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EFFECTS OF GENOTYPE AND SOWING DATE ON THE VEGETATIVE AND REPRODUCTIVE CHARACTERS, POD AND SEED YIELD OF GROUNDNUT (*Arachis hypogea* L.) IN UMUDIKE, SOUTH-EASTERN NIGERIA

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ABSTRACT

The effects of Genotype and Sowing dates on the vegetative and reproductive characters, pod and seed yield of groundnut (A*rachis hypogea* l.) were evaluated at the Research Farm of the Michael Okpara University of Agriculture Umudike in 2018 and 2019 cropping seasons. The experiment was a split plot laid out in a randomized complete block design (RCBD) with three replicates. The main plot was Sowing dates (June, July and August) while the sub plot treatment was Genotypes (RRB, SUMNUT 10, SUMNUT 20, RMP 91S (Small seed), RMP91 (big seed), JL 12, JL24, ICGV-8124, ICGV 89754 and ICGV 15-87281) making a total of thirty treatment combinations. Each treatment combination unit measured 1m^2 with inter and intra row spacing of 1m. At maturity, data were taken on vegetative (number of leaves plant^{-1}, number of lateral branches plant^{-1}, length of branches plant^{-1} and days to 50% flowering) and reproductive characters (number of pods plant^{-1}, weight of pods plant^{-1}, number of seeds plant^{-1}, weight of seeds plant^{-1}, 100 seed weight, pod and seed yield ha^{-1}). The genotypes differed significantly (P<0.05) in vegetative characters, reproductive characters, pod and seed yield ha^{-1}. JL12, JL24, ICGV8124 and ICGV89754performed significantly higher (P <0.01) than others in vegetativeand reproductive characters, pod and seed yield ha^{-1} in both years. The crops also differed significantly (P<0.05) due to Sowing date.June and July Sowing dates recorded plants that performed significantly higher (P<0.05) than August Sowing date in 2018 and 2019. The significant interaction between Genotype and Sowing date showed that, RMP-91-S, ICGV89754 and ICGV-IS-87281 are best sown in July for highest seed yield ha^{-1} while JL24, RRB, RMP-91-S, ICGV89754 and ICGV-IS-8728 are best sown inJuneor July for highest pod yield ha^{-1}.

INTRODUCTION

Groundnut (*Arachishypogaea* L.) is an annual herb in fabaceae family (Batioli*et al*., 2011). Its cultivated type originated from Southern Bolivia and Northern Argentina (Conha*et al*., 2008). According to Hamakareem*et al*., (2016) groundnut was taken across the pacific to the Philippines by the Spaniards before spreading to Asia. The Portuguese imported it into West Africa (Waele and Swanevelders, 2011). The genetic diversity of the genus is classified into four gene pools: primary gene pool consisting of *A. hypogaea* and *A. monticola*, secondary consisting of diploid species from section Arachis that are cross-compatible with *A. hypogaea*, tertiary consisting of species of section procumbent that are weakly-cross compatible with *A hyprogaea* and the fourth gene pool consisting of the remaining wild species classified into seven other sections (Pasupuleti*et al*. 2013). The wild species are used as forage (Waele and Swanevelder, 2011). *A. hypogaea* is a self-pollinating crop with cleistogamous flowers, natural hybridization can occur to a small extent where bees' activity is high. Flowering begins 17-35 days after seedling emergence depending on the cultivar and environmental conditions. Flowers, simple or compound are borne in the axils of leaves and never at the same node as vegetable branch. One or more flowers may be present at a node (Seabra*et al*. 2019). The stigma becomes receptive to pollen about 24 hours before anthesis and remains so for about 12 hours more, and the dehiscence of anthers takes place 2-3 hours prior to opening of the flowers in the morning. Fertilization occurs about 6 hours after pollination (Yusuf *et al*. 2017 and Kumar,*et al*. 2019).

