Journal of Agriculture and Environment Vol. 7 No. 1, June 2011: 31-39
ISSN 1595465X

GROWTH AND HERBAGE YIELD OF GROUNDNUT (*Arachis hypogaea* L.) CULTIVARS AS INFLUENCED BY COW DUNG LEVELS IN SEMI-ARID ZONE OF NIGERIA

M. Musa and A. Singh

Department of Crop Science, Usmanu Danfodiyo University, Sokoto, Nigeria

ABSTRACT

A field experiment was conducted during 2007 and 2008 rainy seasons at the Dry Land Teaching and Research Farm of Usmanu Danfodiyo University, Sokoto, to study the growth and herbage yield of groundnut (*Arachis hypogaea* L.) cultivars as influenced by cow dung levels. Treatments consisted of factorial combination of two groundnut varieties (Ex-Dakar and RMP-12) and three cow dung levels (0, 15 and 30 t ha^{-1}), laid out in a randomized complete block design replicated three times. Results revealed that canopy height was higher in Ex-Dakar, whereas, canopy spread and leaf number was higher in RMP-12. Applications of 15 t ha^{-1} and 30 t ha^{-1} cow dung recorded similar performance in most of the parameters observed, except herbage yield where application of 30 t ha^{-1} cow dung recorded the highest. Thus, it can be concluded that both Ex-Dakar and RMP-12 varieties could be planted for herbage yield of groundnut more so when combined with the application of cow dung at the rate of 30 t ha^{-1}.

Keywords: Groundnut; Cow dung; Growth; Herbage Yield

INTRODUCTION

Groundnut (*Arachis hypogaea* L.), also known as peanut is a valuable cash crop for millions of small scale farmers in the semiarid tropics. It generates employment on the farm and in marketing, transportation and processing. In Nigeria, the crop is produced mostly in the semi-arid regions where the hay is used as livestock feed, and it is a valuable source of cash for small scale farmers. Groundnut cake, formed after the oil is extracted, is high-protein animal feed (Gibbon and Pain, 1985; De waele and Swanevelder, 2001; Gibbons *et al.*, 2002).

Despite the immense importance of groundnut, the yield in Nigeria is very low (FAO, 2005). One way the yield could be improved is through the identification of a more suitable variety. Reddy *et al.* (1993) reported that the yield of groundnut can be increased up to 30-89% provided high yielding varieties are identified. Also, through the application of organic matter such as cow dung, FAO (2000) reported that nutrients' availability in soils is an essential factor for proper growth and development of plants. Organic manure improves the soil structure, reduces soil erosion, has a regulating effect on soil temperature and helps the soil to store more moisture; thus significantly improving soil fertility and, in addition, a necessary food for soil micro organisms. Chandrasekarane *et al.* (2007) reported

significant increase in stover yield with the application of manure. Ahlawat (2004) reported application of 15 t ha^{-1} to maximize haulm yield of groundnut. Omokanye *et al.* (2001), working on groundnut varieties, reported the superiority of RMP-12 for both forage and seed production.

Thus, the present study was undertaken to determine the appropriate groundnut variety and cow dung level for increased groundnut production in the study area.

MATERIALS AND METHODS

Experimental Site

A field trial was conducted in 2007 and 2008 rainy seasons at the Dry Land Teaching and Research Farm of the Usmanu Danfodiyo University Sokoto. Sokoto is located in the Sudan Savanna ecological zone of Nigeria on latitude $13^{0}01^{1}$N; longitude $5^{0}15^{1}$E and at an altitude of about 350 m above sea level. The climate of the area is semi-arid with mean (20 years) annual rainfall of about 600 mm (Kowal and Knabe, 1972) The annual rainfall data in 2007 and 2008 cropping seasons were 452.5 and 667.6 mm, respectively (Sokoto Energy Research Center) as presented in (Table 1).

