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EFFECT OF POULTRY MANURE ON THE GROWTH AND YIELD PARAMETERS OF MUNG BEAN (Vigna radiata (L.) R. WILCZEK) GENOTYPES IN AWKA ALFISOLS, SOUTHEASTERN NIGERIA

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ABSTRACT

This experiment was conducted at the Teaching and Research Agricultural Farm of the Department of Crop Science and Horticulture, Nnamdi Azikiwe University, Awka, Anambra State Nigeria in April-August 2019; to determine the effect of poultry manure on the yield of five Mung beans (*Vigna radiata* (L.) Wilczek) varieties. Poultry manure rates of 0 and 10 tonnes/ha and 5 varieties of Mung beans Tropical *Vigna radiata* (Tvr 6); Tropical *Vigna radiata* (Tvr 12); Tropical *Vigna radiata* (Tvr 14); Tropical *Vigna radiata* (Tvr 15) and Tropical *Vigna radiata* (Tvr 29) were evaluated. The study was carried out as a 2 x 5 factorial experiment with 10 treatment combinations laid out in a complete randomized design (CRD) experiment with 3 replications. Treatment means were separated using the least significant difference (LSD=0.05). Data was taken from the following parameters: days to 50% germination, plant height, number of leaves, number of branches, leaf area, days to 50% flowering, number of pods per plant, pod length, number of seeds per pod and number of nodules per pot. The results showed that the tallest plants, highest number of leaves, pods per plant, pod length, and seed per pods were recorded with the application of 10 tonnes per hectare of poultry manure. Tvr 15 had the tallest plants height for the experiment, while Tvr 29 gave the highest number of leaves and branches. Tvr 6 and Tvr 15 had the highest leaf area. Based on this study, the highest yield was obtained with the application of poultry manure at 10 tonnes/ha + using Tvr 12 mung bean variety.

Keywords: Alfisols, growth, mungbean, poultry manure rates, yield *Correspondence: cc.obasi@unizik.edu.ng, 08032558331

INTRODUCTION

Mung bean (Vigna radiata (L.) Wilczek) also known as green gram belongs to the family Leguminosae [1]. It is one of the most important pulse crops that has an excellent source of high-quality protein and is grown in the tropical and subtropical areas of the world [2]. India has been proposed as the center of origin [3]. Mung bean production is mainly (90%) situated in Asia, with India being the largest producer with more than 50% of the world's production, but it consumes almost its entire production; China also produces large amounts of mung beans, which represents 19% of its legume production [3]. Thailand is the main exporter and its production increased by 22% per year between 1980 and 2000 [3]. Though produced in many African countries, mung bean is yet to become a major crop in these locations [4]. In tropical Africa, particularly Nigeria, the production of the crop has not been ranked probably because of its recent introduction. Mung bean is rich in carbohydrates (54.9 - 58.9%). dietary fiber (6.8-7.1%), energy (340-347 Kcal/100g), iron (103.9 mg/kg), Zinc (30.7 mg/kg), copper (3.84 mg/kg), phosphorus, potassium, and folate; riboflavin and niacin are found in trace amounts [5]. Mung bean is deficient in methionine in contrast with the high methionine that is observed in rice and beans [6].

The use of poultry manure as a soil amendment to sustain adequate crop yield has been found effective on many crops in Southwestern Nigeria [7]. Its use for crop production might be a better substitute for chemical fertilizer [8]. However, mung bean being a leguminous crop does not require high doses of poultry manure or nitrogenous fertilizer, but a starter or initial dose is usually helpful in increasing its growth and yield [9]. The use of organic fertilizers such as poultry manure is an eco-friendly approach to effective fertilizer management for proper growth, yield, and diseases of crops by secretion of different hydrolytic enzymes [10]. The present study investigated the effect of poultry manure on the growth and yield of mung bean varieties grown in Awka, Southeastern Nigeria.

MATERIALS AND METHODS

Study area

The experiment was conducted at the Crop Science and Horticulture Agricultural farm, Nnamdi Azikiwe University Awka, Anambra State, Nigeria, from April to August 2019. Awka is located on latitude 6.24°N and longitude 7.11°E on an altitude of about 100 metres above sea level. The experimental site has an annual rainfall of 1810.3 mm per annum, a mean minimum and maximum temperature of 27°C and 27.3°C and a relative humidity of 72.3% [11]. The mung bean varieties used for the experiment were sourced from the Genetic Resources Centre, International Institute of Tropical Agriculture (IITA) Ibadan.

