Applying organic fertilizer in cassava (*Manihot esculenta*) – mungbean (*Vigna radiata*) intercropped to improve dryland productivity

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Abstract. Organic matter content in the dryland farming system tends to decrease rapidlyin most of arid region of Eastern Indonesia. This experiment aimed to test that hypothesis by growing casava and mungbean with and without organic fertilizer (cattle manure) under monoculture and intercropping. The study used a factorial completely randomized block design. The first factor is two cropping systems, namely monoculture and intercropping, the second factor is 2 applications of organic fertilizer (compost), namely 1) No compost and 2) Compost. Each treatment uses 6 replications. The results showed a significant effect of treatment on cassava yield component and productivity, while mungbean growth and yield was similar between treatment. Cassava grown under intercropping system with additional cattle manure was significantly produced the longest tuber (71.40 cm) and the largest number of tubers (6.40 tubers.plant^{-1}). It also contributed to the highest tuber productivity (28.40 t.h^{-1}), followed by yield of casava under intercropping system without compost (26.00 t.h^{-1}), then the casava monoculture system with compost (21.80 t.h^{-1}). The least was the monoculture system without compost (21.70 t.h^{-1}). This experiment proved that additional organic fertilizer under intercropping system could increase the productivity of dryland (LER = 2.13).

1 Introduction

Semi arid climatedryland is one of the suboptimal land types in Indonesia, with an area up to 13.3 million ha from a total dry area of 122.1 million ha [1]. West Nusa Tenggara (NTB) has dry climate dryland with an area of 1.5 million ha. Dryland with a dry climate is located in areas with the lowest annual rainfall (<2,000 mm.year^{-1}) [2] with a short period. As a result, the water resources are the main constraints for the intensive development of various agricultural commodities. Water limitation and potential for erosion affect low soil fertility in dry climates. Daily rain onsemi arid climate dryland occurs in high volumes quickly (erratic), causing large run off and erosion.

High levels of erosion during the rainy season and low water availability in the dry season are obstacles that cause dryland in Indonesia not intensively use for agricultural cultivation.

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These limiting factors cause the types of plants that can be cultivated to be limited. The type of plant and the proper planting system will greatly determine the success of farming on dryland. Plants that can be cultivated on dry land in dry climates are dry resistant plants. Secondary crops such as maize, sorghum and root crops are relatively able to survive in dryland. Various legumes plants are classified as plants that do not have special land so that other plants easily displace them with more economic value. Various legumes plants are also difficult to develop in areas that have been dominated by certain plants, such as cassava or maize. Various legumes plants have a very important conservation role that can restore soil fertility. Intercropping is one of the efforts to increase productivity and reduce the risk of crop failure in dry land with dry climate [3].

Intercropping is planting two or more types of plants on the same land at the same time or almost simultaneously [4]. This double cropping system is an alternative that can be done to increase land productivity [5-6], especially in dry land. Intercropping increases land efficiency by planting intercrops between main crops. This planting system will increase the efficiency of the use of sunlight, nutrients, water, reduce the risk of crop failure and suppress weed growth [7-8]. Intercropping of cassava and other crops is a subsistence cultivation system, usually carried out by farmers on dry land. Applying the intercropping planting system, it is necessary to consider the types of plants that are intercropped plants. C4 and C3 plants are very suitable for intercropping [9-10].

Cassava and mungbean are C3 plants [11-12] which have low light saturation levels so that they can be developed under low intensity conditions such as intercropping systems. C3 plants are plants whose photosynthesis process follows the Calvin cycle [13]. Photosynthetic efficiency of C3 plants is low with CO_2 utilization of only 50% because it is limited by photorespiration [14]. The success of the sustainable intercropping system is influenced by growth characteristics, different growth phases and plant ages, and environmental engineering. The success of the sustainable intercropping system is influenced by growth characteristics, different growth phases and plant ages, and environmental engineering. Intercropping cassava with cereals such as maize, sorghum and beans supports environmental conservation [15].

