



Effect of Planting Methods on Growth and Yield of Groundnut Cultivars

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ABSTRACT

Background: The low yield in groundnut which can be partly attributed to poor land preparation methods necessitated the need for alternative strategy of land preparation that will promote higher productivity in groundnut farming.

Methods: A field experiment was carried out in two separate locations between May and August in 2016 to assess the effect of planting methods on growth and yield of groundnut cultivars.

Result: The results revealed that groundnut crop sown on modified ridges and furrow with narrow furrow planting recorded significantly higher plant height, number of leaves, 50% flowering, yield attributes and yield when compared to other methods of planting. All the groundnut cultivars responded positively to all planting methods except those grown on flat surface without beds. However, modified ridges and furrow with narrow furrow planting proved to be the best method.

Key words: Groundnut cultivars, Growth, Modified ridges and furrow, yield.

INTRODUCTION

Groundnut is an important oil, food and feed crop of the world (Variath and Janila, 2017). Although majorly valued as a protein oil source, it can also serve as a good for vitamins B and E elements like calcium and phosphorus. The yield in groundnut is largely dependent on the flowering period and viability of the pegs (Lucas *et al.*, 2011). This is because if the pegs fail to contact and enter the soil they usually wither. Failure of some pegs to reach the soil surface in due time is because they are too distant from the surface or the time is not enough for their growth (Lucas *et al.*, 2011). Literature also has it that about 30% of the pods that do not reach the full maturity stage are lost at the end of the cycle (Santos *et al.*, 2000).

The productivity and quality of groundnut depends on the environmental conditions and the improved agronomic practices especially the planting methods which plays a significant role in achieving higher productivity of groundnut crop. Ajeigbe *et al.* (2014) revealed that planting on ridges recorded higher yield compared to flat surface. However, the conical shape of the ridges delay peg penetration by increase the distance between the pegs and the surface of soil (Olayinka *et al.*, 2015). Recent studies have reported that raised beds land preparation method outperformed the conventional ridges planting techniques in wheat, maize and groundnut (Ortega *et al.* 2008; Olayinka *et al.*, 2015).

The high demand for groundnut and groundnut products throughout the world coupled with the defects offered by conventional planting method as earlier mentioned in the foregoing discourse necessitated the need to study alternative planting method that will improve its growing environment and favour higher yield.

MATERIALS AND METHODS

This study was carried out in two different locations at the

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Botanical Garden of University of Ilorin, Ilorin, Nigeria between May and August in 2016. The experimental soil was sandy loamy in texture with low organic matter (0.77%) and slightly acidic pH (6.30) in nature. The available nitrogen was moderately low (0.15%). The soil was low in available calcium, magnesium, sodium potassium and Cation Exchange Capacity with respective values of 4.13 cmol kg⁻¹, 0.42 cmol kg⁻¹, 0.12 cmol kg⁻¹, 0.11 cmol kg⁻¹ and 2.82 cmol kg⁻¹.

The seeds of the four cultivars used were obtained from Institute of Agricultural Research (IAR), Zaria, Nigeria. Samnuts 21 and 23 mature between 115-120 days (medium maturing). Samnut 22 matures between 90-100 days (early-maturing) and Samnut 24 mature between 80-90 days (early-maturing) [Plate 1(a-d)].

