# Influence of Addition of Ameliorant on Productivity of Peanut on Acidic Dry Land in Bengkulu Province

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## ABSTRACT

Acidic dry land the dominant soil types in Bengkulu province which have potential for the development of dryland agriculture, but it has properties to inhibit plant growth due to high soil acidity (average pH <4.5), high Al saturation, poor main macro-nutrient, especially P, K, Ca and Mg and low organic matter content. Application of P and K fertilizer and addition of organic matter (ameliorant) are expected to overcome the problems. The objectives of this study was to investigate the application of ameliorant on growth and yield of four groundnut varieties on acidic dry land planted in Bengkulu. The experiment was carried out on acidic dry land in Central Bengkulu from June to September 2014 in the dry season. The experimental design used was a split plot design with two factor, first factor were addition of amelioran and varieties second factor with four replicates. Peanut varieties used were Talam, Tuban, Kancil and Local. Ameliorant given was Dolomite at 0.5 tons / ha and compost at 2.5 tons / ha. Fertilizer used were Urea,SP-36 and KCL at 75 kg / ha. The results showed that addition ameliorant was significantly different in plant height in early growth phase of peanut 28 and 42 days after planting (DAP) while for number of branch there is no significantly different. Addition ameliorant only provide significant difference in percentage of damaged pods, groundnut varieties provide real difference in weight of 100 grains, number of seeds / hill and number of pods / clump.

**Key words**: Acid dry land, peanuts, ameliorant, bengkulu

## INTRODUCTION

Acidic dry land is one type of soil that has spread widely in the province of Bengkulu. In general, acid dry land brownish yellow to red. In the old classification, acid dry land classified as Red Yellow Podzolic (RYP). This land has a high potential for expansion of dry land farming. For the development of food crops, including corn and peanuts. Good management needed because the soil dry land has acidic properties of inhibiting the growth of plants. Common problems of acidic dry land is high soil acidity (average pH <4.5), high Al saturation, poor nutrient content, especially P, K, Ca, and Mg, and low organic matter content. To overcome these problems can be applied technology liming, fertilizer P and K, and the addition of organic (Prasetyo *et al*., 2006).

Needs peanut in Indonesia continues to increase an average of 900,000 tons with an average production of 783.110 tonnes per year, so the national production only able to meet approximately 87.01% of the needs of peanuts. In 2011, domestic production amounted 691 289 tonnes were obtained from the harvested area of 539 459 ha. Low peanut production caused by low productivity only 1.28 tons/ha (Direktorat Jenderal Tanaman Pangan, 2012).

Peanut production in the Bengkulu Province in 2013 was 4.68 tons / ha. Compared to 2012, peanut production in 2103 decreased by 1.12 thousand tons / ha, down 19.36%. Decline in peanut production in 2013 is closely related to a decrease in harvested area of 1.03 thousand hectares, down 19.12% (BPS Kabupaten Bengkulu Tengah, 2013). In general, peanuts can be cultivated on different types of soil. In the fertile land, through the improvement of soil fertility and method of cultivation, the productivity of peanut reach 2.5 to 4 tonnes / ha, whereas on marginal land, soil fertility improvement and ways of cultivation, the productivity of peanut can reach 1.8 to 2.5 tons /ha (Wijanarko, 2013).

Nutrient content in the acid dry land are generally low due to intensified alkaline leaching, whereas low organic matter content due to the decomposition process runs fast and partly borne erosion. On acid dry land that has kandik horizon, natural fertility depends only on the organic matter in the upper layers. Dominance of kaolinite in this soil does not contribute to the cation exchange

capacity of the soil, so that the cation exchange capacity depends only on the content of organic matter and clay fractions. Therefore, an increase in the productivity of acid dryland can be done through soil improvement (amelioration), fertilization, and the provision of materials organic (Prasetyo *et al*., 2006).

