

## Adaptation Study Of Improved groundnut (*Arachis hypogaea* L ) Varieties At Kellem Wollega Zone, Haro Sabu, Ethiopia

Biru Alemu<sup>1</sup>\* and Daraje Aberal

<sup>1</sup> Oromia Agricultural Research Institute (OARI), Haro Sabu Agricultural Research Center, P.O.Box 10, Kellem Wollega, Dambi Dollo

\*Corresponding author email =qabesadugna@gmail.com

### Abstract

The present study was envisaged to assess the adaptability of twelve improved groundnut (Sadi, manipinter, fayto, Sartu, Nc-4x, wr961, wr962, Harar, Roba, Fetene, Oldhale, and Shulamit) varieties. These varieties were sown in RCBD with three replications during 2012/13 at Haro Sabu Research Center on station and kombo Sub-Site, Ethiopia. Combined analyses of data from the two experimental sites (Haro Sabu Research Center on station and kombo Sub-Site location) revealed very highly significant varietal differences ( $P < 0.05$ ) in grain yield, and days to 50% flower, days to 95% maturity and highly significant for stand count and significant for plant height and hundred seed weight. However, no significant varietal differences observed in branch per plant and seed per pod. The location effect was very highly significant ( $P < 0.05$ ) for days to 50% flower, days to 95% maturity, and highly significant ( $P < 0.05$ ) for grain yield and plant height. There were no significant differences between the two locations with respect branch per plant, seed per pod, stand count and hundred seed weight. The replication across location effect was significant ( $P < 0.05$ ) for grain yield and not significant for all other characters studied. Sadi and Fetene were early to flower (27 days) and early to mature. Manipinter differ from the rest of the tested varieties by its weight (80.7 gram per 100 seed) and this reveals this variety to be extra-large seeded groundnut type. In contrast, sartu differ from the rest of the tested varieties by its small weight (35.9 gram per 100 seed) and this reveals this variety to be small seeded groundnut type. Manipinter was the best yielder (16.9) under respective agro ecology followed by Sartu (12.2), Sadi (11.8) and wr961 (11.05). Fetene and oldhale were poor in performance under respective agro ecology.

**Keywords:** *Arachis hypogaea* L; varieties; adaptability

### INTRODUCTION

The word groundnut, *Arachis hypogaea* L., has been derived from two Greek words, *Arachis* means a legume and *hypogaea* meaning below ground which is referring to the formation of pods or pegs, the structure carrying the young embryo down to the soil, in the soil. Groundnut is cultivated in tropics and subtropical countries Bolivia in southern America, which is considered its origin. Groundnut is primarily cultivated in USA, Nigeria, Senegal, Sudan, China, West Africa, Indonesia and India. India is the largest groundnut producing country in the world, which accounts for 40% of area and 36% of world production (Weiss, 2000). FAOSTAT (2010) reveals that, groundnut yield in Africa is lower (980 kg ha<sup>-1</sup>) than the average world groundnut yields. Groundnut is the second important lowland oilseed of warm climate, which is relatively new to Ethiopia as compared to sesame. It is reported that groundnut was introduced to Ethiopia by Italian explorers in 1920s (Adugna, 1991). It was first introduced to Hararghe, eastern Ethiopia and later on disseminated to lowlands of western Wollega, Gamo gofa, Illubabor, Gojam, Shoa and Wollo (Adugna, 1991).

According to central statistical agency agricultural sample survey, groundnuts is the second lowland oil crops following sesame both in terms of area and in production (CSA, 2012/13). The estimated production area and yield of groundnut in Ethiopia in 2012/2013 cropping season were 90,155.57 hectares and 1,244,187.53 quintals, with respective increment of 0.73% and 0.54% both in area and production, respectively. In addition, the average national yield was reported to be 13.80q/hect. The largest groundnut production areas are found in Oromia (32967.8 ha), Benishangul-Gumuz (9968.73 ha), SNNPR (635.04 ha) and in Amhara (344.57 ha) regional states (CSA, 2011). Somalia and Gambela regional states also produce a considerable amount of groundnuts. Production and productivity of groundnut is increasing from year to year in western Oromia. Over the last five years (2008/09 - 2012/13) Post-harvest estimates of groundnuts have shown an increment of yield that ranges from 11.23 to 13.80Qt/Ha (CSA, 2012/13).

