Effect of Groundnut (*Arachis Hypogea* L.) Varieties as Influence by Sowing Date and Weed Control Methods in Semi-Arid Environment Nigeria

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ABSTRACT: *Two field trials were conducted during the 2023 growing season to find out the effect of sowing dates and weed control methods on groundnut at Teaching and Research Farm of Federal University Dutsin-Ma $11^0 58$`N, $8^0 26$`E and 475m above sea level and Agricultural research farm Tambu-Daura (11^0 33' N, 8^0 23' E and 481m above sea level) Katsina State Nigeria. Treatments consisted of 3x3x4 factorial combination of three groundnut varieties (SAMNUT 24, SAMNUT 26 and Kwan-kwasiya), 3 different sowing dates (end of June, 1st week of July and 2nd week of July) and four 4 weed control methods (use of Imazethapyr as post emergence herbicides 1st and 2nd), application of post-emergence herbicide (Imazethapyr) + 1 hoe weeding at 6WAS, manual weeding at 3 and 6WAS, and control) replicated three times. The treatments were laid out under split plot design (SPD). Results from the study revealed that groundnut variety had a significant effect on growth of groundnut at the two locations. SAMNUT 24 significantly ($P \leq 0.05$) performed better than SAMNUT 26 and local variety (Kwankwasiya) at both locations on Number of days to 50% flowering and Number of branches per plant, although there were no consistent differences recorded at the two locations on crop injury per plot and weed cover score per plot but in most of the sampling stages local variety (Kwankwasiya) significantly ($P \leq 0.05$) recorded the highest values followed by SAMNUT 24 and SAMNUT 26 respectively. Results also indicated that sowing date had a significant ($P \leq 0.05$) effect on most of the parameters tested at the two location and sowing groundnut at the end of June and 1st week of July recorded the highest performance than planting of groundnut at the 2nd week July. However, manual weed control method by using hoe at 3 and 6WAS significantly ($P \leq 0.05$) outperformed better than three other weed control methods tested at both the two locations but on parameters like crop injury and weed cover score per plot control plot (un weeded plot) recorded the highest value followed by use of chemical only (Imazethapyr) and the least was obtaining from manual weed control and use of Imazethapyr+1hoe. In a nutshell the results indicated that combination of SAMNUT 24, sowing of groundnut at end of June or 1st week of July and manual weed control method seems to be most effective and recommended in Semi-arid Zone Nigeria.*

KEYWORDS: control plot, groundnut varieties, manual weeding: sowing date, weed control methods

INTRODUCTION

Groundnut (*Arachis hypogaea L*) is a leguminous oilseed crop cultivated in semi-arid and subtropical regions throughout the world. In Nigeria, the crop is also called as the ***'king'*** of oilseeds. It is one of the most important food and cash crop. Groundnut is an annual legume crop which is also known as peanuts, earthnut, monkey nut and goobers that belongs to "bean" family (Fabaceae). *Hypogaea* means "under the earth". As an important oil and food crop, it is ranked third major oilseed of the world next to soybean and cotton (Bolaji and Emmanuel 2016). The crop was originated from Latin America and the first probable domestication of groundnut took place in the valley of the Panama and Paraguay River System in the Grain Chaco area of South America and then move to the North America through slave trade (Scott and Vikas, 2014).The crop was also introduced into West Africa including the present Nigeria by Portuguese traders in the 16[th]century (Olawale *et al*., 2004). The main agro-ecological zones for groundnut production in Nigeria are Sahel, Sudan, northern guinea and most of the southern guinea and derived savannah (Vabi *et al.,* 2019). It is the 13th most important food crop and 4th most important oil seed crop of the world. Today groundnut is widely distributed and has adapted in various countries of the World. The most important producing countries are Nigeria, India, China, Brazil and USA. In Africa, major producers include Nigeria, Sudan, Senegal, Chad, Congo and Ghana (ICRISAT, 2008). The World production figure of groundnut in 2019 was 48.8 million tonnes from 29.6 million hectares with average production of 1649 kg ha^{-1} (FAO, 2021). Nigeria is the largest groundnut producing country in West Africa accounting for 51% of the total production in the region. Groundnut contains 45-55% oil, 20-25% protein, 16-18% carbohydrate and 5% minerals (Gulluoglu *et al.,* 2016a).