Addition ameliorant (lime and organic matter) can overcome the problems of slow growth and development of plants on acid dry land. However, dose and mode of administration should be known with certainty by the farmers to provide maximum yields. The aim of this study was to determine the effect of ameliorant to the productivity of peanut on acid dry land in Bengkulu.

## MATERIALS AND METHODS

The research was conducted from June 2014 to October 2014. Land that used were acid dryland 4 ha in the Pasar Pedati village, district of Pondok Kelapa, Central Bengkulu Regency. Materials used were varieties of peanut seeds; Talam, Tuban, Kancil (obtained from the Research Institute for nuts and Tuber Crops - Crops Malang ) and Local.

The experimental design used was split plot design with two treatment factors. The first factor is the application of the addition ameliorant with 2 treatments, with the addition of ameliorant (2.5 t / ha compost + 0.5 t / ha dolomite) and without the addition of ameliorant. The second factor is four varieties of peanuts Talam, Tuban, Kancil and Local. The experiments consisted of 8 combinations with four replications with total 32 experimental units.

Compost was given as initial fertilizer during land tillage, dolomite was given at beetwen array of row crop same time first fertilization. Compost that used from farmers Seluma. Urea fertilizer was 75 kg / ha, SP-36 75 kg/ha and 75 kg KCl / ha. First fertilization is carried out when the plant is 10-14 days after planting (DAP). Soil sampling performed on the land before and after research to obtain data on physical properties (moisture content, texture 3 fractions soil) and chemical properties of soil; pH H2O (pH meter), C-organic (Walkley and Black), N-total (Kjedahl), P (Bray method), K (extract NH4OAc), Na (extract NH4OAc), Ca-dd (extract NH4OAc), Mg-dd (extract NH4OAc). Soil analysis conducted at the Laboratory of Soil and Soil Laboratory BPTP Bengkulu Soil Research Institute Bogor.

## RESULTS AND DISCUSSION

### Soil Nutrient Status

Table 1 shows that before planting (preliminary analysis) macro nutrient content of C-organic high, N-total medium, P-Bray high, and the low content of K-dd. Generally, potassium levels more than the phosphorus, but on acid dry land specific Bengkulu, phosphorus content is higher than the content of potassium, because the acid dry land located in near coast, there are many sediment rocks around the coast, causing phosphorus content is higher. The content of Na (low), Ca (very low), Mg (medium), CEC (medium) and Al content (very low). magnesium levels are sometimes found to be higher than the amount of calcium but number of available always a little, therefore, a magnesium deficiency can be overcome by liming. To fulfill the needs of crop nutrient, fertilizer needs to be added so that the needs of Nitrogen, Phosphorus and Potassium fulfilled (Hakim, 1986).

A change in nutrient status of the soil before and after planting peanuts. The results showed that an increase in soil pH from 5.9 to pH 6.01 and k-dd rise of 0,21me / 100 g became 0.72 me / 100 g, whereas organic C, N-total, P-Bray , Na, Ca, Mg, and Al-dd CEC and base saturation impaired nutrient status of the soil. This is because the peanut take nutrients contained in the soil. Liming acid soils aims to increase soil pH, base saturation and suppress the toxic potential of micro-elements (such as Al). N-total is an indicator of nutritional status peanut least decreased because peanuts are legumes that can symbiosis with Rhizobium that are capable of binding free nitrogen from the air and form nodules that can fertilize the soil. Peanut is a plant that can be grown on soil pH range of 5.3 to 6.6 (Foth, 1995).

Tabel 1. The results of soil Preliminary analysis and posterior analysis Pasar Pedati village, Central Bengkulu District

| Type of analysis | Preliminary analysis | Description | Posterior analysis | Description |
|---|---|---|---|---|
| Water content(%) | 5.8 | - | 3.8 | - |
| pH $H_2O$ | 5.9 | Slightly acid | 6.01 | Slightly acid |
| C-Organic (%) | 4.04 | High | 1.90 | Low |
| N-Total (%) | 0.30 | Moderate | 0.23 | Moderate |
| P-Bray I (ppm) | 13.13 | High | 3.54 | Very low |
| K-dd (me/100 gr) | 0.21 | Low | 0.72 | High |
| Na (me/100gr) | 0.30 | Low | 0.19 | Low |
| Ca (me/100gr) | 0.88 | Very low | 0.68 | Very low |
| Mg (me/100gr) | 1.42 | Moderate | 0.89 | Low |
| KTK (me/100gr) | 21.67 | Moderate | 17.50 | Moderate |
| Al-dd | 1.64 | Very low | 1.10 | Low |
| Base saturation | 12.96 | - | 14.17 | - |