Generally, oil crops are the third major crops after cereals and pulses in Ethiopia both in area and in production. Western Oromia zones have areas, which are most favorable for sesame and groundnut. Production and the usage of improved seeds is one of the most efficient ways of raising crop production, but in Ethiopia, less than 10 percent of farmers use improved seeds. (FAO, 2010).

Lack of access to improved varieties in western Ethiopia is the main problem that hampers production of this crop. Therefore, the present study was envisaged to assess the adaptability of improved groundnut varieties that gives best yield under agro ecology of western Oromia.

## MATERIALS AND METHODS

The experiment was conducted on twelve improved groundnut varieties (Sadi, manipinter, fayo, Sartu, Nc-4x, wr961, wr962, Harar, Roba, Fetene, Oldhale, and Shulamit.). These varieties were sown in RCBD with three replications during 2012/13 at Haro Sabu Research Center on station and kombo Sub-Site, Ethiopia. Experimental unit comprised five rows of 3 meters length with row-to-row distance of 60 cm and plant-to-plant distance of 10 cm. Data were recorded for grain yield and its components including days to 50% flowering, days to 95% maturity, plant height (cm), number of primary branches per plant, and number of pods per plant, stand count, and hundred seed weight. The data were subjected to statistical analysis using SAS 9.1 computer software. The significance of means differences were tested by Duncan's Newman Multiple Range Test (DNMRT) as stated in Gomez and Gomez (1984)..

## RESULTS AND DISCUSSIONS

### Analysis of variance

The results of analysis of variance based on randomized complete block design experiments for Haro Sabu Research Center on station and kombo Sub-Site location are presented in Appendix 1 and 2, respectively and for combined one is presented in Appendix 3. Under Haro Sabu Research Center on station (Appendix 1), the mean of squares due to varieties were very highly significant for days to 50% flowering, plant height (cm), hundred seed weight and yield and highly significant for days to 95% maturity and stand count,. The same trend was observed under kombo Sub-Site location (Appendix 2), where varieties showed highly significant difference for days to 50% flowering, days to 95% maturity, hundred seed weight and yield and highly significant plant height (cm)and significant for number of primary branches per plant and stand count. Replication effect was highly significant for grain yield under kombo Sub-Site location.

### Mean performance

Differences in mean performance of the groundnut varieties for the characters studied under Haro Sabu Agricultural Research Center on station, and kombo Sub-Site location are presented in Tables 1 and 2 respectively, and the combined mean is presented in Table 3.

The results indicated that the differences among the means of the groundnut varieties for the studied traits were significant at 5% probability level for all experimental conditions, both at Haro Sabu Agricultural Research Center on station and kombo Sub-Site location.

Days to flower ranged from 30 days to 41 days, and fetene and sadi were early to flower and wr961 was intermediate while the rest were late to flower under Haro Sabu Agricultural Research Center on station and it stays 24 days to 40 to flower under kombo Sub-Site location following the same trend as that of on station. It takes sadi 149.7 days to mature and 167 days for NC-4x under on-station and 121.3 days for wr961 and 167 days for NC-4x under kombo Sub-Site location. Manipinter and NC-4x have a branching habit that makes them significantly different from other varieties, and this indicates that these varieties are spreading type varieties. In contrast to this, sadi and wr961 have fewer branches; this indicates that these varieties are upright varieties. In terms of seed per pod, all of the tested varieties and specially sadi, wr961, roba and fetene have more than one seed in their pods. Plant heights range from 31.7cm for fayo and 54.7cm for sadi under Haro Sabu Agricultural Research Center on station and 35.7cm for roba and 64.6m for sadi under kombo Sub-Site location. Hundred seed weight was 42.4 gram for sartu and 82gram for manipinter under Haro Sabu Agricultural Research Center on station and 42.4gram for sartu and 79.53gram for manipinter under kombo Sub-Site location following the same trend. At both location manipinter was the highest grain yielder followed by sartu,wr961 and sadi.

