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Comparative Effects of Selected Organic Manure and Inorganic Fertilizer on the Vegetative Growth Performance and Flowering of Three Groundnut Varieties

Olasan Olalekan Joseph*, Celestine Uzoma Aguoru, John Ihotu Tracy, Boniface Abogonye

Plant Science and Biotechnology Unit, University of Agriculture, Makurdi, Nigeria

Abstract

This research was aimed at accessing the comparative effects of Organic manure (Saw dust, Cow dung, and compost of selected weeds) and Inorganic fertilizers (NPK Fertilizer) on the growth performance and flowering of some selected Groundnut (*Arachis hypogaea L*) varieties: [*Arachis hypogaea var hirsuta* (*AHH*), *Arachis hypogaea var vulgaris (AHV), Arachis hypogaea var fastigiata (AHF)*]. The pot experiment was carried out in the Department of Plant Science, Federal University of Agriculture, Makurdi. Randomized Complete Block Design was adopted for the experiment with 8 treatment combinations including a control replicated twice. Observations were made on 15 growth parameters 3 weeks before treatment (WBT) and 2 and 5 weeks after treatment (WAT) application. The results showed varietal effect of groundnut on the growth parameters showed significant response in plant spread 3WBT (13.69 cm), height/plant length 3WBT (10.12 cm), and number of plant stems 5WAT (1.41 stems). The effect of fertilizer showed significant response on plant height 2WAT on application of sawdust at the application rate of 300 g Produced tall groundnut plants (16.38 cm) and number of flowers reveals that large number of flowers (20.00 flowers) were produced at application of sawdust at the rate of 150 g. The interaction effect of varietyxfertilizer type significantly influenced Height/plant; *Arachis hypogaea var fastigiata (AHF)* with compost+cow dung at the rate of 300 g (18.44 cm), *Arachis hypogaea var fastigiata (AHF)* with sawdust at the rate of 150 g (18.59 cm), *Arachis hypogaea var fastigiata (AHF)* with compost at the rate of 300 g (17.59 cm), days to flowering; *Arachis hypogaea var hirsuta* (AHH) with all treatments at their different rates (38.02 days/37.97 days), number of flowers; all the varieties with sawdust at the rate of 150 g (25.00 flowers). Among all treatments used, Sawdust at the rate of 150 g / 300 g to obtain significant vegetative growth in groundnut and produced better response. The results of this work points therefore to the fact that the use of organic manure (especially saw dust) presents a very robust prospect for boosting the production of groundnut in Nigeria while at the same time help in effective waste utilization and control of environmental pollution.

Keywords

Vegetative Growth Performance, Groundnut, Manure

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1. Introduction

Groundnut (*Arachis hypogea* L.) also known as peanut belongs to the Family Leguminoseae [1]. It is either grown for its nut, oil or its vegetative residue (haulms). Peanuts grow best in light, sandy loam soil. They require five months

* Corresponding author
E-mail address: lekanolasan@yahoo.com (O. O. Joseph)

of warm weather, and an annual rainfall of 500 to 1,000 mm (20 to 39 in) or the equivalent in irrigation water [2]. Groundnuts are important component of Nigerian diet and about 5 percent of the estimated 58.9 g of crude protein available per head per day is contributed by groundnut [3, 4] particularly to poor people who cannot afford expensive animal protein. A large number of food products are prepared from groundnuts. Groundnut may be used for preparing nutritive and tasty milk. In most areas, it is used as vegetables when the seeds are still tender. About 4-6% of the total global production of groundnut is traded internationally, but most of the crop serve subsistence needs and are marketed domestically, often without entering any formal grain trading channels [1, 5]. The plant is an annual crop, 25-50 cm high at maturity, with either spreading or bushy growth habit. It has a deep tap root system with numerous lateral roots endowed with good nodulation potentials [1, 6].

Nigeria is the highest producer of groundnut in Africa [7] accounting for 51% of production in the West African region. The country contributes 10% of total global production and 39% that of Africa. Between 1956 and 1967, groundnut was the country's most valuable single export crop, exemplified by the famous Kano groundnut pyramids. Groundnut is a major source of edible oil as well as livelihoods for small-scale farmers in Northern Nigeria. Being a labor-intensive crop, it generates employment for the rural poor. It is planted on about 34% of total cultivated area and contributes to 23% of household cash revenue. Groundnut products like oil and cake accounted for a significant percentage of total Nigerian export earnings. Before the fossil oil boom, groundnut was one of the major sources of revenue and foreign exchange earnings. However, in the post-1967 period, the combined effects of drought, increasing prevalence of diseases such as rust, leaf spots and groundnut rosette disease (GRD) have caused a decline in groundnut production. The total output of groundnut in 1970 was 1.6 million tons, but fell to 0.47 million tons in 1980. Due to insufficient groundnut stocks, processors and marketers in Kano State source groundnut from as far as Chad Republic. The year-round demand for groundnut means farmers can increase production without any fear of market glut. Since 1984, production has been increasing at an estimated growth rate of 8%, resulting both from area expansion (6%) and increase in productivity of 2% [8, 9]. Though groundnut is produced across Nigeria, production is concentrated in the nineteen States of the North namely: Kano, Katsina, Kaduna, Jigawa, Sokoto, Zamfara, Kebbi, Adamawa, Bauchi, Yobe, Borno, Benue, Plateau, Taraba, Nasarawa, Abuja, Kogi, Niger and Kwara [1, 8]