Rainfall data in the district of Pondok Kelapa showed that during the growth of peanuts (June to October) decrease the number of days and precipitation lower than the previous year. Data rainfall in the district of Pondok Kelapa show a different rhythm between the odd and even based on the number of days and rainfall. In the odd years of 2011 and 2013 high rainfall and rainy days were in June and September, while in the even-numbered years in 2012 and 2014, rainfall and rainy days in June to September reduced (Balai Penelitian Tanaman Aneka Kacang dan Umbi, 2012). It was therefore advisable for the 2014 planting was done in October when the rainy season or 2015 in June through September.

Each type of plant has the optimal potential can be achieved in an appropriate environment to the needs of the plant. The nature of the soil is a very important physical and chemical fertility. While the most important climatic factor is rainfall and rainy days. Rainfall and rainy days are very varied. Adaptive plant breeding for the acid land needed if soil acidity problems and Al saturation occurs in the inner layer (subsoil). If the problem occurs in the upper layers, less addressed by liming (Hairiah , 2000; Dalovic, 2010; Witcombe *et al*., 2013).

**Vegetative and Generative of Peanuts Growth**

Results of analysis of variance showed significant ameliorant addition effect on plant height at 28 and 56 days after planting, and the number of branches at 42 and 56 days after planting. Crop varieties significantly different ($P<0.05$) on plant height and no significant difference ($P>0.05$) in the number of branches/clump (Table 2).

Table 2. Results of analysis of variance effect of treatment and varieties on plant height and number of branches peanuts at age 28, 42, 56, and 84 days after planting

| Treatment | Plant height (cm) on DAP | | | | Total Branch / clump on DAP | | | |
|---|---|---|---|---|---|---|---|---|
| | 28 | 42 | 56 | 84 | 28 | 42 | 56 | 84 |
| Influence of Ameliorant : | | | | | | | | |
| Addition ameliorant | 10,70$^{b}$ | 12,22$^{b}$ | 24,57$^{a}$ | 44,96$^{a}$ | 6,11$^{a}$ | 8,33$^{a}$ | 8,61$^{a}$ | 8,43$^{a}$ |
| Without the addition of ameliorant | 17,62$^{a}$ | 17,81$^{a}$ | 23,43$^{a}$ | 46,66$^{a}$ | 6,46$^{a}$ | 7,15$^{b}$ | 6,99$^{b}$ | 7,66$^{a}$ |
| Influence of varieties : | | | | | | | | |
| Talam | 14,80$^{a}$ | 16,08$^{a}$ | 24,69$^{a}$ | 48,15$^{ab}$ | 6,08$^{a}$ | 7,25$^{a}$ | 7,65$^{a}$ | 7,68$^{a}$ |
| Tuban | 15,03$^{a}$ | 15,73$^{a}$ | 26,34$^{a}$ | 51,20$^{a}$ | 6,68$^{a}$ | 8,00$^{a}$ | 8,23$^{a}$ | 8,58$^{a}$ |
| Kancil | 14,98$^{a}$ | 15,32$^{a}$ | 24,96$^{a}$ | 44,28$^{bc}$ | 6,38$^{a}$ | 7,65$^{a}$ | 7,40$^{a}$ | 7,55a |
| Lokal | 11,84$^{a}$ | 13,07$^{a}$ | 20,01$^{b}$ | 39,63$^{c}$ | 6,02$^{a}$ | 8,05$^{a}$ | 7,93$^{a}$ | 8,40$^{a}$ |

In the initial phase of growth at 28 and 42 days after planting peanuts without addition of ameliorant granting higher significantly different than that with addition of ameliorant, but at 56 DAP

and 84 DAP not significantly different. Height of 4 plant varieties tested at the age of 28 and 42 HST was not significantly different (Table 2). In 56 DAP, local variety lower than other varieties. At the time of plant varieties aged 84 DAP, Tuban varieties higher significantly different than Kancil and the local varieties.

