

Growth Response Of 3 Local Muna Peanut Ecotypes To Compost Plus Application On Sub-Optimal Land, Southeast Sulawesi

Nini Mila Rahni, Gusnawaty, Rismiyati, Suyati Yahya, Rahma Eka Irawaty

Abstract—Demand for peanuts that continues to increase is not followed by yields every year. Marginalized land conditions and poor adaptation are the limiting factors in the rate of crop production. Compost fertilizer is one solution in overcoming land problems by combining rice straw waste and chicken manure waste. This research was conducted in the village of Huko-Huko from November 2017 to March 2018 using the Split Plot Design in a Randomized Block Design (RBD). The main plot was the Muna local peanut ecotype (E) consisting of three levels, namely: Wadaga ecotype (E1), Parigi ecotype (E2), and Lasehao (E3) ecotype. Subplot was the compost dosage consisting of four levels: without compost (K0), compost 5 t ha⁻¹ (K1), compost 10 t ha⁻¹ (K2) and compost 15 t ha⁻¹ (K3). In total, there were 12 treatment combinations and repeated three times. The results of the study revealed that Rice Straw Compost Fertilizer increased the growth component of the Peanut plant, including the Relative Growth Rate (RGT), Leaf Area Index (LAI) and Net Assimilation Rate (NAR) for all ecotypes. The optimum dose of rice straw compost that affects the growth of local Muna peanuts in marginal dry land was 15 t ha⁻¹ for the Wadaga and Lasehao ecotypes and 5 t ha⁻¹ for the Parigi ecotype.

Keywords: peanut ecotypes, sub-optimal land and compost plus.

1 INTRODUCTION

Peanut is one of the important food crops in Indonesia. They have a strategic role in the national economy because of their multipurpose function that can be used as a source of protein and vegetable oil (Kurniawan et al., 2017). Sondakh et al. (2012) suggested that peanuts can also be used as nutritious food and animal feed because they contain fat (40-50%), protein (27%), 12% carbohydrates (Silitonga et al., 2018), vitamins (A, B, C, D, E and K) and several other minerals, such as Calcium, Chloride, Ferro, Magnesium, Phosphor, Potassium and Sulfur. In addition, peanut plants are also able to increase soil fertility because it can be symbiotic with *Rhizobium* bacteria to bind free nitrogen from the air (Gothwal et al., 2007). Demand for peanuts continues to increase along with an increase in the rate of population growth and public awareness of the need for protein. However, domestic production has not been able to meet these needs. The average national peanut productivity is 1.35 tons ha⁻¹ for dry pods (Silitonga et al., 2018). This number is relatively low when compared to China (3.61 tons ha⁻¹) and the United States (4.73 tons ha⁻¹). Peanut cultivation is limited by quality of the land, especially in Southeast Sulawesi, which is largely dominated by marginal dry land that has a relatively low fertility rate. This is indicated by the acid soil (low pH), low nutrient reserves, low availability of organic matter, high Al-saturation, high Al, Fe and Mn content, rough soil texture, drought-prone soil, and sensitive to erosion (Suharta, 2010). In addition, low peanut production is also related to adaptation aspects. Some superior varieties that have been introduced to communities still have a low level of adaptation to the local conditions. Some improvement efforts have been made, but

have not shown satisfactory results (Azzahra and Koesrini, 2003). Some local varieties that are environmentally adaptive can be an alternative to increase the production. Native Muna peanuts, for example, have a high degree of adaptation to environmental stress due to climate and marginal soils. Another advantage of the local peanut ecotypes is that they have a denser seed texture with a more savory taste (Rahni, 2014).

Underutilized local resources such as rice straw and chicken manure which are widely available can be used as an alternative to overcome the limitations of marginal dry land. Some studies show that the rice straw compost contains three important elements for plant: 1.83% nitrogen, 0.13% phosphate (P), and 1.59% Potassium (K). In addition, the compost can also improve soil fertility, loosen the soil, and increase the development of peanut pods (Jannah, 2018). The application of rice straw bokashi fertilizer at a dose of 10.57 tons ha⁻¹ affects the growth and production of mung bean plants (Syofia et al., 2017). Like rice straw waste, livestock waste can also be made into compost. The use of chicken manure can improve soil properties and support plant growth. Compost fertilizer contains macro and micro nutrients needed for plant growth and development. Application of compost in dry land can improve soil structure and porosity, loosen soil, increase microorganisms, enhance water absorption and storage capacity, so that soil fertility increases (Yuliarti, 2009). Based on the description, rice straw waste and chicken manure waste can be used as compost and can increase peanut production in marginal dry land, but the dose of compost fertilizer for peanut cultivation on marginal dry land is unknown, so research is needed.