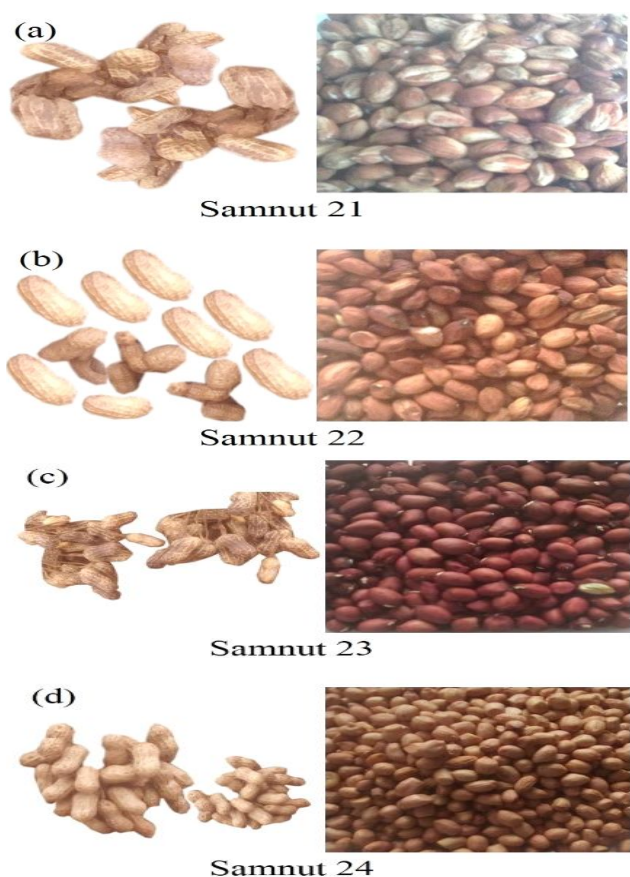


Plate 1: The pods and seeds of four groundnut cultivars.
(a) Samnuts 21, (b) Samnut 22, (c) Samnut 23 and (d) Samnut 24.

Field layout followed 4×4×3 factorial design consisting of four cultivars, four planting methods and three replicates. Gross plot size measured 13 m x 9 m containing 36 subplots each measuring 3 m by 2 m separated by 0.5 m. The four planting methods assessed were flat surface without bed, raised beds, conventional ridges and furrow with ridges planting and modified ridges and furrow with narrow furrow planting [Plate 2 (a-d)].

The field was cleared manually to remove grasses and stumps using cutlass. It was ploughed and harrowed with hoe and demarcated into thirty-six subplots. Prior to sowing, seeds were treated with seedrex (33% permethrin + 15% carbofendazone + 12 chlorothalonil) at the rate of 4 kg of seed per 10 g of the chemical to prevent soil borne diseases. Seeds were sown per hole at a depth of 0.03 m, plant to plant spacing was 0.2 m. Plots were manually weeded to maintain normal crop growth at interval of two weeks. Harvesting was done by carefully uprooting the plants from the soil. The harvested plants were washed in running water and the cleaned pods were detached and air-dried to 12% moisture for 6-7 days.

Vegetative parameters evaluated at 12 week after planting (WAP) were plant height, number of leaves and leaf area. Above-ground dry weight was also determined by oven-dried at 80°C until a constant weight was achieved. Reproductive characters determined were time taken to achieve 50% flowering, number of pegs per plant, number of pods and seeds per plant, pod and seed weight per plant, 100-seed weight, pod length and pod and seed yields in kilogram per hectare and harvest index were also evaluated.