Intercroppingis able to increase land efficiency, effectively control erosion, improve soil physical and chemical properties. In this way, it is able to increase farmer income evenly throughout the year. Mungbean is a C3 plant with a harvest age of 70-75 days, while the Seteluk local cassava has a proper plant morphology, slow branching, slow initial vegetative growth and narrow leaf size characters. Intercrop various early-mature and shade-tolerant beans such as mungbean with cassava wich grows upright, slow/unbranched can increase land productivity [16]. increased production of dry land with a double cropping system (intercropping) requires more nutrient. Most of the dry land is poor in organic content (humus) and nutrients, both macro and micro. Thus, it certainly requires the application of organic matter.

The use of compost is a form of additional organic matter to the soil. Organic fertilizers are able to increase soil physical properties, especially soil porosity and permeability [17], increase water-holding capacity so that more water is available for plants [18], a source of macronutrients [19] and improving soil biological life [20]. This type of organic material can be used either in solid form (manure) or in liquid (biourine). Rosmarkam and Yuwono [21] stated that giving compost in the form of manure can improve the physical, chemical and biological properties of the soil. The use of liquid organic fertilizers (biourine) are able to increase K-available, and N-total [22]. The improvement of soil quality with the addition of compost will increase plant growth and yield both for mungbean and cassava. This study aims to determine the effect of the planting system and the use of compost on cassava and mungbean plants to foster dryland productivity.

2 Methodology

The research was conducted at Narmada Visitor Plot, West Lombok, West Nusa Tenggara (NTB) in January - September 2016. It used Seteluk local cassava from Seteluk district, West Sumbawa and Sampeong local mungbean from Sumbawa District. The applied research design applied was a factorial randomized complete block design (RCBD). The first factor was two planting systems:1) monoculture and 2) intercropping, the second factor was the use of compost: 1) without compost and 2) compost. Each treatment uses 6 (six) blocks.

Cassava with mungbean has different growth phases, so that it does not affect the growth of one plant to another. Monoculture and intercropping plantation of mungbean and cassava were planted on the same land. Soil cultivation applied was minimum tillage with plots size 8 m x 4 m. The compost was applied before planting, with dosage 20 $t.ha^{-1}$. In the monoculture system of mungbean, planting space was 40 cm x 15 cm, two $seeds.holes^{-1}$ (population 200,000 – 400,000 $plants.ha^{-1}$). Cassava monoculture planting system uses a spacing of 100 cm x 70 cm (population 13,000 – 14,000 $plants.ha^{-1}$). In the intercropping system, cassava and mungbean were planted simultaneously.

Cassava was planted in double rows with a distance of (60 x 70) x 260 cm and mungbean were planted in 5 rows between cassava plants with a spacing of 40 cm x 15 cm. Mungbean embroidery was carried out 7 days after planting (DAP). Fertilizer for mungbean were urea 50 kg $urea.ha^{-1}$ was given once when the plant was 7 DAP by adding 5 cm to the side of the plant. Cassava fertilization was carried out twice, i.e. 600 $kg.ha^{-1}$ NPK 15:15:15 at the age of 7–10 DAP, and 350 $kg.ha^{-1}$ NPK 15:15:15 at the age of 2–3 months. Fertilizer application was applied singly at 15 cm from the plant. Weeding was done manually at 21 DAP and 41 DAP. Mungbean was harvested at 60 DAP when the pods had turned black and hardened, while cassava was harvested at 7-8 months after planting.

Yield component observations were carried out at harvest on 5 sample plants/replications/observation plots. The observed of mungbean yield were number of pods/plant, weight of pods/plant, weight of seeds/plant, weight of 100 seeds, production of pods/plot, production of seeds/plot, production/hectare. The components of cassava yield observed were tuber length and tuber weight, number of tubers, tuber production/plot and tuber production/hectare. In order to test the productivity of the land, the Land Equity Ratio (LER) was measured. Observation data were analyzed with analysis of variance (ANOVA) using the Minitab version 16 program and the average difference test using the honest real test (BNJ / Tukey) at the 95% confidence level ($\alpha = 0.05$).