2 MATERIALS AND METHODS

This research was conducted in the village of Huko-Huko, Pomalaa District, Kolaka Regency. Analysis was carried out at the Laboratory of Soil Science and the Laboratory of Agrotechnology in the Faculty of Agriculture, Halu Oleo University, Kendari. This research took place from November 2017 to March, 2018. The materials used in this study were: local Muna peanut seeds (Wadaga ecotype, Parigi ecotype, Lasehao ecotype) and compost fertilizer (rice straw, chicken manure and water). Equipment used during the study was soil

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treatment equipment, measure tape, warring net, sprinklers, plastic rope, plastic bags, scissors, machetes, cameras, writing instruments, analytical scales, electric ovens, leaf areas meters and other laboratory equipment for soil analysis. This study used a Split Plot Design in a Randomized Group Design (RGD). The main plot was the Muna (E) local peanut ecotype consisting of three levels, namely: Wadaga ecotype (E1), Parigi ecotype (E2) and Lasehao (E3) ecotype. The subplot was the compost dosage consisting of four levels, namely: without compost (K0), compost 5 t ha⁻¹ (K1), compost 10 t ha⁻¹ (K2) and compost 15 t ha⁻¹ (K3). From these two treatment factors, 12 treatment combinations were obtained and were repeated three times, so that there were 36 experimental units. The land was divided into 36 plots with a size for each plot was 2.5 m x 3 m x 20 cm (wide x length x height). The distance between plots in a group was 30 cm while the distance between groups was 50 cm. The compost was a 14-days-fermented mixture of rice straw, chicken manure, EM₄, and water. The peanut seeds were first soaked in water for 3 hours. Peanut harvesting was done by pulling the plants and then they were cleaned and dried using an oven with a temperature of 80 °C for 48 hours. Variables observed in this study were plant growth parameters, namely Relative Growth Rate (RGT), Leaf Area Index (LAI), and Net Assimilation Rate (NAR). Response curve analysis was used to determine the optimum dose of the compost fertilizer in marginal dry land which gave the best results on the growth and production of local Muna peanuts.

3 RESULTS AND DISCUSSION

Plant growth is a process that results in changes in size, weight, volume and diameter of stems over time. There are two important factors that influence the growth of a plant, namely genetic and environmental factors. The growth of peanut plants in this study was evaluated by measuring the relative growth rate, leaf area index, and net assimilation rate.

3.1. Relative Growth Rate (RGT)

The relative growth rate indicates the average increase in plant dry weight per unit area over a certain period of time. The relative growth rates of three local Muna peanut ecotypes during the growing period of 14–70 days after plantation (DAP) as the effect of applying rice straw compost showed different responses. Response curves in each ecotype of local Muna peanuts by administering varying doses of rice straw compost showed a quadratic response pattern. The relative growth rate initially increased but then decreased when the plant was older because in addition to maintaining its vegetative growth, plants also begin to enter the generative growth phase so that the rate of photosynthate production is lower than before (Figure 1). In general, the relative growth rate values of Wadaga and Lasehao ecotypes was higher with increase in the dosage of rice straw compost. However, the growth rate value of the Parigi ecotype relatively decreased with increase in the level of rice straw compost. The highest relative growth rate value was obtained after the application of 15 t ha⁻¹ of rice straw compost fertilizer for of the Wadaga ecotype (0.080 g day⁻¹), 5 t ha⁻¹ for the Parigi ecotype (0.072 g days⁻¹), 15 t ha⁻¹ for the Lasehao ecotype (0.079g day⁻¹). In their optimal compost application dosage, the relative growth rate value of Wadaga ecotype was the highest compared to the other two ecotypes. This could be caused by the better ability of Wadaga ecotypes to adapt to soil that have low levels

of fertility and organic matter. Genetically, Wadaga ecotypes are more tolerant of marginal dry land conditions and their morphological conditions are more responsive to treatment than the Parigi ecotype and Lasehao ecotype.

