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Effects of Intra-Row Spacing on Herbage Yields of Two Groundnut (Arachis hypogaea L.) Varieties in Sokoto, Semi-Arid Zone, Nigeria

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Abstract

Field experiments were conducted during 2009 and 2010 rainy seasons at the Dry Land Teaching and Research Farm of the Usmanu Danfodiyo University, Sokoto to study the effects of intra-spacing on herbage yields of two groundnut (Arachis hypogaea L.) varieties in Sokoto, in the semi-arid zone of Nigeria. Treatments consisted of factorial combinations of three intra-row spacing (10, 20 and 30 cm) and two groundnut varieties (Ex-Dakar and RMP-12) laid out in a randomized complete block design replicated three times. Data was collected in respect of haulm and total dry matter yield. Results revealed that, the closest intra-row spacing (10 cm) significantly ($P<0.05$) produced higher herbage yield than the wider intra-row spacing (20 cm and 30 cm) Ex-Dakar was superior to RMP-12 in terms of total dry matter, while RMP-12 was superior to Ex-Dakar in terms of haulm yield. The closest intra-row spacing (10 cm) was the best for optimum herbage yield production.

Key wards: Groundnut, yield, Intra-row spacing, variety and Semi- arid.

Introduction

Groundnut (*Arachis hypogaea* L.), also known as peanut, earthnut and goobers is an annual legume of the *Fabaceae* family (De waele and Swanevelder, 2001). It is one of the world principal oil seed crops widely grown in areas ranging from latitude 40^0 North and South. It is a major crop rotation component in many sub- Saharan countries in the world (Gbehounu and Adango, 2003). The average yields of groundnut i.e unshelled nuts of top six producers in the world are Peoples Republic of China 14.30 tons per hectare, United States 2.34 tons per hectare, India 6.25 tons per hectare, Morocco 2.66 tons per hectare, Egypt 3.12 tons per hectare and Nigeria 1.55 tone per hectare (USDA STAT, 2009). Nigeria is one of the major groundnut producers in Africa. With 11% area, the country produces 7% of the world groundnut production (De waele and Swanevelder, 2001). The annual peanut is grown for both forage and seed in other parts of the world (Larbi *et al.*, 1999). Okolo and Utoh (1999) estimated that the land under groundnut cultivation in Nigeria is about 1.0 to 2.5 million hectares annually, and yield in the range of 500 – 3000 kg/ha.

Forage and fodder crops include pasture and range vegetation, as well as crop residues derived from farm crops. Nigeria has a land area of 92.4 million hectares of which about 44% are under

permanent pastures, which support its domestic ruminants of over 101 million [Federal Ministry of Agriculture and Water Resources (FMAWR), 2012]. It is estimated that only about 3% of this number of animals are reared on improved pastures; the remaining 97% are raised on low nutrient native pastures and farmlands (Okorie *et al.,* 1992). The implication of this is the low output of animals per unit area. This situation is of particular concern, especially in view of the very low animal protein intake of 10 g per caput per day, as against the Food and Agriculture Organization's recommended 36 g per caput per day (FAO, 1992).

The bulk of the animal protein, especially milk and meat, consumed in Nigeria, derive
from ruminant animals, which are dependent mainly on these crops. According to Kallah (2004), grazing lands in Nigeria, including natural wetlands (fadama*)*, woodlands and forest reserves, are estimated to cover about 32.42 million hectares, while cultivated croplands amount to about 39.41 million hectares. These lands provide substantial amount of forage and fodder, which are of vital importance in Nigeria's drive towards self sufficiency in agricultural production, since they provide major sources of feed, especially for the country's ruminant livestock, both domestic and wildlife. Browse plants which are found across the zones make major contributions to livestock feed resources, particularly in the drier northern zones of the country. In spite of the infertile soils and hostile climatic environment, ruminant livestock survival in Nigeria has depended largely on the extensive native pastures, browses and farm crop residues across and within the various agro-ecological zones. These animals provide power, transport and most of the meat for human consumption, as well as the various valuable by- products such as bones, blood and hides and skins for the nation's industrial growth. In addition, they play a significant role in maintaining soil fertility through their dung or droppings and urine on the pasture land.