Table 1: Meteorological data at the experimental site during 2007 and 2008 cropping seasons

	2007		2008	
Month	Mean monthly temp(°C)	Mean monthly rainfall (mm)	Mean monthly temp(°C)	Mean monthly rainfall (mm)
May	34	0.2	34	57.0
Jun.	32	18.0	32	114.2
Jul	29	101.0	28	79.6
Aug.	27	214.8	27	190.4
Sep.	28	118.3	28	221.6
Oct.	31	0.0	30	4.8
Total		452.3		667.6

Sources: Rainfall data: Sokoto Energy Research Centre, Sokoto; Temperature data: Sultan Abubakar III International Airport, Sokoto

Soil Sampling and Analysis

Composite soil samples were randomly collected within the experimental site at 0-20 cm depth using soil auger. The samples were bulked, air-dried, sieved and used for the physico-chemical analysis of the soil (Table 2).

Experimental Design and Management

Treatments consisted of factorial combinations of three cow dung levels (0, 15 and 30 t ha^{-1}) and two varieties of groundnut {Ex-Dakar (SAMNUT-14) and RMP-12 (SAMNUT-10)}. The treatments were laid out in a randomized complete block design (RCBD) replicated three times.

Table 2: Physico-chemical characteristics of the soil at the experimental site in 2007 and 2008 cropping seasons

Properties	Cropping Season	
	2007	2008
Physical Properties		
Sand (g kg^{-1})	940	960
Silt (g kg^{-1})	10	10
Clay (g kg^{-1})	50	30
Textural class	Sand	Sand
Chemical Properties		
pH in (H_20) 1:1 ratio	6.13	6.02
Total nitrogen (%)	0.04	0.03
Organic C (g kg^{-1})	0.58	0.54
Available P (mg kg^{-1})	0.22	0.19
Exchangeable bases (cmol kg^{-1})		
Ca	0.30	0.25
Mg	0.50	0.45
K	0.33	0.31
Na	0.42	0.33
CEC (cmol kg^{-1})	8.2	5.8

In the two cropping seasons, the experimental area was prepared by mechanical ploughing using a tractor, and the pulverized soil was leveled using hoe. Plots measuring 3.75 m x 3 m (11.25 m^2) were demarcated and ridged at 75 cm inter-row spacing. Cow dung was sourced from cattle Market in Sokoto (Table 3) and incorporated into the soil as prescribed by the treatments (0, 15 and 30 t ha^{-1}). Seeds of the two groundnut varieties {Ex-Dakar and RMP-12 released by IAR in 1988 (IAR, 1989)} were sourced from Sokoto Agricultural and Rural Development Authority (SARDA), Sokoto. All the recommended cultural practices were adopted uniformly according to groundnut crop requirements

Table 3: Chemical characteristics of the cow dung (%) used in 2007 and 2008 cropping seasons

Parameter	Concentration (%)	
	2007 Cropping Season	2008 Cropping Season
N	0.71	0.83
P	0.50	0.47
K	1.00	1.30

Data Collection and Analysis

Data were recorded on canopy height, canopy spread, leaf number and herbage yield. The data collected were subjected to analysis of variance (ANOVA) using SAS

(2003) computer software. Duncan's New Multiple Range Test was adopted for means separation among treatments showing significant differences at 95% level.

RESULTS AND DISCUSSION

Canopy Height

Significant differences (P<0.05) in canopy heights of Ex-Dakar and RMP-12 were observed at 4, 8 and 12 weeks after sowing (WAS) in both cropping seasons of 2007 and 2008 (Table 4). Ex-Dakar produced taller canopies than RMP-12 at 4, 8 and 12 WAS in both years. Taller canopies recorded by Ex-Dakar could be attributed to its morphology as IAR (1989) reported Ex-Dakar to be Spanish bunch type of erect growing habit; therefore it was expected to grow taller than RMP-12 that is of semi-erect in its growth habit.