3 Result and discussion

3.1 Yield components and their effects on mungbean yields

The results showed that independently and by interaction, the planting system and the use of compost did not significantly affect the yield of mungbean (Table 1). Yield components per plant, ie number of pods and pod weight were not significantly different in all treatments. Components of crop yields in various treatments that were not significantly different indicated that mungbean plants obtained the same source of nutrients from NPK fertilizer was applied to 7 DAP. The role of compost to increase the availability of macro and micro nutrients and improve the quality of physical, chemical and biological fertility of the soil has not affected the yield component due to the short age of the plant. Sampeong local mungbean have a harvest age of 70-75 days [23]. Besides, according to [24], the application of more compost (20 $t.h^{-1}$) will make the organic matter content in the soil higher. A high C/N ratio in the soil will cause N nutrients to be used by microbes so that N availability is reduced. The low N content in the soil causes stunted plant growth and low plant dry weight production.

Table 1. The performance of mungbean yield components in 2 cropping systems and 2 treatments using compost, Narmada January-September 2016

Planting system	**NonCompost**	**Compost**	**Average**
	Number of pod.plant^{-1} (pod)		
- Mungbean monoculture	7.20a	8.80a	8.00a
- Intercropping Cassava and Mungbean	9.80a	8.60a	9.20a
Average	8.50a	8.70a	-
Planting system	Weight of pod.plant^{-1} (g)		Average
- Mungbean monoculture	5.45a	6.03a	5.74a
- Intercropping Cassava and Mungbean	6.98a	6.07a	6.52a
Average	6.21a	6.05a	-
Planting system	Weight of seeds / plant (g)		Average
- Mungbean monoculture	4.35a	4.58a	4.46a
- Intercropping Cassava and Mungbean	5.17a	3.77a	4.47a
Average	4.76a	4.17a	-
Planting system	Weight 100 seeds (g)		Average
- Mungbean monoculture	2.32a	2.53a	2.42a
- Intercropping Cassava and Mungbean	2.54a	2.58a	2.56a
Average	2.43a	2.56a	-
Planting system	Pod production / plot (kg)		Average
- Mungbean monoculture	228.4a	155.3a	191.8a
- Intercropping Cassava and Mungbean	216.9a	243.9a	230.4a
Average	222.7a	199.6a	-
Planting system	Production of seeds / plot (kg)		Average
- Mungbean monoculture	0.6240a	0.5540a	0.5890a
- Intercropping Cassava and Mungbean	0.5320a	0.5940a	0.5630a
Average	0.5780a	0.5740a	-

Note: The numbers followed by the same letter in each of the same columns are not significantly different according to the BNJ/ HSD Test (Tukey) at the 95% confidence level ($\alpha = 0.05$).

Pods are one of the production components, especially in legumes. The highest number of pods per plant was found in the intercropping system with the use of compost of 9.80 pods, while the lowest number of pods (7.20 pods) was found in the monoculture planting system without the use of compost. The large number of pods per crop contributed to increasing the pod weight per plant. However, in this study, the number of pods produced was not as much as the potential number of local Sampeong mungbean pods. Potential number of pods per plant, Sampeong local mungbean based on the description of [23] varieties are 11-16 pods. High yield components will have an impact on crop production. The highest yield of mungbean was in a monoculture cropping system with compost (1.35 t.h^{-1}) (Figure 1). However, it was not significantly different from other treatments. This condition is in contrast to the results of the analysis of the yield components.

