phosphorus is the car or easy to move between plant tissues. The optimal level of phosphorus in plants during vegetative growth is 0.3% -0.5% of the dry weight of plants.

Elements of phosphorus can be obtained from inorganic fertilizers such as SP-36 fertilizer and TSP fertilizer. SP-36 fertilizer contains P₂O₅ as much as 36%. Phosphorus is very beneficial for plants, especially in terms of energy transfer, preparation of proteins, coenzymes, nucleic acids, and metabolic compounds. Phosphorus is useful for encouraging initial root growth, growth of flowers and seeds, increasing the percentage of flower formation into seeds, increasing plant resistance to pests and diseases, and improving soil nutrient structure. Peanut plants need more phosphorus than nitrogen fertilizers (Marzuki, 2007).

Organic and inorganic fertilizers have advantages and disadvantages so it is necessary to do inorganic and organic combinations because the use of inorganic fertilizers that are continuously followed by organic fertilizer can reduce the quality of the physical, chemical and biological properties of the soil (Musnamar, 2006). conducted by Prasetya (2014), gave higher results than if only using organic materials or single inorganic fertilizers. This study aimed to determine the optimal dosage of phosphorus in each component of the composition of the growth and yield of peanut plants.

MATERIALS AND METHODS

This research was conducted from November 2017 to February 2018 in the area of Bentiring Permai Subdistrict, Muara Bangka Hulu Subdistrict, Bengkulu City at an altitude of ± 10 meters above sea level (masl).

The materials used in this study consisted of peanut seeds, furadan 3G varieties, compost linking, nitrogen fertilizer (Urea), phosphorus fertilizer (SP-36), potassium fertilizer (KCl), EM 4 and tools used are hoes, sickles, meters, Chlorophyll Meter SPAD, ovens, large containers for composting, analytical scales, labels, name placards, cameras.

This study used a Complete Randomized Block Design (RCBD) with two treatment factors. The first factor was compost application consisting of 2 levels, namely: K_0 = No Compost, K_1 = titonia compost 20 tons ha^{-1} . The second factor is the dose of phosphorus (SP-36) with 4 treatment levels : P_1 = 25 kg ha^{-1} , P_2 = 50 kg ha^{-1} , P_3 = 75 kg ha^{-1} , and P_4 = 100 kg ha^{-1} . Based on the two treatment factors, 8 combinations were obtained where each treatment was repeated 3 times, to obtain 24 experimental units.

Parameters observed were plant height (cm), greenness of leaves, number of branches, fresh weight of stover (g), dry weight of stover (g), weight of pods (g), weight of pods per plot (g), number of pods, number of pods hollow, seed weight per plant (g), weight of 100 seeds (g), seed weight per plot (g).

RESULTS AND DISCUSSION

Interaction Effect of Titonia Compost and Phosphor on Plant Growth and Yield

The results showed that there was no interaction between the compost treatment associated with phosphorus doses on all observed variables. The application of compost affected all variables except the weight of 100 seeds, while the application of phosphorus did not affect all observation variables (Table 1). Thus the application of titonia compost and phosphorus together did not showed mutual interaction so that their influence did not appear during growth and production. Good growth can be achieved if the

circumference factors that influence balanced and profitable growth (Dwidjoseputro, 1985). If one factor is out of balance with other factors, this factor can suppress or sometimes stop plant growth.

The treatment between titonia compost and phosphorus was not necessarily a good influence on plants. Both treatments can encourage, inhibit, or not at all respond to the treatment given. This condition occurs because the response to fertilizer given is determined by genetic factors from plants and climatic conditions (Lingga, 2007). On the other hand, the combination of compost linkages and phosphorus doses, although not having a significant effect on the growth and yield of peanuts but can improve soil chemical properties as seen in the increase in soil pH ranging from 5.00 to 5.30, soil P content starting from 2.04 to 4.79 and increases in soil C-organic from 2.29 to 3.02. According to Widiurjani and Suhardjono (2006), giving compost related to plants can improve physical properties, chemical fertility (increasing levels soil of N, P, K, and Mg) and improve the life of soil biota, thereby improving soil quality. titonia also has the potential as an organic fertilizer supplement to support plant growth