The optimization of the mineral nutrition is the key to optimize the production of groundnut, as it has very high nutrient requirement and the recently released high yielding groundnut varieties remove still more nutrients from the soil [10]. On the contrary most groundnut farmers employ imbalanced synthetic fertilizers [11] and poor agronomic practice. Researchers have tried in solving these problems with the intention of increasing groundnut production in Nigeria. As a way of solving soil acidity and poor nutrient status of soils for groundnut production, use of organic manure such as sawdust and compost has been advocated [12]. Application of organic fertilizer is an important means of maintaining soil fertility status and is also environmental friendly. This is because nutrients contained in organic manures are released more slowly and are stored for a longer time in soil, thereby ensuring a long residual effect [13, 14]. In many tropical soils, organic manure has been reported to be the major sources of nitrogen phosphorus, potassium, calcium as well as magnesium [15]. Incorporation of organic fertilizer such as compost is undertaken in this research as it is a good source of nutrients and low Carbon to Nitrogen ratio for quick decomposition, high Nitrogen content helps to improve soil structure, soil microbial activity stabilize the production and productivity of the crops in a cropping system as well as these organic manures are low cost and easily available near this experimental area. Therefore, an attempt has been made to study the effect of different organic and inorganic fertilizers on vegetative growth performance and flowering of 3 groundnut varieties.

More so, the continuous use of synthetic fertilizers has deleterious effects on soil which in turn cause decline in productivity, low nutrient recovery efficiency and increase in cost of production and environmental pollution [16, 17]. Reduction in the use of synthetic inorganic fertilizer and increased used of organic manures is advisable as, the global environment pollution can be controlled considerably. Application of organic fertilizer may also improve availability of native nutrients in soil as well as the efficiency of applied fertilizers [16, 18], stimulate the proliferation of diverse group of soil microorganisms and play an important role in the maintenance of ecological balance of *rhizosphere* [16, 19]. The aim of this work was to evaluate the effect of sawdust, cow dung and compost from selected weeds on the vegetative growth performance and flowering of three (3) groundnuts varieties as well as to compare the vegetative growth parameters of groundnut varieties under the use of organic and inorganic manure (fertilizer).

2. Materials and Methods

2.1. Study Area

This study was carried out at the Department of Plant

science, Federal University of Agriculture, Makurdi located at latitude 07°45′N to 07°50′N, longitude 08°45′E to 08°50′E, 98 m above sea level. The site falls within the Southern Guinea Savannah agro-ecological zone of Nigeria where the rainfall is bi-modally distributed with the highest peak in July/August [1]. The rainy season commences between March/April and terminates in October/November. The total annual rainfall is about 2000-2500 mm and maximum and minimum temperatures of 37°C and 21°C, respectively, while the relative humidity is about 70-80%.

2.2. Sample Collection

A clay loam soil was used for the experiment. About 400 kg bulk of soil was collected from an undisturbed field that had not been cultivated and fertilized for many years. The soil was crushed and passed through a 5 mm sieve. The sawdust used in the study was collected from 'Timber Shade' market, before the Old Bridge, North Bank, Markurdi. NPK fertilizer was bought from the North Bank Market. The compost was obtained from weeds (*Enphorbia hirta* and *Tridax precumbense*) and Cow dung was sourced from the University Animal farm.

2.3. Seed Collection

Viable seeds of 3 groundnut varieties [*Arachis hypogaea var hirsuta* (*AHH*), *Arachis hypogaea var vulgaris (AHV), Arachis hypogaea var fastigiata (AHF)*] were sourced from the Seed germplasm bank of the Department of Botany, Federal University of Agriculture, Makurdi in care of Dr J. O Olasan.

2.4. Experimental Design Structure

The experiment evaluated various combinations of four treatments [sawdust, Cow dung, Compost and NPK (15:15:15)] applied at two levels per combination except the Control. Eight treatments combination were used in the experiment and included; Sawdust, Compost, Cow dung, NPK, Sawdust+Compost, Sawdust+Cowdung, Compost+Cowdung, Sawdust+Compost+Cowdung, and Control (untreated plot). Hence, a total of seventeen (17) treatment levels were done. The experiment was laid-out in Randomized Complete Block Design (RCBD) with two replications. A block contains 34 pots, i.e for 17 treatment levels x 2 replications. Therefore, a total of 102 pots were used in the experiment. A unit of the experiment is a pot containing 10 kg of soil with two groundnut seeds. Sawdust, cowdung and compost were incorporated into randomly selected pots three weeks after planting while the inorganic fertilizers was surfaced applied, also, three weeks after planting (WAP).

Table 1. Rate of applications of treatments.

Treatments levels	Composition	g per pot (10 kg of dry soil)
T1x	100% SD	150
T1y	100% SD	300
T2x	100%CD	150
T2y	100%CD	300
T3x	100%CT	150
T3y	100%CT	300
T4x	100%NPK	1.00
T4y	100%NPK	2.00
T5x	50% SD + 50% CD	150
T5y	50% SD + 50% CD	300
T6x	50% SD + 50% CT	150
T6y	50% SD + 50% CT	300
T7x	50% CD + 50% CT	150
T7y	50% CD + 50% CT	300
T8x	30% SD + 40% CD + 40%CT	100
T8y	30% SD + 40% CD + 40%CT	200
T9	CTL	-

Sample Identification: The three blocks of 34 pots each were labeled accordingly.

2.5. Manure Preparation

In-vessel composter (Static Pile) was used in the composting. The composter is a bucket with lid made of polyethylene and has a capacity of 50 litres. It has a big feeding surface to ensure easy contact between the composting materials and the atmospheric oxygen.

The following steps were taken to composting:

Green weed and dry leaves gotten from the field were properly mixed. The mixture was shredded into tiny pieces. This was to enhance oxygen flow for intense microbial activity and in turn enhance aerobic decomposition. The mixture was laid in layers with microbe rich soil, gotten from the university Animal farm, sprinkled on each layer. This was to initiate decomposition. The bucket was kept closed and insulated. Only the top vent was allowed to control steam escape. The temperature of the compost was maintained between 40°C and 60°C - temperature monitoring was done with clinical thermometer. This was to aid microbial activity and kill harmful seeds and bacteria. The compost pile was turn around daily for more access to oxygen. Composting was done for two weeks. Screening was done. Undecomposed materials were removed leaving fine compost.

