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EFFECT OF DIFFERENT RATES OF COW DUNG ON YIELD INDCES OF GROUNDNUT IN ABRAKA, DELTA STATE, NIGERIA

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ABSTRACT

This experiment was conducted in 2022 and repeated during 2023 farming season at the Teaching and Research Farm of Delta State University, Abraka to assess the response of selected varieties of groundnut to different rates of cow dung in Abraka, Delta State. It was a 5 x 2 factorial experiment carried out in randomized complete block design with three replications. The rates of cow dung in tha^{-1} were 0, 5, 10, 15, and 20, while the varieties were Samnut-21 and Samnut-22. After analysis of variances and means separation with Duncan Multiple Range Test (DMRT) of the data collected on yield indices of groundnut, the results indicated that Samnut-21 was outstanding in all the parameters assessed. Manure application rate of $20tha^{-1}$ gave the highest values with respect to yield of groundnut in Abraka ecology. It was therefore recommended that $20tha^{-1}$ of cow dung be applied to Samnut-21 for increased yield of groundnut in Abraka, Delta State, Nigeria.

Keywords: groundnut, rate of cow dung, Abraka, Nigeria

INTRODUCTION

Arachis hypogaea L. (Groundnut) is a pod bearing annual crop that plays important role in Nigeria. Study have shown that it production employs about 70% of both urban and rural population (Hakeem *et al;* 2015). Besides the mineral and vitamin contents, it has 40% - 50% fat, 20 – 50% protein, 10 – 20% carbohydrtates (Briend, 2001). It is used in making livestock feed, polish and soap. Despite the numerous uses of groundnut in Nigeria, yields across the country are low due to declining soil fertility and inability to identify high yielding varieties best suited to each agro-ecological zone (Audi *et al;* 2013). Differences in yield indices of crops have also been traced by Enujeke (2013) to leaf arrangement, chlorophyll content, light distribution and activities of photosynthetic enzymes associated with crop varieties. The author further recommended that high yielding varieties of crops be given optimum management to enable them easily express their full genetic potentials, including application of appropriate fertilizer requirement, pest and disease control, timely harvesting and good storage.

In the study area, there is paucity of information with respect to most suitable groundnut variety and appropriate rate of cow dung for increased yield. This study was therefore carried out to determine the best rate of cow dung for the most suitable variety of groundnut in Abraka, Delta State, Nigeria.

The objective of this study therefore was to determine the best rate of cow dung for the most suitable variety of groundnut in Abraka, Delta State.

MATERIALS AND METHODS

Site Description

The research was carried out at the Teaching and Research Farm of Delta State University, Abraka, Delta State. Abraka lies between Latitude 6^0 4^0E and Latitude 5^0 54^0 N. Abraka has two distinct seasons. The rainy season starts in April and ends in October. Dry season starts in November till March. Temperature ranges from 25 - 31 ^{0}C while annual rainfall ranges from 2000 *mm* to 3000 *mm* per annum (Efe and Aruegodor,2003).

Soil Analysis and Analytical Procedure

Samples of the soil were randomly collected at a depth of 0–15cm using soil auger. The samples were air-dried, crushed and sieved with a 2 mm sieve mesh and analysed for physico-chemical properties. Particle size distribution was determined by hydrometer method (Gee and Bauder, 1986). The pH was measured using Pyeunican model MK 2pH meterin a 1:2:5 soil water suspension ratio. Organic carbon was determined by Walkey-Black wet oxidation method (Nelson and Sommer, 1982). Total nitrogen was assessed by micro-kjedahl distillation technique as described by Bremiuer and Mulvancy (1982). Available phosphorus was known using Bray No. 1 method (IITA, 1979). Exchangeable potassium was ascertained by Flame photometer, while cation exchange capacity (CEC) was determined by Ammonium acetate saturation method (Roades, 1982). The cow dung used for the research work was analyzed as directed by IITA manuals (1979). Nutrient content of cow dung used for the study was determined as directed by IITA manuals (1979).

Field work

The plots were marked out according to treatments. The five rates of cow dung (0 tha^{-1}, 5 tha^{-1}, 10 tha^{-1}, 15 tha^{-1} and 20 tha^{-1}) were incorporated into the soil two weeks before planting. After the manure incubation period, the two varieties of groundnut were planted at 2 seeds per hole but later thinned to one seedling per stand in the respective plots. Percentage emergence of both varieties was determined at 10 days after planting.