The limited analyses to date of the annual peanut forage indicate that it has very good nutritional value, similar to that of alfalfa and perennial peanut forages (NRC, 2000; Myer *et al.,* 2010). Recent research, however, indicates that annual peanut forage may retain less digestible nutrients than perennial peanut through the haying process and subsequent storage (Eckert, 2008).

The traditional strategy of converting primary forest areas into pastures has been severely restricted by strong enforcement of environmental legislation by the local governments, state, and federal agencies. This forced farmers to search for alternative technologies to reclaim degraded pastures and to intensify their production systems. Therefore, this study was undertaken to determine the optimum intra-row spacing for maximum herbage yield of two groundnut varieties.

Materials and methods

Field trial was conducted in 2009 and 2010 rainy seasons at the Dry Land Teaching and Research Farm of the Usmanu Danfodiyo University, Sokoto, Nigeria., 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 annual rainfall data in 2009 and 2010 rainy seasons were 445.4 and 1146.7 mm respectively. Experimental site soil samples were bulked,

air-dried and sieved. The bulked soil sample was used for physico-chemical analysis. The particle size analysis was determined using hydrometer method (Boyoucous, 1951). Textural classes were assessed using textural triangle. Total nitrogen was determined by regular Macro-Kjeldhal digestion technique (Jackson, 1964). Available phosphorus was determined by the Bray No.1 method (Bray and Kurtz, 1945). Potassium and Sodium were determined using a flame photometer while Magnesium and Calcium were determined by EDTA titration method. Cat ion Exchange Capacity (CEC) was calculated using ammonium acetate method

Treatments consisted factorial combination of three intra row spacing (10, 20 and 30 cm), and two varieties of groundnut (Ex-Dakar and RMP-12)

Ex-Dakar is a short season (90-100 days), drought tolerant, Spanish bunch type of erect growing habit characterized by small pods and thinner bulls with almost no construction, the seeds are small and round weighing 32-40 g 100^{-1} seeds. Seeds is tan in colour, leaves are large and pale green (IAR, 1989).

RMP-12 is a late maturing (130-150 days), rosette resistance of semi erect growing habit. The pods are large and moderately constricted with slightly humped and prominent beak. The hull are thicker and seeds have variegated seed coat colour weighing 50-55 g 100^{-1} seeds. The leaves are small and dark shiny in colour (IAR, 1989)

The treatments were laid out in a Randomized Complete Block Design (RCBD) replicated three times. The land was ploughed and plots measuring 3 m x 3 m (9 m^2) consisting of four rows (3 m long) spaced at 75 cm while the intra-row is as per the treatments. Farm yard manure at the rate of 20 t ha^{-1} was applied to all plots before planting. Two seeds were drilled at 5-7 cm depth. Weeding was carried out manually at 4 and 8 weeks after sowing (WAS) and subsequent weeding only involved hand pulling. Harvesting was carried out from the net plot at physiological maturity (120 days after planting). Data were collected on haulms or hay (a valuable livestock feed) after the pods are removed, and total dry matter yield. The haulms were stacked when they were completely dry, and stored under cover for future use as livestock feeds. Total dry matter yield was obtained from the yields of both the pods and haulms. Data collected was subjected to analysis of variance (ANOVA) using SAS (2003). Duncan's New Multiple Range Test (DNMRT) was adopted for means separation.

Results and discussion

Soil physico-chemical properties

The soil of the experimental site was sandy, slightly acidic, low in organic carbon, total nitrogen, exchangeable cations and available phosphorous (Table 1).