Table 4: Canopy height of two groundnut varieties at 4, 8 and 12 WAS as influenced by cow dung levels in 2007 and 2008 cropping seasons

Treatment	Canopy Height (cm)					
	4 WAS		8 WAS		12 WAS	
	2007	2008	2007	2008	2007	2008
Variety (V)						
Ex-Dakar	14.43^{a}	13.03^{a}	36.89^{a}	24.14^{a}	36.63^{a}	27.44^{a}
RMP-12	8.41^{b}	10.14^{b}	19.09^{b}	19.11^{b}	20.98^{b}	24.08^{b}
SE (±)	0.288	0.257	0.735	0.522	0.827	0.712
Significance	s	s	s	S	s	s
Cow dung (CD) (t ha^{-1})						
0	9.93^{c}	10.25^{b}	21.73^{b}	19.08^{b}	22.98^{b}	21.54^{b}
15	11.65^{b}	12.29^{a}	31.10^{a}	23.58^{a}	30.63^{a}	27.33^{a}
30	12.68^{a}	12.21^{a}	31.10^{a}	22.21^{a}	32.81^{a}	28.42^{a}
SE (±)	0.353	0.315	0.900	0.639	0.013	0.872
Significance	s	s	s	S	s	s
Interactions						
V x CD	ns	ns	ns	Ns	ns	s

Means in column followed by same letter (s) within a treatment group are not significant (P>0.05); ns = not significant, s= significant;

Canopy height of groundnut showed significant (P<0.05) response to cow dung levels in both 2007 and 2008 cropping seasons (Table 4). Application of cow dung at 15 t ha^{-1} recorded statistically similar values with the application of 30 t ha^{-1} at all growth stages in 2007 and 2008, except at 4 WAS in 2007 where the application of 30 t ha^{-1} recorded higher canopy height than 15 and 0 t ha^{-1}. The increase in canopy height observed could be attributed to the improved chemical and physical properties of the soil resulting from manure application (FAO, 2000; Lokanath and Parameshwarappa, 2006).This finding is in harmony with the earlier report by Subrahmaniyan *et al.* (2000), who reported that increasing organic manure in the form of farm yard manure up to 15 t ha^{-1} maximized the canopy height of groundnut.

Significant interaction was observed between cow dung application and groundnut variety at 12 WAS in 2008 (Table 5). Interaction revealed that at 0 cow dung, Ex-Dakar performed better than RMP-12. Addition of 15 t ha^{-1} cow dung resulted in significant increase in canopy height of both varieties, but Ex-Dakar recorded higher plant height than RMP-12. Further addition of 15 t ha^{-1} of cow dung (i.e., 30 t ha^{-1}) did not result in increase in canopy height of both varieties. Thus, for canopy height, 15 t ha^{-1} of cow dung was optimum.

Table 5: Canopy height (cm) of two groundnut varieties at 12 WAS as influenced by variety x cow dung interaction in 2008 cropping season

Variety	Cow dung (t ha^{-1})		
	0	15	30
	----------Canopy height (cm)----------		
Ex-Dakar	24.58 ^{c}	29.50 ^{a}	28.25 ^{abc}
RMP- 12	18.50 ^{d}	25.17 ^{bc}	28.58 ^{ab}
SE (±)		1.250	

Means followed by the same letter(s) across are not significantly different (P>0.05).

Canopy Spread

Significant effect of variety on the canopy spread of the two groundnut varieties was observed at 4 WAS in 2008 and 8 WAS in both years. However, no significant difference was observed between the varieties at all other sampling dates (Table 6). RMP-12 recorded significantly higher spread than Ex-Dakar at 4 WAS in 2008, while at 8 WAS, Ex-Dakar showed significantly higher canopy spread than RMP-12 in both 2007 and 2008. The superiority of RMP-12 over Ex-Dakar at 4 WAS of 2008 may be attributed to its growth habit (Gibbon and Pain, 1985). Likewise, at 8 WAS of both years the superiority of Ex-Dakar over RMP-12 could be attributed to the fact that Ex-Dakar, as an early yielding and erect variety, was at the peak of its growth just prior to pegging and fruit setting. Also, IAR (1989) reported RMP-12 to be semi-erect of the Virginia type.