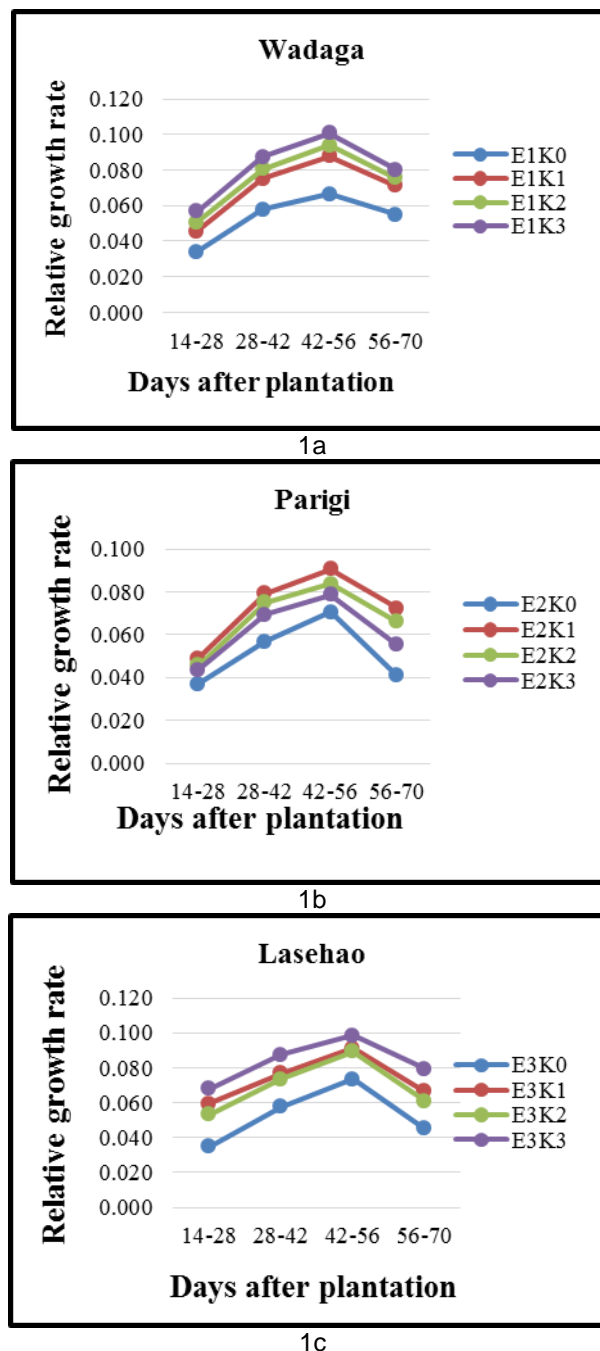


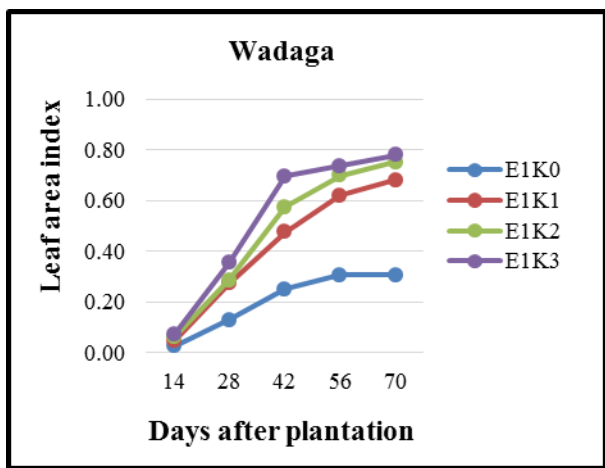
Fig 1. Relative growth rates of three local Muna peanut ecotypes by administering various doses of rice straw compost (1a. Wadaga ecotype; 1b. Parigi ecotype; 1c. Lasehao ecotype).