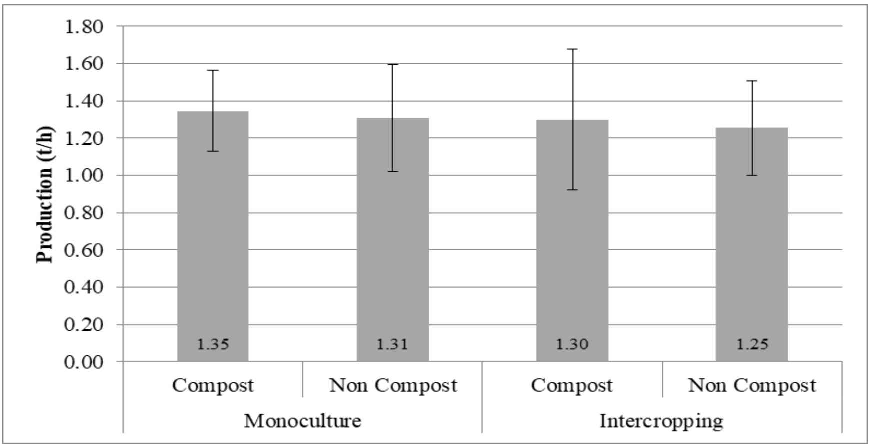

Fig 1. Mungbean production with different planting systems using compost with standard error analysis, Narmada January –September, 2016

Yield component per plant of mungbean in monoculture planting system is lower but total production is higher. The high production of mungbean in the monoculture cropping system is due to the larger population of the monoculture cropping system (400,000 plants) compared to the intercropping system. The plant population in the intercropping system is only 60% - 70% (240,000 plants). Apart from the large population of plants, crop production in a monoculture system is high due to the use of compost which can increase the weight of 100 mungbean seeds. Hastuti et al [25] showed that the application of organic fertilizer at a dose of 15 $t.ha^{-1}$ increased the weight of 100 mungbean seeds. Giving cow rumen compost 50 $t.ha^{-1}$ and 20 $t.ha^{-1}$ increased the weight of 100 mungbean seeds [26]. Yields in monoculture cropping systems are high but not significantly different from intercropping systems because plant population density is not supported by the quality and quantity of $yield.plant^{-1}$ components.

Nutrients available in compost (Table 2) do not significantly affect mungbean production. Compost has the characteristics of low nutrient content with limited quantities and slow nutrient availability. The main purpose of using compost is to improve soil structure in order to increase the ability to hold water, improve physical and chemical properties and contain many microorganisms that able to improve soil biology [27].

Table 2. Specification of utilized organic fertilizer

No.	Chemical properties of compost (Method)	Result	Unit
1	pH-H_2O (Elektroda)	8.22	-
2	C-Organik (Pengabuan)	17.37	%
3	N-total (Kjedahl)	0.7	%
4	P_2O_5 (Spectro)	0.43	%
5	K_2O (AAS)	1.59	%
6	C/N	24.81	-

Soil microorganisms and microorganisms in compost utilize C-organic as a source of carbon energy in the soil to synthesize nitrogen. Mungbean a group of legumese plants that have the ability to symbiosis with Rhizobium sp. Rhizobium sp which acts as a free nitrogen fixator. Rhizobium sp is able to provide 80% nitrogen for legumes, thereby fostering plant productivity by 10-25% [28].

Correlation analysis was conducted to determine the strength of the relationship between the yield components of green beans. The results of correlation analysis (Table 3) show that the components of mungbean yield, ie the number of pods.plant^{-1}, weight of pods.plant^{-1}, weight of seeds.plant^{-1} and weight of 100 seeds were positively and significantly correlated (<0.005) with production. The positive effect on the components of pod.plant^{-1} number, pod.plant^{-1} weight, seed.plant^{-1} weight and 100 seed weight indicated that the higher the four yield components followed by an increase in mungbean production. The component of mungbean yield that most affected production was weight of 100 seeds (r=0.463). The application of NPK fertilizer and the ability of mungbean plants to symbiotically with Rhizobium can meet the N needs of plants. N is an essential component in amino acids as the basis for protein formation, nitrogenous base so that it increases the dry weight of seeds. The amount of photosynthate accumulation in the seeds will be reflected in the weight of seeds.

