EFFECTS OF ORGANIC MANURES ON GROWTH AND YIELD OF JACK BEAN (CANAVALIAENSIFORMIS L.) IN COASTAL SANDY SOIL AND GRUMUSOL SOIL

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Abstract: This study aims to know the influence of kinds and doses of organic manures on growth and yield of jack bean cultivated both in coastal sandy soil and in grumusol soil. The research conducted in coastal sandy land was carried out in Parangtritis beach area, Yogyakarta, Indonesia having latitude 15 m above sea level. Whereas, the research carried out in grumusol land was conducted in Playen Village, Yogyakarta Indonesia having latitude 250 m above sea level. The research conducted both in coastal sandy soil and in grumusol soil used 3 x 3 factorial experiment arranged in Randomized Complete Block Design with 3 replications. The first factor is the kinds of organic manures consisting of 3 levels: cow manure, goat manure, and chicken manure. The second factor is the doses of manures: 10 ton ha^{-1}, 15 ton ha^{-1}, and 20 ton ha^{-1}. Results of the experiment indicate that there is no interaction between kinds and doses of organic manures on both growth and yield of the plant. In coastal sandy soil, chicken manure can result the highest plant dry (biomass) weight and seed yield per hectare. Dose of manures 20 ton ha^{-1} can result the highest biomass weight and seed yield per hectare. In Grumusol soil, chicken manure results higher seed yield per ha^{-1} than that of cow manure as well goat manure. Dose of manures 20 ton ha^{-1} as well 15 ton ha^{-1} results higher biomass weight than that dose of 10 ton ha^{-1}. Dose of manures 20 ton ha^{-1} results the highest seed yield ha^{-1}. Results of the experiment indicate that the growth and yield of jack bean in coastal sandy soil applied by organic manures is better than that in grumusol soil.

Keywords: coastal sandy soil, grumusol, jack bean, organic manures.

I. INTRODUCTION

Jack bean (*Canavaliaensiformis* L.) can be an important food plant to be developed now and future due to this plant has high protein content as well other nutrient components. Seeds of this plant have crude protein content in the range of 29.8 – 32.2 % as well as the crude lipid 3.1 – 6.0 %, crude fiber 7.34 – 9.98 %, and Nitrogen Free Extractive 50.77 – 54.28 % (Doss *et al*., 2011). This plant in not only can be grown well in the arable soil but also can be cultivated in the marginal soil.

Like other developing countries, Indonesia has the problems dealing with the reduction of arable agricultural lands in lines with increasing of residential demand and other public facilities (Muchtar and Soelaeman, 2010). In another hand, the increasing food demand in lines with increasing of population number needs wider agricultural lands to produce enough food. To handle these problems, Indonesia government now tries to motivate the farmers to expand planting area in marginal lands.

As a part of the tropical regions, Indonesia has huge areas of marginal soils in several kinds such as grumusol soils, coastal sandy soils, and peat soils. For example, Yogyakarta as one of 34 provinces in Indonesia has 8,250 ha sandy lands and 40 % (ca 3,300 ha) of them are coastal sandy lands (BAPPEDA-Propinsi DIY, 2003). Whereas, total of grumusol soils in Indonesia is about 2.12 million ha (Nursyamsi*et al*., 2008).

Such as the other coastal sandy areas, the southern coastal sandy lands of Yogyakarta are classified as marginal lands. Chemical and physical properties of the coastal soil are poor plant mineral nutrients, free consistence and very porous so the water holding capacity of the soil is very low. Soil characteristic of the southern coastal sandy lands in Yogyakarta, in depth of 150 cm, consist of 98 % of sand, 0.17 % P2O5, 0.015 % K2O and 0.05% organic matter, with pH 6-6.5 (Puslittanak, 1994).

One of the main problems in crop cultivation in coastal sandy lands is loss of soil moisture very fast due to evaporation and infiltration. To increase soil permeability and soil humidity, not only the use of compost but also the use of mulch and soil conditioners is recommended in coastal sandy lands. Manures and clay application to the soil can be very important to make better plant growth in coastal sandy lands (Muchtar and Soelaeman, 2010).

Like the growth of plant in coastal sandy soil, the growth of plant in grumusol soil faces the problems of infertility of the soil. Grumusol soil has low content of organic matter in range of 0.06 – 4.5 %, low nutrients content, crack up to 5 inches wide are formed when the soil dry out and very hard when dry (Moormann and Panabokke, 1961). The texture of grumusol soils was generally heavier than that of podzolic soils (Supriyo*at al*., 1992).

To increase the soil fertility of both coastal sandy soil and grumusol soil, the application of manures as soil ameliorant can be recommended. Smith (2003) state that soil ameliorant can be applied in soils to increase physical and chemical soil fertility. The usage of organic fertilizers such as manures can give more advantages compare to the usage of chemical fertilizers. Organic fertilizer not only can encrease

soil fertility, but also can create more healthy ecosystem and environment.