Aminah *et. al.*, (2018) states that nitrogen in rice straw compost can support and enhance vegetative growth. This is related to the role of nitrogen as a constituent of amino acids, such as tryptophan (IAA precursor), and a component in the molecular constituent of a chlorophyll. Mulyanto *et. al.*, (2018), states that N levels are directly proportional to the ability of plants to produce assimilates, which will affect the growth rate.

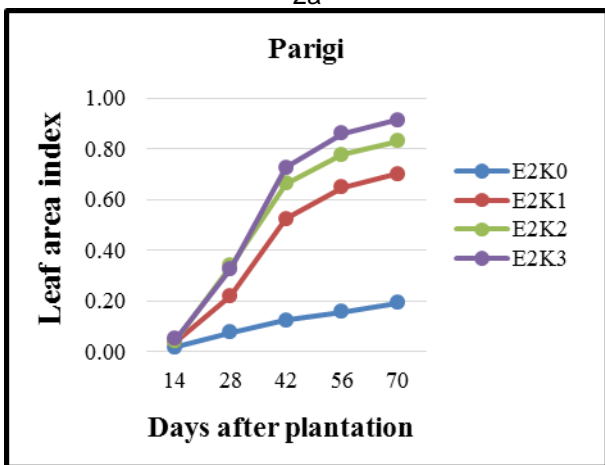
In addition, the compost is also able to improve the physicochemical properties of the soil, thus helps the root system to absorb water.

3.2. Leaf Area Index (LAI)

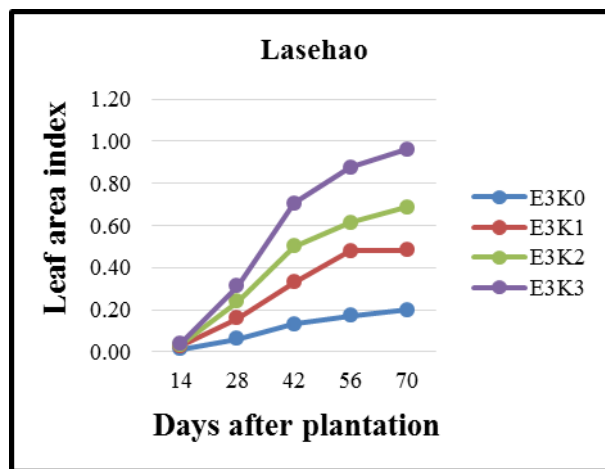
The leaf area index shows the average of the ratio between the area of green leaves and the area of the planted land over a period of time. The changes of the LAI of local Muna peanuts of Wadaga ecotype, Parigi ecotype, and Lasehao ecotype during 28-70 days after plantation showed different responses due to the administration of rice straw compost at different levels (Figure 2). The highest leaf area index value of Muna Wadaga ecotype (0.78), Parigi ecotype (0.91), and Lasehao ecotype (0.96) was obtained when the compost was given at the dose of 15 t ha⁻¹.



2a



2b



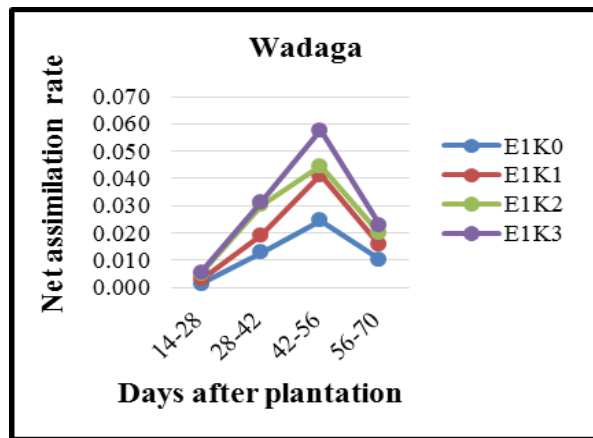
2c

Fig 2. Leaf area index of three local Muna peanut ecotypes with various dosage of rice straw compost (2a. Wadaga ecotype; 2b. Parigi ecotype; 2c. Lasehao ecotype)

The increase in Wadaga ecotype leaf area index was the highest in all levels of rice straw compost administration compared to the Parigi ecotype and Lasehao ecotype. Generally, the leaf area index of the three Muna local peanut ecotypes continues to increase over time and with increase in the dose of the compost. Higher level of compost provides more organic material in marginal dry land so that improves the growth of the plants. Syafrullah., *et al* (2016) states that the application of rice straw bokashi and P fertilizer increases the value of the plant leaf area index.