Cow dung levels significantly (P<0.05) affected the canopy spread of the two groundnut varieties at all sampling periods in both years (Table 6). Application of 30 t ha^{-1} cow dung recorded higher canopy spread at 4 and 12 WAS in 2007 followed by the application of 15 t ha^{-1} and the least recorded was in the control. However, at 8 WAS in 2007 and 4, 8 and 12 WAS in 2008, application of 15 and 30 t ha^{-1} recorded statistically similar values that were above the control. The increase in canopy spread of groundnut could be attributed to the nutrient supply through cow dung (FAO, 2000).
No significant interaction between variety and cow dung levels was observed in 2007, 2008 and the combined (Table 6).

Leaf Number per Plant

Results showed significant effect of variety in relation to number of leaves per plant at all sampling dates in both 2007 and 2008 cropping seasons (Table 7). RMP-12 recorded significantly higher leaf number per plant at 4, 8 and 12 WAS in 2007 and 2008 than Ex-Dakar.

Table 6: Canopy spread of two groundnut varieties at 4, 8 and 12 WAS as influenced by cow dung levels in 2007 and 2008 cropping seasons

Treatment	Canopy spread (cm)					
	4 WAS		8 WAS		12 WAS	
	2007	2008	2007	2008	2007	2008
Variety (V)						
Ex-Dakar	11.59	9.69[b]	27.29[a]	19.89[a]	26.50	25.94
RMP-12	11.57	11.22[a]	20.31[b]	16.75[b]	25.64	24.31
SE (±)	0.207	0.283	0.597	0.424	0.689	0.826
Significance	ns	S	s	S	ns	ns
Cow dung (CD) (t ha^{-1})						
0	9.57[c]	9.62[b]	17.50[b]	15.88[b]	20.67[c]	20.83[b]
15	11.69[b]	10.63[a]	26.12[a]	19.67[a]	27.09[b]	26.46[a]
30	13.03[a]	11.13[a]	27.79[a]	19.42[a]	30.45[a]	28.08[a]
SE (±)	0.253	0.347	0.731	0.519	0.844	1.012
Significance	s	S	s	S	s	s
Interactions						
V x CD	ns	ns	ns	Ns	ns	ns

Means in a column followed by same letter (s) within a treatment group are not significantly different (P>0.05); ns = not significant, s= significant;

The superiority of RMP-12 in terms of leaf number could be attributed to its morphology since varieties with alternate branching pattern of the Virginia type are known to be leafier (IAR, 1989; Gibbon and Pain, 1985). Ado *et al.* (1989), working on sunflower found increase in seed yield as a result of increase in number of leaves per plant and attributed increase in leaf number with increase in photosynthetic apparatus and hence the more the amount of photosynthetic material stored in the seeds.

The results revealed significant effect of cow dung on leaf number of groundnut at 4, 8 and 12 WAS in both 2007 and 2008 cropping seasons (Table 7). Application of 30 t ha^{-1} cow dung significantly resulted in the highest number of leaves per plant of groundnut followed by the application of 15 t ha^{-1} and the least was recorded in the control plots at 4 and 8 WAS in 2007. However, at 12 WAS in 2007 and all sampling dates in 2008, application of 30 t ha^{-1} recorded statistically similar leaf numbers with the application of 15 t ha^{-1} all above the control which could be due to enhanced chemical and physical properties of the soil resulting from manure application. Similar effect of manure on groundnut was reported by Chandrasekarane *et al.* (2007). Similarly, Lokanath and Parameshwarappa (2006) reported increased leaf number and leaf area due to manure application.

Significant interaction was observed between cow dung application and groundnut variety at 8 WAS in 2007 (Table 8). Without manure, RMP-12 recorded higher leaf number than Ex-Dakar, but with addition of 15 t ha^{-1}, there was significant increase in the number of leaves in both RMP-12 and Ex-Dakar, but RMP-12 recorded higher leaf number than

Ex-Dakar. Further increment of 15 t ha^{-1} cow dung (30 t ha^{-1}) did not result in significant increase in leaf number per plant in Ex-Daka,r but RMP-12 recorded significant increase.