Depending on the prevailing temperatures, the peg or gynophore carrying the ovary and fertilized ovule on its tips appears in 6-10 days and grows to enter the soil (Positive geotropic) where it develops into pods. The tip orients itself horizontally away from tap roots; (Yadlapalli, 2014), Bamshaiye*et al*., (2011) reported that groundnut is derived from Greek word *arachis* (legurre) and *hypogaea* meaning "below ground" referring to formation of pods in the soil. Shalini*et al*., (2016) reported that groundnut is valued as a rich source of energy contributed by oil (48-50%) and protein (25-28%) in the kernels. They provide 564Kcal of energy from 100g of kernals. Groundnut oil is an excellent cooking medium because of its high smoking point (Yusuf *et al*. 2017). Bodena (2018) reported that groundnut merg fix as much as 190kg nitrogen per hectare, being a legume crop. It helps to improve soil health and fertility by leaving behind N_2 and organic matter in the soil. Groundnut is not produced at commercial quantity in the southeast even with her enormous potentials that could favour its production. Identification of genotypes with high seed yield capacities, determination of the relationship between seed yield and yield components and the yield components that influenced seed yield ha^{-1} most as well as time of planting are the objectives of this research work.

MATERIALS AND METHODS

The experiment was a split plot laid out in randomized complete block design with the sowing dates as main plot, the genotypes as sub plot treatments, replicated three times.

The main plot was three (3) sowing dates (June, July and August) while the sub plot treatment was ten (10) genotypesRRB, SUMNUT 10, SUMNUT 20, RMP 91S (Small seed), RMP91 (big seed), JL 12, JL24, ICGV-8124, ICGV 89754 and ICGV 15-87281 were evaluated for vegetative and reproductive characters, pod and seed yieldha-^{1} in 2018 and 2019 cropping seasons. The experiment was carried out at the Research Farm of the Michael Okpara University of Agriculture, Umudike (Longitude 07^{0} 33^{1}E, latitude 05^{0} 29^{1}N and altitude 122m) with temperature of 26^{0}C, (Meteorological Centre, National Root Crops Research Institute, Umudike). The seeds sourced from Agricultural Research and Extension Services (IAR) Zaria, Kaduna State, were planted at a spacing of 50cm by 50cm with a distance of 1m separating the plots and blocks. Nine stands per plot and ten plots per block, on a land area of 19m by 5m. Weeding was done manually using hoe and hand pulling method as soon as they appeared. Data were collected on length of branches plant^{1}, number of leaves plant^{-1}, number of branches plant^{-1}, days to 50% flowering, number of pods plant^{-1}, weights of pods plant^{-1}, number of seeds plant^{-1}, weight of seeds plant^{-1}, 100 seed weight, pod yield ha^{-1} and seed yield ha^{-1}.Data were analyzed following the procedure outlined by Obi (2001) for split-plot laid out in randomized complete block design using Genstat Edition 4. Comparison of treatment means and significant differences between treatment means were separated using Fisher's Least Significant Differences (FLSD) as outlined by Gomez and Gomez, (1984) andSnedeco and Cochran (1989)

RESULTS AND DISCUSSION

The physical and chemical characteristics of the soil experimental site were taken and analyzed before planting. The results are given on Table 1.

Table 1. Physico-chemical properties of the experimental site in 2018 and 2019

Physical characteristics	2016	2017	Method of Analysis.
Sand(%)	75.6	74.2	Hydrometer (Jackson, 1962)
Silt (%)	10.3	11.8	Hydrometer (Jackson, 1962)
Clay (%)	14.0	13.9	Hydrometer (Jackson, 1962)
Textural class	Sandy-loam	Sandy-loam	
Chemical properties			
PH (H_20)	5.8	6.1	pH meter
Organic Carbon (%)	1.12	1.3	Flame Photometric (Kjedahl, 1983
Total Nitrogen (%)	0.097	0.15	Kjedahl method (Kjedahl, 1983
Available P ($mgKg^{-1}$)	33.4	22.7	Flame photometric (Kjeldahl, 1983)
Exchangeable K($CmolKg^{-1}$)	0.221	0.3	Oxidation (Kjeldahl, 1983)
Exchangeable Ca($CmolKg^{-1}$)	3.20	4.0	A. A. S. (Kjeldahl, 1983)
Exchangeable Mg($CmolKg^{-1}$)	0.96	1.1	A. A. S. (Kjeldahl, 1983)
Cation exchange capacity ($CmolKg^{-1}$)	5.72	7.0	
Base Saturation	83.21	84.9	

Source: National Root Crops Researches Institute Umudike, Abia State, Nigeria.