Sowing date is one of the critical factor affecting groundnut production in Nigeria due to climatic differences, although the total annual rainfall of 1,018mm of Sudan Savannah Zone is adequate, for groundnut production, the amount of rainfall during April and May is usually low and therefore, not optimal for good germination and establishment of groundnut plants, the rain however, get stabilized around mid-June, but at times the distribution becomes erratic (ADP, 2000).

Groundnut cannot compete effectively with weeds, particularly at 3 - 6 weeks after planting; therefore, early removal of weeds is important before flowering and during pegging weeds varies in their growth habit and life cycle therefore; no single weed control method may provide effective control of weed (Sathya priya *et al.,* 2013). The effect of weed control method on growth parameters was studied in a field experiment however the results showed that weed control method had a significant effect on the growth rate of groundnut. Sathya priya *et al.,* (2013) reported that various weed management practices are in vogue in groundnut and each has its own merits and demerits and weed control could only be achieved through direct methods (hand weeding,

herbicide application and mechanical weeding) used within systems and indirect methods such as land preparation, water management, planting method and fertility management.

MATERIAL AND METHODS

Description of the Experimental Site
Multi location field experiments were conducted during 2023 growing season at Teaching and Research Farm of Federal University Dutsin-Ma $11^0 58`N$, $8^0 26`E$ and 475m above sea level and Agricultural research farm Tambu-Daura ($11^0 33'$ N, $8^0 23'$ E and 481m above sea level) Katsina State Nigeria. The area has the annual rainfall range of 550-650 and 600- 750 respectively and means annual temperature ranging from $15^0 C$ to $41^0 C$. 3x3x4 factorial combination of treatments was factorized and laid out in a split plot design (SPD) and replicated three times. Soil samples were collected randomly from the experimental site at 0 - 30 cm soil depths diagonally across the field before conducting the trial. The composite sample was analyzed for some physical and chemical properties using standard procedures as described by (Black, 1968). The soil of the area is sandy loamy. Data on rainfall distribution, temperature, sunshine and relative humidity for the growing seasons was collected. The field was cleared, harrowed and ridged. The ridges were also sub-divided into plots of 6 ridges per plot at 9 meters in length and 4.5m width for main plot and 3m x4.5m as sub plot while the net plot consisting of two inner rows at a spacing of 0.75m x 3 x 2 = 4.5m. A Pass way of 1 m was made between the boundary of the trial site and the 1m between the replications. The seeds of the two varieties (SAMNUT 24 and SAMNUT 26) were sourced from Katsina State Agricultural and Rural Development Authority (KTARDA) while the local variety (Kwankwasiya) was source from the market. The seeds were treated with Difenoconazole @10g per 3 kg of seeds prior to planting to protect the seeds against soil pathogens and pests. The seeds were sown manually at inter and intra-row spacing of 75 cm x 15 cm at 5 cm depth using two seeds per hole. The seeds were sown on 25th June, 5th July and 14th July, 2023 as per treatment while NPK fertilizer at the rate of 30:30:30 were applied three weeks after sowing. At 3 and 6 WAS weed control was made as per treatment. The data on plant growth was collected at 3, 6, and 9WAS from five (5) tagged plants per plot the data collected was subjected to statistical analysis of variance (ANOVA) as described by Gomez and Gomez. (1984) using SAS package 2002 version 9.0. The treatment means were separated for the significant difference using Duncan Multiple Range Test (DMRT) Duncan, (Duncan, 1955) at 5% level of probability ($P \leq 0.05$).

RESULTS AND DISCUSSIONS

The effect of variety, sowing date and weed control method on number of days to 50% flowering of groundnut is presented in Table 1.