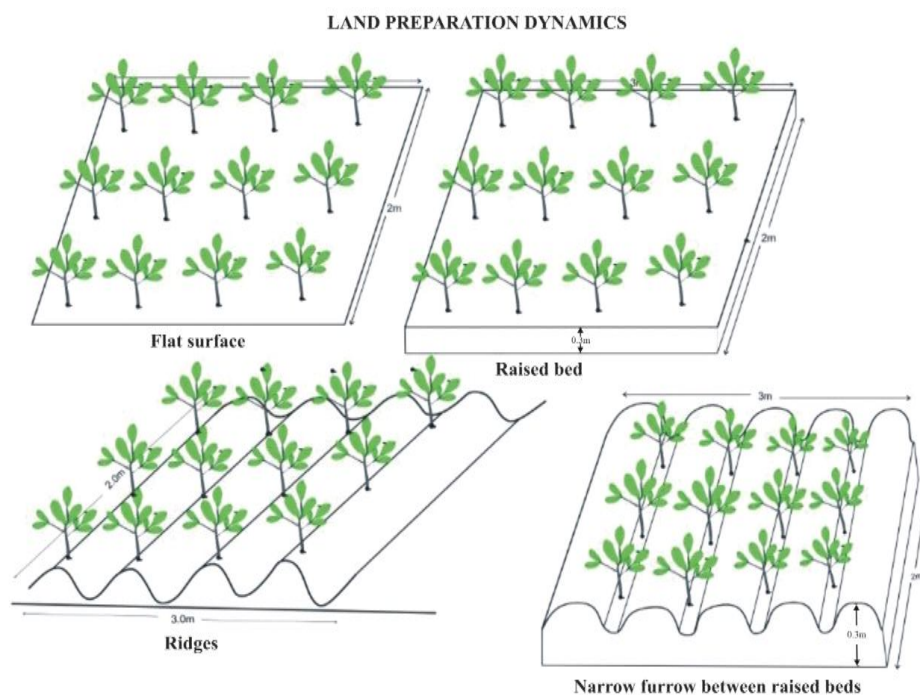


Plate 2: Planting methods layout and dimension (a) Flat surface without raised beds (b) Conventional ridges and furrow with ridges planting (c) Raised bed and (d) Modified ridges and furrow with narrow furrow planting.

Data recorded for the two locations were pooled together on account of zero interaction between location by cultivars by planting methods using Univariate Analysis of variance under general model of Statistical Package for Social Science (SPSS) software version 17. Duncan Multiple Range Test (Duncan, 1955) was used to separate the means.

RESULTS AND DISCUSSION

Growth attributes

The plant height and number of leaves were influenced by cultivar and land preparation dynamics. In all the cultivars, modified ridges and furrow with narrow furrow planting recorded significantly taller stem compared to all other planting methods except in Samnut 23 (Fig 1). The results of number of leaves followed similar trend as recorded for plant height (Fig 1) Groundnut raised under modified ridges and furrow with narrow furrow planting recorded the highest leaf area and above-ground dry weight among all the planting methods (Fig 2). The flat surface without beds showed the lowest value of all the growth attributes (Fig 1 and 2). The increased growth attributes by this treatment could be attributed to a more conducive soil conditions like proper aeration and availability of moisture both in the furrow and the soil surface. Also the soil surface as well the furrow where the seeds were planted in the narrow are friable and well loose which offered additional advantages over those of raised beds and ridges. Higher crop productivity had been attributed to factors such proper aeration and availability of moisture (Joshi, 2017). Further still, modified ridges and furrow with narrow furrow planting provided further less

mechanical compaction that permitted root to grow profusely in the furrow where the planting was done compared to flat surface and other planting methods. The results agreed with findings of Sripunitha *et al.*, (2011) and Olayinka *et al.* (2015). These growth attributes varied significantly among the cultivars and were highest in Samnut 21 and lowest in Samnut 24. The observed variability could be attributed to differential genetic constitution (Hernandez *et al.*, 2008).

50% flowering and number of pegs per plant

The time taken to attain 50% flowering as affected by planting methods was not significant. However, modified ridges and furrow with narrow furrow planting, raised beds and conventional ridges and furrow with ridges planting attained their 50% flowering 2-4 days (Fig 3). Groundnut grown on modified ridges and furrow with narrow planting recorded significantly highest peg number as compared to other planting methods (Fig 3). The early flowering in modified ridges and furrow with narrow furrow planting may be due to better crop growing environment provided by these treatments. Subrahmaniyan *et al.* (2002) reported earlier flowering where soil conditions were altered by the agronomic practices in groundnut. The lower peg number in flat surface without raised beds compared to other planting methods could be hinged on factors that were attributed for growth attributes (Chassot and Richner, 2002).

Yield attributes, yield and harvest index

Number of matured pods per plant, pod weight per plant, number of seed per plant, seed weight per plant were significantly influenced by planting methods (Table 1).