Table 1. The results analysis of variance (ANOVA) for all observed variables

No	Variable	F-Rate 5%		
		Interac- tion (I)	Com- post (C)	Phos- phor (P)
1	Plant height (cm)	0.57 ns	75.98 *	1.64 ns
2	Green leaves	0.89 ns	18.75 *	0.06 ns
3	Number of plant branches	0.78 ns	34.19 *	0.95 ns
4	Fresh weight	0.67 ns	31.49 *	0.06 ns
5	Dry weight	0.55 ns	19.66 *	0.09 ns
6	Weight of pods	1.07 ns	34.21 *	0.37 ns
7	Seed weight per plant	1.50 ns	35.25 *	0.42 ns
8	Number of piths	0.58 ns	26.71 *	0.80 ns
9	Number of empty pods	0.28 ns	16.52 *	0.25 ns
10	Weight of 100 seeds	1.23 ns	0.61 ns	0.66 ns
11	Weight of pods per plot	0.44 ns	21.34 *	1.02 ns
12	Seed weight per plot	0.77 ns	17.32 *	1.50 ns

Notes: * = significantly effects at 5% level,
ns = not significant influence

and production, able to reduce pollutants and reduce active levels of P, Al, and Fe.

The results of variance analysis showed that the composition of compost significantly affected all variables observed including plant height, leaf greenery, number of plant branches, fresh weight, dry weight, pod weight, seed weight per plant, number of rice pods, number of empty pods, pod weight per plot and number of seeds per plot (Tables 1 and 2).

These results indicate that the use of organic fertilizers based on associated compost can contribute to plant growth through its contribution to nutrient availability and to improve its growing environment. The height of peanut plants fertilized with associated compost at a dose of 20 tons ha⁻¹ was 41.47 cm and normal growth. The results of Wibawa's research (2014) showed that the peanut plant height was 48.37 cm. When compared with controls, this plant height increased by 53% (Table 2). This increase in plant height was due to the relatively high nutrient content in associated compost. The results of the study of Hartatik (2007) showed that the nutrient content of *Tithonia* compost was N total of 3.50%, P total was 0.35%, K total was 3.50% and Ca (0.59%). The function of nitrogen is very important for the vegetative growth of plants. Musnamar (2006) stated that high organic fertilizer application could add micronutrients and also increase the availability of nutrients in the soil for plants, especially N elements for vegetative development of plants.

High availability of hydrogen can increase the vegetative growth of plants because nitrogen serves to stimulate overall plant growth, especially stems, branches, and leaves. Table 2 also showed that thitonia compost can increase the greenness of leaves. With good vegetative growth of plants then the cell size increases and leaves the leaves greener. Lingga (2007) stated that one of the roles of nitrogen in plant growth is to be able to build new cells, increase cell size, increase the part of the protoplasm, make the leaves greener and last longer and make delays in maturation.

The increase in plant height and leaf greenery was also followed by an increase in the number of branches namely 7.5 while in

control plants the number of branches was 5.3 (Table 2). This result is in line with the results of Wibawa's research (2014) with the number of branches 7.53 - 7.81. Compost at a dose of 20 tons/ha contributed to the nutrient content of both nitrogen and potassium sufficient to stimulate branch growth where this branch can play a role in strengthening the plant's body.

Table 2. Effect of *Tithonia* compost on plant height (TT), green leaves (KD), number of plant branches (JCT), plant fresh weight (BSB) and plant dry weight (BKB) of peanut plant

Tithonia compost (kg ha ⁻¹)	Variable				
	Plant height (cm)	Leaf greenness	Number of branches	Plant fresh weight (g/tan)	BKB (g/tan)
0	26,95 b	39,88 b	5,35 b	86,62 b	24,33 b
20	41,47 a	44,23 a	7,53 a	147,1 9 a	38,46 a

Notes: Numbers followed by the same letter in the same column indicate no significantly different based on F-test at the level of $\alpha = 5\%$

Compost addition can increase the availability of nutrients such as N, P, K, Mg as well as microelements derived from the decomposition process of organic matter which can increase plant metabolic processes so that the fresh weight of plants in this study also increases. Both the fresh weight and dry weight of plants that were given compost were higher than the control plants (Table 2). Pramitasari (2016) stated that the plant fresh weight is influenced by plant height and leaf area. The higher the plant and the larger the leaf area, the higher the weight of the plant. The effect of compost on the vegetative growth of this plant was also followed by its influence on the growth of generative plants. Plants fertilized with titonia compost possessed pods and pod weights were higher compared to control plants (Table 3).

