Original Research Article

Influence of Cow Dung Application on the Yield and Yield Components of Two Groundnut (*Arachis hypogaea* L.) Varieties in Sokoto, Semi-arid Zone of Nigeria

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Abstract

Groundnut (*Arachis hypogaea* L.) is a valuable crop for millions of small scale farmers around the tropics. Despite its importance, the production of the crop in semi-arid tropics is constrained by shorter rain duration and low soil nutrient status. The present studies was carried out during the 2007 and 2008 rainy seasons to study the influence of cow dung application on the yield and yield components of two groundnut varieties in the region. 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) making a total of six treatment combinations. The treatments were laid out in a randomized complete block design replicated three times. The findings of this research revealed that Ex-Dakar variety performed better than RMP-12 in all the parameters measured. Application of cow dung increased the number of pods plant⁻¹, pod yield and grain yield of the crop and was optimum at the rate of 15 t ha⁻¹. Thus, Ex-Dakar variety could be suggested for increased groundnut production in the study area. Application of cow dung at the rate of 15 t ha⁻¹ was optimum for groundnut production in the study area.

Keywords: animal manure; grain legume; livestock feed; oil crop; sandy soils.

INTRODUCTION

Groundnut (*Arachis hypogaea* L.), also known as peanut, is an important source of edible oil (50%), easily digestible protein (25%) and carbohydrates (20%). The crop is also a valuable source of E, K and B vitamins (it is the richest plant source of thiamine (B1), and is also rich in niacin, which is low in cereals). Groundnut cakes, formed after the oil is extracted, are a high-protein livestock feed. The hay is used as animal fodder in the arid and semi-arid regions of Africa characterized by shortage of animal feed during the long dry season (8-9 months) and is a valuable source of income for small scale farmers in the region (Gibbon and Pain, 1985; De Waele and Swanevelder, 2001; Gibbons et al., 2002; Musa et al., 2012).

Despite the immense importance of the crop, the yield obtained by farmers in Nigeria (FAOSTAT, 2005) is very low when compared to some other African countries. The low yield of the crop could be attributed to the inherent low soil fertility constraint and shorter rain duration in the region (Gibbons et al., 2002). Information on the response of the crop to application of cow dung in the region is limited. One way the yield could be improved is through the addition of organic matter to improve the soil physical and chemical properties and the identification of a more suitable variety. Reddy et al. (1993) reported that the yield of groundnut

could be increased up to 30-89% provided that high yielding varieties are identified.

Thus, the present study was undertaken to evaluate the influence of cow dung application on the yield and yield components of two groundnut varieties under semi-arid conditions of Nigeria.

MATERIALS AND METHODS

Experimental site

Field trial was conducted in 2007 and 2008 rainy seasons at the Dryland Teaching and Research Farm of Usmanu Danfodiyo University, Sokoto. Sokoto is located in the Sudan Savanna ecological zone of Nigeria on latitude 13°01'N; longitude 5°15'E and at an altitude of about 350 m above sea level. The climate of the area is semi-arid with mean (20 years mean) annual rainfall of about 600 mm (Kowal and Knabe, 1972). The area is characterized with erratic and scanty rainfall (Singh, 1995). The relative humidity ranges from 21-47% in the dry season and 51-79% during the rainy season. Temperature ranges from 14 to 41 °C. The annual rainfall data in 2007 and 2008 cropping seasons were 452.3 and 667.6 mm, respectively (Table 1). Textural class of the soil in the experimental site was sandy. The soil was slightly acidic (pH 6.75 in H₂O), low in organic carbon (0.56 g kg⁻¹), low in

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

Year	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
June	32	18.0	32	114.2
July	29	101.0	28	79.6
August	27	214.8	27	190.4
September	28	118.3	28	221.6
October	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

Table 2. Physico-chemical characteristics of the soil at the experimental site in 2007 and 2008 cropping seasons collected at 0-20 cm soil depth 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 ₂ O) 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

available phosphorus (0.21ppm), low in Ca (0.27 cmol kg⁻¹) and low in residual nitrogen (0.04%) (Table 2).

Treatments and experimental design

Treatments consisted of factorial combination 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)] laid out in a randomized complete block design (RCBD) replicated three times.