### Variations in grain yield and other agronomic traits

Combined analyses of data from the two experimental sites(Haro Sabu Agricultural Research Center on station and kombo Sub-Site location)revealed very highly significant varietal differences ( $P < 0.05$ ) in grain yield, and days to 50% flower, days to 95% maturity and significant for plant height and hundred seed weight and highly significant for stand count. However, no significant varietal differences observed in branch per plant and seed per pod. (appendix 3).

The location effect was very highly significant ( $P < 0.05$ ) for days to 50% flower, days to 95% maturity, and highly significant ( $P < 0.05$ ) for grain yield and plant height. There were no significant differences between the two locations with respect branch per plant, seed per pod ,stand count and hundred seed weight (appendix 3).The replication across location effect was significant ( $P < 0.05$ ) for grain yield and not significant for all other characters studied.

Sadi and Fetene were early to flower (27 days) and early to mature, 136 days for sadi and 139.3days for fetene and this finding collaborate the report of EARO(2004).Therefore the name fetene is probably given due to their earliness to mature. In contrast to these, wr961 was intermediate to mature, and NC-4x,sartu and the rest were late to mature. Nc-4x, manipinter, wr961, fetene and harar have branching habit while shulamit,sadi and roba

have fewer branch. In terms of seed per pod sartu was first(3.4) followed by sadi(2.3), wr961(2), and fetene(2.1). on the other hand sadi was highest in height(59.6cm) and the lowest was sartu(35.9cm) and from this one can judge sartu as spreading type variety while sadi was upright type. Manipinter differ from the rest of the tested varieties by its weight(80.7gram per 100 seed) and this reveals this variety to be extra-large seeded groundnut type. In contrasts ,sartu differ from the rest of the tested varieties by its small weight(35.9 gram per 100 seed) and this reveals this variety to be small seeded groundnut type. Manipinter was the best yielder (16.9) under respective agro ecology followed by Sartu(12.2), Sadi(11.8) and wr961(11.05). The best yielding ability of manipinter variety may be attributed from being extra-large seeded groundnut type and its stand count. Fetene and oldhale were poor in performance under respective agro ecology.

Table 1. Mean values of yield and yield components of groundnut varieties at Haro sabu on-station site.