The weight of plant pods fertilized by compost at a dose of 20 tons ha⁻¹ was 36.59 g or 67% higher than that of control plants (21.84 g). This result was higher when compared with the results of research by Wibawa (2014), 18.76 g, even though the basic fertilizer Urea 75 kg, SP36 75 kg, KCL 75 kg and ameliorant in the form of manure 2.5 tons/ha and 0.5 dolomite ton/ha. In this treatment, the adequacy

of available nutrients can meet the needs of plants for the process of growth and yield of peanuts. Tisdale *et al.*, (1975), stated that nutrient availability in organic matter varied and had implications for nutrient uptake in seed formation in pods. The formation of plant pods requires elements of potassium (K) which help the development of roots, the formation of carbohydrates (starch), the opening of stomata, physiological processes in plants, metabolic processes in cells and affect the absorption of other elements and enhance resistance to drought. Increase the weight of the pod is also followed by increasing the weight of the seeds.

Plants which was fertilized with compost yielded seed weight of 25.15 g or 71% increase while the un-fertilized plant only 14.70 g. This was probably due to the fulfillment of nutrients in plants. In addition, the maximum number and size of seeds are determined by genetic factors and conditions experienced during seed filling (Mimbar, 1991). Good planting conditions such as sufficient soil nutrient requirements will maximized plants in the formation of filling seeds so that the size and the weight of the seeds increase (Sjamsijah, 2016)

Compost application makes gynophore easier to penetrate the soil, simplify the process of pod formation, and maintain a loose soil structure so that this increase the number of full pods in peanut plants and increase the yield. The weight of pithy pods of plants fertilized with compost was 49% higher than that of control (Table 3). According to the Bina Karya Tani Team (2009) compost application makes the soil more porous, fertile, porous soil becomes loose, remains in condition crumbs and moist and suitable for seed pod formation. The seeds that grow on loose soil are usually

more than the seed pods that grow on dense soil. However, the number of empty pods was also higher.

The associated compost can increase both the weight of pods and peanut seeds per plot. The weight of pods on soil fertilized by tithonia compost was 1995.60 g whereas in control plants was 1808.77 g. Seed weight in compost treatment was 1692.12 g and in control plants was 1199.57 g (Table 3). The weight of pods per plot was affected by the number of seeds/pods formed in the soil. Goldsworthy and Fisher (1992) stated that the dry weight of pods was constant during pod growth in each variety. According to Marzuki (2007), the provision of organic matter in providing elements of nitrogen, potassium, calcium and the availability of elements of phosphorus which are easily soluble in soil was sufficient to support peanut plants to develop pods. Nutrients donated by titonia compost increase the result of plant photosynthesis. The results of photosynthesis in the form of reducing sugars are used as an energy source to maintain plant life, formed as plant bodies (roots, stems, leaves) and accumulated in other fruit, seeds or hoarding organs (sink).

The results of photosynthesis accumulated in the vegetative part are partially regenerated to the generative part (pods) after this part is formed and grows. Thus filling the pods occurs by regenerating the photosynthates from the vegetative parts. Photosynthates in the vegetative section are recorded in plant dry weight, and photosynthate accumulated in pods is reflected in the dry weight of seeds.

Effect of Compost Paitan on Peanut Plants

Phosphorus is given at doses of 25 kg ha⁻¹, 50 kg ha⁻¹, 75 kg ha⁻¹ and 100 kg ha⁻¹ did not

Table 3 Effect of compost associations on pod weight (PW), seed weight per plant (SWP), number of seed pods (NSP), number of empty pods (NEP), weight of 100 seeds (W100), pod weight of per plot (PWP) and the seed weight per plot (SPP) of peanut plants