The number of branches of peanut at age 28 DAP with ameliorant treatment was not significantly different than without ameliorant. At the age of 42- 84 DAP starting to look for significant differences in the number of branches on the addition of the plant with the addition of ameliorant. The number of branches was not significantly different in the four varieties tested at any age observations.

Results of analysis of variance showed no effect of addition of ameliorant to dry weight of stover, dry weight of pods and pod number/clump. Addition of ameliorant only have a significant impact on the percentage of damaged pods. Crop varieties were not significantly different in stover dry weight, dry weight and the percentage of pods damaged pods. Crop varieties were significantly different only in the number of pods/clump (Table 3).

The effect of addition ameliorant were significant on the percentage damaged pods (Table 3). Ameliorant additions increase the percentage of damaged pods than without the addition of ameliorant. Addition ameliorant no effect on stover dry weight, pods dry weight and the percentage of damaged pods.

Plant varieties significantly affect the number of pods /clump. Tuban varieties have a number of pods significantly different from the Kancil varieties. Effect of plant varieties were not significantly different in stover dry weight, dry weight of pods, and the percentage of plants (Table 3).

Table 3. Results of analysis of variance to the treatment effect and varieties forage dry weight, dry weight of pods, number of pods / clump and percentage of damaged pods of peanut plants

| Treatment | Stover dry weight (g/clump) | Pods dry weight (gr/clump) | Number of pods/ clump | Percentage of damaged pods |
|---|---|---|---|---|
| Effect of Ameliorant : | | | | |
| Addition of Ameliorant | 17.52[a] | 21.30[a] | 21.78[a] | 24.27[a] |
| Without the addition of ameliorant | 16.74[a] | 25.90[a] | 21.93[a] | 14.36[b] |
| Effect of varieties : | | | | |
| Talam | 15.84[a] | 22.39[a] | 18.98[ab] | 21.76[a] |
| Tuban | 22.31[a] | 22.45[a] | 25.95[a] | 20.40[a] |
| Kancil | 15.15[a] | 24.00[a] | 18.73[b] | 16.97[a] |
| Lokal | 15.25[a] | 25.56[a] | 23.75[ab] | 18.15[a] |

Results of analysis of variance showed no effect of ameliorant addition to the number of seeds / hill, 100 grain weight, dry weight of crop and harvest index. Crop varieties no significant effect on the dry weight of crop and harvest index, but significant effect on the number of seeds / clump and weight of 100 grains (Table 4).

Table 4. Results of analysis of variance and treatment effect on the number of seed varieties / clump, weighing 100 grains, dry weight of crop and harvest index peanuts

| Treatment | Number of seeds/clump | weight 100 grains (g / clump) | dry weight of crop | harvest index |
|---|---|---|---|---|
| Effect of Ameliorant: | | | | |
| Addition of Ameliorant | 29.21[a] | 501.25[a] | 1.54[a] | 43.76[a] |
| Without the addition of ameliorant | 29.89[a] | 508.36[a] | 1.62[a] | 46.32[a] |
| Effect of varieties: | | | | |
| Talam | 23.83[ab] | 520.50[b] | 1.52[a] | 49.44[a] |
| Tuban | 38.94[a] | 488.25[c] | 1.54[a] | 45.50[a] |
| Kancil | 19.74[b] | 548.13[a] | 1.60[a] | 43.98[a] |
| Lokal | 35.68[ab] | 462.38[c] | 1.66[a] | 41.25[a] |

Crop varieties differ significantly affected the number of seeds/clump and weight of 100 grains (Table 4). Talam has biggest number of seeds/clump and significantly different from the Kancil varieties.Kancil varieties has the greatest weight of 100 grains significantly different from Tuban and Local varieties. Addition ameliorant not significantly different in the number of seeds / hill, 100 grain weight, dry weight of crop and harvest index.