3.3. Net Assimilation Rate (NAR)

The local Muna peanuts of Wadaga, Parigi, and Lasehao ecotypes have different responses in term of the net assimilation rate during 14-70 days after plantation due to the administration of rice straw compost in different doses (Figure 3).



3a

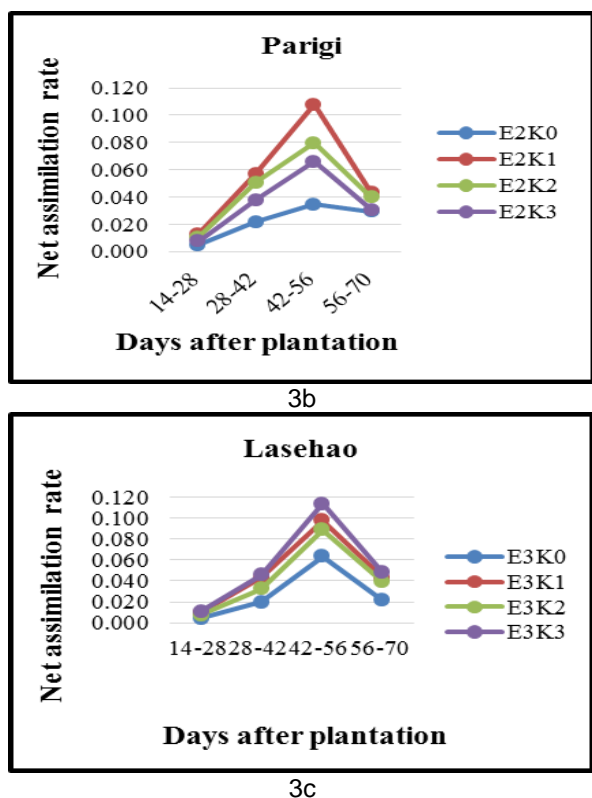


Fig 3. The net assimilation rate of three local Muna peanut ecotypes with various dosage of rice straw compost (3a. Wadaga ecotype; 3b. Parigi ecotype; 3c. Lasehao ecotype).

The net assimilation rate of the local Muna peanut plant from Lasehao ecotype was the highest compared to the net assimilation rate of the peanut plant from the Wadaga and Parigi ecotypes. The highest net assimilation rate of the Lasehao ($0.048 \text{ mg cm}^{-2} \text{ day}^{-1}$) and Wadaga ($0.023 \text{ mg cm}^{-2} \text{ day}^{-1}$) ecotypes was obtained from the application of 15 t ha^{-1} rice straw compost fertilizer, while in the Parigi ecotype, the highest net assimilation rate ($0.043 \text{ mg cm}^{-2} \text{ days}^{-1}$) was obtained in the administration of rice straw compost of 5 t ha^{-1} . The pattern of the net assimilation rate of the three local Muna peanut ecotypes can be described as a quadratic curve, ie at the beginning of growth until 56 days after plantation the net assimilation rate continues to increase and after that period or with increasing plant age the net assimilation rate decreased. According to Gardner *et al.*, (2007), the net assimilation rate of plants is not constant, but tends to decrease with increasing plant age. This is in line with the research of Arifin (2013) in Hidayaty *et al.*, (2017), which states that the net assimilation rate is maximum when the plants are young and most of the leaves are exposed to the sun. The growth of cultivated plants and the increase in leaf area index increase the number of leaves that are not directly exposed to sun light so that the net assimilation rate decreases.