The result indicated that variety had significant effect (P<0.05) on number of days to 50% flowering at both location and SAMNUT 24 with 34.00 and 40.11significantly (P<0.05) outperformed better than SAMNUT 26 with 29.67 and 38.14 respectively and control variety

(Kwankwasiya) with the least value of 25.11 and 36.31 Table 1. Sowing date had significant (P<0.05) effect on the number of days to 50% flowering at both locations at FUDMA planting of groundnut variety at the end of June significantly performed better than all other sowing date but at TAMBU-DAURA the result indicated that planting of groundnut at the first week of July (39.00) recorded the highest value when compared to planting at June (37.50) and second week of July with (37.56) respectively. However, manual weed control method using hoe and chemical+1hoe weeding recorded the highest number of days to 50% flowering followed by use of chemical and control at both locations. Interactions between variety, sowing date and weed control method was significant (P>0.05) at FUDMA Table 2 and 3.

Table 1: - Effect of variety, sowing date and weed control method on number of days to 50% flowering per plot at FUDMA and Tambu-Daura during the 2023 growing season

Treatment	Number of days to 50% flowering per plot	
	FUDMA	**TAMBU-DAURA**
Varieties (V)		
SAMNUT 24	34.00[a]	40.11[a]
SAMNUT 26	29.67[b]	38.14[b]
KWANKWASO	25.11[c]	36.31[c]
S.E($\pm$)	0.35	0.88
Significance	**	*
Sowing Date (T)		
S1	30.06[a]	37.50[b]
S2	29.27[b]	39.0[a]
S3	29.06[b]	37.56[b]
S.E($\pm$)	0.35	0.88
Significance	*	*
Weed control method (W)		
Chemical method	29.59[b]	39.15[a]
Chemical+1hoe	30.89[a]	38.30[a]
Manual weeding	30.85[a]	38.44[a]
Control	27.04[c]	36.19[b]
S.E($\pm$)	0.41	0.97
Significance	**	*
Interactions		
V x T	*	NS
V x W	*	NS
W x T	NS	NS
V x T x W	NS	NS

Note *= Significant, NS= Not Significant at 5% level of probability. Means followed by the same letter(s) within the same column and treatment are not significantly different at 5% level of probability using DMRT.

Table 2:- Interaction of variety and sowing date on number of days to 50% flower at FUDMA farm

	Number of Days to 50% flowering		
Treatments	**T1**	**T2**	**T3**
Varieties (V)			
SAMNUT 24	25.42^e	28.33^d	33.42^b
SAMNUT 26	25.00^e	30.17^c	36.17^a
Kwankwasiya	24.92^e	30.50^c	32.52^b
S.E(+)		0.59	

Means followed by the same letter are statistically the same using DMRT at 5% level of significance

Table 3:- Interaction of variety and weed control method on number of days to 50% flower at FUDMA

	Number of Days to 50% flowering			
Treatments	**Chemical control**	**Chemical + manual**	**Manual only**	**Control**
Varieties (V)				
SAMNUT 24	24.78^{gh}	29.32^{ef}	35.54^{ab}	26.33^{gh}
SAMNUT 26	30.67^{cd}	35.67^{ab}	25.33^{gh}	30.78^{cd}
Kwankwasiya	36.44^{ab}	24.78^{gh}	27.89^{ef}	28.44^{ef}
S.E(+)		0.67		

Means followed by the same letter are statistically the same using DMRT at 5% level of significance

Number of branches of three groundnut varieties at 3, 6 and 9WAS was affected by sowing date and weed control method. Number of branches progressively increases from 3 to 9WAS at the two locations and SAMNUT 24 significantly (P<0.05) performed better than SAMNUT 26 and local variety (Kwankwaso). Sowing date at 3, 6 and 9WAS was not significant at both locations. Weed control method was significant (P<0.05) on number of branches at all the sampling stages at both locations and manual weed control method using hoe and chemical+1hoe weeding recorded the highest value followed by use of chemical and the least was obtain from control method. All the interaction was not significant (P>0.05) at the two locations.

