Original Research Article

EFFICACY OF ORGANIC AND INORGANIC FERTILIZER ON THE GROWTH AND YIELD OF *Glycine max. L* (SOYA BEAN) IN THE NORTHERN GUINEA SAVANNA REGION OF NIGERIA

ABSTRACT

This research study was conducted at the Federal College of Forestry, Jos demonstration farm to determine the efficacy of poultry droppings, cow dung, saw dust and NPK fertilizer on the growth, yield components and yield of *Glycine Max. L.* (Soya Bean). Randomised complete block design (RCBD) was used with five treatments replicated four times. Growth and yield characteristics were recorded on plant height, number of leaves, stem girth, number of branches, leaf area, days to 50% flowering, number of pods/plant, number of seeds/pod, 1000 seeds weight, yield and biomass weight. The data collected was analysed using SPSS 25 and where significance was declared, Duncan Multiple Range Test (DMRT) was carried out to separate the means. The result shows that there was significant difference at the application of the treatments. poultry droppings differed significantly as it gave the highest plant height (54.78cm), number of leaves (50.40), number of branches (3.80), leaf area (143.80cm^2), stem girth (3.26cm), number of pods/plant (95.00), number of seeds/pod (2.62), 1000 seeds weight (420.80g), yield (24.84 tons/ha) and biomass (15.66 tons/ha). The least number of days it takes for 50% of the seeds to flowering was also recorded on the application of poultry manure. It can be concluded that the application of poultry droppings gave the highest growth and yield characteristics of soya bean in the study area. Thus, soya bean farmers are encourage to apply poultry droppings for better growth and yield.

Key Words: Soya bean, Organic, Yield, inorganic Fertilizers.

1.0 INTRODUCTION

Soya beans (*Glycine max. (L.) Merr.*) are one of the oldest cultivated crops of the temperate regions and one of the world's most important sources of oil and protein. Available records indicate that Soya beans originated from china and from there it spread to all parts of the world (1). The annual average world soybean production was about 125.7 million metric tons, corresponding 50% of this amount to North America, 31.5% to Central and South America, 16% to Asia and the remaining 2.5% to Africa, Europe and Oceania (2). In Africa, Nigeria is the largest producer of soybean with an annual turnover of about 500,000 metric tons (3). Soya bean seeds contain 43.2% protein, 19.5% fat, 20.9% carbohydrate and a good amount of other nutrients like calcium, phosphorus, iron and vitamins (4). Soya bean has 3% lecithin which is helpful for brain development.

Organic manure is a cheap and readily available source of essential nutrients to the plants. It is used primarily as a source of plant nutrients (5). Naturally, the use of organic manure can improve soil properties and maintain the quality of soil fertility. Organic manures act not only as a source of nutrients and organic matter, but also increase microbial biodiversity and activity in soil, influence structure, nutrients get turnover and many other changes related to

physical, chemical and biological parameters of the soil (6). The soil having higher organic matter concentrations have been proved to enhance the growth and yield of different crops (6) as well as soil aeration, soil density and maximizing water holding capacity of soil for seed germination and plant root development.

In spite of the increase in land areas under soya bean production, yield is still low. Some of the major causes of low yields are declining soil fertility and insufficient use of fertilizers resulting in severe nutrient depletion of soils. In the past, a long fallow period (5-10 years) allowed natural restoration of soil fertility. However, because of pressure on land to increase food production and other socio-economic activities, the fallow period is almost nonexistent in many farming communities in Nigeria. Fertilizer/manure has been shown to be an effective means of enhancing crop performance for more than a century. It has contributed largely to the major increase in yields which have been achieved worldwide and for the substantial improvement of human and animal health.

Soya bean being a high protein and energy crop its productivity is often limited due to poor yield. The interest in soybean has recently been increased, and a lot of researches have been conducted due to the increasing demand for soya bean both for domestic and industrial purposes. Thus, this research work is carried out to determine the efficacy of poultry droppings, cow dung, saw dust and NPK fertilizer on the growth, yield components and yield of *Glycine max. L* (soya bean) in the northern guinea savanna region of Nigeria.

2.0 Materials and Methods

The field experiment was carried out between June to August, 2018 at the Federal College of Forestry demonstration farm located in Jos, Plateau state. The region lies between latitude 7° and 11° north, longitude 7° and 25° east and at an altitude of about 1200km above sea level. The area lies in the northern guinea savanna of Nigeria with an annual rainfall of 1460mm and a temperature of 19°C to 32°C, (7).

2.1 Soil Analysis

Soil samples from the study area were collected randomly at a depth of 0cm to 30cm to determine the physical and chemical properties. A soil analysis was carried out at ASTC (Agricultural Services and Training Center) KASSA, VOM, Jos, Plateau sate.