Cultural practices

In both 2007 and 2008, the land was prepared by mechanical plowing using tractor and the pulverized soil was leveled using a hoe. Plots measuring 3.75 m × 3.00 m (11.25 m²) were demarcated and ridged at 75 cm inter-row

spacing. Cow dung was sourced from Sokoto Cow Market (Kara) and incorporated into the soil as prescribed by the treatments (0, 15 and 30 t ha⁻¹). Analysis of the cow dung used revealed that it contains 0.77% N, 0.49% P₂O₅ and 1.15% K₂O. 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. Ex-Dakar (SAMNUT-14) is a short season (90-100 days) drought tolerant Spanish bunch type of erect growing habit characterized by small pods and thinner hulls with almost no constriction. The seeds are small and round weighing 32-40 g per 100 seeds⁻¹. The leaves are small and dark shiny green in color (IAR, 1989). RMP-12 (SAMNUT-10) is a late maturing (130-150 days) rosette resistant of semi erect growing habit. The pods are large and moderately constricted with slightly humped and prominent beak. The hulls are thicker and the seeds have variegated seed coat color weighing 50-55 g 100-seeds⁻¹. Seed coat is tan in color, leaves are large and pale green (IAR, 1989). Sowing was done on ridges spaced at 75 cm apart. Two seeds per hole were sown at about 3-5 cm depth at a plant-plant distance of 15 cm. Sowing was carried out on 9th July and 23rd June for 2007 and 2008, respectively. Weeding was carried out manually at 4 and 8 weeks after sowing to ensure good crop establishment and subsequent weeding involved only hand pulling. Harvesting was carried out from the net plot at physiological maturity. Maturity was determined through the use of calendar days for each variety and also through sampling of the stands to check for brown inner hulls color and peculiarity of seed coat color to each variety. The tap root below the pod bearing layer was severed at a soil depth of 10-15 cm, the crop was then pulled gently out of the ground. The crop was air-dried under the tree shade to a constant weight, as harvesting was at the onset of the dry season when the relative humidity is usually very low; threshing, sorting and shelling were all manually carried out. The moisture content at the time of weighing was determined to be 10%.

Data collection and analysis

Data were collected on number of pods plant⁻¹, pod yield, grain yield and shelling percentage. The data were subjected to analysis of variance (ANOVA) using SAS (SAS Institute Inc. Cary, NC, USA.) computer software. Duncan's Multiple Range Test (DMRT) was adopted for means separation.

RESULTS

Number of pods plant⁻¹

Number of pods plant⁻¹ of two groundnut varieties as influenced by cow dung application in 2007 and 2008 cropping seasons is presented in Table 3.

Table 3. Number of pods plant⁻¹ of two groundnut varieties as influenced by variety, cow dung and variety x cow dung interaction in 2007 and 2008 cropping seasons at Dryland Teaching and Research Farm of the Department of Crop Science, Usmanu Danfodiyo University Sokoto.

Variety	Number of pods plant ⁻¹			Mean (Variety)
	Cow dung (t ha ⁻¹)			
	0	15	30	
2007				
Ex-Dakar	18b	31a	35a	28a
RMP-12	8c	11c	13bc	11b
Mean (Cow dung)	13b	21a	24a	
	Variety	Cow dung	Interaction	
SEM	1.1	1.4	1.9	
Significance	*	*	*	
2008				
Ex-Dakar	36b	58a	65a	53a
RMP-12	23c	34b	31bc	29b
Mean (Cow dung)	30b	46a	48a	
	Variety	Cow dung	Interaction	
SEM	1.7	2.2	2.9	
Significance	*	*	*	

For interaction, means followed by same letter(s) across rows and columns within a year are not significantly different at 5% level of significance using Duncan's Multiple Range Test. * = Significant at 5% probability level, SEM = Standard error of mean.

Significant ($P < 0.05$) difference between the varieties in number of pods plant⁻¹ was observed in both 2007 and 2008 cropping seasons. Ex-Dakar variety recorded 28 and 53 pods per plant in 2007 and 2008 respectively and was higher than 11 and 29 pods per plant recorded by RMP-12 in 2007 and 2008.

Significant ($P < 0.05$) effect of cow dung application on number of pods plant⁻¹ of groundnut was observed in both 2007 and 2008 cropping seasons. Application of 15 and 30 t ha⁻¹ cow dung recorded higher number of pods plant⁻¹ in 2007 (21-24 pods) and 2008 (46-48 pods) growing seasons than the treatments receiving no cow dung application which recorded 13 and 30 pods per plant respectively.