Soil textural class was sandy loam. The soil was relatively suitable for the cultivation of *A. hypogaea*, (Baughman *et al*. 2015). The soil was analyzed at National Root Crop Research Institute Umudike, Soil Science Laboratory. The soil was slightly acidic with pH in H_2O of 5.8 in 2018 and 6.1 in 2019. The rise in organic carbon, total nitrogen and available phosphorus in 2019 was due to the residual effects of application of organic manure, which released nutrients slowly. Table 2 showed the agro-metrological data of the experimental site in 2018 and 2019. The mean maximum temperatures were 31.75 and

32.22, while mean rainfall (amount) were 193.56 and 171.76 for 2016 and 2017 respectively. The minimum temperatures in both years are also given. The weather conditions were good enough for the production of *A. hypogaea*in Umudike.

Table2.: Agro- Meteorological Data for Umudike Ecological Zone Showing the Means for 2018 and 2019

	Rainfalls		Temperature (^{0}C)		Relative Humidity (%)		Sun shine	Rainfall AMT		Temperature (^{0}C)		Relative Humidity (%)		Sun-shine
Month	AMT	Days	Max	Min	900 HRS	1500 HRS	(HRS)	(MM)	DAY	MAX	MIN	0900 HRS	1500 HRS	(HRS)
January	0	0	34	23	50	31	7	51	2	33	23	68	49	5.7
February	0	0	36	24	62	36	4.7	0	0	35	24	70	38	6.4
March	257	10	33	25	80	66	4.4	80.5	5	35	25	76	54	7.9
April	129.3	8	33	25	79	70	5.1	140.7	8	33	24	79	62	6.3
May	278.4	16	32	25	82	72	5.4	144.8	11	32	24	82	71	7
June	354.7	16	29	23	85	72	4.7	274.4	15	31	24	85	79	5.8
July	268.7	15	29	24	89	81	3.9	457.6	19	30	23	88	78	3.7
August	396.2	22	29	24	89	81	3.4	133.1	11	31	23	84	78	4.6
September	312.6	15	29	23	86	77	6.7	263.7	14	30	23	85	73	4.9
October	273.4	7	30	24	80	69	5.8	288.9	10	31	24	82	70	5.6
November	45	2	31	24	83	64	7.4	83	7	33	24	78	65	7.3
December	73	1	33	24	71	51	7.4	40	2	33	24	73	50	7.4
Total	2322.7	112	381	288	986	770	65.4	1957.8	104	387	285	717	582	50.4
Mean	193.56	9.33	31.75	24	78	64.17	5.45	163.14	8.67	32.25	23.7	79.67	64.67	5.6

From Table 3 ANOVA showed that genotypes significantly (0.05) affected the length of branches in 2018 and 2019. In both years, the genotypes JL24 and ICGV-IS-87281 branches were longest while RMP-91-S bore the shortest branches. Length of branches also differed significantly (0.05) with respect to sowing date in both years. In 2018, July sowing date recorded branches that were significantly (0.05) longer than June and August sowing dates. In 2019, June and July Sowing Dates recorded branches that were longer than those sown in August. The Genotype and Sowing Date significantly (0.05) affected length of branches in both years. In 2018, ICGV-IS-87281 and ICGV

89754sown in July bore the longest branches (70cm and 69.99 cm respectively), while RRB (75.67cm) and JL24 (73.67cm) recorded longest branches which were statistically (0.05) longer than others. The interaction showed that ICGV-IS-87281, ICGV89754, RRB and JL24 planted in July produced longer branches which differed than others.