Other data were days to 50% flowering, numbers of pods/plant, number of seeds/pod, and weight of pods. Effects of soil amendment on soil chemical properties at 90 DAP were determined. The effect of interaction of varieties, rates of cow dung, and rate variety on the parameters investigated were determined, while the data collected were subjected to analysis of variance (ANOVA). Differences between treatment means were separated using Duncan Multiple Range Test (DMRT) at 5% level of significance according to Wahua (1999).

RESULTS AND DISCUSSION

Physico-Chemical Properties of Experimental Site

The initial physic-chemical properties of the soil used for the study is shown in Table 1. Particle size distribution shows that the soils were sandy loam that is not fertile as indicated by the low organic matter content (12.4 gkg^{-1}) and total nitrogen of

0.62 gkg^{-1}). Available phosphorus was 5.2 gkg^{-1}), while water soluble potassium (K) was 0.12 $cmolkg^{-1}$ which were low based on FMANR (1996) ratings for Abraka environment. The cation exchange capacity was 9.20$cmolkg^{1}$. These low fertility values of the study area are typical of humid environments where heavy rainfall erodes, leaches and weather slow activity clay minerals resulting in high soil acidity

The sandy loam texture of the experimental site may be attributed to the parent material (PM) from which the soil was formed and the climate of the area. The soil might be formed from sandstone and quartz parent materials. This is consistent with the report of Brady and Weil (1999) who indicated that high sand content of soil could be attributed to high content of quartz in the parent material. The acidic nature of the soil, low available phosphorus and soluble potassium may be traced to heavy rainfall which causes erosion and leaching of low activity clay minerals in the area has been reported (Esu, 2001; Enujeke, 2013). The low organic matter status of the experimental site could be attributed to rapid decomposition of organic residues due to high solar radiation and moisture which favour optimum microbial activities in the soil. It could also be attributed to the annual bush burning which tend to deplete organic matter accumulation in the soil (Landor, 1991; Enujeke, 2013). The low levels of total nitrogen could be attributed to leaching of nitrate by torrential rainfall prevalent in the environment (Olatunji, 2007; Enujeke, 2013).

Table 1: Physico-chemical properties of experimental site

Soil property	Value
Particle size fractions (%)	
Coarse sand	35.0
Fine sand	45.0
Silt	13.0
Clay	7.0
Textural class	Sandy loam
pH H_2O	5.2
Organic matter (gkg^{-1})	12.4
Total Nitrogen (gkg^{-1})	0.62
Available P ($mgkg^{-1}$)	5.2
Exchangeable K ($cmolkg^{-1}$)	0.12
Cation exchange capacity ($cmolkg^{-1}$)	9.20

Chemical Properties of the cow dung used for the study

The analytical values of the cow dung used for the study as shown in Table 2. The result showed that the quantities of macro and micro nutrients in the cow dung were adequate to enhance increased growth and yield of crops, including groundnut.

Table 2: Chemical properties of the cow dung used for the study

Nutrient elements	Values obtained
N (%)	1.40
P (%)	1.0
K (%)	0.42
Ca (%)	3.30
Mg (%)	0.32
Fe ($mgkg^{-1}$)	1584
Mn ($mgkg^{-1}$)	474
Zn ($mgkg^{-1}$)	592
Cu ($mgkg^{-1}$)	480

Effect of variety and rates of cow dung on percentage emergence of groundnut in 2022 and 2023

The response of percentage emergence of groundnut to variety and rates of cow dung in 2022 and 2023 is shown in Table 3. In 2022, significant differences were observed in percentage emergence of the two groundnut varieties investigated. Samnut -21 had higher percentage emergence (91.2%) than Samnut – 22 which had 86.2%. Similar trend was observed in 2023 where Samnut – 21 had higher percentage emergence (92.4%) than Samnut – 22 which had 87.4% emergence.

With respect to rate of application of cow dung, plants that received 20 tha^{-1} of manure had the highest percentage emergence (96%) in 2022, while plants that did not receive manure (control plot or $0tha^{-1}$) had the lowest percentage emergence of 88%. The trend did not change in 2023, where groundnut plants that received $20tha^{-1}$ of cow dung had the highest percentage emergence (98%) while plants that receive $0tha^{-1}$ had the lowest percentage emergence (88%).

The interaction effects (Tables 4 and Table 6) indicated that variety, rate, and variety x rate were significantly ($p < 0.05$) different in both years of evaluation.

Table 3: Effects of variety and rates of cow dung on percentage (%) emergence of groundnut in 2022 and 2023.