Table 3. The correlation coefficient of components and yields of mungbean crops on the planting system and compost in Narmada, January - September 2016

Variabel	Number of pod/ plant(pod)	Weight of pod/ plant (g)	Weight of seed/ plant (g)	Weight 100 seeds (g)	Pod production / plot (kg)	Seed production / plot(t.h^{-1})
Weight of Pod/ plant(g)	***0.681****					
Weight of seed/ plant (g)	***0.674****	***0.622****				
Weights 100 seeds (g)	***0.869****	***0.726****	***0.573****			
Pod production/ plot (kg)	0.053	0.103	0.230	0.103		
Seed production/ plot(kg)	-0.109	0.223	0.220	0.122	***0.386****	
Production/ha (t/h)	***0.425****	***0.402****	***0.372****	***0.463****	0.018	0.173

Note: Pearson correlation
P-Value

The high distribution of assimilate from leaves and stems to pods during the seed filling process causes sufficient assimilate availability to be available during seed filling [29]. The results of photosynthesis are stored as food reserves in the form of carbohydrates in the form of seeds [30]. The highest weight of 100 seeds was resulted on compost intercropping treatment (2.58 g) compared to other treatments. The compost monoculture cropping system weighed 100 seeds (2.53 g) higher than the monoculture without compost (2.32 g) but was not significantly different from other treatments. This result is supported by the research of [31] that the use of organic fertilizers can increase the weight of 100 seeds. The weight of 100 mungbean seeds using compost was almost the same as the potential weight of 100 Sampeong mungbean seeds (2.5-3.0 g).

The results of the regression analysis of the effect of the weight of 100 seeds on production (Figure 2) showed a medium correlation and significantly different by statistical analsys. The addition of one unit weight of 100 seeds was able to increase the production of mungbean by 0.49 t.ha^{-1}. The weight of 100 seeds affected the productivity of mungbean plants by 21%, while the rest was influenced by other factors, including the number of pods, pod weight per plant and seed weight per plant.

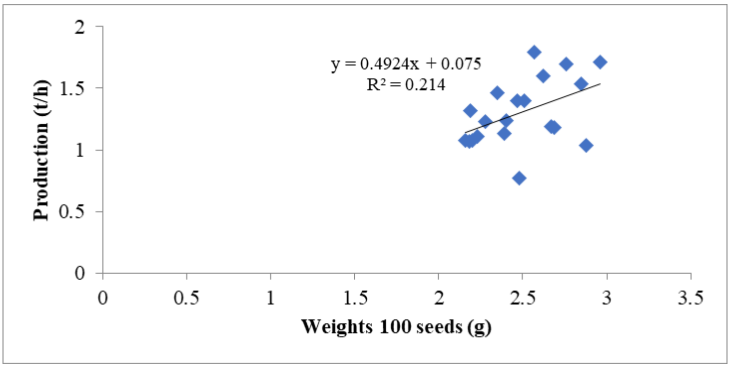

Fig 2. Regression coefficients of weight of 100 seeds mungbean plants in the planting system and compost in Narmada, January - September 2016

The quality and quantity of plant product components are closely related to the presence of nutrients that are available and can be absorbed by plants. The response of plants to fertilizer application is also related to the condition and nutrient content of the soil to support crop production. The components of plant production without compost are not significantly different from plants provided with compost. Nutrient on the organic fertilizer more slow release than the inorganic fertilizer, so that more time needto take by the plants [32], and mungbean adsorp the nutrient from the inorganic fertilizer.

