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EVALUATION OF THE GROWTH AND YIELD OF THREE SPECIES OF CANAVALIA UNDER THE HUMID TROPICAL LOWLANDS OF SOUTH EAST NIGERIA

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ABSTRACT

The trial was conducted at the Research and Teaching farm, School of Agriculture and Agricultural Technology, Imo State Polytechnic Umuagwo. The experiment was arranged in a factorial design fitted into a Randomized Completely Block Design with four (4) replications. Each replication is made up of 9 plots making a total of 36 plots. The treatments include T_1 - 0t/ha Pig manure, 10t/ha and 15t/ha which were applied to three varieties of canavalia spp. Data were obtained at 2, 4, 6, 8 and 10 weeks after planting on plant height, number of leaves/plant, leaf area and the number of pods/plant obtained. At 10 weeks after planting. Analysis of Variance (ANOVA) result indicates that 15t/ha performed best in all the three varieties of canavalia spp. However the best result was observed from canavalia gladiata (V_1) in all the parameters investigated. Therefore canavalia gladiata (V_1) is adaptable in the study area than V_2 (canavalia ensiformis) and V_3 (canavalia rosea).

Keywords: Growth and yield, Canavalia, tropical, south east Nigeria.

INTRODUCTION

Canavalia spps notably, sword bean (Canavalia gladiata) otherwise called "magic bean", Canavalia ensiformis (jackbean) and Canavalia rosea (bay bean) can be used to cushion food security and sustainable development goals (SDGs) in sub Saharan Africa. It is an underutilized leguminous crop for global food security and nutrition (Bruegmann and Caraway, 2003). Canavalia is a genus of flowering plants in the legume family (fabaceae) and

comprises approximately 48 to 50 species of tropical vines (Holt-Gemenez and Loren, 2008). Canavalia is a vigorous, deep-rooted, and annual to perennial climbing plant. The stems, which are often slightly woody, can grow up to 10 metres long, scrambling over the ground or twining into other plants for support (TNAU, (2014). Both species of Sword bean (Canavalia gladiata) and Jack bean (Canavalia ensiformis) are used in Northern Nigeria as ornamental plants and in some places are believed to be "snake repellents". Several species are valued legume crops, including common jack-bean (C. ensiformis), sword bean (C. gladiata) and C. cathartica. At least the first makes a beneficial weed and pathogen-suppressing living mulch (Min et al., 1992). The common jack-bean is also a source of the lectin concanavalin A, which is used as a reagent in glycoprotein biochemistry and immunology. The jack-bean is also a common source of purified urease enzyme used in scientific research. Sword bean is used as vegetable cover crop, forage and green manure (Udedibie, 2012). The young green pods are extensively eaten in tropical Asia, served as a boiled green vegetable similar to common bean (Phaseolus vulgaris L.). The full - grown but still fresh, green seeds are consumed as a cooked vegetable similar to broad bean (Vicia faba L.) sword bean is not a popular pulse because of the strong flavour and the thick, tough seed-coat. Dry full mature seeds should be eaten with caution as they may be somewhat poisonous. Detoxification by changing the cooking water, soaking rinsing or fermentation is possible but laborious. White seeds are considered to have a better flavour than coloured seeds (Sheahan, 2012). Both the flowers and young leaves are used steamed as a flavouring. In Java, sword bean is used as a short duration cover crop and as a green manure. It is occasionally used as fodder but

less so than the related jack bean (C. ensiformis (L.) DC). Pink seeds are sometimes employed in traditional Chinese medicine. The urease extracted from sword beans is used in analytical laboratories. Canavalia rosea on the other hand is a perennial herb with a trailing or climbing stem growing 2 - 10 metres long and becoming somewhat woody with age. The plant is sometimes harvested from the wild for local use as a food and medicine (Steve, 2004).

Manure is organic matter that is used as organic fertilizer in agriculture (Udedibie, 2012). More manure consists of animal faeces other sources include compost and green manure. Manures contribute to the fertility of soil by adding organic matter and nutrients, such as nitrogen that are utilised by bacteria, fungi and other soil microorganisms in the soil. Higher organisms then feed on the fungi and bacteria in a chain of life that comprises the soil food web (Sheahan, 2012). Pig manure contains plentiful essential nutrition ingredients like nitrogen, phosphorus and potassium for plant growth, which can promote healthy growth and increase the yield of grain crop (Sheahan, 2012). Fertilizers are materials (organic and inorganic) added to the soil to enrich and compliment the nutrients status of the soil, fertilizer can either be organic or inorganic in nature. Chemical materials added to the soil to enrich and compliment the nutrient status of the soil. Fertilizers dissolve quickly and are made available to the plant for their use within a short time. Organic fertilizers on the other hand release their nutrients to plants for a long period of time (Ayenigbara, 2000). The best fertilizer for soil found in the humid tropics is mixtures of organic and inorganic of organic fertilizer (Ayenigbara, 2000). A complimentary application of organic manure and mineral