Soil sampling and analysis

Soil samples from 0-30 cm depth of the experimental site were taken by simple random sampling method to analyze the physiochemical properties of the soil at the start of the experiment. Ten sub-samples were randomly selected and mixed thoroughly to get a composite sample. The soil samples were analyzed at The National Root Crop Research Institute (NRCRI) Umudike Soil Science Laboratory. The soil sample was then pre-treated by air drying and passing the soil through a 2mm sieve before analysis. The sand, silt and clay contents of the soils was determined by hydrometer method using sodium hexametaphosphate (Calgon) as dispersing agent [24]. Total nitrogen was determined by micro Kjeldahl method [25]. Organic Carbon was determined by chromic acid wet oxidation method as described [26]. Available phosphorus was determined using Bray II solution [27]. The result of the physicochemical characteristics of the soils of the experimental site is given in Table 2.

Experimental treatment and experimental design The experiment was a 2 x 5 factorial experiment laid out in Complete Randomized Design (CRD) with 3 replications and was carried out in pots. Pots in the form of black polyethene bags were used for the experiment. 14kg weight of sand was weighed using a weighing scale. Poultry manure (Cured chicken droppings) at 10 tonnes/ha was accurately measured using a weighing scale for the treatment combinations that needed poultry manure which was further incorporated with the soil using a hoe. The poultry manure was allowed to cure for 2 weeks before it was applied to the pots. Two seeds per variety were planted per hole. All agronomic practices required for healthy growth and yield of the crop were duly observed. Weeding was done at 4 and 8 weeks after sowing via hand weeding.

Treatment combinations for the pot experiment

The treatment combinations include: Factor A- Poultry manure rates (0 and 10 tonnes/ha) Factor B- 5 Mung bean varieties (Table 1).

The treatment combination for the pot includes:

PM 0 tonnes/ha $+$ V1,	PM 10 tonnes/ha
+ V1	
PM 0 tonnes/ha + V2	PM 10 tonnes/ha
+ V2	
PM 0 tonnes/ha + V3	PM 10 tonnes/ha
+ V3	
PM 0 tonnes/ha + V4	PM 10 tonnes/ha
+ V4	
PM 0 tonnes/ha + V5	PM 10 tonnes/ha
+ V5	

Table 1: Genotypes, varieties code, and source of mung bean collection for the experiment

S/N	Genotypes	Varieties code	Sourced
1	Tropical Vigna radiata (Tvr 6)	V1	IITA
2	Tropical Vigna radiata (Tvr 12)	V2	IITA
3	Tropical Vigna radiata (Tvr 14)	V3	IITA
4	Tropical Vigna radiata (Tvr 15)	V4	IITA
5	Tropical Vigna radiata (Tvr 29)	V5	IITA

IITA: International Institute of Tropical Agriculture (IITA) Ibadan

Data collection

Data were collected from each pot on the following parameters:

Emergence parameters

Days to 50% germination: The number of days it took half of the mung bean seedlings to germinate was recorded. Days to 50% flowering: The number of days it took half of the randomly selected plants to flower was recorded.

Growth parameters

Growth parameters were taken from 4, 6, and 8 weeks after sowing. The growth parameters taken include: Plant height/plant (cm): Heights of two plants were randomly selected from each pot. The selected plants were marked with a white rope and were measured using a measuring tape from the base of the plants to the growing tip of the main stem. The average plant height was calculated by taking the mean of observation of the two plants and expressed in centimeter (cm).

Number of trifoliate leaves per plant: The number of green trifoliate leaves per plant of mung bean was counted at 4, 6, and 8 weeks after sowing, from the selected tagged plants per pot and the mean were computed and recoded.

Number of branches per plant: The number of branches per plant of mung bean was counted at 4, 6, and 8 weeks after sowing, from the selected tagged plants per pot and the mean of observation of the randomly selected plants were computed and recoded. Leaf area/plant (cm): The leaf area was randomly selected twice to get an average. The length and breadth of the leaf area were measured with a

measuring tape. This same procedure was repeated for the randomly tagged plant per pot and the average was computed and recorded.

Harvest parameters

Parameters assessed at harvest include:

Pod length/plant: The pod lengths from the randomly selected plants were counted and the average number of pod lengths was calculated and recorded.

Number of pods per plant: The total number of pods on the tagged plants was counted and the average number of pods per plant was recorded.

Number of seeds per pod: The number of seeds per pod was randomly selected from the already tagged plants, counted, and the average was recorded.

Number of nodules per plant: The number of nodules in each plant per row was recorded in the pot experiment after 12 weeks of sowing.