3.2 Yield components and their effects on cassava yields

Yield component parameters observed in Cassava plants were tuber length, tuber weight and tuber number (Table 4). The results of the variance analysis showed that the interaction between the planting system and the use of compost had a significant effect on tuber length and tuber count. The intercropping system with compost produced the longest tuber (71.40 cm) and the highest number of tubers (6.40) which was different from other treatments. Interaction of plantation system and uses of compostwas effected to cassava production, which dominated by one or both of it. The interaction between the planting system and the use of compost together affects the length parameters of Cassava tubers. On the parameter of the number of tubers, the independent factor of the planting system was more dominant than the use of compost.

In the intercropping system, different planting types of plants with different ages will affect the production of the plants. Minimalizer of competition between plants on intercropping system is the aim of selection the different plant type with different age, especially at the crusial phase on vegetative growth. Cassava with mungbean has different growth phases, so that it does not affect the growth of one plant to another. The initial vegetative growth of Cassava plants was relatively slow so that it did not interfere with the growth of mungbean. Sampeong mungbean have a harvest age of 70-75 days, while the local Seteluk Cassava has a harvest age of 7-8 months. Cassava plants begin to form leaves and tuber candidates at 15-30 DAP [33]. The leaves that are formed will begin to actively carry out the photosynthesis process with the support of the root fibers that begin to form at the age of the first 3 months. This condition causes Cassava plants to obtain nutrients, water and sunlight without competition from mungbean plants.

Table 4. The performance of the components of the Cassava plant in various planting systems and compost use in Narmada, January - September 2016

Planting system	**Non compost**	**Compost**	Average
	Length of tuber.plant^{-1} (cm)		
- Monoculture Cassava	51.68b	53.97b	53.83b
- Intercropping Cassava and Mungbean	57.60ab	71.40a	64.50a
Average	54.64b	62.69a	-
Planting system	Weight of tuber.plant^{-1} (kg)		Average
- Monoculture Cassava	3.10a	2.98a	3.04a
- Intercropping Cassava and Mungbean	3.00a	3.24a	3.12a
Average	3.05a	3.11a	-
Planting system	Number of tuber (tuber).plant^{-1}		Average
- Monoculture Cassava	4.00b	4.80ab	4.40b
- Intercropping Cassava and Mungbean	6.00ab	6.40a	6.20a
Average	5.00a	5.60a	-
Planting system	Production of tuber.plot^{-1} (kg.h^{-1})		Average
- Monoculture Cassava	17.16a	22.35a	19.75a
- Intercropping Cassava and Mungbean	22.50a	23.48a	22.99a
Average	19.83a	22.92a	-

Note: The numbers followed by the same letter in each of the same columns are not significantly different according to the BNJ/HSD Test (Tukey) at the 95% confidence level ($\alpha = 0.05$).

The application of compost able to increase the yield of Cassava compared to without the provision of compost. Formation and development of the dominant component yields of cassava are influenced by the provision of compost which can be seen from the high yield components of cassava with compost. The slow-breaking nature of compost, which is able to support the provision of macro and micro nutrients in the long term, has a positive effect on cassava plants compared to mungbean. This is in accordance with the research of [34] that the provision of 20 t.ha^{-1} of cow dung bokashi and NPK 250 kg.ha^{-1} + 150 kg.ha^{-1} Urea in cassava plants gives the highest tuber production.plot^{-1}.

The results of the analysis on cassava production (Figure 3) show that the effect of the cropping system with the use of compost shows non significant interactions. The average results showed that the highest tuber production (28.40 t.h^{-1}) was obtained in the intercropping system using compost, intercropping without the use of compost (26.00 t.h^{-1}), monoculture cropping patterns using compost (21.80 t.h^{-1}) and the lowest was in a monoculture cropping system without the use of compost (21.70 t.h^{-1}). Planting cassava with the intercropping system provides higher productivity compared to the monoculture system. In monoculture planting systems, close spacing results in shorter tubers and fewer tubers even though the plant population is larger.