Manures, as organic matters, have many functions, and the relative importance of wich differ with soil type, climate, and land use (Craswell and Lefroy, 2001). The important functions of manures include the formation of stable aggregates, soil surface protection, and increasing the chemical, biological, as well the physical soil fertility. The utilization of organic compost was very important for plant growth of pigeon-pea cultivated in cassiterrte mine soil (Filho*et al*., 2011).

II. MATERIALSAND METHODS

Date and place of the experiment

The experiment dealing with the cultivation of jack bean in coastal sandy soil was conducted from March until August 1915. This experiment was carried out in Parangtritis beach area, Yogyakarta, Indonesia. This area has altitude 15 m above sea level and it has soil pH 6, daily minimum temperature 28^0Cand maximum temperature 32^0C, air humidity 49-94%, and wind velocity 15 km hour^{-1}. The experiment dealing with the cultivation of jack bean in grumusol soil had been conducted since February until July 1917. This experiment was carried out in Playen Village, Yogyakarta, Indonesia. This area has altitude 250 m above sea level and it has soil pH 6.7, daily minimum temperature 27^0C and maximum temperature 31^0C, air humidity 54-95%, and wind velocity 9.5 km hour^{-1}.

Land preparation and Experimental design

The land preparation of coastal sandy soil consists of land cleaning by mechanically weeding, and plotting the area.Whereas, the land preparation of grumusol soil consists of soil ploughing in 20 cm depth used a tractor, and plotting the area. The size of each plot is 2 x 3 m that has total 3 x 3 x 3: 27 plots separated in 3 blocks. While making the plots the manures were applied based on the doses.

These experiments were carried out by 3 x 3 factorial experiment arranged in Randomized Complete Block Design (RCBD) with 3 replications. The first factor is the kinds of organic manures consisting of 3 levels: cow manure (M1), goat manure (M2), and Chicken manure (M3). The second factor is the doses of manures: 10 ton ha^{-1} (D1), 15 ton ha^{-1} (D2), and 20 ton ha^{-1} (D3).

Plant planting and plant maintenance

Seeds of jack bean were planted in each plot by space 60 x 40 cm. Each planting hole was placed one seed. After one week, the seed failed to grow was replaced by a new seed. The weed control was done manually. Fertilization was done 2 months after planting used urea 50 kg ha^{-1}, Super Phosphate 100 kg ha^{-1}, and Potassium Chloride 75 kg ha^{-1}. Watering to the plants was done in the midday used well water when it was no rain for several days.

Data collection and Analysis

Parameters observed include growth parameters and yield parameters. Growth parameters were observed i.e. plant height, leaf number, branch number, and biomass dry weight. Whereas, yield parameters were observedi.e. flowering stage, harvesting stage, pod number plant^{-1}, pod length, weight of 100 seeds, and seed yield ha^{-1}.Plant height, leaf number, and branch number were observed when the plants have age 12 weeks. Whereas, dry weight of plant biomass was observed at harvesting stage. Analysis of variance was used to analysis data and continue with Duncan's Multiple Range Test, DMRT 5% (Gomez and Gomez, 1984).

III. RESULTS AND DISCUSSION

Results of the experiment conducted in coastal sandy land indicate that there is no interaction between kinds and doses of organic manures on both growth and yield of the plant. Chicken manure can result the highest plant height, leaf number,branch number, plant dry (biomass) weight (Table 1), and seed yield per hectare(Table 2). Dose of manures 20 ton ha^{-1} can result the highest biomass weight (Table 1), flower number, pod number, seed weight per plot, 100 seeds weight, and seed yield per hectare (Table 2). A research conducted by Darini*et al*. (2016) on sandy soil indicated that there was positively influence of manure on both the chemical properties of sandy soil and the physiological properties of aloe plant. Furthermore, a research conducted by Soelaeman and Muchtar(2010) indicates that application of 15 Mg ha^{-1} of green manure affected positively toward the characteristic of coastal sandy soil.

Table 1. Growth parameters of plants cultivated in coastal sandy soil

Parameters	Kinds of manures			Application doses		
	Cow manure (M1)	Goat manure (M2)	Chicken manure (M3)	10 ton ha^{-1} (D1)	15 ton ha^{-1} (D2)	20 ton ha^{-1} (D3)
Plant height (cm)	59.82 a	61.53 a	77.96 b	72.09 p	62.51 p	64.71 p
Leaf number	25.87 ab	21.60 a	31.33 b	26.04 p	25.00 p	24.22 p
Branch number	3.49 a	3.56 a	5.07 b	4.18 p	3.73 p	4.2 p
Biomass weight (g)	57.17 a	68.99 ab	70.39 b	52.65 p	65.28 pq	71.40 q

Means in the row followed by the same letters are not significantly different by DMRT 5%