varieties	DTF	DTM	BR	SPP	PHT	SCT	HSW	YQHC
Sadi	30 <sup>t</sup>	149.7 <sup>cd</sup>	8.2 <sup>c</sup>	2.3 <sup>ab</sup>	54.7 <sup>a</sup>	66.0 <sup>cd</sup>	53.7 <sup>d</sup>	14.62 <sup>ab</sup>
manipinter	39.7 <sup>c</sup>	155.7 <sup>abcd</sup>	19.7 <sup>a</sup>	1.75 <sup>b</sup>	39.7 <sup>cde</sup>	84.3 <sup>a</sup>	82.0 <sup>a</sup>	16.09 <sup>a</sup>
fayo	38 <sup>d</sup>	158.7 <sup>abcd</sup>	15.13 <sup>abc</sup>	1.643 <sup>b</sup>	31.7 <sup>f</sup>	69.7 <sup>dc</sup>	63.3 <sup>bc</sup>	4.81 <sup>e</sup>
wr961	31 <sup>e</sup>	159.7 <sup>abc</sup>	8.2 <sup>c</sup>	2.29 <sup>ab</sup>	44.3 <sup>bc</sup>	80.3 <sup>ab</sup>	43.7 <sup>ef</sup>	11.94 <sup>bc</sup>
wr962	41 <sup>a</sup>	164.7 <sup>ab</sup>	13.9 <sup>abc</sup>	1.64 <sup>b</sup>	40.3 <sup>cde</sup>	76.0 <sup>abc</sup>	51.7 <sup>ed</sup>	5.61 <sup>d</sup>
Harar	41 <sup>a</sup>	166.7 <sup>a</sup>	17.8 <sup>ab</sup>	1.77 <sup>b</sup>	35.1 <sup>ef</sup>	65.3 <sup>cd</sup>	56.8 <sup>bcd</sup>	9.15 <sup>cd</sup>
Roba	41 <sup>a</sup>	158 <sup>abcd</sup>	13.7 <sup>abc</sup>	1.89 <sup>ab</sup>	40.2 <sup>cde</sup>	74.3 <sup>bcd</sup>	65.3 <sup>bc</sup>	10.07 <sup>c</sup>
Fetene	30 <sup>f</sup>	150.7 <sup>cd</sup>	9.867 <sup>bc</sup>	3.12 <sup>ab</sup>	46.8 <sup>b</sup>	76.0 <sup>abc</sup>	65.5 <sup>b</sup>	4.01 <sup>e</sup>
Oldhale	41 <sup>a</sup>	165 <sup>ab</sup>	12.23 <sup>abc</sup>	1.19 <sup>b</sup>	41.27 <sup>bcd</sup>	69.7 <sup>dc</sup>	53.4 <sup>d</sup>	4.29 <sup>e</sup>
Shulamit	41 <sup>a</sup>	164 <sup>ab</sup>	12.4 <sup>abc</sup>	1.82 <sup>b</sup>	40.7 <sup>cde</sup>	77.7 <sup>abc</sup>	63.5 <sup>bc</sup>	9.16 <sup>cd</sup>
Sartu	40 <sup>b</sup>	166 <sup>a</sup>	13 <sup>abc</sup>	5.08 <sup>a</sup>	35.9 <sup>edf</sup>	60.0 <sup>e</sup>	42.4 <sup>f</sup>	12.17 <sup>bc</sup>
Nc-4x	40 <sup>b</sup>	167 <sup>a</sup>	19.1 <sup>a</sup>	1.7 <sup>b</sup>	39.1 <sup>cde</sup>	68.7 <sup>cde</sup>	56.6 <sup>cd</sup>	8.83 <sup>cd</sup>
Lsd(5%)	0.28	9.6	7.9466	3.19	5.95	9.26	8.89	3.79
SE(m)	0.03	32.1	22.02	3.57	12.36	29.92	27.55	5.0
Cv(%)	0.44	3.53	34.53	87.09	8.61	7.56	9.023	24.27

\*Means with the same letter are not significantly different. DTF = Days to 50% Flowering, DTM = Days to 90% maturity PHT = Plant height, BR =Number of primary branches per stand, SCT=Stand count, SPP =Seed per pod, HSW =Hundred seed weight, YQHC =yield per hectare (Qt)

Table 2. Mean values of yield and yield components of groundnut varieties under Kombo sub-site.