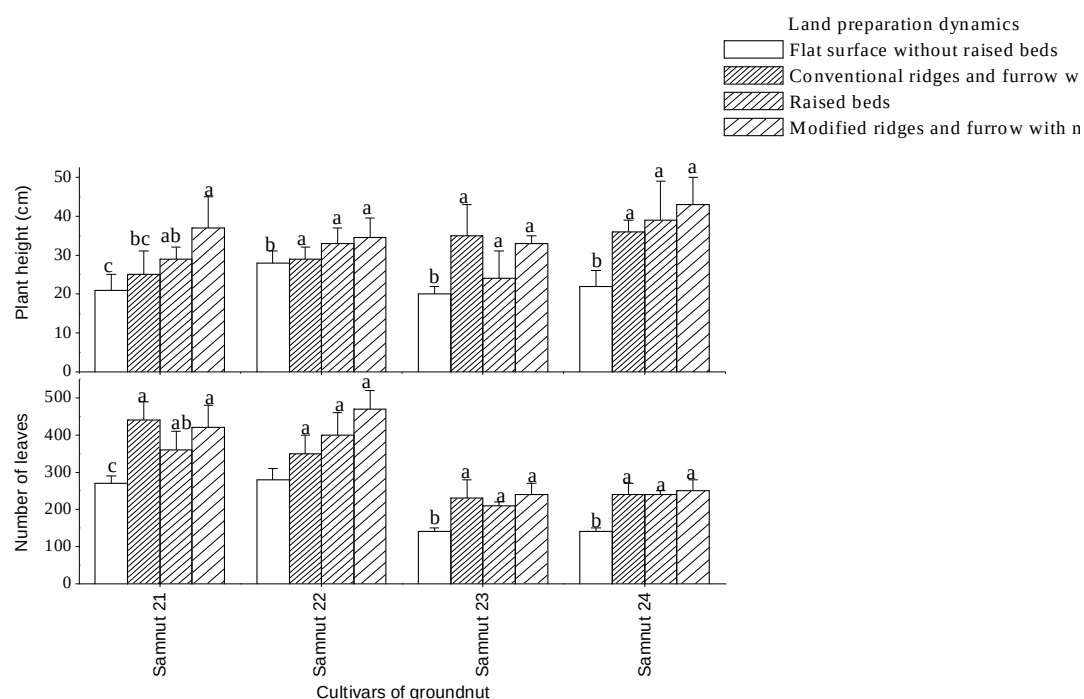


Fig 1: Plant height and number of leaves of four cultivars of groundnut (Samnuts 21, 22, 23 and 24) as affected by land preparation dynamics. Vertical bars represent standard error ($\pm$ SE) of treatment means. Within each cultivar mean followed by the same letter are not significantly different at $p \leq 0.05$.

Modified ridges and furrow with narrow furrow planting recorded highest number of pods per plant which was closely followed by those of raised beds, conventional ridges and furrow with ridges planting except in Samnut 22 (Table 1). Lowest number of pods per plant was recorded from flat

surface without raised beds. The results of other yield components such as seed weight per plant and number of seed per plant, 100-seed weight, pod length and pod circumference recorded similar result as recorded for number of pods per plant (Table 1 and 2).