Table 4: - Effect of variety, sowing date and weed control method on number of branches per plant at 3,6 and 9WAS at FUDMA and Tambu-Daura during the 2023 growing season

| | Number of branches per plant | | | | | |
| | FUDMA | | | | TAMBU-DAURA | |
Treatment	3WAS	6WAS	9WAS	3WAS	6WAS	9WAS
Varieties (V)						
SAMNUT 24	8.69	10.73^a	18.25^a	8.08^a	11.37^a	17.08^a
SAMNUT 26	8.61	10.26^b	17.47^a	7.53^b	10.67^b	16.02^b
KWANKWASO	8.61	9.44^c	16.05^b	6.61^c	9.17^c	13.77^c
S.E($\pm$)	0.20	0.23	0.40	0.22	0.33	0.49
Significance	NS	**	**	**	**	**
Sowing Date (T)						
S1	8.75	10.09	17.17	7.53	10.51	15.78
S2	8.53	10.01	17.02	7.44	10.52	15.81
S3	8.64	10.34	17.58	7.25	10.17	15.27
S.E($\pm$)	0.20	0.23	0.40	0.22	0.33	0.49
Significance	NS	NS	NS	NS	NS	NS
Weed control method (W)						
Chemical method	7.89^b	9.33^b	15.86^b	7.51^a	10.72^a	16.10^a
Chemical+1hoe	9.52^a	11.10^a	18.86^a	7.41^a	11.11^a	16.69^c
Manual weeding	9.30^a	10.94^a	18.60^a	7.63^a	11.44^a	17.19^c
Control	7.85^b	9.24^b	15.70^b	6.85^b	8.33^b	12.50^b
S.E($\pm$)	0.23	0.27	0.46	0.26	0.38	0.57
Significance	**	**	**	*	*	*
Interactions						
V x T	NS	NS	NS	NS	NS	NS
V x W	NS	NS	NS	NS	NS	NS
W x T	NS	NS	NS	NS	NS	NS
V x T x W	NS	NS	NS	NS	NS	NS

Note *= Significant, NS= Not Significant at 5% level of probability. Means followed by the same letter(s) within the same column and treatment are not significantly different at 5% level of probability using DMRT.

Although there was no consistent difference on number of crop injury recorded from the three groundnut varieties tested, consequently most of the results indicated that local variety (Kwankwasiya) recorded the highest crop injury per plot followed by SAMNUT 24 and SAMNUT 26 which are statistically the same in terms of crop injury per plot. However, sowing date at 3, 6 and 9WAS was significantly (P<0.05) affected at both locations and planting of groundnut at the end of June significantly performed better than planting at 1st and 2nd week of July respectively. Weed control method was significant (P<0.05) on crop injury per plot at all the sampling stages and at both locations and control plot (No weeding) recorded the highest value followed by use of chemical only and the least was obtain from manual weed control method using hoe and

chemical+1hoe weeding respectively. The interaction between variety and sowing date at 6WAS at TAMBU-DAURA was also significant (P>0.05) Table 6.

Table 5: - Effect of variety, sowing date and weed control method on crop injury per plot at 3,6 and 9WAS at FUDMA and Tambu-Daura during the 2023 growing season

	Crop injury per plot					
	FUDMA				**TAMBU-DAURA**	
Treatment	**3WAS**	**6WAS**	**9WAS**	**3WAS**	**6WAS**	**9WAS**
Varieties (V)						
SAMNUT 24	3.89^b	3.44^a	5.14^b	4.17^a	4.44^a	5.31^b
SAMNUT 26	4.00^b	3.61^a	5.00^b	3.28^c	4.39^a	5.19^c
KWANKWASO	4.94^a	3.17^b	5.58^a	3.72^b	3.58^b	5.94^a
S.E($\pm$)	0.15	0.13	0.12	0.21	0.13	0.10
Significance	*	*	**	*	**	*
Sowing Date (T)						
S1	4.61^a	3.22^b	5.44^a	3.94	4.69^a	5.75^a
S2	4.11^b	3.64^a	5.39^a	3.81	3.75^b	5.42^b
S3	4.11^b	3.36^b	4.89^b	3.42	3.97^b	5.28^b
S.E($\pm$)	0.15	0.13	0.12	0.21	0.13	0.10
Significance	**	**	**	NS	**	*
Weed control method (W)						
Chemical method	4.44^a	3.11^b	4.93^c	3.81	4.11^b	5.63^b
Chemical+1hoe	4.30^a	3.30^b	5.41^b	3.48	3.74^c	4.89^c
Manual weeding	4.56^a	2.53^c	4.41^d	3.33	3.33^d	5.00^c
Control	3.81^b	4.70^a	6.22^a	4.18	5.37^a	6.41^a
S.E($\pm$)	0.18	0.15	0.13	0.23	0.16	0.12
Significance	*	**	**	NS	**	**
Interactions						
V x T	NS	NS	NS	NS	*	NS
V x W	NS	NS	NS	NS	NS	NS
W x T	NS	NS	NS	NS	NS	NS
V x T x W	NS	NS	NS	NS	NS	NS