Data analysis

The data collected were subjected to analysis of variance to show the significance between treatment

means and to draw valid conclusions. The significant means were separated using the least significant difference at 5% level of probability [12].

RESULTS AND DISCUSSION

Table 2: The physical and chemical characteristics of the soil of the experimental site were taken before planting. The physicochemical characteristics were analyzed, and the result is shown in Table 2. The textural class was found to be sandy loam while the soil pH was slightly acidic (6.56) and was generally low in essential plant nutrients like nitrogen (0.07%), phosphorus (3.63 mg/kg), and potassium (0.18 Cmol/kg). The soil of the experimental site was about 78.80% sand, 8.80% silt, and 12.40% clay. The soil sample had an organic carbon content of 0.78%, organic matter content of 1.34%, total exchangeable acidity of 1.20 Cmol.kg, magnesium content of 1.60 Cmol/kg, CEC of 5.52 Cmol/kg and base saturation of 78.2%.

Fable 2 : Physical and chemica	properties of the alfisol taken fr	rom 0-30 cm depth of the experimental site
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Physiochemical properties	Values
Physical properties	
Sand (%)	78.8
Silt (%)	8.8
Clay (%)	12.4
Textural class	Sandy-loam
Chemical properties	-
Organic Carbon (%)	0.78
Organic matter content (%)	1.34
Total Nitrogen (%)	0.07
Total exchangeable acidity (Cmol/kg)	1.2
Aluminium (Cmol/kg)	0.7
Hydrogen (Cmol/kg)	0.5
Available phosphorus (mg/kg)	3.63
Potassium (Cmol/kg)	0.18
Sodium (Cmol/kg)	0.14
Calcium (Cmol/kg)	2.4
Magnesium (Cmol/kg)	1.6
Soil pH (H ₂ O)	6.56
Cation Exchange Capacity (Cmol/kg)	5.52
Base Saturation (%)	78.2

Table 3: The result of the pot experiment showed that poultry manure rates and variety affected the emergence and flowering of Mungbean. Moreover, there were no significant differences (P>0.05) in the poultry manure rates at emergence and among the varieties but significant differences (P<0.05) in the poultry manure in the days to 50% flowering were recorded (Table 3). The plants flowered earlier at 10tonnes/ha because poultry manure is known to support vegetative growth in legumes which will later take time to flower than when no poultry manure was applied [18]. For varietal response on emergence and flowering, Tvr 29 emerged earlier, while Tvr 12 flowered earlier. The result of the analysis of variance showed no significant difference (P>0.05) in the interaction between poultry manure and variety in both emergence and days to 50% flowering. However, PM 10 tonnes/ha + Tvr 29 emerged earlier because an initial or starter dose of poultry manure is usually helpful in increasing its growth and yield, while PM Otonnes/ha + Tvr 12 flowered lately (Table 3). The result agreed with the findings of Anwar *et al.* [9].

Main Effects of	Main Effects of Poultry Manure Rates			Interactions of Poultry Manure Rates			
PM Rates	Days to 50%	Days to 50%	PM X Variety	Days to 50%	Days to 50%		
(tonnes/ha)	Emergence	Flowering	-	Emergence	Flowering		
0 tonnes/ha	4.47	69.9	PM10 X V1	4.33	52.3		
10 tonnes/ha	4.27	53.3	PM10 X V2	4.00	62.7		
LSD0.05	NS	6.89	PM10 X V3	4.33	46.0		
Variety			PM10 X V4	3.33	58.3		
V1	4.50	65.2	PM10 X V5	5.33	47.0		
V2	4.33	71.7	PM0 X V1	4.67	78.0		
V3	4.33	48.8	PM0 X V2	4.67	80.7		
V4	4.00	64.3	PM0 X V3	4.33	51.7		
V5	4.67	57.8	PM0 X V4	4.67	70.3		
LSD 0.05	NS	10.89	PM0 X V5	4.00	68.7		
			LSD0.05	NS	NS		

 Table 3: Main effect and interaction of poultry manure rates and variety on emergence and flowering of mung bean for pot experiment

WAP-Weeks after planting

Table 4: The result of the analysis of variance showed that there was a significant difference (P<0.05) in the poultry manure rates on heights of mung bean and varieties at 4, 6, and 8 WAP. As for the number of leaves, there was a significant difference (P<0.05) in the poultry manure rates at 4, 6, and 8 WAP. In terms of the variety, there was a significant difference (P<0.05) at 4 and 8 WAP concerning the number of leaves. The effect of poultry manure on the plant

height and number of leaves showed that the maximum plant height and number of leaves was obtained at 10 tonnes/ha PM, which could be because the application of poultry manure helped in the supply of essential nutrients for growth. Tvr 15 and Tvr 29 produced the maximum plant height and number of leaves respectively as shown in (Table 4). The result agreed with the findings of Anwar *et al.* and Sitinjak & Purba [9, 18].