From Table 4 ANOVA showed that genotypes significantly (0.05) affected the number of leaves in 2018 and 2019. In 2018, the genotypes JL12 (243.15), ICGV8124(229.81) and ICGV89754 (229.59) bore more number of leaves while in 2019, ICGV 8124 (240.11), ICGV89754 (237.92) and JL12 (225.52) bore number of leaves that were significantly (0.05) higher than that of others. Sowing Date also affected the number of leaves per plant of groundnut significantly (0.05) in 2018 and 2019. In 2018 July Sowing

Table 3. Effect of Genotypes and Sowing Dates on Length of Branches of Groundnut

GENOTYPE	SOWNG DATE							
	2018				2019			
	JUNE	JULY	AUGUST	MEAN	JUNE	JULY	AUGUST	MEAN
RRB	69.67	58.67	47.33	58.56	58.33	75.67	51.33	61.78
JL24	66.67	62.33	52.00	60.33	62.67	73.67	46.33	60.89
ICGV-IS-87281	65.00	70.00	45.67	60.11	68.67	66.33	47.00	60.67
SAM NUT 20	48.67	47.00	26.00	40.56	53.00	43.00	28.00	41.33
ICGV 89754	55.67	69.99	45.67	57.11	59.67	61.00	47.33	52.67
JL 12	58.00	56.67	36.67	50.44	66.67	61.00	46.00	57.89
ICGV 8124	62.00	64.67	48.67	58.44	66.67	71.67	41.33	59.89
RMP-91-S	58.67	48.33	25.00	44.00	46.33	44.33	24.33	38.33
RMP-91-B	57.33	61.67	36.67	51.89	52.00	49.33	34.33	45.22
SAM NUT 10	48.00	61.33	36.67	48.67	59.67	52.33	33.33	51.78
MEAN	58.97	60.07	40.00		59.37	59.83	39.93	
LSD (0.05) Genotype	2.117**				2.001**			
LSD (0.05) Sowing Date	1.159**				1.096*			
LSD (0.05) Genotype x Sowing Date	3.666**				3.466**			

Table 4. Effect of Genotypes and Sowing Dates on Number of Leaves per plant of Groundnut.

GENOTYPE	SOWNG DATE							
	2018				2019			
	JUNE	JULY	AUGUST	MEAN	JUNE	JULY	AUGUST	MEAN
RRB	180.44	277.88	169.67	209.78	231.78	193.00	160.44	195.07
JL24	264.22	306.00	259.89	215.11	215.11	231.33	217.11	221.18
ICGV-IS-87281	227.33	211.22	170.33	207.44	207.44	207.55	207.00	207.33
SAM NUT 20	133.78	172.00	76.66	183.00	183.00	136.33	142.44	153.92
ICGV 89754	280.44	257.22	151.11	229.59	249.67	241.66	222.44	237.92
JL 12	266.55	250.89	212.00	243.15	211.00	241.00	225.78	225.92
ICGV 8124	269.89	276.44	143.11	229.81	283.77	227.77	209.33	240.11
RMP-91-S	123.55	114.33	76.00	104.63	191.55	151.11	107.89	150.18
RMP-91-B	164.11	196.55	202.89	187.85	43.33	204.22	270.22	205.89
SAM NUT 10	131.00	213.55	130.67	158.40	181.33	171.66	135.89	162.96
MEAN	204.13	227.41	159.23		219.80	200.50	179.85	
LSD (0.05) Genotype	4.708**				3.981**			
LSD (0.05) Sowing Date	2.579**				2.181**			
LSD (0.05) Genotype x Sowing Date	8.155**				6.896**			

*= significant, **= highly significant

Date had more number (227.41) of leaves which differed significantly (0.05) with that of June and August Sowing Dates. The Genotypes and Sowing Date significantly (0.05) affected number of leaves per plant. The interaction showed that JL24sown in July and ICGV89754 sown in June produced 306.00 and 249.67 number of leaves in 2018 and 2019 respectively that significantly differed from that of others.