The population of cassava in the intercropping system is slightly lower, but the components of cassava yield, ie tuber length and number of tubers, are higher so that the total yield is higher than monoculture. Cassava production is strongly influenced by tuber quality. When forming tubers, cassava plants require sufficient P and K elements to increase tuber weight, to increase starch content and reduce HCN content in tubers [35]. K fertilizer plays a role in increasing the number of tubers while P is needed in the formation of plant roots [36]. In cassava plants, the roots function is as sink organs.

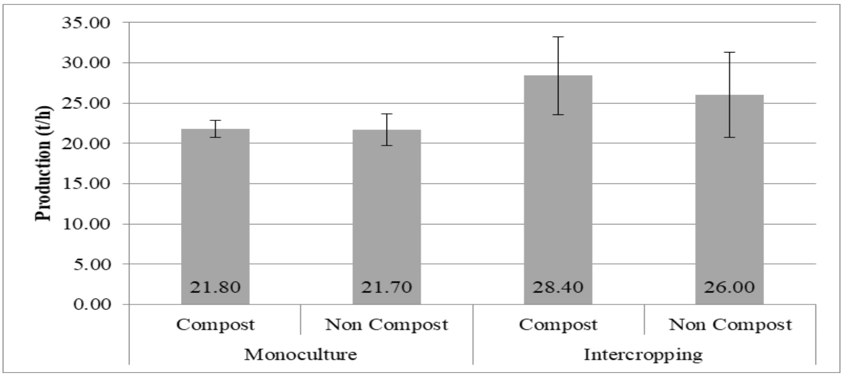

Fig 3. Cassava production with different planting systems and compost using standard error analysis, Narmada January - September 2016

Compost is a form of organic matter that affects plant growth by improving soil physical, chemical and biological properties. Cassava plants are very responsive to N elements to stimulate plant vigor. Organic matter has a chemical function to provide the elements N, P and K for plants, a biological function to influence the activity of organisms and a physical function to improve soil structure. This is supported by [37] that fertilization using cow manure can increase the availability of soil nutrients such as nitrogen, phosphorus and potassium which plants need. The source of N for cassava plants in the intercropping system can be obtained from the permeation of N in mungbean plants.

Correlation analysis was conducted to determine the strength of the relationship between the yield components of green beans. The results of the correlation analysis (Table 5) showed that the yield components of cassava, ie tuber length.plant^{-1} and number of tubers.plant^{-1}, were positively and significantly correlated (<0.005) with production. The positive effect on the tuber.plant^{-1} length component and the number of tubers.plant^{-1} indicated that the higher the yield component would be followed by an increase in cassava production. The component of cassava yield that most influenced the production was tuber length ($r=0.432$). At the age of 3-6 months, there is no competition between mungbean and cassava because the mungbean plants have been harvested. The growth of cassava stems and leaves can occur optimally. At the age of 4-5 months the photosynthesis process occurs optimally so that photosynthate is mostly used for the development of leaves and tubers. This period is the most active vegetative growth [33]. The tuber development period occurs at 6-8 months after planting, the highest rate of dry matter accumulation in the tubers.

Table 5. Correlation coefficient of components and yields of Cassava plants in various planting systems and compost use in Narmada, January - September 2016

Parameter	Length of tuber (cm)	Weight of tuber (kg)	Number of tuber (tuber)	Production of tuber.plot^{-1} (kg.h^{-1})
Weight of tuber(kg)	0,046			
Number of tuber (tuber)	0,489*	0,001		
Production of tuber/plot (kg.ha^{-1})	0,079	0,628*	0,246	
Production (t.ha^{-1})	0,432*	0,051	0,420*	0,259

Note :Pearson correlation,
P-Value

The length of Cassava tubers harvested at the age of 8 months has a number of tubers of 4 - 6 tubers.plant^{-1}. The tuber size reaches 51.68 cm - 71.40 cm with a tuber weight of 2.98 kg - 3.24 kg.plant^{-1}. Availability of nutrients, adequate water and no competition for space and light with other plants causes cassava plants to carry out the photosynthesis process optimally. The results of photosynthesis (photosynthate) at the age of 6-8 months of cassava plants will be used to increase the length and number of tubers. The different distribution of photosynthate causes a large number of tubers per plant to be correlated with tuber weight per plant.