Significant ($P < 0.05$) interaction between the cow dung levels and the two groundnut varieties on number of pods plant⁻¹ was observed in both 2007 and 2008 cropping seasons (Table 3). Cow dung application significantly increased the number of pods per plant in Ex-Dakar from 18 and 36 pods per plant where no cow dung was applied in 2007 and 2008, respectively, to 31-35 and 58-65 pods respectively in 2007 and 2008 cropping seasons. The difference between 15 and 30 t ha⁻¹ on the variety was not observed. However, for RMP-12 variety, the performance was lower than that of Ex-Dakar at all levels of cow dung application in both 2007 (8-13 pods plant⁻¹) and 2008 (23-31 pods plant⁻¹) cropping seasons and was not consistently influenced by application of cow dung on the variety (Table 3).

Pod yield

Pod yield of two groundnut varieties as influenced by cow dung application in 2007 and 2008 cropping seasons is presented in Table 4.

Table 4. Pod yield of two groundnut varieties as influenced by variety, cow dung and variety x cow dung interaction in 2007 and 2008 cropping seasons at Dryland Teaching and Research Farm of the Department of Crop Science, Usmanu Danfodiyo University Sokoto.

Variety	Pod yield (kg ha ⁻¹)			Mean (Variety)
	Cow dung (t ha ⁻¹)			
	0	15	30	
2007				
Ex-Dakar	834bc	1637a	1701a	1391 a
RMP-12	408d	719c	1025b	717 b
Mean (Cow dung)	621 c	1178 b	1363 a	
	Variety	Cow dung	Interaction	
SEM	50.58	61.87	87.20	
Significance	*	*	*	
2008				
Ex-Dakar	2722b	4575a	4979a	4092 a
RMP-12	1434c	1860c	1495c	1596 b
Mean (Cow dung)	2078 b	3218 a	3236 a	
	Variety	Cow dung	Interaction	
SEM	173.29	221.24	295.40	
Significance	*	*	*	

For interaction, means followed by same letter(s) across rows and columns within a year are not significantly different at 5% level of significance using Duncan's Multiple Range Test. * = Significant at 5% probability level, SEM = Standard error of mean.

Significant ($P < 0.05$) difference between the varieties in pod yield was observed during both years of the trial. Ex-Dakar variety recorded higher pod yield of 1391 and 4092 kg ha⁻¹ in 2007 and 2008 growing seasons, respectively, than RMP-12 which recorded 717 and 1596 kg ha⁻¹.

Significant ($P < 0.05$) effect of cow dung application on pod yield of groundnut was observed in both 2007 and 2008 growing seasons. In 2007, application of cow dung at the rate of 30 t ha⁻¹ recorded the highest pod yield 1363 kg ha⁻¹, followed by the application of 15 t ha⁻¹ (1178 kg ha⁻¹) and the least (621 kg ha⁻¹) was recorded with the control plots. However, in 2008 application of cow dung at 30 and 15 t ha⁻¹ recorded similar (3218-3236 kg ha⁻¹) pod yield which was higher than 2078 kg ha⁻¹ recorded by the control treatments.

Significant ($P < 0.05$) interaction between the cow dung levels and the two groundnut varieties was on pod yield of the crop was observed in 2007 and 2008 cropping seasons (Table 4). In 2007, application of cow dung on the crop increased the pod yield of both Ex-Dakar and RMP-12 varieties but in 2008 the influence of cow dung application on RMP-12 variety was not observed. In 2007, application of cow dung increased the pod yield of Ex-Dakar from 834 kg ha⁻¹ recorded where no

cow dung was applied to 1637-1701 kg ha⁻¹ recorded with the application of 15 and 30 t ha⁻¹ which was similar between the levels. Likewise, for RMP-12 in 2007, the pod yield was increased from 408 kg ha⁻¹ recorded where no cow dung was applied to 719 and 1025 kg ha⁻¹ recorded with the application of 15 and 30 t ha⁻¹ respectively. In 2008, the pod yield of Ex-Dakar variety was increased from 2722 kg ha⁻¹ recorded where no cow dung was applied to 4575-4979 kg ha⁻¹ recorded with the application of 15 and 30 t ha⁻¹ which was similar the two. For RMP-12 however, the pod yield which ranged from 1434-1860 kg ha⁻¹ in 2008 was not influenced by cow dung application and was lower than the values recorded by Ex-Dakar variety.