fertilizer has shown tremendous increase in the nutrient efficiency of plants (Murwira and Kirchmarn, 1993) and organic manure is usually required in large quantities to sustain crop production which may not readily be available to small scale farmers (Olowokudejo, 2008). Since there is dearth of information on the cultivation of canavalia spps in the South Eastern zone of Nigeria, the use of pig manure which is available and very cheap could be used to enhance productivity and boost food security in Nigeria.

MATERIALS AND METHODS

Location of the experimental site

The experiment was carried out at the Teaching and Research Farm of Imo State Polytechnic, Umuagwo-Ohaji, which is in humid tropical rainforest zone of South Eastern Nigeria. It lies between latitudes $5^{0}17^{1}$ and 5^{0} 19^{1}N and longitudes 07^{0} 54^{1} and 06^{1} 56^{1}E (NIMET, 2015). The area which lies in the low land geomorphology of South Eastern Nigeria has a bimodal rainfall pattern, April to August being the longer and September to November being shorter wet periods. The average annual rainfall is about 2,000 - 2,500 mm with mean temperature of 27 - 32°c and mean relative humidity of 85% (NIMET, 2015).

Soil Sampling and Analysis

Soil samples were randomly collected from the experimental site using auger driller at a depth of 0 - 20 cm. This was analyzed chemically before land clearing. The parameters that was analyzed included; particle site distribution, bulk density, soil pH, organic carbon, total nitrogen, available, phosphorus, exchangeable cation like potassium (K), calcium (Ca), sodium (Na) magnesium (Mg), and exchangeable acidity.

Laboratory Analysis

Particle size distribution was determined by hydrometer method according to the procedure of Gee and Or. (2002). Bulk density was measured by core method according to Grossman and Reinschi in (2002). Soil pH was determined electrometrically in 1:2:5 soil/water ratio (Hendershot et al., 1993). The total nitrogen was determined using Bray II method (Oisdim and summer (1992). Exchangeable cations was extracted with 0.1 m bael method (Handershort et al., 1993) and analyzed with atomic absorption. Exchangeable acidity was determined by potassium chloride (kcl) extraction method and was determined by (kcl) extraction method the extraction was filtrated against 0.0510. Effective cation exchangeable capacity (ECEC) was collected at the summation of the exchangeable bases and kcl extractable, Aluminuim and Hydrogen (JUO et al., (1976). The percentage base saturation was the summation of total exchangeable bases expressed as a percentage of effective cation exchangeable capacity (ECEC).

Land Preparation and Experimental Design

The land was cleared manually using cutlass, stumping, was done using spade and cutlass. Thereafter, seed beds preparations was made. Each bed measuring 2m x 2m with 0.5 pathways and 1m in between replications. The experimental design was factorial arranged into a Randomized Complete Block Design (RCBD) with nine (9) treatments replicated four times. Each replication was made up 6 plots giving a total of 36 plots. The total land area was 132 sqm.

Experimental Treatment/Application

The experimental material was three different seeds of Canavalia notably *Canavalia gladiate, Canavalia ensiformis and Canavalia rosea* procured from Samaru College of Agriculture, Ahamadu Bello University Zaria. Pig manure used in the cultivation was obtained from the Department of Animal Production and Health Technology, Imo State Polytechnic Umuagwo. The pig manure was applied to the crop two (2) weeks after planting at the rate of 0t/ha, 15t/ha and 10t/ha respectively. The seed was planted at a depth of 2 - 3 cm, spacing of 50 cm x 45 cm, three (3) seeds was planted/hole and later thinned down to two seedlings. Data was collected at 4, 8, 12, 16, and 20 weeks after planting (WAP) on vine length (cm) which was measured using flexible measuring tape. Measurement was taken on four sampled plants from the base of the soil near the ground to the last tip of the vine of canavalia; The mean number of leaves was obtained by physically counting the number of leaves each canavalia Spp has produced while the mean fresh weight of Canavalia Spp was obtained by using a weighing balance to measure the harvested plants. The mean fresh weight taken from the sampled plants as harvest was determined.

Statistical Analysis

All the data collected was subjected to statistical analysis of variance (ANOVA) for Factorial Design while Least Significant Difference (LSD) at 5% level probability was used to separate the means as outlined by (Gomez and Gomez, 1984).