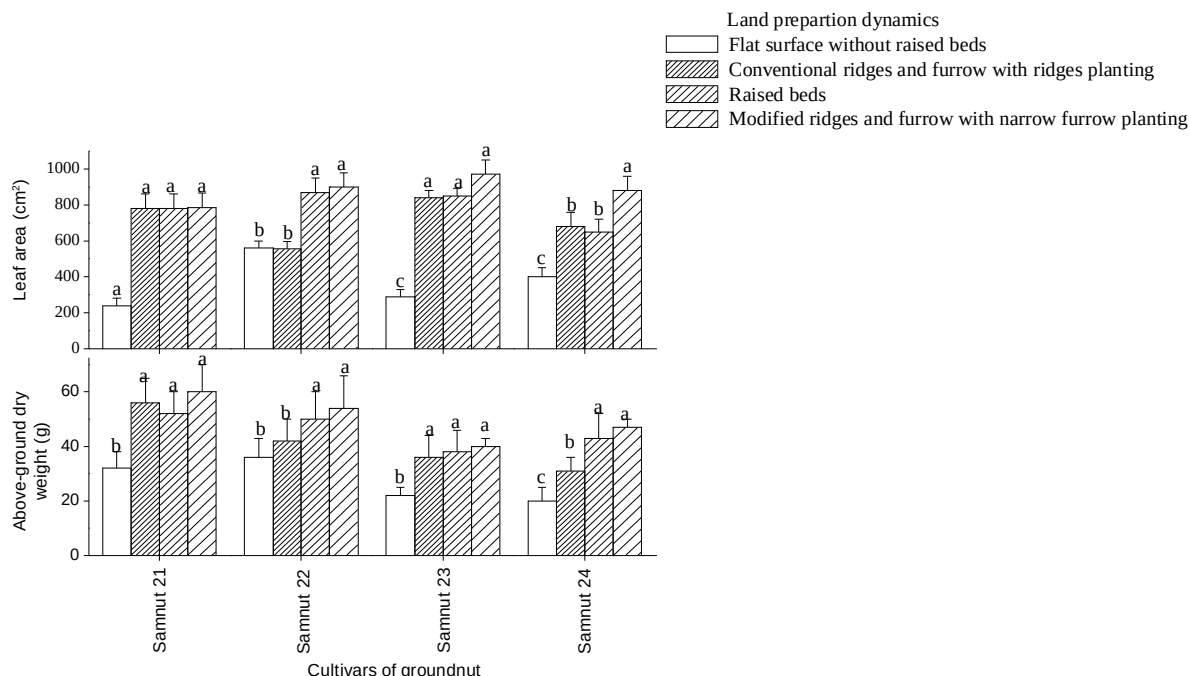


Fig 2: Leaf area and above-ground dry weight of four cultivars of groundnut (Samnuts 21, 22, 23 and 24) as affected by land preparation dynamics. Vertical bars represent standard error ($\pm$ SE) of treatment means. Within each cultivar mean followed by the same letter are not significantly different at $p \leq 0.05$.

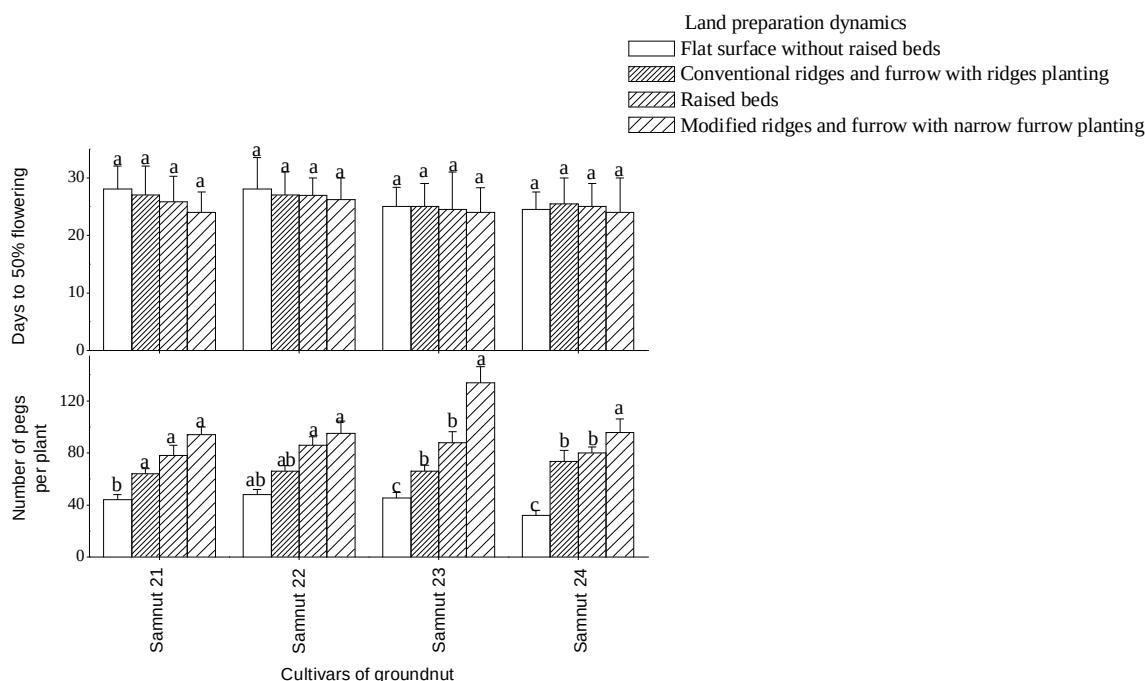


Fig 3: Number of days to 50% flowering and number of pegs per plant of four cultivars of groundnut (Samnuts 21, 22, 23 and 24) as affected by land preparation dynamics. Vertical bars represent standard error ($\pm$ SE) of treatment means. Within each cultivar mean followed by the same letter are not significantly different at $p \leq 0.05$.