Tithonia compost (kg ha ⁻¹)	Variabel						
	PW (g/ plant)	SWP (g/ plant)	NSP	NEP	W100 (g/plant)	PWP (g/6m ²)	SPP (g/6m ²)
0	21,84 b	14,70 b	23,03 b	4,63 b	45,87	1808,77 b	1199,57 b
20	36,59 a	25,15 a	34,33 a	8,16 a	44,76	1995,60 a	1692,12 a

Notes: Numbers followed by the same letter in the same column indicate no significantly different based on F-test at the level of $\alpha = 5\%$

affect the growth and yield of peanut plants. (Tables 1, 4 and 5). Thus the phosphorus given is not yet available to plants so that plant growth has not been maximized. Based on the results of the soil analysis before the study, it was found that the soil in the research area was acidic (Ultisol) with pH 5.0. The availability of P in the soil is greatly affected by soil pH. In general, P availability decreases below pH 5.5 because it is fixed by Al, Fe, hydroxide, and clay, whereas at pH above 7.0, P is fixed by Ca and Mg.

One of the factors that inhibit the growth of peanuts is a growing condition where peanut plants need a variety of agro climate environments with varying temperatures, rainfall and soil types that are good for growth. The type of soil needed by peanut plants has acidity (pH) around 6.5 - 7.0. Thus the land used in this study is not optimal for peanut growth because it has an acidic pH (pH = 5). The acid soil is identical to the high content of Al and Fe. The soil used at the time of this study included ultisol soil. Ultisol soil reactions are generally acidic, very acidic (pH 5 - 3.10), except Ultisol soil from limestone which has a neutral reaction to slightly acidic (pH 6.80 - 6.50) (Prasetya, 2014).

On the other hand, it is said that the factors

that influence the availability of P for plants are the most important soil pH. According to Sutanto (2002), nutrient P is available at a pH of 6.0-7.5. This is because at this pH the P element is ready to be absorbed by the plant roots so that it can provide optimal growth and yield. However, in this study, the pH possessed by peanut plants was low or sour. So that the plant roots were not able to absorb P elements optimally. 25 ton ha⁻¹ of phosphorus raised to 100 ton ha⁻¹, in the end, did not show a significantly different effect.

The highest average plant height was produced by plants fertilized with phosphorus at a dose of 100 kg, i.e. 36.11 cm, but the plant height was still lower than the average height of peanut plant based on the description, namely 42 cm. However, the number of pods is comparable to that shown in the description of varieties, namely 27 pods per plant.

CONCLUSIONS

There was no interaction between the treatment of titonia compost and phosphorus fertilizer on the growth and yield of peanut plants. Titonia compost of 20 ton ha⁻¹ increased the growth and yield of peanut plants. Compost related to these doses can increase plant height,

Table 4. Effect of phosphorus dose on plant height (PH), leaf greenness (LG), number of plant branches (NB), plant fresh weight (PFW) and plant dry weight (PDW) on peanut plants

phosphorus dose (kg ha ⁻¹)	Variable				
	PH (cm)	LG	NB	PFW (g/plant)	PDW (g/plant)
25	31,56	42,42	6,20	113,34	31,10
50	33,40	42,06	6,90	115,99	32,81
75	35,78	41,81	6,10	118,88	30,56
100	36,11	41,95	6,56	119,41	31,12

Table 5 Effect of phosphorus doses on pod weight (PW), seed weight per plant (SWP), number of seed pods (NSP), number of empty pods (NEP), weight of 100 seeds (W100), pod weight per plot (PWP) and seed-weight per plot (SWP) in peanut plants.

Phosphorus dose (kg ha ⁻¹)	Variable						
	PW (g/plant)	SWP (g/plant)	NSP	NEP	W100 (g/plant)	PWP (g/6m ²)	SWP (g/6m ²)
25	28,62	19,55	27,46	6,93	44,56	1970,88	1364,19
50	31,2	21,26	31,16	6,33	44,82	2389,76	1329,75
75	29,49	20,35	29,3	5,86	47,04	2246,8	1653,36
100	27,57	18,55	26,8	6,46	44,85	2215,91	1436,08

stover dry weight, pod weight, and peanut seed weight 53%, 58%, 67% and 71% higher, respectively, compared to that of control plants. Application of Phosphorus at dose 25, 50, 75, 100 kg ha⁻¹ did not affect the growth and yield of peanut plants.