Table 2. Yield parameters of plants cultivated in coastal sandy soil

Parameters	Kinds of manures			Application doses		
	Cow manure (M1)	Goat manure (M2)	Chicken manure (M3)	10 ton ha^{-1} (D1)	15 ton ha^{-1} (D2)	20 ton ha^{-1} (D3)
Flowering stage (days)	58.19 a	58.41 a	58.49 a	57.71 p	57.94 p	59.42 p
Flower number $plant^{-1}$	14.57 a	13.79 a	16.89 a	11.22 p	13.67 p	20.33 q
Harvesting stage (days)	134.67 a	138.00 a	134.67 a	138.00 p	134.67 p	134.67 p
Pod number $plant^{-1}$	7.33 a	5.68 a	8.11 a	5.44 p	5.89 p	9.79 q
Seed weight $plot^{-1}$(g)	341.44 a	231.36 a	380.57a	229.27 p	257.38 p	466.72 q
Weight of 100 seeds (g)	103.17 a	107.56 a	111.22 a	102.00 p	102.22 p	117.72 q
Seed yield ha^{-1} (g)	4.58 a	3.54 a	6.01 b	3.67 p	3.95 p	6.50 q

Means in the row followed by the same letters are not significantly different by DMRT 5%

Results of the experiment conducted in grumusol soil indicate that there is no interaction between kinds and doses of organic manures on both growth and yield of the plant. Chicken manure results higher leaf number than that of both cow manure and goat manure. Chicken manure as well goat manure can result seed yield per hectare higher than that of cow manure (Table 3).

Table 3. Growth parameters of plants cultivated in grumusol soil

Parameters	Kinds of manures			Application doses		
	Cow manure (M1)	Goat manure (M2)	Chicken manure (M3)	10 ton ha^{-1} (D1)	15 ton ha^{-1} (D2)	20 ton ha^{-1} (D3)
Plant height (cm)	54.12 a	50.76 a	55.82 a	51.73 p	55.86 p	53.09 p
Leaf number	12.13 ab	11.57 a	14.07 b	12.31 p	12.59 p	12.87 p
Branch number	2.84 a	3.12 a	2.87 a	1.81 p	3.34 q	3.68 q
Biomass weight (g)	39.45 a	47.61 ab	49.28 b	36.33 p	45.04 q	49.98 q

Means in the row followed by the same letters are not significantly different by DMRT 5%

Chicken manure results higher flower number $plant^{-1}$, pod number $plant^{-1}$, seed weight $plot^{-1}$, and seed yield per ha^{-1} than that of cow manure as well goat manure (Table 4). Dose of manures 20 ton ha^{-1} as well 15 ton ha^{-1} can result higher branch number and biomass weight than that dose of 10 ton ha^{-1} (Table 3). Dose of manures 20 ton ha^{-1} results the highest seed weight $plot^{-1}$, weight of 100 seeds, and seed yield ha^{-1} (Table 4).

Table 4. Yield parameters of plants cultivated in grumusol soil

Parameters	Kinds of manures			Application doses		
	Cow manure (M1)	Goat manure (M2)	Chicken manure (M3)	10 ton ha^{-1} (D1)	15 ton ha^{-1} (D2)	20 ton ha^{-1} (D3)
Flowering stage (days)	59.66 a	58.99 a	59.35 a	58.96 p	60.22 p	58.82 p
Flower number $plant^{-1}$	6.08 a	6.16 a	8.56 b	6.58 p	6.64 p	7.57 p
Harvesting stage (days)	134.37 a	136.55 a	133.33 a	135.34 p	134.24 p	134.66 p
Pod number $plant^{-1}$	2.82 a	2.96 a	4.07 b	3.21 p	3.08 p	3.56 p
Seed weight $plot^{-1}$ (g)	173.52 a	171.62 a	313.41 b	159.29 p	177.18 p	322.07 q
Weight of 100 seeds (g)	102.12 a	105.51 a	109.21 a	101.88 p	100.17 p	114.78 q
Seed yield ha^{-1} (ton)	3.28 a	3.24 a	4.38 b	3.22 p	3.25 p	4.44 q

Means in the row followed by the same letters are not significantly different by DMRT 5%

The average plant biomass weight of three manures application is 65.52 g in coastal sandy soil and 45.45 g in grumusol soil. Whereas the seed yield ha^{-1} of three manures application is 4.71 ton in coastal sandy soil and 3.63 ton in grumusol soil. These results indicate that the growth and yield of jack bean in coastal sandy soil applied by three kind organic manures (cow, goat, and chicken manure) is better than that in grumusol soil.

CONCLUSIONS

There is no interaction between kinds and doses of organic manures on both growth and yield of the plantof the experiment conducted in both coastal sandy soil and grumusol soil. In coastal sandy soil, chicken manure can result the highest plant dry (biomass) weight and seed yield per hectare. Dose of manures 20 ton ha^{-1} can result the highest biomass weight and seed yield per hectare.

In Grumusol soil, chicken manure as well goat manure can result seed yield per hectare higher than that of cow manure. Chicken manure results higher seed yield per ha^{-1} than that of cow manure as well goat manure. Dose of manures 20 ton ha^{-1} as well 15 ton ha^{-1} can result higher biomass weight than that dose of 10 ton ha^{-1}. Dose of manures 20 ton ha^{-1} results the highest seed yield ha^{-1}.

Results of the experiment indicate that the growth and yield of jack bean in coastal sandy soil applied by cow manure, goat manure, as well chicken manure is better than that in grumusol soil.

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