Grain yield

Grain yield of two groundnut varieties as influenced by cow dung application in 2007 and 2008 cropping seasons is presented in Table 5.

Results obtained revealed significant ($P < 0.05$) difference between the varieties in grain yield during both 2007 and 2008 cropping seasons. Ex-Dakar variety recorded higher grain yield of 1016 and 2748 kg ha⁻¹ in 2007 and 2008 cropping seasons than RMP-12 variety which recorded 446 and 921 kg ha⁻¹, respectively.

Results obtained revealed significant ($P < 0.05$) effect of cow dung application on the grain yield of groundnut in both 2007 and 2008 growing seasons. Application of 15 and 30 t ha⁻¹ cow dung recorded similar grain yield in 2007 (820-

927 kg ha⁻¹) and 2008 (2015-2123 kg ha⁻¹) which was higher than 446 and 1363 kg ha⁻¹ recorded where no cow dung was applied in 2007 and 2008, respectively (Table 5).

Significant ($P < 0.05$) interaction between the cow dung levels and the two varieties on grain yield of the crop was observed in both 2007 and 2008 cropping seasons (Table 5). In 2007, application of cow dung on the crop resulted in significant increase in the grain yield of both the varieties. For Ex-Dakar variety, application of 15 and 30 t ha⁻¹ recorded similar grain yield of 1181-1227 kg ha⁻¹ which was higher than 640 kg ha⁻¹ recorded where no cow dung was applied (control). For RMP-12 variety, the grain yield in 2007 was lower than Ex-Dakar and was highest (628 kg ha⁻¹) where 30 t ha⁻¹ cow dung was applied and the least (252 kg ha⁻¹) was recorded where no cow dung was applied. In 2008, the grain yield recorded by RMP-12 variety (754-1036 kg ha⁻¹) was not influenced by the application of cow dung on the crop and was lower than the grain yield (1756-3277 kg ha⁻¹) recorded by Ex-Dakar variety. For Ex-Dakar variety however, the grain yield was increased from 1756 kg ha⁻¹ where no cow dung was applied to 3210-3277 kg ha⁻¹ recorded where 15 and 30 t ha⁻¹ cow dung were applied which was similar between the levels.

Shelling percentage

Shelling percentage of two groundnut varieties as influenced by cow dung application in 2007 and 2008 cropping seasons is presented in Table 6.

Table 5. Grain yield of two groundnut varieties as influenced by variety, cow dung and variety × cow dung interaction in 2007 and 2008 cropping seasons at Dryland Teaching and Research Farm of the Department of Crop Science, Usmanu Danfodiyo University Sokoto.

Variety	Grain yield (kg ha ⁻¹) (10% Moisture)			Mean (Variety)
	Cow dung (t ha ⁻¹)			
	0	15	30	
2007				
Ex-Dakar	640b	1181a	1227a	1016a
RMP-12	252d	459c	628b	446b
Mean (Cow dung)	446b	820a	927a	
	Variety	Cow dung	Interaction	
SEM	37.5	53.0	64.8	
Significance	*	*	*	
2008				
Ex-Dakar	1756b	3210a	3277a	2748a
RMP-12	971c	1036c	754c	921b
Mean (Cow dung)	1363b	2123a	2015a	
	Variety	Cow dung	Interaction	
SEM	105.8	129.5	180.9	
Significance	*	*	*	

For interaction, means followed by same letter(s) across rows and columns within a year are not significantly different at 5% level of significance using Duncan's Multiple Range Test. * = Significant at 5% probability level, SEM = Standard error of mean.

Table 6. Shelling percentage of two groundnut varieties as influenced by variety, cow dung and variety × cow dung interaction in 2007 and 2008 cropping seasons at Dryland Teaching and Research Farm of the Department of Crop Science, Usmanu Danfodiyo University Sokoto.

Variety	Shelling percentage (%)			Mean (Variety)
	Cow dung (t ha ⁻¹)			
	0	15	30	
2007				
Ex-Dakar	75.50	73.25	72.43	73.72a
RMP-12	61.42	63.17	60.92	61.83b
Mean (Cow dung)	68.46	68.21	66.67	
	Variety	Cow dung	Interaction	
SEM	1.102	1.349	1.989	
Significance	*	ns	ns	
2008				
Ex-Dakar	67.33a	70.08a	66.00a	67.81a
RMP-12	68.42a	55.42b	50.42b	58.03b
Mean (Cow dung)	67.88a	62.75b	58.21c	
	Variety	Cow dung	Interaction	
SEM	1.087	1.331	2.006	
Significance	*	*	*	

For interaction, means followed by same letter(s) across rows and columns within a year are not significantly different at 5% level of significance using Duncan's Multiple Range Test. * = Significant at 5% probability level, ns = Not significant, SEM = Standard error of mean.