RESULTS AND DISCUSSION

The effect of pig dung on vine length of three varieties of canavalia spp shows that 15t/ha of pig dung gave the best performance at 4, 8, 12, 16, and 20WAP. However, the highest vine length was obtained at 20WAP on the plot treated with 15t/ha (163 cm) pig manure. V_1 gave a vine length of (163 cm), V^2 (100.4cm) and V^3 (60.5cm) respectively. Result is shown on table 1.

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Table 1: Effect of pig dung on mean vine length of different varieties of canavalia spps Mean vine length (cm)

V1 – Canavalia gladiata					V2 –Canavalia ensiformis					V3- Canavalia rosea				
Pig dung	4WAP	8WAP	12WAP	16WAP 20WAP	4WAP	8WAP	12WAP	16WAP 20WAP		4WAP	8WAP	12WAP	16WAP	20WAP
Ot/ha	5.33^{b}	14.13^{c}	26.97^{c}	49.61^{c} 75.33^{c}	3.00^{b}	10.32^{c}	20.01^{c}	39.98 68.0^{c}		5.00^{a}	13.60^{b}	10.32^{c}	20.10^{b}	55.30^{c}
10/ ha	7.50^{a}	29.52^{b}	51.76^{b}	101.2^{c} 156.67^{b}	6.33^{a}	19.26^{b}	39.75^{b}	56.52^{b} 83.67^{b}		6.00^{a}	18.30^{b}	30.60^{b}	27.30^{b}	75.00^{b}
15t/ha	8.06^{a}	38.17^{a}	76.11^{a}	82.8^{a} 163.a	6.67^{a}	27.13^{a}	68.16^{a}	98.97^{a} 100.4^{a}		7.00^{a}	36.00^{a}	48.00^{a}	51.00^{a}	60.50^{a}

^{abc*}Mean in the same column having the same letters are not significantly different using (DMRT)

Number of Leaves/Plant

The highest mean number of leaves were obtained from pig manure 15t/ha at 10WAP. V_1 (99.0), V_2 (101.67) and V_3 (70.50) respectively. The lowest values were consistently recorded from 0t/ha pig manure which were V_1 (70.0), V_2 (35.30) and V_3 (33.30) respectively statistically at ($P<0.05$).

Table 2: Effect of pig manure on mean number of leaves of different varieties of canavalia spps Mean number of leaves

V_1 – Canavalia gladiata					V_2 – canavalia ensiformis					V_3 – Canavalia rosea				
Pig dung	4WAP	8WAP	12WAP	16WAP	20WAP	4WAP	8WAP	12WAP	16WAP	20WAP	4WAP	8WAP	12WAP	16WAP	20WAP
Ot/ha	2.67^a	12.61^c	34.33^c	52.13^c	70.0^c	3.33^b	9.62^c	19.28^c	26.72 ^{c}	35.33^c	3.50^a	13.60^c	30.00^c	32.00^c	33.33^c
10t/ ha	3.00^a	15.17^c	41.21^b	64.76^b	80.67^b	4.00^b	17.47^c	50.50^b	70.10^b	91.67^b	4.1^a	16.20^b	43.2^b	56.10^b	60.50^b
15t/ha	3.33^a	19.95^a	52.11^a	78.07^a	99.0^a	6.33^a	23.14^a	56.18^a	80.07^a	101.67^a	3.8^a	20.10^a	52.4^a	60.10^a	70.5^a

^{abc*}Mean in the same column having the same letters are not significantly difference using (DMRT)

Leaf Area

The application of pig manure has a pronounced effect of the leaf area development of canavalia spps. At 4WAP, the highest value on the leaf area development was obtained at 15t/ha of pig manure. V_1 recorded the highest of (85.30 cm) as against the value for V_2 (41.3) and V_3 (80.40) significantly different ($P < 0.05$) from other treatments. The trend continued till 20 WAP. However, the highest leaf area for the crop was observed at the crop treated with 15t/ha pig manure, where V_1 recorded (101.2) cm, V_2 (41.30) cm which differed significantly. The lowest was recorded for crop where no manure was applied (Table 3).