2.6. Parameters Evaluated

Data were collected three weeks after planting, two and five weeks after treatment application. The following growth performance was evaluated: Number of leaves (NOL), Plant spread (PS), Plant height (H/PL), Percentage germination (%Ger), Seedling vigor (SV), Number of Plant Stem (NOPS), Stem circumference (SC), Leaf Breadth/Width (LB), Leaf length (LL), Days to flowering (DTF), Number of

flowers (NOF), Flower length (FL), Number of branches (NOB), Trace of diseases (TOD), Plant performance (PP).

2.7. Data Analysis

The data were expressed as mean + or – standard error of mean (SEM) and were compared using One Way Analysis of Variance (ANOVA) using Mini Tab 17.0 version. Statistical significance was accepted at $p<0.05$.

3. Results and Discussion

3.1. Effect of Organic and Inorganic Fertilizers on Growth Parameters of Different Groundnut Varieties

The analysis of variance showing the effect of organic and inorganic fertilizers on growth and yield of different groundnut varieties are presented in Table 2.

The results show that the main effect of variety significantly influence the plant spread, height/plant length 3WBT, number of plant stems and days to flowering. However, there was no observed significant variety effect on number of germination, percentage germination, seedling vigour, number of leaves 3WBT, height/plant length 2WAT, plant height, stem circumference, leaf length, leaf breadth, plant spread 5WAT, Number of leaves 5WAT and flower length (Table 3).

The effect of fertilizer type on the growth and yield of different groundnut varieties was found to significantly influence height/plant length 2WAT, number of plant stems and number of flowers. However, number of germination, percentage germination, seedling vigour, number of leaves 3WBT, plant spread, height/plant length 3WBT, plant height, stem circumference, leaf length, leaf breadth, plant spread 5WAT, number of leaves, days to flowering and flower length (Table 3).

The interaction of variety×fertilizer was found to only produce significant effect in number of plant stems and flower length. All other parameters measured did not respond significantly to the interaction effect of variety×fertilizer type (Table 3).

Table 2. Analysis of Variance showing the effect of organic and inorganic fertilizers on growth and yield of different groundnut varieties.

Source	df	NOG	%G	SV	NOL	PS	H/PL 3WBT	H/PL 2WAT	H/PL 5WAT	NOPS
Replicate	2	0.3255^{ns}	361.8^{ns}	6.968^{ns}	12.90^{ns}	6.695^{ns}	0.2280^{ns}	0.8597^{ns}	4.472^{ns}	1.3019**
Variety	2	1.3550^{ns}	1508.0^{ns}	10.258^{ns}	63.01^{ns}	211.848**	49.1382**	6.5837^{ns}	3.621^{ns}	1.3638**
Fertilizer	17	0.3674^{ns}	408.8^{ns}	15.302^{ns}	23.97^{ns}	7.626^{ns}	3.3448^{ns}	22.8331**	1.147^{ns}	0.6817**
Variety×Fertilizer	34	0.7211^{ns}	801.8^{ns}	22.030^{ns}	36.65^{ns}	19.756^{ns}	7.5022^{ns}	5.6591^{ns}	1.323^{ns}	0.7516**
Error	52	0.7279	809.6	16.907	46.63	15.332	7.4286	4.7811	1.469	0.3730
Total	107									

Table 2. Continued.

Source	df	SC	LL	LB	PS 5WAT	NOL 5WAT	DTF	NOF	FL
Replicate	2	0.05689^{ns}	0.02632^{ns}	0.02478^{ns}	17.358^{ns}	290.98^{ns}	0.118^{ns}	0.001^{ns}	0.07953^{ns}
Variety	2	0.03450^{ns}	0.09296^{ns}	0.12088^{ns}	8.651^{ns}	146.84^{ns}	289.322**	0.002^{ns}	0.03889^{ns}
Fertilizer	17	0.08212^{ns}	0.06078^{ns}	0.03008^{ns}	17.351^{ns}	63.19^{ns}	0.231^{ns}	137.850**	0.04804^{ns}
Variety×Fertilizer	34	0.08036^{ns}	0.18272^{ns}	0.20680^{ns}	15.460^{ns}	254.57^{ns}	0.231^{ns}	0.009^{ns}	0.05214**
Error	52	0.07320	0.12658	0.13407	13.739	224.96	0.236	0.009	0.02886
Total	107								

Table 3. Main effect of variety on growth of different groundnut varieties applied with organic and inorganic fertilizers.

Variety	NOG	%G	SV	NOL 3WBT	PS	H/PL 3WBT	H/PL 2WAT	H/PL 5WAT	NOPS 5WAT
AHH	2.37a	79.05a	8.06a	16.98a	13.69a	10.12a	12.19a	20.30a	1.41a
AHV	1.99a	66.14a	9.15a	15.26a	8.77c	7.75b	12.10a	20.64a	1.14a b
AHF	2.24a	74.48a	8.60a	17.86a	11.01b	9.08a b	12.88a	20.94a	1.03b

Key: Means that do not share a letter are significantly different
Number of Germination (NOG), Percentage germination (%Ger), Seedling vigor (SV), Number of leaves (NOL), Plant spread (PS), Plant height (H/PL), Number of Plant Stem (NOPS).

Table 3. Continued.