From Table 5, Genotypes significantly differed (P<0.05) with respect to number of branches per plant. JL24 and ICGV8124 bore 11.22 branches which was higher than number of branches borne by other genotypes in 2018. In 2019, JL12, JL24, ICGV89754 and ICGV8124 number of branches were statistically higher ($P<0.05$) than that borne by other genotypes. Number of branches also differed significantly ($P<0.05$) in both years with respect to Sowing date. In 2018, July Sowing date recorded 10.07 branches which differed significantly with 9.40 and 8.00 branches recorded for June and August Sowing dates respectively. The interaction between Genotype and Sowing date revealed that ICGV8124 sown in July and JL12 sown in August produced highest number of branches plant^{-1} in 2018 and 2019 respectively.

From Table 6, Genotypes significantly differed (0.05) with respect to number of days to 50% flowering. The Genotype ICGV-IS-87281 flowered earliest, its numbers of days to flowering was significantly fewer than those of other genotypes in both years. Sowing date also differed significant ($P<0.05$) in number of days to 50% flowering. Number of days to flowering for July and August Sowing dates were significantly fewer ($P<0.05$) than number of days for June sowing date. Genotype interaction with Sowing date also showed number of days to 50% flowering of ICGV-IS-87281remained the same whether sown in June, July or August. For synchronization and availability of fresh pollens and mature stigma to ensure prolonged and effective hybridization, scattered planting should be adopted due to differences and flowering and short duration flowers before anthesis according to Chinatu *et al*, (2017).

Table 5. Effect of Genotype and Sowing Date on Number of Branches per plant of Groundnut

GENOTYPE	SOWNG DATE							
	2018				2019			
	JUNE	JULY	AUGUST	MEAN	JUNE	JULY	AUGUST	MEAN
RRB	8.67	11.00	8.00	9.22	9.67	9.00	9.00	9.22
JL24	11.00	12.33	10.33	11.22	10.67	10.67	11.33	10.89
ICGV-IS-87281	8.00	7.67	8.00	7.89	9.33	8.00	8.67	8.67
SAM NUT 20	6.33	8.67	8.00	7.44	6.33	8.33	9.67	8.11
ICGV 89754	12.00	11.00	7.33	10.22	9.33	11.67	11.33	10.78
JL 12	11.00	9.33	9.00	9.78	9.33	9.67	14.00	11.00
ICGV 8124	12.67	13.67	7.33	11.22	11.22	11.33	11.00	10.56
RMP-91-S	8.67	7.33	7.00	7.67	7.67	8.00	8.33	8.67
RMP-91-B	8.33	8.00	8.33	8.22	8.22	9.00	7.67	8.56
SAM NUT 10	7.33	11.67	7.00	8.67	8.67	7.67	8.33	8.22
MEAN	9.40	10.07	8.00		9.13	9.33	9.33	
LSD (0.05) Genotype	0.499**				1.037**			
LSD (0.05) Sowing Date	0.274**				0.168*			
LSD (0.05) Genotype x Sowing Date	0.865**				1.796**			

TABLE 6: EFFECT OF GENOTYPE AND SOWING DATE ON DAYS TO 50% FLOWERING OF GROUNDNUT

GENOTYPE	SOWNG DATE							
	2018				2019			
	JUNE	JULY	AUGUST	MEAN	JUNE	JULY	AUGUST	MEAN
RRB	33.000	33.000	33.000	33.000	33.000	33.000	33.000	33.000
JL24	32.000	33.000	32.000	32.333	32.000	33.000	32.000	32.333
ICGV-IS-87281	31.000	31.000	31.000	31.000	31.000	31.000	31.000	31.000
SAM NUT 20	33.000	31.000	32.000	32.000	33.000	33.000	32.000	32.667
ICGV 89754	33.000	32.000	31.000	32.000	33.000	31.000	31.000	31.667
JL 12	32.000	31.000	32.000	31.667	32.000	31.000	32.000	32.000
ICGV 8124	32.000	32.000	32.000	32.000	32.000	32.000	32.000	31.556
RMP-91-S	32.000	31.000	31.000	31.556	32.000	31.000	31.000	31.333
RMP-91-B	33.000	31.000	31.000	31.667	33.000	33.000	31.000	32.333
SAM NUT 10	31.000	31.000	32.000	31.333	32.000	32.000	31.000	31.666
MEAN	32.200	31.600	31.767		32.200	31.800	31.667	
LSD (0.05) Genotype	0.0995**				0.0995**			
LSD (0.05) Sowing Date	0.0545**				0.0441**			
LSD (0.05) Genotype x Sowing Date	0.1723**				0.1552**			