REFERENCES

- Ding, G, J.M. Novak, D. Amarasiriwardena, P.G. Hunt, and B. Xing. 2002. Soil organic matter characteristics as affected by tillage management. *Soil Science Society of America Journal* 66:421-429.
- Dwidjoseputro, D. 1985. The basics of microbiology. Djambatan. Jakarta.
- Goldsworthy, P.R dan N.M. Fisher. 1992. Physiology of tropical cultivation plants (translation). UGM Press. Yogyakarta. 179p.
- Hartatik, W. 2007. *Tithonia diversifolia* source of green fertilizer. *Agricultural research and Development News* 29(5):3-5.
- Kurniansyah, D. 2010. Production of dried organic soybean is harvested from two soybean varieties with various types of organic fertilizer. Thesis. Departemen of Agronomy and Horticulture, Faculty of Agriculture, Bogor Agricultural University. Bogor (unpublished).
- Lestari, S.A.D. 2016. Utilization of paitan (*Tithonia diversifolia*) as an organic fertilizer in soybean plants. Research Institute for Various Plants of Beans and Bulbs, Malang 11 (1):49-56.
- Lingga, P. 2007. Instructions for use of fertilizers. Revised edition of Swadaya, Jakarta.
- Marzuki, R. 2007. Growing peanuts. Penebar Swadaya Press, Jakarta.
- Mimbar, S.M. 1991. Effects of density on miscarriage of pod retention and soybean yield. Thesis. Faculty of Agriculture, Brawijaya University, Malang (unpublished).
- Muhsanati, A. Syarif, and S. Rahayu. 2008. Effect of several doses of *Tithonia* compost on the growth and yield of sweet corn (*Zea mays Saccharata*). *Jerami* 1:87-91.
- Musnamar, E.I. 2006. Manufacture and application of solid organic fertilizers. Penebar Swadaya Press, Jakarta.
- Pramitasari, H. E., Tatik, W., and M. Nawawi. 2016. Effect of nitrogen fertilizer dosage and plant density level on growth and yield of kailan (*Brassica oleraceae* L.). *Malang. Journal of plant production* 4(1):49-56.
- Prasetya, M. E. 2014. The effect of NPK pearl fertilizer and cow manure on the growth and yield of arimbi curly red chilli (*Capsium annum* L.) varieties. *Agrifor Journal* XIII (2): 191-198.
- Ceenter for Agricultural Data and Information Systems Ministry of Agriculture. 2016. Peanuts. <http://epublikasi.setjen.pertanian.go.id/>. Diakses 19 Juli 2018.
- Saptoadi, H. 2001. Utilization Of Organic Matter From Municipal Solid Waste InCompost Industries. *Journal of Humans and the Environment* VIII :119 – 129.
- Setyamidjaja, D. 1986. Fertilizer and fertilization. CV. Simplex, Jakarta. 122 pp.
- Sjamsijah, N. Kuswanto, B. Guritno, and N. Basuki. 2016. Genotype interaction high production and early aged promising lines soybean with environment in east java. *Agriculture and Agricultural Science Procedia* 9:510 – 517.
- Sutanto, R., 2002. Application of Organic Agriculture : Correctional and Development. Kanisius, Yogyakarta.
- Bina Karya Tani. 2009. Guidelines for growing peanuts. Yrama Widya, Bandung.
- Tisdale, L.M. and F. R. Nelson. 1975. Soil Fertility and Fertilizers. McMillan Publ. Co. inc., New York.
- Widiwurjani and Suhardjono. 2006. The response of two mustard varieties to the administration of *Tithonia* biofertilizer (*Tithonia diversifolia*) as a substitute for inorganic fertilizer. Proceedings of the National Seminar on Biotechnology and Plant Breeding. Department of Agronomy and Horticulture, Faculty of Agriculture, Bogor Institute of Agriculture, Bogor. August 1-2, 2006.
- Winarso, S., 2005. Soil fertility : Basic health and soil quality. Gaya Media, Yogyakarta.
- Wibawa, W. 2014. Utilization of acid dry land with corn and peanut intercropping in Bengkulu Province. Ministry of Agriculture Agricultural Research and Development Agency Bengkulu Agricultural Technology Study Center, Bengkulu.