Variety	SC 5WAT	LL	LB	PS 5WAT	NOL 5WAT	DTF	NOF	FL
AHH	1.94a	3.99a	1.78a	30.91a	114.63a	37.87a	10.90a	0.61a
AHV	1.90a	3.90a	1.68a	30.03a	117.19a	38.02a	10.88a	0.66a
AHF	1.88a	3.91a	1.68a	30.86a	118.69a	33.02b	10.88a	0.66a

Key: Means that do not share a letter are significantly different
Stem circumference (SC), Leaf length (LL), Leaf Breadth/Width (LB), Plant spread (PS), Number of leaves (NOL), Days to flowering (DTF), Number of flowers (NOF), Flower length. (FL).

3.2. The Effect of Variety on the Growth of Different Groundnut Varieties Applied with Organic and Inorganic Manures

The effect of Variety on growth of groundnut was found to significantly influence plant spread 3WBT, height/plant length 3WBT and number of plant stems 5WAT in Table 2. Plant spread variation showed that *Arachis hypogaea var hirsuta* produced more plant spread (13.69 cm) in groundnut significantly different from the reduced plant spread in *Arachis hypogaea var vulgaris* (8.77 cm) and *Arachis hypogaea var fastigiata* (11.01 cm).

The effect of variety on height/plant length showed there was more plant height in *Arachis hypogaea var hirsuta* (10.12 cm), significantly different from the reduced plant height in *Arachis hypogaea var vulgaris* and *Arachis hypogaea var fastigiata* (7.75 cm/9.08 cm) respectively (Table 2). The effect of variety on the number of stems 5WAT showed there was more plant stems in *Arachis hypogaea var hirsuta* (1.41 stems), significantly better than *Arachis hypogaea var vulgaris* (1.14 stems) but statistically same as *Arachis hypogaea var fastigiata* (1.03 stems) Table 3.

Table 4. Main effect of fertilizer type on growth of different groundnut varieties.

Fertilizer	NOG	%G	SV	NOL	PS	H/PL 3WBT	H/PL 2WAT	H/PL 5WAT	NOPS	SC	LL	LB	PS 5WAT	NOL 5WAT	DTF	NOF	FL
SDx	2.01a	67.06a	8.07a	20.07a	11.82a	8.77a	16.38a	20.74a	1.53a	1.93a	4.12a	1.73a	33.83a	122.44a	36.35a	25.00a	0.52a
SDy	2.35a	78.19a	8.87a	15.38a	12.13a	9.79a	12.49abc	20.66a	1.03a	1.68a	3.84a	1.78a	29.13a	120.10a	36.35a	16.50b	0.77a
CDx	2.33a	77.77a	8.72a	17.17a	11.78a	9.27a	11.97abc	21.00a	1.33a	1.88a	4.02a	1.80a	33.00a	114.17a	36.35a	12.00e	0.62a
CDy	2.35a	78.18a	9.33a	14.46a	11.07a	8.22a	13.63abc	20.59a	1.19a	2.01a	3.85a	1.71a	29.57a	116.94a	36.35a	6.50l	0.46a
CTx	2.35a	78.19a	9.50a	17.74a	11.43a	8.17a	15.33ab	20.43a	1.36a	1.79a	3.81a	1.73a	30.35a	118.10a	36.35a	10.00g	0.62a
CTy	2.35a	78.19a	9.34a	14.91a	10.00a	9.42a	14.38abc	20.66a	0.69a	1.99a	3.88a	1.76a	32.32a	117.27a	36.35a	9.33h	0.67a
SD+CDx	2.68a	89.30a	10.06a	16.68a	12.75a	8.87a	13.03abc	19.54a	1.19a	1.88a	3.81a	1.68a	29.23a	117.10a	36.35a	12.20e	0.61a
SD+CDy	1.85a	61.51a	6.80a	16.85a	10.48a	9.29a	11.56bc	21.09a	1.03a	1.91a	4.05a	1.79a	30.12a	117.94a	36.35a	12.00e	0.81a
SD+CTx	2.51a	83.74a	8.74a	16.96a	12.65a	9.72a	13.76abc	21.24a	0.69a	1.83a	3.85a	1.79a	31.78a	120.52a	36.35a	6.94k	0.71a
SD+CTy	2.01a	67.06a	6.78a	17.57a	12.62a	9.90a	14.41abc	21.01a	0.69a	1.93a	3.86a	1.69a	33.82a	119.27a	36.35a	8.15i	0.66a
CT+CDx	2.18a	72.63a	8.18a	16.77a	11.15a	9.44a	12.49abc	21.06a	1.53a	1.99a	3.90a	1.68a	29.32a	116.60a	36.35a	16.00c	0.56a
CT+CDy	1.85a	61.52a	7.33a	19.35a	10.87a	8.42a	10.21c	20.31a	1.36a	2.13a	3.83a	1.73a	31.52a	111.10a	36.35a	14.50d	0.64a
SD+CT+CDx	2.01a	67.06a	7.09a	17.30a	11.95a	9.45a	11.31bc	20.13a	1.53	1.74a	3.93a	1.54a	28.80a	109.44a	36.35a	11.00f	0.69a
SD+CT+CDy	2.18a	72.63a	13.53a	16.46a	8.95a	7.04a	10.23c	20.16a	0.86a	1.96a	4.10a	1.66a	30.48a	115.94a	36.35a	6.80k	0.74a
NPKx	1.85a	61.51a	7.45a	15.38a	9.55a	8.10a	10.06c	20.78a	1.69a	1.73a	3.94a	1.66a	30.15a	113.77a	36.35a	6.90k	0.59a
NPKy	2.18a	72.63a	8.37a	20.52a	11.03a	8.97a	10.18c	21.00a	1.19	1.99a	3.98a	1.65a	28.48a	117.27a	36.35a	6.40l	0.66a
Cltrlx	2.51a	83.75a	9.47a	13.05a	11.17a	9.19a	11.74bc	20.13a	1.69a	1.99a	4.03a	1.83a	28.68a	115.27a	36.35a	7.70j	0.72a
Cltrly	2.01a	67.07a	7.23a	13.99a	9.43a	9.65a	9.91c	20.81a	0.86a	1.99a	4.03a	1.64a	30.32a	119.77a	36.35a	8.00i	0.56a

Key: Means that do not share a letter are significantly different.
Number of Germination (NOG), Percentage germination (%Ger), Seedling vigor (SV), Number of leaves (NOL), Plant spread (PS), Plant height (H/PL), Number of Plant Stem (NOPS), Stem circumference (SC), Leaf length (LL), Leaf Breadth/Width (LB), Days to flowering (DTF), Number of flowers (NOF), Flower length (FL).