Significant ($P < 0.05$) difference between the varieties in shelling percentage was observed in both 2007 and 2008 cropping seasons. Ex-Dakar variety recorded significantly higher shelling percentage of 73.7% and 67.8% in both 2007 and 2008 cropping seasons, respectively as compared to that recorded by RMP-12 in 2007 (61.83%) and 2008 (58.0%).

Significant ($P < 0.05$) effect of cow dung application on shelling percentage of groundnut was only observed in 2008 cropping season. The highest shelling percentage (67.88%) was recorded where no cow dung was applied, followed by the application of 15 t ha⁻¹ cow dung (62.75%) and the least (58.21%) was recorded with the application of cow dung at the rate of 30 t ha⁻¹ on the crop.

Significant ($P < 0.05$) interaction between the cow dung levels and the two varieties on shelling percentage of the crop was only observed in 2008 growing season. When no cow dung was applied, the shelling percentage of the two varieties was similar (67.33-68.42%). However, application of 15 and 30 t ha⁻¹ cow dung on RMP-12 significantly decreased the shelling percentage of the crop from 68.42% recorded where no cow dung was applied to 50.42-55.42%. For Ex-Dakar variety however, the shelling percentage (66.00-70.08%) was not influenced by application of cow dung on the crop and was similar with the shelling percentage of 68.42% recorded where no cow dung was applied on RMP-12 variety.

DISCUSSION

The varying performance of the two varieties in the yield and its components could be attributed to the differences in their genetic makeup and to the response of the varieties to addition of nutrients contained in the cow dung used. The superiority of Ex-Dakar over RMP-12 in most of the parameters measured could be attributed to its shorter growth duration which was satisfied by the length of the rainy season recorded in both years of the trial (Table 1). Likewise, the lower performance of RMP-12 variety could be attributed to its requirement for longer duration of growth which was not met by the length of the growing period recorded in both seasons of the trial. The tremendous increase in the yield and its components of the crop recorded as a result of cow dung application as a source of manure could be attributed to the its beneficial role in improving soil physical conditions and to its nutrients content.

The higher performance of the crop in pod yield, kernel yield and number of pods per plant in 2008 compared to 2007 could be attributed to more favorable rainfall received during the 2008 growing season (667.6 mm) compared to that received during the 2007 growing season (452.3 mm), see Table 1.

The higher number of pods plant⁻¹ recorded by Ex-Dakar variety compared to RMP-12 could be attributed to its

ability to tolerate erratic and shorter rain duration which is the characteristics of semi-arid climate. However, for RMP-12, which is a long duration (130-150 days) variety probably the erratic and shorter rain duration did not allow it to express its full genetic potentials. This finding is in support of Duncan et al. (1978) and Gupta, (1978). On the contrary, Gibbon and Pain (1985) reported long duration varieties to have higher number of pods per plant as a result of longer period of growth and pod addition. Likewise, Duncan et al. (1978) reported length of the growing period among the three physiological processes to explain most of the yield variation in groundnut. But in this study, since the rain duration is shorter in both seasons, it is likely to favour the early maturing and short duration varieties than the long duration types.

The optimum number of pods per plant recorded with the application of 15 t ha⁻¹ which was higher than the control treatments and similar to the application of 30 t ha⁻¹ on the crop, agrees with that of Subrahmaniyan et al. (2000) who reported application of 15 t ha⁻¹ to maximize the number of pods per plant in groundnut. The increase in number of pods per plant as a result of cow dung application could be attributed to the role of manure in supplying the major nutrients such as N, P, K, Ca and S required for plant growth. Likewise, organic matter such as cow dung addition to the soil is known to improve the overall soil physical conditions including soil moisture retention in the case of sandy soils. De Waele and Swanevelde (2001) reported organic matter to be the most important source of S in the soil. Likewise, ICRISAT (1995) reported S deficiency to decrease the number of pods per plant. The differences in the response of the varieties to the applied manure could be attributed to their differences in response to added nutrients especially N.