Table 3: Effect of pig manure on mean number of leaves of different varieties of canavalia spps Mean number of leaves (CM^2)

	V_1 –Canavalia gladiata					V_2 – Canavalia ensiformis					V_3-Canavalia rosea mean number of leaves				
Pig dung	4WAP	8WAP	12WAP	16WAP	20WAP	4WAP	8WAP	12WAP	16WAP	20WAP	4WAP	8WAP	12WAP	16WAP	20WAP
Ot/ha	40.8^c	50.20^c	54.75^c	67.34^c	73.5^c	16.0^c	16.56^c	17.14^c	19.25^c	2.80^c	45.40^b	49.60^c	52.30^c	64.10c	72.60^b
10/ ha	67.00^a	69.08^b	77.10^b	84.11^b	94.6^b	22.10^b	27.10^b	29.78^b	32.9^b	24.31^b	55.90^b	69.00^b	73.00^b	80.00^b	90.30^a
15t/ha	85.30^a	89.61^a	91.32^a	98.13^a	101.0^a	30.0^a	33.42^a	35.17^a	38.60^a	41.3a	85.40^a	87.00^a	89.00^a	92.50^a	94.30^a

^{abc*}Mean in the same column having the same letters are not significantly difference using (DMRT)

Number of Pods/plant

Table 4 shows the mean number of Pods per plot of different varieties of canavalia spps. 15t/ha of pig manure gave the highest mean number of pods per plot with V_1 (10.0), V_2 (7.50) and V_3 (8.30). The least mean number of pods was obtained from 0t/ha (3.80 from V_3). The mean number of pods/plant between V_2 and V_3 were statistically the same ($P > 0.05$) with respect to 0t/ha pig manure application. Also, the values recorded on the application of 15t/ha between V_2 (7.50) and V_3 (8.30) were statistically the same.

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Table 4: Effect of Pig manure on mean number of pods per plot of different varieties of sword bean

Mean number of pods per plot			
Pig dung	V_1 - *C. gladiata*	V_2 – *C. ensiformis*	V3 –*C. rosea*
0t/ha	5.50[b]	4.0[c]	3.80[c]
10t/ha	9.25[a]	5.50[b]	4.80[b]
15t/ha	10.0[a]	7.50[a]	8.30[a]

[abc]*Mean in the same column having the same letters are not significantly difference using (DMRT)

DISCUSSION

The result of the trial showed that pig manure at different rate supported the growth and other parameters of Canavalia spps. However, pig manure influence was higher on variety one (*Canavalia gladiata*) than the other two varieties notably *Canavalia ensiformis* and *Canavalia rosea* indicating that variety one is adaptable to the environment. Nweke et al., (2013) observed that application of different organic manures enhanced plant growth and development. The differences in the value of the parameters measured may be attributed to the difference in nutrient contained in the rate of pig manure applied. Asiegbu and Carol (2000) observed that higher organic manure rates 15t/ha and 20t/ha gave higher yield than where manure was not applied. Also Obi and Ogbonna (2000) in their research reported that the application of poultry manure at the rate of 5t and 10t/ha were significantly higher than the control. All the applied rates of pig manure produced canavalia plants that were taller than those in the control plots.

The V_1 (*Canavalia gladiata*) produced significantly higher number of leaves and other parameters. The interaction between pig manure and varieties were significant for plant height with V_1 producing significantly taller plants in

combination with the applied pig manure rates. Varietal effect was significant for the number of pods/plot. The pig manure and variety interaction was significantly for number of pods/plot with pig manure at 15t/ha in combination V_1 producing the highest values of pod number. The high pH and base element contents of the pig manure used also have strong tendency of reducing soil acidity, raising soil buffering capacity and providing micro elements such as Zn, B, Cu, and Fe that can influence crop yield positively, hence the superior performance of crops treated with higher pig manure rates. Significant differences ($P<0.05$) in the parameters observed between the canavalia varieties are attributed to the genetic makeup. V_1 pod mean numbers were optimized on plots amended with 15t/ha pig manure. This combination produced more than one and half times the pod obtained at the untreated control plots. Also Uwah and Ogbonna (2013) reported the optimum performance of okra crop with the application of pig manure which were beneficial as the optimized the pod. The variety V_1 gave a better performance relative to V_2 and V_3 in most of the measured parameters and is thus recommended for cultivation.

CONCLUSION

From the result of the study, it can be deduced that the use of pig dung in sword bean production is desirable as it has various effect on the crop. The use of manure will improve the physical, chemical and biological properties of the soil and a source of macro and micro nutrients for healthy growth of crops. The three varieties of canavalia spp were found to be adapted to the environmental condition in the study area. Nevertheless *Canavalia gladiata* is observed to be more adaptable than c. ensiformis and *C. rosea*.

RECOMMENDATION

1. It is advisable to use organic manures in the study area.
2. The use of pig manure at rate of 15t/ha is advisable in the production of Canavalia spps.
3. The study area supports the production of variety 1 (*Canavalia gladiata*) than variety II *Canavalia ensiformis* and variety II1 *Canavalia rosea.*
4. Therefore variety 1 *Canavalia gladiata* is adapted to the study area and therefore should be adopted.

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