3.3. Effect of Fertilizer Type on Growth of Different Groundnut Varieties

The main effect of fertilizer type on growth of different groundnut varieties is presented in Table 4. The result showed significant responses to height/plant length 2WAT and Number of flowers.

The effect of fertilizer type on plant height 2WAT showed on application of sawdust at the application rate of 300 g Produced tall groundnut plants (16.38 cm), significantly different from the control 2 (9.91 cm). The variation in the effect of fertilizer type on the number of flowers reveals that large numbers of flowers (20.00 flowers) were produced at application of sawdust at the rate of 150 g significantly different from the reduced number of flowers produced by application of NPK at the rate of 2.00 g.

3.4. Effect of Variety × Fertilizer Type on Growth of Different Groundnut Varieties

The main effect of variety × fertilizer type interaction on growth of different groundnut varieties is presented in table 4. The result showed significant responses to seedling vigour, height/plant length 2WAT, days to flowering and Number of flowers.

The effect variety × fertilizer interaction on seedling vigour showed that groundnut varieties produced with great strength at *Arachis hypogaea var vulgaris* with sawdust + compost + cow dung at application rate of 300 g (25.17) significantly better than the reduced strength produced from *Arachis hypogaea var hirsuta* with sawdust+compost+cow dung at application rate of 300 g (4.93) and *Arachis hypogaea var fastigiata* with sawdust+compost at application rate of 300 g.

Table 5. Main effect of variety × fertilizer interaction on growth of different groundnut varieties applied with organic and inorganic fertilizers.