2.2 Experimental Design

The experiment was laid out on a Randomised Complete Block Design (RCBD) with five treatments: control, poultry droppings 2.5t/ha, cow dung 2.5t/ha, saw dust 2.5t/ha and NPK fertilizer 180Kg/ha according to (7) replicated four times. The seeds were obtained at IITA Kano and planted at the rate of two seeds per hole. Growth and yield characteristics were recorded on;

i. plant height was measured using a meter rule from the base to the tip of the plant in centimeter (cm)
ii. number of leaves for the individual plants randomly selected (and tagged) were counted
iii. stem girth of the tagged plants were measured using a vernier caliper in centimeter (cm)
iv. number of branches were counted for the tagged plants
v. leaf area was calculated after measuring the length and breadth of the respective leaves using

the equation, Leaf Area(cm^2) = Length of leaf / Breath of leaf ……(i)

vi. days to 50% flowering was counted as the number of days it took 50% of the plants to flower

vii. number of pods/plant involves counted the number of pods produced per plant

viii. number of seeds/pod involves counting the number of seeds in each pod produced by the plant

ix. 1000 seeds weight entails counting 1000 seeds produced by the plants and weighing them using a weighing balance in grams (g)

x. yield was weight and calculated as,

$$\text{Yield (tons/ha)} = \frac{\text{Total weight (Kg) of produce} \times 10000m^2}{\text{Plot size } (m^2)} \quad \ldots\ldots\ldots\ldots \text{(ii)}$$

xi. biomass weight involves measuring the weight of the dry matter and calculated as

$$\text{Yield (tons/ha)} = \frac{\text{Total weight (Kg) of Dry matter} \times 10000m^2}{\text{Plot size } (m^2)} \quad \ldots\ldots\text{(iii)}$$

The data collected was analysed using SPSS 25 and where significance was declared, Duncan Multiple Range Test (DMRT) was carried out to separate the means.

3.0 Results and Discussions

3.1 Physical and Chemical Properties of Soil in The Study Area

The physical and chemical properties of the soil as presented in Table 1 showed that the soil PH was 5.8 which is slightly acidic. It is the preferred soil PH range for good growth and development of most crops. Organic matter had an average value of 115%, while the respective nutrient constituents of nitrogen, phosphorus, potassium, calcium and magnesium were 0.04%, 6.2, 96.0, 530 and 102ppm were in average quantities for optimum production of most crops. The soil can be classified as sandy loam. The percentage composition of sand, silt and clay (10.88% clay, 12% silt, and 77.12% sand) confirms the presences of organic matter which make the soil good for crop production.

Table 1: Physical and Chemical Properties of Soil in The Study Area

Sample Depth	0- 15cm
pH	5.8
N (%)	0.04
P ppm	6.2
K ppm	96.0
Ca ppm	530
Mg ppm	102
O.M (%)	115
H+ mMol/100g	157x10

Caly (%)	10.88
Silt (%)	12
Sand (%)	77.12
Textural Class	Sandy loam

Source: - Agricultural Services and Training Center KASSA/VOM, 2018

3.2 Efficacy Of Poultry Droppings, Cow Dung, Saw Dust And Npk Fertilizer On The Growth *Glycine max. L* (SOYA BEAN)

3.2.1 Plant Height: The efficacy of poultry droppings, cow dung, saw dust and NPK fertilizer on plant height as presented in Table 2 indicates that there is significant difference between the treatments at both 1% levels of probability. The highest mean plant height was 54.78cm given by the application of poultry droppings, the application of cow dung gave 45.92cm, NPK fertilizer gave 38.56cm while saw dust and the control gave 36.18cm and 32.14cm respectively.

3.2.2 Number of Leaves: The efficacy of poultry droppings, cow dung, saw dust and NPK fertilizer on number of leaves as shown from Table 2 indicates the there is significant difference between the treatments at both 1% levels of probability. The highest (50.40) mean number of leaves was obtained at the application of poultry droppings, followed by the application of cow dung (45.60), then Npk fertilizer (43.80), with saw dust (36.00) and the control (31.00) producing the least number of leaves.

3.2.3 Number of Branches: The result from Table 2 shows that significant differences exist between the treatments on the number of branches at 1% level of probability. The application of poultry droppings produced the highest (3.80) mean number of branches while the control produced the least (1.60) mean number of branches.

3.2.4 Leaf Area: The efficacy of poultry droppings, cow dung, saw dust and Npk fertilizer on leaf area as shown in Table 2 revealed that significant differences exist between the treatments. Poultry droppings gave the highest mean leaf area of 143.80cm^2. Although no significant difference exist between the control and the application of saw dust, it has the least mean leaf area of 100.40cm^2.

3.2.5 Stem Girth: The application of poultry droppings has significant effect (3.26cm) on stem girth at 1% level of probability compared to saw dust (2.64cm), cow dung (2.56), NPK fertilizer (2.52cm) and the control (1.92cm).