Table 4: Effect of poultry manure rates on plant height and number of leaves on mung bean varieties at 4WAP, 6WAP and 8WAP.

		Plant He	eight (cm)	Number	r of Leaves	
PM rates (ton/ha)	4WAP	6WAP	8WAP	4WAP	6WAP	8WAP
0	8.30	12.02	16.0	11	17	23
10	15.12	27.06	46.6	31	71	148
$LSD_{0.05}$	1.446	3.518	6.46	6	10	28
Variety						
V1	13.42	23.15	39.1	22	42	85
V2	14.33	23.32	37.6	22	38	69
V3	9.00	16.40	26.8	19	39	95
V4	14.43	21.33	28.5	18	38	70
V5	7.37	13.50	24.3	22	62	106
$LSD_{0.05}$	2.286	5.562	10.21	NS	16	NS

WAP- Weeks after planting

Table 5: The result of the analysis of variance showed that there was no significant difference (P>0.05) in the interaction of poultry manure and variety on plant height at 4, 6, and 8 WAP. For the days to 50% flowering, there was a significant difference (P<0.05)

in the interaction of poultry manure and variety at 4 and 8 WAP. For the interaction (i.e., poultry manure and variety) effect on plant height and number of leaves, PM 10 tonnes/ha + Tvr 6 and PM 10 tonnes/ha + Tvr 29 gave the highest number of leaves.

Table 5: Interaction of poultry manure rates and variety on plant height and number of leaves of mung bean

	Plant Height (cm)			Number of 1	Leaves	
PM rates x Variety	4WAP	6WAP	8WAP	4WAP	6WAP	8WAP
PM10 X V1	16.57	32.37	59.7	33.0	67.7	148.3
PM10 X V2	19.03	33.17	58.8	33.3	57.7	117.3
PM10 X V3	11.23	22.30	38.8	28.0	61.0	165.3

PM10 X V4	18.67	28.13	37.5	23.7	58.0	114.0
PM10 x V5	10.10	19.33	37.9	35.7	108.0	192.7
PM0 X V1	10.27	13.93	18.4	11.7	16.7	21.0
PM0 X V2	9.63	13.47	16.4	11.0	17.7	21.0
PM0 X V3	6.77	10.50	14.8	10.7	17.0	24.7
PM0 X V4	10.20	14.53	19.5	12.7	18.7	26.7
PM0 X V5	4.63	7.67	10.7	8.7	16.7	20.0
LSD _{0.05}	NS	NS	NS	NS	23.09	NS

WAP- Weeks after planting

Results shown in (Table 6): There was a significant difference (P<0.05) in the poultry manure rates in both the number of branches and leaf area. In terms of the variety, there was no significant difference in both the number of branches and in the leaf area (P>0.05). The result of the effect of poultry manure rates on the number of branches and leaf area of mung beans statistically showed that the maximum number of branches and leaf area was obtained at the rate of 10 tonnes/ha of poultry manure as approved by Mainuel *et al.* and Aniefiok *et al.* [19, 20]. For the varietal influence, Tvr 29 produced the maximum number of branches while Tvr 6 and Tvr 15 produced the maximum leaf area.

Table 6: Main effect of poultry manure rates and variety on number of branches and leaf area at 4 WAP, 6WAP and 8WAP.

		Number of Brai	nches	Leaf Area		
PM rates	4WAP	6WAP	8WAP	4WAP	6WAP	8WAP
0	3.13	5.73	7.2	9.2	21.4	27.0
10	9.53	24.33	49.7	60.7	83.5	93.3
LSD _{0.05}	2.025	4.156	9.25	14.99	13.61	11.0
Variety						
V1	6.83	1 4.67	28.5	42.4	61.2	71.3
V2	6.67	12.17	23.0	37.7	50.0	59.6
V3	5.83	14.33	31.7	29.8	51.1	58.9
V4	5.50	13.83	22.2	31.2	54.9	60.6
V5	6.83	20.17	36.8	33.5	45.1	50.3
LSD _{0.05}	NS	NS	NS	NS	NS	NS

WAP- Weeks after planting

Table 7: The analysis of variance depicts no significant difference (P>0.05) in the interaction of poultry manure and variety in both the number of branches and leaf area. The interaction (i.e., poultry manure and variety) effect on the number of branches

and leaf area PM 10 tonnes/ha + Tvr 29 gave the maximum number of branches for the pot experiment, while PM 10 tonnes/ha + Tvr 6 and PM 10 tonnes/ha + Tvr 15 produced the maximum leaf area for the pot experiment.