V×F	NOG	%G	SV	NOL	PS	HP/L 3WBT	H/PL 2WAT	H/PL 5WAT	NOPS	SC	LL	LB	PS 5WAT	NOL 5WAT	DTF	NOF	FL
1SDx	2.35a	78.18a	7.35b	25.69a	14.67a	12.17a	14.84abc	21.23a	0.86a	1.96a	4.55a	2.23a	35.67a	125.77a	38.02a	25.00a	0.57a
1SDy	2.35a	78.20a	7.86ab	16.85a	12.77a	10.52a	12.54abc	20.05a	0.86a	1.71a	4.00a	2.03a	29.32a	123.27a	38.02a	16.50b	0.77a
1CDx	2.30a	76.94a	7.25ab	15.30a	12.97a	10.46a	12.42abc	19.43a	2.28a	2.31a	4.11a	2.06a	40.77a	105.46a	37.97ab	12.00e	0.56a
1CDy	3.35a	111.53a	10.07ab	14.18a	18.37a	11.47a	14.39abc	19.08a	1.86a	1.76a	3.60a	1.86a	29.97a	110.27a	38.02a	6.50lm	0.42a
1CTx	1.85a	61.52a	7.51b	22.85a	12.62a	8.57a	15.04abc	20.73a	1.86a	1.86a	3.65a	2.13a	30.32a	115.27a	38.02a	10.00g	0.47a
1CTy	1.85a	61.52a	5.36b	19.35a	11.67a	11.32a	14.69abc	18.48a	1.36a	1.71a	3.95a	1.78a	33.22a	107.77a	38.02a	9.33h	0.47a
1SD+CDx	2.85a	94.87a	10.61ab	18.02a	18.17a	9.67a	12.54abc	20.53a	1.36a	2.01a	3.70a	1.33a	28.62a	102.77a	38.02a	12.20e	0.42a
1SD+CDy	1.35a	44.85a	4.34b	20.85a	12.52a	10.62a	11.99abc	21.98a	1.86a	1.61a	4.05a	1.53a	28.32a	105.77a	38.02a	12.00e	0.57a
1SD+CTx	3 35a	111.53a	9.69ab	13.69a	19.37a	11.77a	13.84abc	20.98a	0.36a	1.81a	3.60a	1.63a	32.62a	115.52a	38.02a	6.80klm	0.67a
1SD+CTy	3.35a	111.53a	9.74ab	15.85a	18.67a	11.77a	13.29abc	21.18a	0.36a	2.16a	3.55a	1.78a	33.12a	106.27a	38.02a	8.45i	0.87a
1CT+CDx	2.35a	78.20a	8.96ab	15.10a	14.07a	8.57a	13.39abc	19.73a	1.86a	2.31a	3.95a	1.38a	30.72a	108.77a	38.02a	16.00c	0.57a
1CT+CDy	2.35a	78.20a	8.74ab	19.35a	14.82a	9.12a	12.39abc	18.58a	1.36a	2.31a	3.90a	1.28a	34.12a	105.77a	35.52a	14.50d	0.62a
1SD+CT+CDx	2.35a	78.18a	8.00ab	15.69a	13.22a	9.52a	9.64abc	19.48a	1.86a	1.61a	4.30a	1.63a	26.97a	100.77a	38.02a	11.00f	0.77a
1SD+CT+CDy	1.35a	44.86a	4.93b	22.85a	10.17a	9.32a	11.79abc	20.23a	1.86a	1.81a	4.40a	1.53a	27.12a	118.27a	38.02a	6.80klm	0.82a
1NPKx	1.85a	61.52a	7.42b	15.60a	11.92a	7.87a	9.39abc	20.73a	1.36a	1.71a	4.17a	1.78a	28.12a	123.27a	38.02a	6.90kl	0.47a
1NPKy	2.85a	94.87a	10.77ab	13.35a	10.67a	8.57a	9.29abc	20.73a	0.36a	2.01a	4.25a	2.04a	29.12a	136.27a	38.02a	6.40m	0.57a
1Cltrlx	2.35a	78.20a	7.88ab	12.60a	12.17a	10.07a	9.84abc	21.53a	1.86a	2.31a	4.05a	2.03a	28.62a	118.77a	38.02a	7.70j	0.77a
1Cltrly	2.35a	78.18a	8.52ab	8.52a	7.62a	10.67a	9.29abc	20.53a	1.86a	2.31a	4.15a	2.13a	29.62a	133.27a	38.02a	8.00j	0.47a
2SDx	1.35a	44.83a	5.65b	18.35a	10.12a	7.82a	15.69abc	20.38a	1.36a	1.96a	3.60a	1.63a	34.22a	136.27a	38.02a	25.00a	0.57a
2SDy	1.85a	61.52a	11.23ab	11.60a	5.92a	4.82a	10.89abc	20.98a	0.86a	1.66a	3.60a	1.78a	26.97a	128.27a	38.02a	16.50b	1.02a
2CDx	1.85a	61.52a	9.86ab	17.85a	8.22a	6.82a	10.04abc	20.48a	0.36a	1.96a	4.05a	1.38a	29.12a	118.77a	38.02a	12.00e	0.47a
2CDy	1.35a	44.83a	7.48b	14.35a	6.27a	5.92a	10.84abc	20.73a	0.86a	1.96a	3.95a	1.28a	28.62a	117.27a	38.02a	6.50lm	0.57a
2CTx	2.35a	78.18a	9.35ab	14.69a	10.02a	7.62a	15.89abc	20.73a	0.86a	1.66a	3.55a	1.33a	27.12a	133.27a	38.02a	10.00g	0.67a
2CTy	2.35a	78.18a	12.30ab	10.35a	6.27a	6.87a	10.84abc	21.13a	0.36a	2.16a	3.70a	1.53a	28.12a	126.77a	38.02a	9.33h	0.77a
2SD+CDx	1.85a	61.52a	7.30b	16.35a	8.42a	7.92a	12.39abc	22.12a	1.86a	2.06a	4.20a	1.78a	29.12a	115.27a	38.02a	12.20e	0.82a
2SD+CDy	1.85a	61.53a	6.42b	15.85a	9.47a	9.92a	11.19abc	20.88a	0.86a	1.76a	4.35a	2.03a	29.12a	121.27a	38.02a	12.00e	0.87a
2SD+CTx	2.35a	78.18a	9.22ab	18.85a	6.12a	8.12a	13.84abc	21.53a	0.86a	2.01a	4.10a	1.63a	29.62a	109.77a	38.02a	7.00k	0.77a
2SD+CTy	1.35a	44.48a	6.64b	13.52a	7.62a	6.42a	14.79abc	21.23a	1.36a	1.81a	4.32a	1.53a	30.62a	123.27a	38.02a	8.00j	0.67a
2CT+CDx	2.35a	78.18a	8.15ab	11.85a	9.92a	9.72a	12.24a	20.28a	1.86a	1.81a	4.05a	2.03a	30.62a	122.27a	38.02a	16.00c	0.37a
2CT+CDy	1.85a	61.52a	8.03a	16.35a	9.42a	7.22a	10.79abc	20.08a	1.86a	2.12a	4.00a	2.13a	31.62a	110.27a	38.02a	14.50d	0.52a
2SD+CT+CDx	1.85a	61.52a	5.78b	19.35a	14.07a	11.22a	13.59abc	20.23a	1.36a	1.91a	3.90a	1.68a	31.12a	117.77a	38.02a	11.00f	0.77a
2SD+CT+CDy	2.85a	94.87a	25.17a	12.85a	5.97a	4.77a	7.94c	20.88a	0.36a	2.31a	4.15a	1.93a	33.62a	106.27a	38.02a	6.80klm	0.72a
NPKx	2.35a	78.18a	9.15ab	10.69a	7.72a	8.92a	11.94abc	20.53a	2.36a	1.61a	3.70a	1.83a	28.12a	102.77a	38.02a	6.90kl	0.47a
NPKy	1.85a	61.52a	9.16ab	17.35a	7.07a	6.07a	11.84abc	20.53a	1.36a	1.81a	3.55a	1.63a	29.32a	105.27a	38.02a	6.40m	0.57a
Cltrlx	2.35a	78.18a	7.39b	14.85a	13.67a	10.02a	11.29abc	19.03a	1.36a	1.71a	3.75a	1.78a	30.32a	108.77a	38.02a	7.70j	0.77a
Cltrly	1.85a	61.52a	6.52b	19.60a	11.67a	9.37a	10.29abc	20.63a	0.36a	2.01a	3.70a	1.38a	33.22a	105.77a	38.02a	8.00j	0.47a
3SDx	2.35a	78.18a	11.21ab	16.19a	10.67a	6.32a	18.59a	20.48a	2.36a	1.86a	4.17a	1.33a	31.62a	105.27a	33.02c	25.00a	0.42a
3SDy	2.85a	94.87a	7.52b	17.69a	17.72a	14.02a	14.04abc	20.88a	1.36a	1.66a	3.90a	1.53a	31.12a	108.77a	33.02c	16.50b	0.52a
3CDx	2.85a	94.87a	9.04ab	18.35a	14.17a	10.52a	12.44abc	21.83a	1.36a	1.71a	3.90a	1.98a	29.12a	118.27a	33.02c	12.00e	0.82a
3CDy	2.35a	78.18a	10.45ab	14.85a	8.57a	7.27a	15.64abc	21.88a	0.86a	1.76a	4.00a	2.03a	30.12a	123.27a	33.02c	6.50lm	0.37a
3CTx	2.85a	94.87a	11.64ab	15.69a	11.67a	8.32a	15.04abc	21.48a	1.36a	1.96a	4.25a	1.73a	33.62a	105.77a	33.02c	10.00g	0.72a
3CTy	2.85	94.87a	10.09ab	15.02a	12.07a	10.07a	17.59ab	21.28a	0.36a	1.96a	4.00a	1.98a	35.62a	117.27a	33.02c	9.33h	0.77a
3SD+CDx	3.35a	111.53a	12.26ab	15.69a	11.67a	9.02a	14.14abc	19.03a	0.36a	1.86a	3.55a	1.93a	29.97a	133.27a	33.02c	12.20e	0.57a
3SD+CDy	2.35a	78.18a	9.65ab	13.35a	9.47a	7.32a	11.49abc	20.63a	0.36a	1.96a	3.75a	1.83a	32.62a	126.77a	33.02c	12.00e	0.97a
3SD+CTx	1.85a	61.52a	7.31b	18.35a	12.47a	9.27a	13.59abc	20.88a	0.86a	1.86a	3.85a	2.13a	33.12a	136.27a	33.02c	7.00k	0.67a
3SD+CTy	1.35a	44.83a	4.11b	23.35a	11.57a	11.52a	15.14abc	20.53a	0.36a	2.16a	3.70a	1.75a	37.72a	128.27a	33.02c	8.00j	0.42a
3CT+CDx	1.85a	61.52a	7.44b	23.35a	9.47a	10.02a	12.64abc	20.78a	0.86a	2.01a	3.70a	1.63a	26.62a	118.77a	33.02c	16.00c	0.72a
3CT+CDy	1 35a	44.83a	5.23b	22.35a	8.37a	8.92a	18.44a	20.93a	0.86a	1.96a	3.60a	1.78a	28.82a	117.27a	33.02c	14.50d	0.77a
3SD+CT+CDx	1 85a	61.48a	7.58ab	16.85a	8.47a	7.62a	10.69abc	21.73a	1.36a	1.71a	3.60a	1.33a	28.32a	109.77a	33.02c	11.00f	0.52a
3SD+CT+CDy	2.35a	78.18a	10.50ab	13.69a	10.72a	7.02a	10.94abc	20.78a	0.36a	1.76a	3.75a	1.53a	30.72a	123.27a	33.02c	6.80klm	0.67a
3NPKx	1.35a	44.83a	5.79b	19.85a	9.02a	7.52a	8.84bc	21.23a	0.36a	1.86a	3.95a	1.38a	34.22a	115.27a	33.02c	6.90kl	0.67a
3NPKy	1.85a	61.62a	5.18b	30.85a	15.37a	12.27a	9.39abc	21.73a	1.36a	2.16a	4.15a	1.28a	26.97a	110.27a	33.02c	6.40m	0.82a
3Cltrlx	2.86a	94.87a	13.13ab	11.69a	7.67a	7.47a	14.09abc	20.63a	1.86a	1.96a	4.30a	1.68a	27.12a	118.27a	33.02c	7.70j	0.62a
Cltrly	1.85a	61.52a	6.65b	13.85a	9.02a	8.92a	10.14a c	20.28a	0.36a	1.66a	4.25a	1.48a	28.12a	120.27a	33.02c	8.00j	0.72a