varieties	DTF	DTM	BR	SPP	PHT	SCT	HSW	YQHC
Sadi	24 <sup>c</sup>	122.3 <sup>d</sup>	17.5 <sup>bcd</sup>	2.23 <sup>a</sup>	64.6 <sup>a</sup>	59.7 <sup>bcd</sup>	51.23 <sup>cd</sup>	8.99 <sup>cd</sup>
manipinter	36 <sup>b</sup>	137.3 <sup>b</sup>	17.4 <sup>bcd</sup>	1.7 <sup>ab</sup>	38.9 <sup>cd</sup>	79 <sup>a</sup>	79.53 <sup>a</sup>	17.73 <sup>a</sup>
fayo	36.3 <sup>b</sup>	138 <sup>b</sup>	16 <sup>bcd</sup>	1.7 <sup>ab</sup>	40.3 <sup>bcd</sup>	79.3 <sup>a</sup>	68.77 <sup>ab</sup>	3.89 <sup>fg</sup>
wr961	25 <sup>c</sup>	121.3 <sup>d</sup>	27.8 <sup>a</sup>	1.8 <sup>ab</sup>	49.5 <sup>b</sup>	50.7 <sup>dc</sup>	40.97 <sup>d</sup>	10.16 <sup>bc</sup>
wr962	36 <sup>b</sup>	134 <sup>bc</sup>	12.7 <sup>dc</sup>	1.5 <sup>ab</sup>	43.7 <sup>bcd</sup>	73.3 <sup>ab</sup>	58.17 <sup>bc</sup>	6.86 <sup>de</sup>
Harar	36 <sup>b</sup>	137.7 <sup>b</sup>	15.7 <sup>bcd</sup>	1.7 <sup>ab</sup>	43.7 <sup>bcd</sup>	65 <sup>abcd</sup>	56.03 <sup>c</sup>	5.24 <sup>ef</sup>
Roba	37 <sup>b</sup>	138 <sup>b</sup>	9.87 <sup>d</sup>	1.6 <sup>ab</sup>	35.7 <sup>d</sup>	82 <sup>a</sup>	61.3 <sup>bc</sup>	4.64 <sup>efg</sup>
Fetene	24 <sup>c</sup>	128 <sup>cd</sup>	22.7 <sup>ab</sup>	1.1 <sup>b</sup>	47.4 <sup>bc</sup>	69 <sup>abc</sup>	57.3 <sup>c</sup>	3.83 <sup>fg</sup>
Oldhale	39.3 <sup>a</sup>	139 <sup>b</sup>	14.7 <sup>bcd</sup>	1.6 <sup>ab</sup>	48.7 <sup>b</sup>	49.7 <sup>d</sup>	58.63 <sup>bc</sup>	2.4 <sup>g</sup>
Shulamit	39 <sup>a</sup>	138 <sup>b</sup>	8.6 <sup>d</sup>	1.2 <sup>b</sup>	48.7 <sup>b</sup>	79 <sup>a</sup>	59.77 <sup>bc</sup>	7.82 <sup>d</sup>
Sartu	40 <sup>a</sup>	166 <sup>a</sup>	13 <sup>dc</sup>	1.75 <sup>ab</sup>	35.9 <sup>d</sup>	60 <sup>bcd</sup>	42.4 <sup>d</sup>	12.18 <sup>b</sup>
Nc-4x	40 <sup>a</sup>	167 <sup>a</sup>	19.1 <sup>abc</sup>	1.7 <sup>ab</sup>	39.1 <sup>cd</sup>	69 <sup>abc</sup>	56.6 <sup>c</sup>	8.8 <sup>cd</sup>
Lsd(5%)	1.2	6.95	9.25	0.87	9.5	18.6	11.17	2.27
SE(m)	0.5	16.87	29.8	0.26	31.5	121.1	43.52	1.8
Cv(%)	2.14	2.96	33.57	31.34	12.56	16.18	11.46	17.34

\*Means with the same letter are not significantly different. DTF = Days to 50% Flowering, DTM = Days to 90% maturity PHT = Plant height, BR =Number of primary branches per stand, SCT=Stand count, SPP =Seed per pod, HSW =Hundred seed weight, YQHC =yield per hectare (Qt)

Table3. Mean values of yield and yield components of groundnut varieties combined over location.