The higher performance of Ex-Dakar variety in pod yield compared to RMP-12 in both seasons of the trial could be attributed to its higher number of pods per plant than RMP-12 and to its early maturing (90-100 days), hence, its ability to escape late season drought which is a common constraint to crop production in most of the arid and semi-arid environments. On the contrary, IAR (1989) reported RMP-12 to be more superior (2498-3123 kg ha⁻¹) than Ex-Dakar (1784-2498 kg ha⁻¹). Similarly, Omokanye et al. (2001) working on IAR varieties at Shika, Zaria reported the superiority of RMP-12 for both forage and grain production. However, since Shika, Zaria is located in the sub-humid Agro-ecological zone of Nigeria (Omokanye et al., 2001) as contrary to the present environment of study which is semi-arid, the growing conditions obtained could have favored the longer duration variety. The increase in pod yield of the crop due to the application of cow dung could be attributed to its beneficial role in improving soil nutrients availability and soil physical conditions. This has special reference in groundnut crop as pod setting and development takes

place in the sub-surface soil and the crop is mainly grown in arid and semi-arid climate where water storage capacity of the soil plays a vital role (Ahlawat, 2004; Lokanath and Parameshwarappa, 2006; Chandrasekaran et al., 2007).

The response of Ex-Dakar to the applied manure could be attributed to its greater nutrients demand as early maturing is always associated with increasing competition for a limited source (ICRISAT, 1995). Also, Ahlawat (2004) reported application of 15 t ha⁻¹ to maximize pod yield of peanut.

The higher grain yield recorded by Ex-Dakar variety could be attributed to its higher number of pods per plant and pod yield. Duncan et al. (1978) reported length of the pod filling period among the three physiological processes to explain most yield variation in groundnut. Omokanye et al. (2001) reported RMP-12 to be promising for both forage and seed production. The contradiction could be attributed to shorter rain duration received during the trial which could be said to satisfy the requirement of Ex-Dakar variety. De Waele and Swanevelder (2001) reported moisture stress to be the most limiting factor to groundnut production in the tropics. The increase in grain yield as a result of cow dung application on the crop could be attributed to the role of manure in promoting the soil physical and chemical properties which could have resulted in to more number of pods per plant and pod yield of the crop in the treatments receiving cow dung application and eventually grain yield. Similar effect of manure on the grain yield of groundnut was reported by many researchers (Subrahmanian et al., 2000; Chandrasekaran et al., 2007).

The positive response to cow dung application observed with Ex-Dakar variety compared to RMP-12 variety in grain yield could be attributed to its early maturing (90-100 days) ability, as a result therefore, a very strong competition in the partitioning of nutrients and photosynthetic products between the vegetative and reproductive organs exists during pod development and grain filling as evidenced through its lighter leaves (Gupta, 1978) and therefore, it is more likely to respond to applied nutrients than RMP-12 that grows slowly and the leaves are always dark green in color showing more nitrogen fixing ability.

The higher shelling percentage recorded by Ex-Dakar variety compared to RMP-12 variety could be attributed to its thinner shells. Phudenpa et al. (2004) reported small seed size to be associated with high shelling percentage because of the thinner shells. This agrees with the earlier report by many researchers (Gibbon and Pain, 1985; De Waele and Swanevelder, 2001; Gibbons et al., 2002). Despite the higher number of pods per plant and higher yields recorded with the application of cow dung, since the crop is indeterminate in its growth habit it continues to utilize the available nutrients to develop higher number of pods that may run out of time to fill especially with the shorter rain duration. Lokanath and Parameshwarappa (2006) reported increase in shelling

percentage with the application of organics under rainfed situation. The contradiction however, could be due to the difference in the length of the growing season. Therefore, it was observed that application of cow manure led to reduction in shelling percentage of RMP-12 which could be attributed to the shorter rain duration that did not allow the variety to have well filled pods.

CONCLUSIONS

The finding of this study revealed that Ex-Dakar variety was superior to RMP-12 in number of pods per plant, pod yield, grain yield and shelling percentage therefore, is said to be more suitable for increased groundnut production in the study area. Application of cow dung was found to increase the number of pods per plant, pod yield and grain yield of the crop. However, a decreasing trend was observed with cow dung application in shelling percentage of the crop. Thus, Ex-Dakar variety could be suggested for increased groundnut production in the study area. Application of cow dung at the rate of 15 t ha⁻¹ was optimum for groundnut production in the study area.

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