Key: Means that do not share a letter are significantly different.
Number of Germination (NOG), Percentage germination (%Ger), Seedling vigor (SV), Number of leaves (NOL), Plant spread (PS), Plant height (H/PL), Number of Plant Stem (NOPS), Stem circumference (SC), Leaf length (LL), Leaf Breadth/Width (LB), Days to flowering (DTF), Number of flowers (NOF), Flower length (FL).

Height/plant length response to the effect of variety×fertilizer type interaction showed that *Arachis hypogaea var fastigiata* with compost+cow dung at the rate of 300 g (18.44 cm), *Arachis hypogaea var fastigiata* with sawdust at the rate of 150 g (18.59 cm), *Arachis hypogaea var fastigiata* with compost at the rate of 300 g (17.59 cm) produced taller

groundnut varieties significantly different from the reduced heights of groundnut plant from *Arachis hypogaea var vulgaris* with sawdust+compost+cowdung interaction at the rate of 300 g (7.94 cm).

Response of days to flowering to variety×fertilizer type interaction showed that *Arachis hypogaea var hirsuta* with sawdust and all other treatments at their different rates (38.02 days), except for cow dung interaction at the rate of 150 g (37.97 days) where it significantly produced flowers earlier than *Arachis hypogaea var fastigiata* with all fertilizer type interactions and their application rates (33.02 days).

The effect of variety×fertilizer interaction on number of flowers showed that the varieties with sawdust at the rate of 150 g (25.00 flowers) produced flowers significantly different than the reduced number of flowers produced by the varieties with NPK at the rate of 300 g (6.40 flowers).