	Percentage emergence		
	2022	**2023**	**Mean**
Variety			
Samnut -21	91.2_a	92.4_a	91.8
Samnut -22	86.2	87.4	86.8

Rates of application of cow dung (tha^{-1})			
0	88_{dd}	88_{de}	88
5	89_{C}	89_{d}	89
10	90_{C}	92_{C}	91
15	93_{b}	95_{b}	94
20	96_{a}	98_{a}	97

Means with the same letter (s) under same column are not significantly different at 5% level of probability using Duncan Multiple Range Test (DMRT).

Effects of variety and rates of cow dung on days to 50% flowering of groundnut in 2022 and 2023.

The effects of variety and rates of cow dung on days to 50% flowing of groundnut in 2022 and 2023 is shown in Table 4. In 2022, Samnut – 21 was first to attain 50% flowering (31.2 days) while Samnut – 22 attained 50% flowering in 33.6 days. Based on manure application rate, plants that received $30tha^{-1}$ of cow dung attained 50% flowering first at 25 days. Significant differences were observed in days to 50% flowering with respect to variety and rate of application of cow dung. Similar trend was observed in 2023 when Samnut – 21 attained 50% flowering at 31.8 days while Samnut – 22 attained 50% flowering in 33.8 days. Manure application rate indicated that plants that received $30tha^{-1}$ of cow dung also attained 50% flowering at 25 days while plants that received $0tha^{-1}$ and $5tha^{-1}$ of cow dung attained 50% flowering in 37 days. Significant differences were also observed in days to 50% flowering with respect to variety and rates of application of cow dung.

The interaction effects (Tables 5 and 6) showed that variety, rate of manure were significantly ($p < 0.05$) different in the two years of the investigation.

Table 4: Effects of variety and rates of cow dung on days of 50% flowering of groundnut in 2022 and 2023.

	Days to 50% flowering		
	2022	**2023**	**Mean**
Variety			
Samnut -21	31.2_{a}	31.8_{a}	31.5
Samnut -22	33.6_{b}	33.8_{b}	33.7
Rates of application of cow dung (tha^{-1})			
0	37_{d}	37_{d}	37
5	37_{d}	37_{d}	37
10	30_{C}	32_{C}	31
15	27_{b}	28_{b}	28
20	25_{a}	25_{a}	25

Means with the same letter (s) under same column are not significantly different at 5% level of probability using Duncan Multiple Range Test (DMRT).

Table 5: Effects of interaction of variety and rates of cow dung on percentage emergence, days to 50% flowering, number of pods/plants, number of seeds/pod, weight of pods of groundnut in 2022.

	Rate of cow dung (tha^{-1})	**Percentage emergence**	**Days to 50% flowering**	**No. of pods per plant**	**No. of seeds per plant**	**Weight of pods ($kgka^{-1}$)**
Variety						
Samnut - 21	0	88	37	19.2	1.2	1520
	5	89	37	20.4	1.3	1640
	10	90	30	21.2	1.4	1760
	15	93	27	23.4	1.5	1820
	20	96	25	26.2	1.6	1870
	Mean	91.2	31.2	22.08	1.4	1722
Samnut - 22	0	82	39	16.2	1.1	1280
	5	83	38	17.2	1.2	1340
	10	85	35	18.0	1.3	1420
	15	89	32	20.2	1.4	1660
	20	92	30	23.8	1.5	1780
	Mean	86.2	33.6	19.08	1.30	1496
Variety		*	*	*	ns	*
Rate		*	*	*	ns	*
Variety x Rate		*	*	*	ns	*

*Legend * = significant at 0.05 level of probability, ns = not significant*

Effects of variety and rates of cow dung on yield indices of groundnut in 2022 and 2023

The response of yield indices of groundnut (number of pods/plant, number of seeds/pod and weight of pods) in 2022 and 2023 is shown in Table 6.

In 2022, Samnut – 21 had higher number of pods/plant (22.08) than Samnut – 22 which had 19.08 pods/plant. Significant differences were observed between the varieties with respect to number of pod/plant. Based on rates of application of cow dung, plants that received 20tha^{-1} of manure had the highest number of pods/plant (26.2) while plants that received 0tha^{-1} (control) had 19.2 pods/plant. There were significant differences also in the number of pods/plant with respect to manure application rates.

Similar trend was observed in 2023 when Samnut – 21 had higher number of pods/plant of 22.8 while Samnut – 22 had lower number of pods/plant of 19.6. Manure application rates showed that plants that received 20tha^{-1} of cow dung had 28.8 pods/plant, while plants that did not receive cow dung (0tha^{-1}) had 19.6 pods/plant. There were significant differences in number of pods/plant between the two varieties investigated and the rates of cow dung evaluated.