Note *= Significant, NS= Not Significant at 5% level of probability. Means followed by the same letter(s) within the same column and treatment are not significantly different at 5% level of probability using DMRT.

Table 6: - Interaction effect of variety and sowing date on crop injury at Tambu-Daura farm

Treatments	Crop injury per plot		
	T1	T2	T3
Varieties (V)			
SAMNUT 24	5.00^{ab}	4.92^{ab}	4.17^{cd}
SAMNUT 26	4.00^{cd}	4.00^{cd}	3.25^{cd}
Kwankwasiya	4.33^{cd}	4.25^{cd}	3.33^{e}
S.E(+)		0.59	

Means followed by the same letter are statistically the same using DMRT at 5% level of significance

Weed cover score per plot was recorded at 3, 6 and 9WAS during the 2023 growing season at FUDMA and TAMBU-DAURA as presented in Table 7.

The results indicated that variety, sowing date and weed control method had significant ($P<0.05$) effect on weed cover score and the highest value of weed cover score at 3 and 9WAS was recorded by local variety (Kwankwasiya) at FUDMA while SAMNUT 24 and SAMNUT 26 was significantly higher at 3, 6 and 9WAS at TAMBU-DAURA followed by local variety (Kwankwasiya) as the lowest in terms of weed cover score per plot. Sowing of groundnut variety at the 1st week of July significantly ($P<0.05$) outperformed better than sowing at the end of June and 2nd week of July at FUDMA while at TAMBU-DAURA sowing at 2nd week of July significantly performed better than all other sowing dates tested during the experiment. Weed control method had significant ($P<0.05$) effect on weed cover score per plot. The result also indicated that control plot (un weeded plot) significantly ($P<0.05$) gave higher weed cover score at all the sampling stages the least value was obtain from manual method of weed control using hoe. The interaction between variety and sowing date was significant ($P>0.05$) at 3WAS at TAMBU-DAURA (Table 8).

Table 7: - Effect of variety, sowing date and weed control method on weed cover score per plot at 3,6 and 9WAS at FUDMA and Tambu-Daura during the 2023 growing season

| | Weed Cover Score Per Plot | | | | | |
| | FUDMA | | | | TAMBU-DAURA | |
Treatment	3WAS	6WAS	9WAS	3WAS	6WAS	9WAS
Varieties (V)						
SAMNUT 24	3.75^b	3.69^a	3.64^b	4.42^a	3.42^b	3.61^a
SAMNUT 26	3.75^b	3.75^a	3.75^b	3.86^b	3.75^a	3.58^a
KWANKWASO	4.94^a	3.06^b	4.42^a	3.39^c	3.17^c	3.36^b
S.E($\pm$)	0.11	0.14	0.10	0.43	0.09	0.10
Significance	**	**	**	**	**	*
Sowing Date (T)						
S1	3.92^b	3.06^b	3.58^c	4.14^b	3.75^a	3.50
S2	4.28^a	3.72^a	4.39^a	3.06^c	2.80^b	3.67
S3	4.25^a	3.72^a	3.83^b	4.47^a	3.77^a	3.39
S.E($\pm$)	0.11	0.14	0.10	0.10	0.09	0.10
Significance	**	**	**	**	**	NS
Weed control method (W)						
Chemical method	3.74^b	3.52^b	4.11^b	3.90^b	3.81^a	3.15^b
Chemical+1hoe	4.30^a	3.19^c	3.37^c	3.74^b	3.22^b	3.00^b
Manual weeding	4.33^a	2.89^c	3.07^c	3.56^b	2.78^c	2.59^c
Control	4.22^a	4.41^a	5.19^a	4.27^a	3.96^a	5.33^a
S.E($\pm$)	0.12	0.16	0.12	0.12	0.10	0.12
Significance	**	**	**	**	**	**
Interactions						
V x T	NS	NS	NS	*	NS	NS
V x W	NS	NS	NS	NS	NS	NS
W x T	NS	NS	NS	NS	NS	NS
V x T x W	NS	NS	NS	NS	NS	NS