Table 7: Number of leaves of two groundnut varieties at 4, 8 and 12 WAS as influenced by cow dung levels in 2007 and 2008 cropping seasons

Treatment	Number of leaves per plant					
	4 WAS		8 WAS		12 WAS	
	2007	2008	2007	2008	2007	2008
Variety (V)						
Ex-Dakar	23^{b}	46^{b}	58^{b}	190^{b}	60^{b}	209^{b}
RMP-12	34^{a}	57^{a}	123^{a}	244^{a}	130^{a}	273^{a}
SE (±)	0.78	2.28	3.57	7.19	4.14	7.62
Significance	S	s	s	S	s	s
Cow dung (CD) (t ha^{-1})						
0	22^{c}	43^{b}	61^{c}	169^{b}	73^{b}	181^{b}
15	30^{b}	56^{a}	95^{b}	248^{a}	99^{a}	277^{a}
30	33^{a}	55^{a}	111^{a}	234^{a}	113^{a}	266^{a}
SE (±)	0.96	2.79	4.37	8.81	5.07	9.33
Significance	S	s	s	S	s	s
Interactions						
V x CD	Ns	ns	s	Ns	ns	ns

Means in a column followed by same letter (s) within a treatment group are not significantly different (P>0.05); ns = not significant, s= significant;

Table 8: Leaf number of two groundnut varieties at 8 WAS as influenced by variety *x* cow dung interaction in 2007 cropping season

Variety	Cow dung (t ha^{-1})		
	0	15	30
	---------- Leaf number per plant ----------		
Ex-Dakar	40^{e}	61^{d}	71^{cd}
RMP-12	82^{c}	129^{b}	156^{a}
SE (±)		6.75	

Means followed by the same letter(s) are not significantly different (P>0.05).

Herbage Yield

Significant effect of variety on the herbage yield of groundnut was not observed in both 2007, 2008 and the combined (Table 9). This could be attributed to the shorter rain duration received during the two years of trial that inhibited RMP-12 variety from expressing its full genetic potential. This is so because RMP-12 is a Virginia type with a lot of branches as evidenced through higher number of leaves. Duncan *et al.* (1978) proposed

the length of the growing period among the processes to explain most yield variation in peanut. Also, Omokanye *et al.* (2001), working on groundnut varieties, reported the superiority of RMP-12 for both forage and seed production. The contradiction here could be due to the environmental factor since Shika (Zaria) is sub-humid environment (Omokanye *et al.*, 2001).

Table 9: Herbage yield of two groundnut varieties as influenced by cow dung levels in 2007 and 2008 cropping seasons and the combined

Treatment	Herbage yield (kg ha^{-1})		
	2007	2008	Combined
Variety (V)			
Ex-Dakar	1514	4333	2924
RMP-12	1476	4580	3028
SE (±)	55.47	230.96	118.76
Significance	Ns	Ns	ns
Cow dung (CD)(t ha^{-1})			
0	1138^{b}	2539^{c}	1838^{c}
15	1719^{a}	4892^{b}	3305^{b}
30	1629^{a}	5940^{a}	3784^{a}
SE (±)	67.94	282.86	145.45
Significance	S	s	s
Interactions			
V x CD	Ns	ns	ns

Means in a column followed by same letter (s) within a treatment group are not significantly different (P>0.05); ns = not significant, s= significant;

The results revealed significant (P<0.05) effect of cow dung on the herbage yield of groundnut in both years of trial and the combined (Table 9). Application of 30 t ha^{-1} recorded statistically similar values with that of 15 t ha^{-1} in 2007, while in 2008 and the combined, application of 30 t ha^{-1} of manure recorded higher herbage yield than 15 t ha^{-1}. No significant effect of interaction between variety and cow dung levels on the herbage yield of groundnut was observed in 2007, 2008 and the combined (Table 9).