Peanut plants are unique when compared to other food crops, such as paddy and corn. Peanut pods come from the development of peanut plants flower experiencing flowering and develop into ginofor. Ginofor need to penetrate the soil surface to become pods. Plant height and number of branches in peanuts has a considerable influence on peanut plants. If the growth of peanuts too high then ginofor takes longer time to penetrate the soil and develop into pods. Giving ameliorant on peanut plants give the effect of slowing the growth of plant height at 28 and 42 days after planting. Age flowering plant several varieties of peanut plants vary, ranging from 25-27 days (Faronika *et al*., 2013). At the age of 28 DAP peanut flowers have begun to bloom so expected the growth of peanuts in the early phase of growth to a minimum as possible to facilitate ginofor penetrate the soil surface.

According to Mona faronika (Faronika *et al*., 2013). Low percentage ginofor forming pods (not reaching 50%) presumably due to the high number of ginofor fallen or low number of ginofor that gone into the soil, this is caused by the distance between ginofor and soil; also caused by soil conditions, textured clay soil is not porous, making it hard ginofor penetrate into the soil.

Number of branches of the plant serves as a place of attachment of the leaf to plant photosynthesis to produce carbohydrates that are used for charging ginofor into pods. The more branches and more leaves means more ginofor that can be formed.

The effect of adding ameliorant not visible on generative components such as number seeds / hill, 100 grain weight, dry weight of crop and harvest index. Stover dry weight, dry weight of pods, number of pods / clump and percentage of damaged pods (Table 4). This is because the environmental conditions (in this case the number of rainy days and rainfall) that do not support the peanut plants to develop in accordance with the expected yield potential. Due to larger percentage of damaged pods; peanut production with the addition of ameliorant not significantly different without the addition of ameliorant. If the damage percentage factor can be reduced then the addition ameliorant land to increase peanuts production.

The percentage of damaged pods (Table 3) on each plant varieties were not significantly different though peanut varieties grown are varieties resistant to bacterial wilt disease, moderately resistant to leaf rust, moderately resistant to leaf spot and hold *A. flavus* (up to 3 months after harvest) as well as moderately resistant acidic soil (pH 4,5- 5,6) with Al saturation of 30-35% (Faronika *et al*., 2013). This is caused by the lack of rainfall at planting time and the unavailability of adequate water resources resulting in dolomite supplied to the ground is not completely absorbed. Lack of water causes dry land cropping index is still relatively low (Table 4).

Drought stress is an environmental factor that often limits the results of peanuts. Reduction of yields are influenced by the growth phase of the plant during drought stress occurs. Expected role of government can be enhanced for the provision of irrigation in acid dry land. Drought stress at pod filling stage until the harvest decrease up to 43% of yields (Purnomo et al., 2007). Purposes of liming on acid dry land sub-tropic regions is to raise the pH to neutral evidently can not be applied in the tropics region. Lime addition to neutralize the pH in the tropics often disrupt production, because it liming on tropical soil near neutral is not necessary. The purpose of liming on acid soils in tropical regions should be directed to counteract the toxic effects of aluminum (Al) and providing nutrients calcium (Ca) for plants (Witcombe *et al*., 2013).

## CONCLUSION

Peanut varieties Tuban, Talam and Kancil successfully grown on acid dry land Bengkulu-specific with productivity each 2.04 ; 1.76 and 1.89 tonnes / ha and without the addition of each ameliorant productivity is 1.87; 2.17 and 2.17 tonnes / ha. It is advisable to do research in the rainy season to study the interaction of ameliorant and stability of the production of varieties Tuban, Talam and Kancil in the province of Bengkulu.

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