Table 1: Influence of different land preparation dynamics on number of pods per plant, pod weight per plant, number of seeds per plant and seed weight per plant.

Groundnut cultivars	No. of pod per plant			Pod weight per Plant (g)			Number of seeds per plant			Weight of seed (g) / Plant		
	F	CR	MR	Cultivar means	F	CR	MR	RB	CR	F	CR	MR
Samnut 21	12.67 ^c	30.67 ^a	27.00 ^{ab}	34.67 ^a	27.50 ^b	16.12 ^c	30.43 ^a	26.82 ^{ab}	32.64 ^a	26.50 ^b	20.54 ^c	58.84 ^a
Samnut 22	16.67 ^c	22.67 ^b	38.33 ^a	34.67 ^a	26.53 ^b	16.09 ^c	22.01 ^b	35.33 ^a	33.00 ^a	26.12 ^b	30.84 ^c	42.11 ^b
Samnut 23	26.00 ^c	41.00 ^b	38.00 ^b	62.67 ^a	40.50 ^a	24.52 ^c	40.76 ^b	36.67 ^b	60.10 ^a	40.51 ^a	41.97 ^d	80.00 ^b
Samnut 24	13.67 ^c	29.33 ^b	41.67 ^a	43.67 ^a	35.33 ^{ab}	12.25 ^c	28.53 ^b	43.00 ^a	43.64 ^a	31.86 ^b	21.13 ^c	55.46 ^b
L.P. mean	18.25 ^c	26.50 ^b	32.50 ^{ab}	43.92 ^a	-	17.25 ^c	27.68 ^b	35.45 ^{ab}	42.35 ^a	-	28.62 ^c	59.10 ^b
Cultivar	S			S			S			S		
L.P.D.	S			S			S			S		
Interaction	NS			NS			NS			NS		

Within rows and columns, means followed by the same superscripts are not significantly differ at $p \leq 0.05$.

KEY: F - Flat Surface without raised beds; CR - Conventional ridges and furrow with ridges planting; RB - Raised Beds; MR - Modified ridges and furrow with narrow furrow planting.

LPD - Land preparation dynamics; S - Significant; NS- Non Significant.

Table 2: Influence of different land preparation dynamics on 100 seed weight, pod length and pod circumference.

Groundnut cultivars	100 seed weight (g)			Pod length (cm)			Pod circumference (cm)		
	F	CR	MR	Cultivar means	F	CR	MR	RB	CR
Samnut 21	28.62 ^b	41.98 ^a	43.00 ^a	42.86 ^a	39.12 ^a	2.53 ^b	2.63 ^a	2.64 ^a	3.37 ^b
Samnut 22	25.81 ^b	38.10 ^a	37.14 ^a	39.92 ^a	35.14 ^a	2.59 ^b	2.78 ^a	2.78 ^a	3.20 ^{ab}
Samnut 23	30.95 ^b	41.00 ^a	41.85 ^a	44.14 ^a	39.44 ^a	2.70 ^b	2.99 ^a	3.20 ^a	3.30 ^b
Samnut 24	32.09 ^{ab}	36.36 ^a	37.96 ^a	39.50 ^a	36.48 ^a	2.03 ^b	2.47 ^a	2.37 ^a	2.93 ^b
L.P. mean	29.38 ^b	39.36 ^a	39.95 ^a	41.61 ^a	-	2.46 ^b	2.72 ^a	2.75 ^a	3.20 ^b
Cultivar	NS			NS			S		
L.P.D	S			S			S		
Interaction	NS			NS			NS		

Within rows and columns, means followed by the same superscripts are not significantly differ at $p \leq 0.05$.

KEY: F - Flat Surface without raised beds; CR - Conventional ridges and furrow with ridges planting; RB - Raised beds; MR - Modified ridges and furrow with narrow furrow planting.

LPD - Land preparation dynamics; S - Significant; NS- Not Significant.

Table 3: Influence of different land preparation dynamics on pod and seed yields and harvest index.