Table 1: Soil physico- chemical properties of the experimental site during the 2009 and

Physico-chemical properties	2009	2010
Physical Properties		
Sand (g kg^{-1})	96.8	97.52
Silt (g kg^{-1})	2.1	1.96
Clay (g kg^{-1})	1.1	0.52
Textural class	Sandy	Sandy
Chemical Properties		
pH in (H_20) 1:1 ratio	6.8	6.5
Total nitrogen (%)	0.021	0.14
Organic C (g kg^{-1})	7.80	4.59
Available P (mg kg^{-1})	0.39	0.42
Exchangeable bases (cmol kg^{-1}):		
Ca	0.40	0.25
Mg	0.40	0.35
K	0.30	0.59
Na	0.20	0.91
CEC (Cmol kg^{-1})	24.20	20.52

2010 rainy season

Haulm Yield (kg ha^{-1})

Significant ($P<0.05$) effect of intra-row spacing was observed on haulm yield. In both seasons, the closest intra-row spacing (10 cm) had significantly ($P<0.05$) highest haulm yield, followed by 20 cm intra-row spacing, while the lowest haulm yield was from the widest intra-row spacing. This result is in harmony with earlier report by Yayock (1979), which stated that closer spacing is more effective in haulm production while wider spacing is more effective in pod production.

The result revealed significant ($P<0.05$) effect of cultivar on haulm yield. In both seasons, RMP-12 was superior to Ex-Dakar in terms of haulm yield. This superiority of RMP-12 over Ex-Dakar was mainly due to the presence of both primary and secondary branches possessed by RMP-12. This result is in accord with the reports of Omokanye *et al.* (2001) and Ibrahim (2009). Omokanye *et al.* (2001) reported that RMP-12 is superior to RMP-12 for both forage and seeds production.

Total dry matter yield kg ha^{-1}

Effect of intra-row spacing on total dry matter was similar to that obtained for haulm yield in both seasons (Table 1). The closest intra-row spacing (10 cm) differed significantly with the highest total dry matter yield, followed by 20 cm intra-row spacing, while the lowest total dry matter yield was from the widest intra-row spacing. This could be as a result of differences in plant population; the widest intra-row spacing recorded the lowest total dry yield as a result of low plant population, the wider the intra-row spacing the fewer the plant population. The result is similar to that of Subrahmaniyan *et al.* (2000), who

reported significant effect of intra-row spacing on total dry matter.

The results revealed significant ($P<0.05$) effect of cultivar on total dry matter yield. In 2009 rainy season, Ex-Dakar produced significantly higher herbage yield compared with RMP-12, while in 2010 rainy season, there was no significant effect of cultivar on herbage yield. The superiority of Ex-Dakar over RMP-12 in 2009 rainy season could be as a result of its early maturity (90-100 days) and drought tolerant ability (IAR, 1989).

The interaction between cultivar and intra -row spacing was not significant.

Table 2: Herbage yield of ground nut as influenced by intra-row spacing and cultivar in 2009 and 2010 rainy seasons at Sokoto.

Treatments	Haulm yield kg ha^{-1}		Total dry matter yield kg ha^{-1}	
	2009	2010	2009	2010
Intra-row spacing (cm)				
10	2776^{a}	5934^{a}	4410^{a}	6576^{a}
20	2129^{b}	4621^{b}	4283^{b}	5529^{b}
30	1848^{c}	4398^{b}	3670^{c}	4520^{c}
SE (±)	65.25	388.9	35.3	309
Significance	*	*	*	*
Cultivar				
Ex- Dakar	2040^{b}	3741^{b}	4218^{a}	6414
RMP-12	2461^{a}	4841^{a}	4024^{b}	5301
SE (±)	53.28	333	28.9	246.23
Significance	*	*	*	NS
Interaction				
S X V	*	NS	NS	NS

Means followed by similar letter(s) across rows and columns in superscript within a year do not differ significantly at 5% level of significance using DNMRT

Conclusion

Results revealed significant effect of intra-row spacing and cultivar on herbage yield. Ex-Dakar was superior to RMP-12 in terms of total dry matter, while RMP-12 was superior to Ex-Dakar in terms of haulm yield. The closest intra-row spacing (10 cm) proved to be the best for optimum herbage yield production.

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