 Table 7: Interaction of poultry manure rates and variety on number of branches and leaf area of mung bean for pot experiment

	Number of	Branches		Leaf Area	(cm ²)	
PM rates x Variety	4WAP	6WAP	8WAP	4WAP	6WAP	8WAP
PM10 X V1	10.33	23.67	50.0	74.1	101.9	117.6
PM10 X V2	10.00	18.67	39.3	64.0	77.1	92.4
PM10 X V3	8.67	22.33	55.7	51.7	82.3	91.6
PM10 X V4	7.33	21.67	36.7	51.8	83.7	86.8
PM10 X V5	11.33	35.33	66.7	61.9	72.7	78.0
PM0 X V1	3.33	5.67	7.0	10.7	20.5	25.1
PM0 X V2	3.33	5.67	6.7	11.5	23.0	26.7
PM0 X V3	3.00	6.33	7.7	7.9	20.0	26.2
PM0 X V4	3.67	6.00	7.7	10.7	26.1	34.4
PM0 X V5	2.33	5.00	7.0	5.2	17.5	22.6
LSD _{0.05}	NS	NS	NS	NS	NS	NS

WAP- Weeks after planting

Table 8: The results of the analysis of variance reveal a significant difference (P < 0.05) in poultry manure

rates in terms of the total number of pods and number of seeds per pod. There was no significant difference in the (P>0.05) in the poultry manure rates of the pod length. Thus, the varieties revealed significant differences (P<0.05) across all the yield attributes. Bhargavi [21] noted that maximum productivity of yield is achievable at 10 tonnes/ha of poultry manure. The result aligned with the findings of Azu [22] and Vilmar *et al.* [23] which approve of the increase in the number of nodules per plant in groundnut and soybean. For varietal influence, Tvr 12 gave the highest number of pods, pod length, and number of seeds per pod, while Tvr 29 gave the highest number of nodules per plant.

Table 8: Effect of poultry manure rates on yield attributes of mung bean varieties.

PM rates	Pod/plant	Pod length (cm)	No of seeds/pod	Nodules/plant
0	28	5.53	10	11
10	119	6.13	11	399
$LSD_{0.05}$	41	NS	1	54.7
Variety				
V1	39	7.03	12	85
V2	120	7.27	14	143
V3	74	4.62	9	251
V4	35	6.57	11	121
V5	98	3.68	7	425
LSD _{0.05}	65	1.055	12	86.5

WAP- Weeks after planting

Table 9: The result of the analysis of variance depicts a significant difference (P<0.05) in the interaction of poultry manure and variety on the total number of pods and nodules, while there was no significant difference (P>0.05) in the interaction of poultry manure rates and variety on the pod length and number of seeds per pod. For the interaction, PM 10 tonnes/ha + Tvr 12 gave the maximum number of pods and the highest number of seeds per pod. The maximum pod length was obtained at PM 10 tonnes /ha + Tvr 6 and PM 10 tonnes/ha + Tvr 15, while the maximum number of nodules was obtained at PM 10 tonnes/ha + Tvr 29.

Fable 9: Interaction of	poultry manure	rates and variety on	yield attributes of mung	bean
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PM rates x Variety	Pod/plant	Pod length	No of seeds/pod	Nodules/plant
PM10 X V1	64.7	7.67	13.7	163
PM10 X V2	233.3	7.47	13.67	285
PM10 X V3	114.7	5.33	10.00	483
PM10 X V4	39.7	6.30	11.67	233
PM10 X V5	140.3	3.90	7.00	832
PM0 X V1	13.3	6.40	11.00	6
PM0 X V2	5.7	7.07	14.00	1
PM0 X V3	34.0	33.90	7.33	19
PM0 X V4	31.0	6.83	10.00	9
PM0 X V5	56.0	3.47	6.67	18
$LSD_{0.05}$	91.43	NS	NS	122.3

WAP- Weeks after planting

CONCLUSION

In conclusion, the application of poultry manure at 10 tonnes/ha on Tvr 12 mung bean variety should be used by farmers to obtain maximum yield while Tvr 29 should be used as a cover crop and for nitrogen-fixing ability because it produced a maximum number of leaves and nodules per plant.

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