varieties	DTF	DTM	BR	SPP	PHT	SCT	HSW	YQHC
Sadi	27 <sup>e</sup>	136 <sup>e</sup>	12.77 <sup>abc</sup>	2.3 <sup>ab</sup>	59.67 <sup>a</sup>	62.8 <sup>de</sup>	52.5 <sup>f</sup>	11.8 <sup>b</sup>
manipinter	37.8 <sup>dc</sup>	146.5 <sup>bcd</sup>	18.53 <sup>ab</sup>	1.7 <sup>b</sup>	39.27 <sup>def</sup>	81.67 <sup>a</sup>	80.77 <sup>a</sup>	16.9 <sup>a</sup>
fayo	37.17 <sup>d</sup>	148.3 <sup>bc</sup>	15.57 <sup>abc</sup>	1.5 <sup>b</sup>	36 <sup>f</sup>	74.abc	66.03 <sup>b</sup>	4.35 <sup>fg</sup>
wr961	28 <sup>e</sup>	140.5 <sup>cde</sup>	18 <sup>ab</sup>	2 <sup>ab</sup>	46.9 <sup>b</sup>	65.5 <sup>cde</sup>	42.3 <sup>g</sup>	11.05 <sup>bc</sup>
wr962	38.5 <sup>bdc</sup>	149.3 <sup>b</sup>	13.3 <sup>abc</sup>	1.6 <sup>b</sup>	42 <sup>bcde</sup>	74.67 <sup>abc</sup>	54.9 <sup>ef</sup>	6.23 <sup>ef</sup>
Harar	38.5 <sup>bdc</sup>	152.17 <sup>b</sup>	16.7 <sup>abc</sup>	1.7 <sup>b</sup>	39.4 <sup>cdef</sup>	59.67 <sup>e</sup>	56.4 <sup>def</sup>	7.2 <sup>ed</sup>
Roba	39 <sup>ab</sup>	148 <sup>bcd</sup>	11.8 <sup>bc</sup>	1.8 <sup>b</sup>	39.1 <sup>ef</sup>	78.17 <sup>ab</sup>	63.3 <sup>bc</sup>	7.4 <sup>ed</sup>
Fetene	27 <sup>e</sup>	139.3 <sup>ed</sup>	16.3 <sup>abc</sup>	2.1 <sup>ab</sup>	47.1 <sup>b</sup>	72.5 <sup>abcd</sup>	61.4 <sup>bcde</sup>	3.2 <sup>g</sup>
Oldhale	40.17 <sup>a</sup>	152 <sup>b</sup>	13.5 <sup>abc</sup>	1.4 <sup>b</sup>	45 <sup>bc</sup>	49.7 <sup>d</sup>	56 <sup>def</sup>	4.1 <sup>fg</sup>
Shulamit	40 <sup>ab</sup>	151 <sup>b</sup>	10.52 <sup>c</sup>	1.5 <sup>b</sup>	44.7 <sup>bcd</sup>	78.3 <sup>ab</sup>	61.7 <sup>bcd</sup>	8.5 <sup>de</sup>
Sartu	40 <sup>ab</sup>	166 <sup>a</sup>	13 <sup>abc</sup>	3.42 <sup>a</sup>	35.9 <sup>f</sup>	60 <sup>e</sup>	42.4 <sup>g</sup>	12.2 <sup>b</sup>
Nc-4x	40 <sup>ab</sup>	167 <sup>a</sup>	19.1 <sup>abc</sup>	1.73 <sup>b</sup>	39.1 <sup>def</sup>	68.8 <sup>bcde</sup>	56.6 <sup>cdef</sup>	8.8 <sup>cd</sup>
Lsd(5%)	1.5	8.74	7	1.63	5.67	11.3	6.7	2.4
SE(m)	1.7	57.15	36.67	1.99	24.08	96.01	33.6	4.35
Cv(%)	3.65	5.05	40.56	74.1	11.48	13.96	10.03	24.65

\*Means with the same letter are not significantly different. DTF = Days to 50% Flowering, DTM = Days to 90% maturity PHT = Plant height, BR =Number of primary branches per stand, SCT=Stand count, SPP =Seed per pod, HSW =Hundred seed weight, YQHC =yield per hectare (Qt)

### CONCLUSIONS AND RECOMENDATIONS

Generally, the present study entails the presence of significant variations among Groundnut varieties. Results revealed that Manipinter(16.9) showed to be best performer variety followed by Sartu(12.2),Sadi(11.8) and wr961(11.05) Hence if the above mentioned varieties are demonstrated and popularized to the small scale holder farmers, they can boost the income of poor farmer.