Note *= Significant, NS= Not Significant at 5% level of probability. Means followed by the same letter(s) within the same column and treatment are not significantly different at 5% level of probability using DMRT.

Table 8: -Interaction of variety and sowing date on weed cover score at 3WAS at Tambu-Daura farm

Treatments	Weed cover score at 3WAS		
	T1	T2	T3
Varieties (V)			
SAMNUT 24	4.92^{ab}	4.08^{cd}	3.42^{ef}
SAMNUT 26	3.50^{ef}	3.17^{ef}	2.50^{g}
Kwankwasiya	4.83^{ab}	4.33^{cd}	4.25^{cd}
S.E(+)		0.59	

Means followed by the same letter are statistically the same using DMRT at 5% level of significance

DISCUSSION

Most of the growth parameters tested revealed that SAMNUT 24 and SAMNUT 26 significantly performed better than the local variety (Kwankwasiya) on number of days to 50% flowering and number of branches per plant at the two locations. This could be attributed to the varietal difference in their genetic makeup as well as ability to utilize photosynthesis effectively. It also indicated that both SAMNUT 24 and SAMNUT 26 have higher potentials in growth over local variety (Kwankwasiya). However, the similarity exhibited by SAMNUT 24 and SAMNUT 26 in all the growth component could be regarded as both two varieties are similar or the same in terms of genetic makeup. These finding is in conformity with report of Patel *et al.* (2008) that varieties of groundnut differ in their potential growth and yield. Ibrahim, (2021) also reported that Crops differ in their ability to assimilate photosynthesis and partition of assimilates to growth and yield components. Sowing date of groundnut was not consistent in all the parameters tested at the two locations these could be attributed to fluctuations of temperature recorded during the growing season 2023 and differences that exist on soil chemical composition of the two locations. This is in line with findings of Stalker, (1997) that Groundnut requires abundant sunshine and warmth for normal development, but does not appear to be especially sensitive to day-length, though it generally produces more flowers under long day conditions. Among the weed control methods tested manual weed control method using hoe only significantly performed better than other three method this could be due the specie of weed and their number available in the area as well as their characteristics in nature it could also be attributed to the fact that manual weeding facilitates plants growth in generating more resources for photosynthesis and aeration. These finding is also in conformity with findings of Ajeigbe *et al.*, (2014) that weeding twice help to keep the crop free of weeds after emergence. However, the ultimate choice depends on the species of weeds involved and the level of infestation. Generally, 2-3 weeding operations are recommended, the first before flowering and at least one more during pegging. Mubarak, (2004) also reported that higher growth component was obtained when the crop was weeded twice which could also be attributed to vigorous plant with less competition for light, nutrients and free space in weed free environment.

CONCLUSION

Based on the findings of this research, it can be concluded that SAMNUT 24 is far better than local variety (Kwankwasiya) in terms of growth. The results also revealed that sowing date was not consistent in their significant difference but it indicated that sowing of groundnut at the end of June and 1st week of July performed better than sowing in 2nd week of July. However, 2 weeding operations significantly increased growth of groundnut when compared with other weed control methods and control that recorded the lowest values at all the sampling stages at the two locations. Therefore planting of SAMNUT 24 or SAMNUT 26 when 24 is not available at the end of June or 1st week of July using manual method of weed control method twice is the best and recommended in the study area.

CONFLICT OF INTERESTS
The authors have declared that there is no any conflict of interests reported in this work.

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