The interaction effects (Tables 4.2.10) showed that variety, rate were significantly ($p < 0.05$) different in two years of assessment.

Effects of variety and rates of cow dung on number of seeds/pod of groundnut in 2022 and 2023

The response of number of seeds/pod of groundnut to variety and rate of cow dung is shown in Table 6. Significant differences were not observed in number of seeds/pod as affected by varieties and manure application rates in 2022 and 2023. However, Samnut – 21 had higher number of seeds/pod of 1.4 in 2022 and 1.7 in 2023 than Samnut – 22 which had 1.30 seeds/pod in 2022 and 1.34 seeds/pod in 2023. With respect to rates of cow dung applied, plants that received 20tha^{-1} of manure had highest number of seeds/pod of 1.6 in 2022 and 2.1 in 2023, while plants that received 0tha^{-1} of manure (control) had lowest number of seeds/pod of 1.2 in 2022 and 1.4 in 2023.

The interaction effects (Tables 8) indicated that variety, rate and variety x rate were not significantly ($p > 0.05$) different in both years of evaluation.

Effects of variety and rates of cow dung on weight of pods of groundnut in 2022 and 2023

Table 7 shows the effects of variety and rates of cow dung on weight of pods of groundnut in 2022 and 2023. There were significant differences in weight of pods as affected by variety and manure application rates. Samnut – 21 had higher weight of pods of 1722kgha^{-1} in 2022 and 1849kgha^{-1} in 2023 than Samnut - 22 which had lower weight of pods of 1496kgha^{-1} in 2022 and 1632kgha^{-1} in 2023. With respect to rates of cow dung applied, plants that received 20tha^{-1} of manure had highest weight of pods of 1870kgha^{-1} in 2022 and 2022kgha^{-1} in 2023, while plants in the control plot which did not receive cow dung had lowest weight of pod of 1520kgha^{-1} in 2022 and 1670kgha^{-1} in 2023.

The interaction effects (Table 8) showed that variety, rates and variety x rate were significantly ($p < 0.05$) different in the two years of evaluation.

Table 7: Effects of variety and rates of cow dung on yield indices of groundnut in 2022 and 2023.

	Days after planting								
	No. of pods/plant			**No. of seeds/pod**			**Weight of pods**		
	2022	2023	Mean	2022	2023	Mean	2022	2023	Mean
Variety									
Samnut -21	22.08_a	22.8_a	22.4	1.4_a	1.7_a	1.55	1722_a	1840_a	1781
Samnut -22	19.08_b	19.8_b	19.3	1.30	1.34	1.32	1496_b	1632_b	1564
Rates of application of cow dung (tha^{-1})									
0	19.2_{Cd}	19.6_{Cd}	19.3	1.2_a	1.4_a	1.3	1520_e	1670_e	1595
5	20.4_C	20.2_C	20.3	1.3_a	1.5_a	1.4	1640_d	1710_d	1675
10	21.2_C	21.6_C	21.4	1.4_a	1.6_a	1.5	1760_C	1840_C	1800
15	23.4_b	23.8_b	23.6	1.5_a	1.7_a	1.60	1820_b	1960_b	1890
20	26.2_a	28.8_a	27.5	1.6_a	2.1_a	1.85	1870_a	2022_a	1946

Means with the same letter (s) under same column are not significantly different at 5% level of probability using Duncan Multiple Range Test (DMRT).

Table 8: Effects of interaction of variety and rates of cow dung on percentage emergence, days to 50% flowering and yield indices of groundnut in 2023.

	Rate of cow dung (tha^{-1})	**Percentage emergence**		**Plant 50% flowering**		**No. of pods per plant**		**No. of seeds per plant**		**Weight of pods (kgka^{-1})**	
		2022	**2023**	**2022**	**2023**	**2022**	**2023**	**2022**	**2023**	**2022**	**2023**
Variety											
Samnut - 21	0	88	88	37	37	19.2	19.6	1.2	1.4	1520	1670
	5	89	89	37	37	20.4	20.2	1.3	1.5	1640	1710
	10	90	92	30	32	21.2	21.6	1.4	1.6	1760	1840
	15	93	95	27	28	23.4	23.8	1.5	1.7	1820	1960
	20	96	98	25	25	26.2	28.8	1.6	2.1	1870	2022
	Mean	91.2	92.4	31.2	31.8	22.8	22.8	1.4	1.7	1722	1840
Samnut - 22	0	82	82	39	39	16.2	16.1	1.1	1.2	1280	1470
	5	83	83	38	38	17.2	17.0	1.2	1.2	1340	1540