**Acknowledgment:** The authors would like to acknowledge Oromia Agricultural Research Institute (OARI) for funding the project “Adaptation trial of improved groundnut varieties under agro ecology of western Oromia” during 2012/13 and Haro Sabu Agricultural Research Center for facilitating the working conditions throughout the research period.

### References

- Adugna Wakjira, 1991. A review of the recent groundnut breeding activities in Ethiopia. Paper Presented at the first national oil seed workshop, 3-5 Dec 1991, Addis Ababa Ethiopia.
- CSA (Central Statistic Agency of Ethiopia). 2005. Statistical report on area and production country forecast of major crops: Agricultural sample enumeration surveys, various issues, Addis Ababa, Ethiopia
- CSA (Central Statistic Agency of Ethiopia). 2003. Statistical report on area and production country forecast of major crops: Agricultural sample enumeration surveys, various issues, Addis Ababa, Ethiopia
- EARO (Ethiopian Agricultural Research organization). 2004. Directory Of Released Crop Varieties & Their Recommended Cultural Practices. *Addis Ababa* ,Ethiopia
- FAO/WFP (Food and Agriculture Organization). 2010. CROP AND FOOD SECURITY ASSESSMENT MISSION TO ETHIOPIA. Available at: <http://www.fao.org>.
- Gomez, K. A. and A. A. Gomez. 1984. Statistical Procedures for Agricultural Research. 2nd Ed., John Willey and Sons. Singapore
- Weiss, E.A., 1971. Castor, Sesame and Safflower. Barnes & Noble Inc., New York. 901p

### Appendices

Appendix 1. Mean square values of yield and yield components of groundnut varieties under Haro sabu on-station site.

Source of variation	Degree of freedom	Mean square							
		DTF	DTM	BR	SPP	PHT	SCT	HSW	YQHC
Rep	2	0.03 <sup>ns</sup>	17.69 <sup>ns</sup>	24.67 <sup>ns</sup>	7.77 <sup>ns</sup>	13.25 <sup>ns</sup>	31.58 <sup>ns</sup>	60.58 <sup>ns</sup>	3.20 <sup>ns</sup>
Treat	11	63.36 <sup>***</sup>	111.30 <sup>**</sup>	45.18 <sup>ns</sup>	3.27 <sup>ns</sup>	105.13 <sup>***</sup>	146.24 <sup>**</sup>	347.84 <sup>***</sup>	48.37 <sup>***</sup>
Error	22	0.03	32.15	22.02	3.57	12.36	29.92	27.55	5.02
Cv(%)		0.44	3.53	34.53	87.09	8.61	7.56	9.023	24.27

\*\*\*= Very highly significant at  $P \leq 0.001$ , \*\* = highly significant at  $P \leq 0.01$ , \*= significant at  $P \leq 0.05$ , ns = not significant at  $P = 0.05$ . \* DTF = Days to 50% Flowering, DTM = Days to 90% maturity PHT = Plant height, BR =Number of primary branches per stand, SCT=Stand count, SPP =Seed per pod, HSW =Hundred seed weight, YQHC =yield per hectare (Qt)  
 CV (%) = coefficient of variation.

Appendix 2. Mean square values of yield and yield components of groundnut varieties under Kombo sub-site.