The study reveals that the main effect of variety significantly influenced the plant spread 3WBT, height/plant length 3WBT and number of plant stems 5WAT. This confirms the findings of several authors [20-23] who reported significant differences for soybean traits measured. For example, Mamia [23] reported variation in growth parameters among old and newly released groundnut varieties. Similarly, Shaahu et al., [22] reported genotypic difference in growth and yield traits among seventeen advanced groundnut lines. Plant spread 3WBT variation showed that *Arachis hypogaea var hirsuta* produced more plant spread (13.69 cm) in groundnut significantly different from the reduced plant spread in *Arachis hypogaea var fastigiata* and *Arachis hypogaea var vulgaris* (11.01 cm/8.77 cm). The effect of variety on the number of stems 5WAT showed there was more plant stems in *Arachis hypogaea var hirsuta* (1.41 stems), significantly better than *Arachis hypogaea var vulgaris* (1.14 stems) but statistically same as *Arachis hypogaea var fastigiata* (1.03 stems) Table 4. The effect of variety on height/plant length showed there was more plant height in *Arachis hypogaea var hirsuta* (10.12 cm), significantly different from the reduced plant height in *Arachis hypogaea var vulgaris* and *Arachis hypogaea var fastigiata* (7.75 cm/9.08 cm) respectively (Table 4). The study shows that the increase in height/plant length resulted to an increase in number of plant stem and plant spread in groundnut. This agreeing trend between plant spread and height/plant length shows the relationship between this two measured parameters.

The effect of fertilizer type on growth and yield of groundnut has also been evaluated by some authors [24]. The current study shows that significant differences influenced by fertilizer type were observed for height/plant length 2WAT and number of flowers. The effect of fertilizer type on plant height 2WAT showed on application of sawdust at the application rate of 300 g Produced tall groundnut plants (16.38 cm), significantly different from the control 2 (9.91 cm). This shows that application of organic manure in groundnut can play a critical role in increasing plant height. This agrees with the findings of Kadam et al. [24], who studied the effects of FYM, 20 $KgSha^{-1}$ on growth of groundnut and observed significantly increased plant height and other vegetative growth parameters. The variation in the effect of fertilizer type on the number of flowers reveals that large number of flowers (20.00 flowers) were produced at application of sawdust at the rate of 150 g significantly different from the reduced number of flowers produced by application of NPK at the rate of 2.00 g (6.40 flowers). The findings of this study also shows that growth attributes of the crop were found to be enhanced with the increase in the application of organic matter. The findings of this study shows that growth attributes of the crop was found to be enhanced by the application of sawdust as organic manure.

The interaction of variety x fertilizer type was found to only produce significant effect in the height/plant length 2WAT, days to flowering 5WAT and number of flowers 5WAT in groundnut. The effect variety×fertilizer interaction on seedling vigour showed that groundnut varieties produced with great strength at *Arachis hypogaea var vulgaris* with sawdust+compost+cow dung at application rate of 300 g (25.17) significantly better than the reduced strength produced from *Arachis hypogaea var hirsuta* with sawdust+compost+cow dung at application rate of 300 g (4.93) and *Arachis hypogaea var fastigiata* with sawdust+compost at application rate of 300 g. Seedling vigour was significantly influenced by variety and not manure type applied as at 3WBT. Height/plant length 2WAT response to the effect of variety×fertilizer type interaction showed that *Arachis hypogaea var fastigiata* with compost+cow dung at the rate of 300 g (18.44 cm), *Arachis hypogaea var fastigiata* with sawdust at the rate of 150 g (18.59 cm), *Arachis hypogaea var fastigiata* with compost at the rate of 300 g (17.59 cm) produced taller groundnut varieties significantly different from the reduced heights of groundnut plant from *Arachis hypogaea var vulgaris* with sawdust+compost+cowdung interaction at the rate of 300 g (7.94 cm). The interaction of variety×fertilizer type influenced plant height by increasing plant height, stem length and producing healthy plants. Response of days to flowering to variety×fertilizer type interaction showed that *Arachis hypogaea var hirsuta* with sawdust and all other treatments at their different rates (38.02 days), except with cow dung interaction at the rate of 150 g (37.97 days) where it significantly produced flowers earlier than *Arachis hypogaea var fastigiata* with all fertilizer type interactions and their application rates (33.02 days). The effect of

variety×fertilizer interaction on number of flowers showed that all three varieties with sawdust at the rate of 150 g (25.00 flowers) produced flowers significantly different than the reduced number of flowers produced with NPK at the rate of 300 g (6.40 flowers). The effect of variety×fertilizer type interaction influenced days to flowering and number of flowers by producing many flowers and early flower initiation. Tillman et al. [25] reported for peanut plants, compound D plots managed to get quantities of potassium, phosphorus and nitrogen as well as calcium (65%), which are basic nutrients in peanut production at the initial stage of growth. This enhanced vigorous and quick growth of plants in such plots leading to early flower initiation. Also P is a crucial element in crop production which plays an important role for many characteristics of plant growth such as photosynthesis use, cell division and organization, flower initiationing and seed and fruit development [26]. Number of days to flowering could be influenced by climatic factors including rainfall, temperature and radiation as the lowest mean rainfall (1.16 mm) was experienced during the onset of reproductive stage. Kaizzi et al. [27] reported that soil and micro-climatic conditions have effect on the performance of different groundnut genotypes. Similar observations were made by Reddy et al. [28]. Tang et al. [29] also reported the impact of climatic stresses on plant nutrient uptake especially during reproductive phase.

4. Conclusion and Recommendation

The findings of this study show that various combinations of different manure (fertilizer) types is a determinant factor in accessing the variable response to growth in groundnut varieties.

The increase in plant height when sawdust at the rate of 300 g; Number of flowers, when sawdust at the rate of 150 g, were all applied, showed that the application of organic manure in groundnuts can play a critical role in increasing plant photosynthesis by increasing metabolic activity and stimulation of root growth. The interaction of varietyxmanure type was found to only produce significant effect in plant height, days to flowering and number of flowers.

To overcome the challenge of soil infertility, it is recommended that organic fertilizers especially sawdust at the rate of 150 g/300 g should be used to obtain significant vegetative growth in groundnut. Organic farming should be encouraged all over because it is best suited for vegetable farming.

The use of organic manure such as saw dust, cow dung and compost of weeds in boosting the yield of groundnut is also an effective way of utilizing wastes and minimizing pollution occasioned by the indiscriminate disposal of these wastes in the environment.

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