The effect of tuber length on cassava production (Figure 4) shows a middle correlation and significantly different by statistic analisys. It shows that the addition of one tuber length can increase cassava production by 177.31 t.ha^{-1}. Tuber length affects the productivity of the cassava plant by 18%, while the rest is influenced by other factors such as the number of tubers per plant. The effect of tuber length on cassava production shows an indicator of the dominance of genetic influences compared to environmental influences. Sateluk local Cassava has a relatively longer tuber size (32 cm – 103 cm) so that the contribution of tuber length to production is more dominant than other parameters [38].

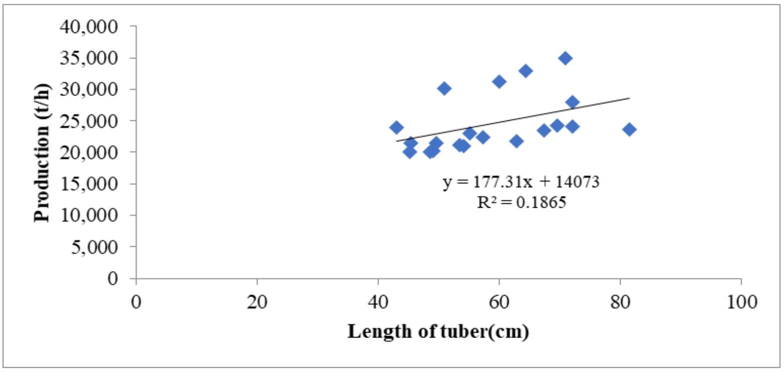

Fig 4. Regression coefficient length of tuber of Cassava plants on various planting systems and compost use in Narmada, January - September 2016

3.3 Land equivalent ratio (LER)

Land equality ratio (LER) is a parameter that describe the level of productivity of land use [39]. The success of planting with the intercropping system can be seen from the value of the LER (Table 6). The intercropping system cassava- mungbean had higher LER than the monoculture system. This shows that the intercropping system cassava-mungbean has higher land productivity. In accordance with the research results of [40-41]. In order to support the provision of foodstuffs in dry land agroecology, a planting system that can be developed is the intercropping of cassava+ mungbean with the addition of compost (LER = 2.31). These results indicated that intercropping of cassava with mungbean gave favorable results because it was more efficient in land use compared to the monoculture cropping system. The LER increase in the intercropping system with the use of compost was influenced by the production of cassava because the production of cassava in the intercropping system with the use of compost is higher than the production of mungbean.

Table 6. LER values for various planting systems and compost use, Narmada January - September 2016

Planting system	Land Equivalent Ratio (LER)		
	Based on the results of Cassava tubers (A)	Based on the results of dry mungbean (B)	Total (A+B)
Cassava monoculture	1.00	-	1.00b
Mungbean monoculture	-	1.00	1.00b
Intercropping non compost	1.20	0.99	2.19a
Intercropping with compost	1.30	1.01	2.31a

Note: The numbers followed by the same letter in each of the same columns are not significantly different according to the BNJ/HSD Test (Tukey) at the 95% confidence level ($\alpha = 0.05$).

The LER value describes how much area is needed for total monoculture production to be equivalent to one hectare of intercropping production [42]. This means that for cassava and mungbean plants, to obtain a total monoculture production equivalent to one hectare of intercropping crop production using compost requires an area of 2.31 ha. LER is also often defined as the level of profit obtained, meaning that intercropping Cassava and mungbean using compost can provide 2.31 times the profit compared to the monoculture cropping system.

4 Conclusion

The intercropping system of cassava and mungbean with the addition of organic matter (compost) was able to increase the productivity of dry land with an LER of 2.31, followed by an intercropping system without compost with an LER of 2.19.

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