Table 2: Efficacy Of Poultry Droppings, Cow Dung, Saw Dust And Npk Fertilizer On The Growth *Glycine max. L* (SOYA BEAN)

Treatment	Plant Height (cm)	Number of Leaves	Number of Branches	Leaf Area (cm^2)	Stem Girth (cm)

Control	32.14a	31.00a	1.60a	100.40a	1.92a
Saw Dust	36.18b	36.00b	2.60b	102.40a	2.64b
NPK	38.56c	43.80c	2.20ab	132.00c	2.52b
Fertilizer					
Cow Dung	45.92d	45.60d	2.80b	121.80b	2.56b
Poultry	54.78e	50.40e	3.80c	143.80d	3.26c
Dropping					
SE±	0.98	0.79	0.37	1.70	0.23
	**	**	**	**	**

Source: Field Experiment 2018
Means within a column having same letters are not significantly different at $P \leq 0.05$.
** = Significant at .001

This result is similar to (5) who opined that chicken manure fertilizer had significant effect on stem diameter, number of branches, plant height and number of leaves. The result is also in agreement with (8) that all the growth (plant height, number of branches, number of leaves and leaf area index), were differed significantly due to the application of organic manures. (4) conducted an experiment and reported that the growth characteristics of soya beans were enhanced by organic and inorganic fertilizers. Organic manure is a reservoir of nutrients and these nutrients are released, thus supplying the necessary elements for plant growth (9).

3.3 Efficacy Of Poultry Droppings, Cow Dung, Saw Dust And Npk Fertilizer On The Yield *Glycine max. L* (SOYA BEAN)

3.3.1 Days to 50% Flowering: The efficacy of poultry droppings, cow dung, saw dust and NPK fertilizer on days to 50% flowering as presented in Table 3 indicates that there is significant difference between the treatments at both 1% and 5% levels of probability. The least number of days to 50% flowering was obtained at the application of poultry droppings while the control takes the most number of days to 50% flowering.

3.3.2 Number of Pods/Plant: The efficacy of poultry droppings, cow dung, saw dust and NPK fertilizer on number of pods per plant as revealed in Table 3 indicates that there is significant difference between the treatments at both 5% levels of probability. The highest (95.00) number of pods per plant were obtained on treating soya bean with poultry droppings while the least (72.00) was obtained when no treatment was given.

3.3.3 Number of Seeds/Pod: Significant differences were observed among the treatments on

number of seeds per pod as shown in Table 3. The highest number of seeds per plant was recorded by poultry droppings (2.62) as compared to the other treatments.

3.3.4 1000 Seeds Weight: The efficacy of poultry droppings, cow dung, saw dust and NPK fertilizer on 1000 seeds weight as given in Table 3 indicates that there is significant difference between the treatments at both 1% and 5% levels of probability. The largest weight (420.80g) was obtained at the application of poultry droppings while the control takes the least (328.00g).

3.3.5 Yield: Soya bean yield significantly differed among the various treatments as shown in Table 3. The seed yield ranges between 28.84 tons/ha to 14.08tons/ha. All the application of fertilizer gave significantly higher grain yield over control. The highest soya bean grain yield (24.84 tons/ha) was obtained at the application of poultry droppings, while the least (14.08 tons/ha) at the control.

3.3.6 Biomass: The application of poultry droppings gave better (15.66 tons/ha) biomass than the Saw dust (11.62 tons/ha), NPK fertilizer (12.96 tons/ha), cow dung (12.76 tons/ha) and the control (9.34 tons/ha). Significant difference was observed at the application of the different treatments given during the growing seasons in terms of biomass.

Table 3: Efficacy Of Poultry Droppings, Cow Dung, Saw Dust And Npk Fertilizer On The Yield *Glycine max. L* (SOYA BEAN)

Treatment	Days to 50% Flowering	Number of Pods/Plant	Number of Seeds/Pod	1000 Seeds Weight (g)	Yield (tons /ha)	Biomass (tons/ha)
Control	57.60d	72.20a	1.60a	328.00a	14.08a	9.34a
Saw Dust	55.80c	76.00b	2.00ab	353.00b	17.40b	11.62b
NPK	56.80cd	81.20c	1.40ab	356.00b	20.66c	12.96c
Fertilizer						
Cow Dung	52.20b	88.60d	2.20a	377.00c	20.34c	12.76bc
Poultry	48.20a	95.00e	2.62b	420.80d	24.84d	15.66d
Dropping						
SE±	0.70	0.99	0.36	8.65	0.81	0.61
	**	*	**	**	**	**

Source: Field Experiment 2018
Means within a column having same letters are not significantly different at $P \leq 0.05$.
* = Significant at .05

** = Significant at .001

These results is similar to (5) who opined that chicken manure had positive influence on growth and yield of soybean which gave the highest means in most growth and yield attributes. Poultry manure showed better performance in producing grain yield with respect to other organic manures. (10) found that the combination of inorganic with organic fertilizers increased the seed yield. It can be concluded that a 50% substitution of inorganic fertilizer with poultry manure is recommended to reduce use of chemical fertilizers without sacrificing crop yield (11).

4.0 Conclusion

It can be concluded that the application of poultry droppings gave the highest plant height, number of leaves, number of branches, leaf area, stem girth, number of pods/plant, number of seeds/pod, 1000 seeds weight, yield and biomass weight while the control gave the highest number of days for the plant to attain 50% flowering. The application of poultry droppings therefore, gave the highest growth and yield characteristics of soya bean in the study area. Thus, soya bean farmers are encourage to apply poultry droppings for better growth and yield.

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