	10	85	87	35	34	18.2	19.2	1.3	1.3	1420	1660
	15	89	91	32	30	20.2	21.6	1.4	1.4	1660	1780
	20	92	94	30	28	23.8	24.2	1.5	1.6	1780	1780
	Mean	86.2	87.4	33.6	33.8	19.08	19.6	1.30	1.34	1492	1632
Variety		*	*	*	*	*	*	ns	ns	*	*
Rate		*	*	*	*	*	*	ns	*	*	*
Variety x Rate		*	*	*	*	*	ns	ns	ns	*	*

*Legend * = significant at 0.05 level of probability, ns = not significant*

Effects of soil amendment on chemical properties of ground at 90DAP

The effects of soil amendment on chemical properties of groundnut at 90 DAP is shown in Table 9. The results showed that nutrients present in the analyzed groundnut were those from both applied cow dung (Table 2) and the nutrients previously existing in the soil (Table 1) that were made available to the test crop through the activities of beneficial organisms. This observation is similar to the findings of Gudugi (2013), Mehedi *et al*. (2011) and Tilley (2022) who reported the nutrients supplied by cow dung positively enhanced growth and yield indices of crops.

Table 9: Effects of soil amendment on chemical properties of groundnut at 90DAP

Rates of cow dung (tha^{-1})	pH (H_2O)	Organic matter (gkg^{-1})	Total N (gkg^{-1})	C ($cmolkg^{-1}$)	Mg	K
0	6.3_a	0.76_e	0.72_e	3.10_a	0.42_e	0.12_C
5	6.2_a	0.82_d	0.76_d	3.0_a	0.46_d	0.16_b
10	6.2_a	0.86_C	0.80_C	3.2_a	0.50_C	0.14_{bC}
15	6.1_a	0.92_b	0.83_b	3.1_a	0.54_b	0.17_{ab}
20	6.0_a	1.10_a	1.20_a	3.0_a	0.62_a	0.19_a

Means with the same letter (s) under same column are not significantly different at 5% level of probability using Duncan Multiple Range Test (DMRT).

Effects of rates of cow dung on yield indices of groundnut.

Plants that received manure rate of $20tha^{-1}$ had the highest number of pods/plant, seeds/pod and weight of pods. This could be attributed to higher carbon content of the applied manure, resulting to increased activities of beneficial micro-organism that improve soil fertility and avail nutrients for plants' use. This is similar to the findings of Enujeke (2013) who reported that highest rate of organic manure gave a corresponding increase in fruit yield of cucumber. It is also synonymous with the findings of Iputu *et al*. (2019) who reported that highest rate of manure gave a corresponding highest fruit weight of tomato. It is also consistent with the findings of Metiedi *et al*. (2011) and Fikadu-Lebeta and Refisa-Jabessa (2019) who reported that highest application rate of cow dung to carrot had better growth and marketable yield. It is also similar to the finding of Enujeke *et al*. (2022) who reported that $20tha^{-1}$ of pig manure gave highest fruit yield of watermelon.

CONCLUSION

The study was carried out to assess the response of selected varieties of groundnut to different rates of cow dung in Abraka, Delta State. Parameters assessed to achieve the objectives of the study were percentage emergence, days to 50% flowering, number of pods/plant, number of seeds/pod, weight of pods, physico-chemical properties of sol, chemical properties of the cow dung used for the study, and effects of soil amendment on chemical properties of groundnut. The results obtained showed that Samnut – 21 was superior to Samnut – 22 with respect to all the parameters assessed in 2022 and 2023, while manure application rate of $20tha^{-1}$ was outstanding based on parameters investigated. The interaction effect indicated that variety, rate and rate of cow dung application were significantly ($p < 0.05$) different and positively affected weight of pods of groundnut. The present study has established that: Samnut – 21 is suitable for Abraka ecology, and that the application of $20tha^{-1}$ of cow dung is most appropriate rate of application for increased yield of groundnut in Abraka, Delta State, Nigeria. In view of the results and findings of the study, it is recommended that: Samnut – 21 which was outstanding in yield indices be grown in the study area and that manure application rate of $20tha^{-1}$ which resulted in better growth performance and yield be adopted in groundnut production.

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