4 CONCLUSION

The application of rice straw compost influenced the growth of the three local Muna peanut ecotypes. The application of higher doses of rice straw compost increased growth in the Wadaga ecotype and Lasehao ecotype. In contrast, application of rice straw compost at lower doses increased growth and yield in the Parigi ecotype. The optimum dose of

rice straw compost in the marginal dry land that resulted the highest growth of local Muna peanuts was 15 t ha^{-1} for Wadaga and Lasehao ecotypes and 5 t ha^{-1} for Parigi ecotype

REFERENCES

- [1] Aminah. S., H. Hanum., & Sarifuddin. (2018). The Effects of Potassium, Nitrogen and Straw Compost Giving to Increase Organic Material Levels and K-Exchangeable Rice Fields and Rice Growth. *IOP Conf. Series : Earth and Environmental Science*, 260 (2019) : 1-6.
- [2] Azzahra F., & Koesrini. (2003). Penampilan Genotipe-Genotipe Kacang Tanah di Lahan Lebak Dangkal. Balai Penelitian Lahan Rawa. Banjarbaru.
- [3] Gothwal, R.K., Nigam. V.K., Mohan. M.K., Samsal. D., & Gosh. (2007). Screening of Nitrogen Fixers from Rhizospheric Bacterial Isolates Associated with Important Desert Plants. *Appl. Ecol. And Environ. Res.* 6(2) : 101-109.
- [4] Hidayaty. N., I. Suliansyah., & Irawati. (2017). Pengaruh Pupuk Kompos Jerami Padi dan Kompos Titonia (*Tithoniadiversivolia*) terhadap Pertumbuhan dan Hasil Tanaman Gandum (*Triticumaestivum*L.) Kultivar GURI 6 UNAND. *Jurnal Agroteknologi Universitas Andalas*, 1(1) : 30-35.
- [5] Jannah. R. (2018). Pengaruh Penggunaan Kompos Jerami Padi terhadap Pertumbuhan dan Hasil Tanaman Kacang Tanah (*Arachis hypogaea*L.). *Agrotropika Hayati*, 5(1) : 64-70.
- [6] Kurniawan. R. M., H. Purnamawati., & Y. Wahyu. (2017). Respon Pertumbuhan dan Produksi Kacang Tanah (*Arachishypogaea*L.) terhadap Sistem Tanam Alur dan Pemberian Jenis Pupuk. *Bul. Agrohorti* : 5(3) : 342-350.
- [7] Mulyanto, F. D., N.E. Suminarti., & Sudiarmo. (2018). Respon Kacang Tanah (*Arachis hypogaea*L.) pada Berbagai Aplikasi Pupuk N dan Kompos Azolla. *Jurnal Produksi Tanaman*, 6(5) : 791-800.
- [8] Silitonga. L, E. Turmudi., & Widodo. (2018). Growth and Yield Response of Peanut (*Arachis hypogaea* L.) To Cow Manure Dosage and Phosphorus Fertilizer on Ultisol. *Agrosia Deed*, 21(1): 11-18.
- [9] Sondakh. T.D., D.N. Joroh., A.G. Tulungen., D.M.F. Sumampow., L.B. Kapugu., & R. Mamarimbing. (2012). Hasil kacang Tanah (*Arachis hypogaea*L.) pada Beberapa Jenis Pupuk Organik. *Eugenia*, 18(1) : 64-72.
- [10] Suharta. N. (2010). Karakteristik dan Permasalahan Tanah Marginal dari Batuan Sedimen Masam di Kalimantan. *Jurnal Litbang Pertanian*, 29 (4) : 139-146.
- [11] Syarullah, N. Marlina, Gusmiatun., R.I.S.Aminah., A.Y. Zairani., H. Hawalid., Rosmiah, Khodijah., & E. Hawayanti. (2016). The Effect of Balance Fertilization Composing Of Rice Straw Organic Fertilizer and NPK Fertilizer on Growth and Yield of Paddy Field Rice (*Oryza sativa* L.). *Internasional Journal of Engineering Research and Science and Technology*, 5(1) : 1-12.
- [12] Syofia. I., D., & J.S., I. Rezeki. (2017). Respon Pertumbuhan dan Produksi Tanaman Kacang Hijau (*Vigna radiate* L.) terhadap Pemberian Pupuk Bokashi Jerami Padi dan Pupuk Cair Limbah Udang. *Agrium*, 21(1) : 104-113.