Source of variation	Degree of freedom	Mean square							
		DTF	DTM	BR	SPP	PHT	SCT	HSW	YQHC
<b>Rep</b>	2	0.69 <sup>ns</sup>	13.78 <sup>ns</sup>	28.66 <sup>ns</sup>	0.25 <sup>ns</sup>	22.30 <sup>ns</sup>	48.08 <sup>ns</sup>	40.16 <sup>ns</sup>	16.25 <sup>**</sup>
<b>Treat</b>	11	117.57 <sup>***</sup>	615.35 <sup>***</sup>	84.97 <sup>*</sup>	0.2 <sup>ns</sup>	192.17 <sup>**</sup>	374.73 <sup>*</sup>	321.08 <sup>***</sup>	55.45 <sup>***</sup>
Error	22	0.54	16.87	29.81	0.26	31.49	121.08	43.52	1.79
Cv(%)		2.14	2.96	33.57	31.34	12.56	16.18	11.46	17.34

\*\*\*= Very highly significant at  $P \leq 0.001$ , \*\* = highly significant at  $P \leq 0.01$ , \* = significant at  $P \leq 0.05$ , ns = not significant at  $P = 0.05$ . \* DTF = Days to 50% Flowering, DTM = Days to 90% maturity PHT = Plant height, BR =Number of primary branches per stand, SCT=Stand count, SPP =Seed per pod, HSW =Hundred seed weight, YQHC =yield per hectare (Qt)  
 CV (%) = coefficient of variation

Appendix 3. Mean square values of yield and yield components of groundnut varieties combined over location.

Source of variation	Degree of freedom	Mean square							
		DTF	DTM	BR	SPP	PHT	SCT	HSW	YQHC
<b>location</b>	1	210.13 <sup>***</sup>	8385.13 <sup>***</sup>	128.51 <sup>ns</sup>	5.13 <sup>ns</sup>	266.81 <sup>**</sup>	338.0 <sup>ns</sup>	6.72 <sup>ns</sup>	41.39 <sup>**</sup>
<b>Rep</b>	2	0.22 <sup>ns</sup>	19.68 <sup>ns</sup>	30.33 <sup>ns</sup>	3.07 <sup>ns</sup>	16.12 <sup>ns</sup>	4.54 <sup>ns</sup>	82.91 <sup>ns</sup>	16.48 <sup>*</sup>
<b>Treat</b>	22	173.17 <sup>***</sup>	530.71 <sup>***</sup>	48.01 <sup>ns</sup>	1.79 <sup>ns</sup>	263.75 <sup>***</sup>	339.12 <sup>**</sup>	639.87 <sup>***</sup>	95.38 <sup>***</sup>
Error	57	1.74	57.15	36.67	1.99	24.08	96.01	33.66	4.36
Cv(%)		3.65	5.05	40.56	74.1	11.48	13.96	10.03	24.65

\*\*\*= Very highly significant at  $P \leq 0.001$ , \*\* = highly significant at  $P \leq 0.01$ , \* = significant at  $P \leq 0.05$ , ns = not significant at  $P = 0.05$ , \* DTF = Days to 50% Flowering, DTM = Days to 90% maturity PHT = Plant height, BR =Number of primary branches per stand, SCT=Stand count, SPP =Seed per pod, HSW =Hundred seed weight, YQHC =yield per hectare (Qt)  
 CV (%) = coefficient of variation

The IISTE is a pioneer in the Open-Access hosting service and academic event management. The aim of the firm is Accelerating Global Knowledge Sharing.

More information about the firm can be found on the homepage:  
<http://www.iiste.org>

## CALL FOR JOURNAL PAPERS

There are more than 30 peer-reviewed academic journals hosted under the hosting platform.

**Prospective authors of journals can find the submission instruction on the following page:** <http://www.iiste.org/journals/> All the journals articles are available online to the readers all over the world without financial, legal, or technical barriers other than those inseparable from gaining access to the internet itself. Paper version of the journals is also available upon request of readers and authors.

## MORE RESOURCES

Book publication information: <http://www.iiste.org/book/>

## IISTE Knowledge Sharing Partners

EBSCO, Index Copernicus, Ulrich's Periodicals Directory, JournalTOCS, PKP Open Archives Harvester, Bielefeld Academic Search Engine, Elektronische Zeitschriftenbibliothek EZB, Open J-Gate, OCLC WorldCat, Universe Digital Library, NewJour, Google Scholar