CONCLUSION

The result of this work revealed significant effect of variety on the performance of groundnut. Canopy height was higher in Ex-Dakar while leaf number was higher in RMP-12. Application of 15 and 30 t ha^{-1} cow dung recorded better but similar performance in canopy height, canopy spread and leaf number. For herbage yield, application of 30 t ha^{-1} cow dung recorded the highest yield. From the findings of this study, the two groundnut varieties could be used for increased herbage production with the application of cow dung at the rate of 30 t ha^{-1}.

REFERENCES

Ado, S. G., B. Tanimu, C. A. Echekwu and S. O. Alabi (1989). Correlation and path analysis between yield and other characters in sunflower. *Nigerian J. Agron., 3 (1): 1-4.*

Ahlawat, R. P. S. (2004). Integrated nutrient management in Groundnut. *In: National Symposium on Enhancing Productivity of Groundnut for Sustaining Food and Nutritional Security*, held during October, 11-13 at National Research Center for groundnut, Junagadh, Gujarat, pp. 65-66.

Chandrasekarane, R., E. Somasundaram, M. M. Amanullah, K. Nalini, K. Thirukkuruman and K. Sathyamoorthi (2007). Response of confectionary groundnut (*Arachis hypogaea* L.) varieties to farm yard manure. *Journal of Applied Sciences Research*, 3(10): 1097-1099.

De waele, D. and C. J. Swanevelder (2001). Groundnut. *In:* Romain, H. R (Ed.) *Crop Production in Tropical Africa*. DGIC Belgium, pp743-763.

Duncan, W. G., D. E. McCloud, R. L. McGraw and K. J. Boote (1978). Physiological aspects of peanut yield improvement. *Crop Science*, 18:1015-1020.

FAO (2000). *Fertilizers and Their Use: A Pocket Guide for Extension Officers* 4th ed. Longman Publishing Company, Singapore.

FAO (2005). *Food and Agriculture Organization's Statistics*. http://www.fao.org (Last updated February, 2005) Accessed on 01/05/2007

Gibbon, D. and A. Pain (1985). *Crops of the Drier Regions of the Tropics*, 1st ed. Longman Publishing Company, Singapore. 155p

Gibbons, R., S. Nigam and S. Chater (2002). *The Tropical Agriculturalist- Groundnut.* Macmillan Education Ltd. London and Oxford. 146p

IAR (1989). *Code and Descriptor List of Crop Varieties.* Institute for Agricultural Research (IAR), Samaru. Ahmadu Bello University, Nigeria.

Kowal, J. M. and D. T. Knabe (1972). *An Agroecological Atlas of the Northern Nigeria*. ABU Press, A.B.U. Zaria. 128p

Lokanath, H. M. and K. G. Parameshwarappa (2006). Effect of organics on productivity of Spanish Bunch groundnut under rainfed farming situations. In: *Proceedings of the 18th World Congress of Soil Science*. July, 9-15, Philadelphia, Pennsylvania, USA. pp. 62-63.

Omokanye, A. T., O. S. Onifade, P. E. Olorunju, A. M. Adamu, R. J. Tanko and R. O. Balogun (2001). The evaluation of dual purpose groundnut (*Arachis hypogaea* L.) varieties for fodder and seed production at Shika, Nigeria. *J. Agric. Sci. (Camb)*, 136: 75-79.

Reddy, L. J., S. N. Nigam, P. Subrahmanyam and R .G. S. Reddy (1993). Registration of ICGV-86590, peanut cultivar. *Crop Sci*., 33: 357-358

SAS (2003). Statistical Analysis System. SAS Release 9.1 for windows, SAS Institute Inc.Cary, NC, USA.

Subrahmaniyan, K., P. Kalaiselven, G. Maniekam and N. Arulmozhi (2000). Response of confectinary groundnut varieties to organic and inorganic fertilizers. *Crop Res. Hisar.,* 19:207-209.