Groundnut cultivars	Pod yield (Kg/ha)			Seed yield (Kg/ha)			Harvest Index			Cultivars means		
	F	CR	RB	MR	means	F	CR	RB	MR	means	CR	RB
Samnut 21	490.00 ^c	901.33 ^b	911.23 ^b	1232.84 ^a	608.84 ^b	304.01 ^c	670.82 ^b	678.21 ^b	972.95 ^b	656.50 ^b	0.27 ^a	0.29 ^a
Samnut 22	704.44 ^b	842.62 ^b	1387.80 ^a	1259.30 ^a	1048.54 ^{ab}	444.56 ^b	585.00 ^b	1098.73 ^a	971.26 ^a	774.89 ^{ab}	0.27 ^b	0.26 ^b
Samnut 23	800.55 ^c	1587.80 ^b	1421.31 ^b	2075.60 ^a	1471.12 ^a	510.85 ^c	1282.78 ^b	1121.34 ^b	1733.11 ^a	1162.02 ^a	0.44 ^b	0.31 ^c
Samnut 24	596.67 ^d	1021.10 ^c	1516.07 ^b	1735.19 ^a	1217.26 ^a	407.67 ^d	821.09 ^c	1267.42 ^b	1406.90 ^a	975.77 ^a	0.48 ^b	0.46 ^b
L.P mean	647.92 ^c	1088.21 ^b	1309.10 ^{ab}	1575.73 ^a	-	416.77 ^c	839.92 ^b	1041.43 ^{ab}	1271.06 ^a	-	0.31 ^a	0.36 ^a
Cultivars					S					S		S
L.P.D					S					S		NS
Interaction					NS					NS		NS

Within rows and columns, means followed by the same superscripts are not significantly differ at $p \leq 0.05$.

KEY: F - Flat Surface without raised beds; CR - Conventional ridges and furrow with ridges planting; RB - Raised Beds; MR - Modified ridges and furrow with narrow furrow planting.

LPD - Land preparation dynamics; S - Significant; NS- Non Significant

Groundnut yields were only significantly influenced by cultivars and planting methods. Samnuts 23 and 24 recorded higher mean yield, in groundnut raised under modified ridges and furrow with narrow furrow planting as compared to other planting methods (Table 3). Significantly lowest pod and seed yields per hectare were recorded for all the cultivars grown on flat surface without raised beds. Result recorded for harvest was similar to those recorded for yield except that the effect of planting methods was not significant (Table 3). The enhanced yield attributes, yield and harvest index by ridges and furrow with narrow furrow most importantly in Samnut 23 and 24 could be due to greater photosynthetic capacity and partition of assimilates into various parts of the plant. This to large extent was enhanced by the factors such as leaf area development, rate of flower formation, peg production and soil conditions created by this planting method. The results agreed with the view of Bhoi *et al.* (2010) who reported that yield or productivity of any field crop is governed by net photosynthetic efficiency as well as microclimate and edaphic factors of the area in which the crop is grown.

Another possible explanation for enhanced yield in modified ridges and furrow with narrow furrow planting was that this treatment offered more opportunity for peg proximity to the soil surface. For instance, it was observed that pegs produced at the upper parts of the branches had a shorter distance to travel and therefore end up in forming pods as a result of uniform distance that was maintained between the pegs and the soil surface as the branches extend outward from the main stem. According to Santos *et al.* (2005) the most efficient plants at transforming pegs into viable fruits have most pegs in the first 15 cm of plant height, which is the maximum size reached by pegs under field conditions. Mathukia *et al.* (2014) had also reported that alternate furrow and beds increased growth and yield of groundnut over flat surface. The low yield in the conventional ridges could be attributed to the conical shape of the ridges which prevented the pegs from enjoying close proximity to the soil surface (Olayinka *et al.*, 2015). This could be the reason why African farmers often practice earthing-up the branches with soil to decrease the distance between the pegs and soil surface (Nigam *et al.*, 2006). This practice resulted in more damaged and infected pods.

CONCLUSION

The great economic importance of groundnut throughout the world enhances its high demand. The low yield of the crop that be partly ascribed to poor planting method entail alternative planting method if the high demand for groundnut and groundnut products will be met. Experiment results revealed that all the cultivars responded positively to planting methods with the exception of those grown on flat surface without raised beds. However, modified ridges and furrow with narrow furrow planting was found to be more effective most importantly because of its positive influence on the growth and yield of the cultivars studied.

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