*= significant, **= highly significant

From Table 7, ANOVA showed that Genotype differed significantly (P< 0.05) with respect to Number of Pods per plant in both years. The genotypeICGV89754recorded the highest Number of pods per plant, 28.11 in 2016 and 25.88 in 2019. Sowing date also differed significantly (P<0.05) with respect to Number of pods per plant in both years. In 2018, July and August Sowing dates produced plants with higher Number pods while in 2019, June and July Sowing date recorded higher Number of pods per plant. Genotype and Sowing date also affected Number of Pods per plant significantly (P<0.05) in both 2018 and 2019. In 2018, the genotypes

ICGV89754 sown in July and RMP-91-S sown in August produced highest number (30.99) and (30.77) of pods per plant respectively which differed significantly (P<0.05) from others. In 2019, ICGV89754 sown in the Jul**y** also produced highest number (29.55) of pods per plant which differed statistically (P<0.05) from others.

From Table 8, ANOVA showed that Genotype differed significantly (P< 0.05) with respect to Number of Seeds per plant in both years. The genotypesRMP-91-S and ICGV89754recorded the highest Number of Seeds per plant, 38.22 and 37.63in 2018. In 2019, ICGV89754also recorded highest Number of Seeds per plant (34.14)which was statistically different (P<0.05) from others. Sowing date also differed significantly (P<0.05) with respect to Number of Seeds per plant in both years. In 2016, August Sowing dates produced plants with higher Number of Seeds per plant while in 2019, June Sowing date recorded highest Number of pods per plant. Genotype and Sowing date also affected Number of Pods per plant significantly (P<0.05) in both years. In 2018, the genotype RMP-91-S sown in July produced highest number (44.66) of Seeds per plant which differed significantly (P<0.05) from others. In 2019, ICGV89754 sown in the July also produced highest number **(37.55**) of pods per plant which differed statistically (P<0.05) from others.

TABLE 7. EFFECT OF GENOTYPE AND SOWING DATE ON NUMBER OF PODS PER PLANT OF GROUNDNUT

GENOTYPE	SOWNG DATE							
	2018				2019			
	JUNE	JULY	AUGUST	MEAN	JUNE	JULY	AUGUST	MEAN
RRB	16.99	25.22	22.11	21.44	31.000	21.66	22.33	20.48
JL24	22.22	25.44	26.89	24.85	26.33	20.77	22.66	23.25
ICGV-IS-87281	22.11	24.99	27.22	24.77	21.22	20.88	23.33	21.81
SAM NUT 20	20.99	22.44	23.55	22.23	22.66	23.78	23.22	23.22
ICGV 89754	28.33	30.99	25.00	28.11	24.44	29.55	23.66	25.88
JL 12	20.89	22.66	24.55	22.70	20.11	27.44	22.22	23.25
ICGV 8124	18.33	26.44	25.55	23.33	31.00	21.66	22.33	25.00
RMP-91-S	23.67	26.22	30.77	26.89	25.22	25.22	23.11	24.51
RMP-91-B	26.33	28.44	22.99	25.92	27.44	22.55	22.00	24.00
SAM NUT 10	23.66	23.11	25.74	24.17	20.44	26.55	23.33	22.11
MEAN	22.35	25.59	25.40		24.02	24.01	22.56	
LSD (0.05) Genotype	0.657**				1.238**			
LSD (0.05) Sowing Date	0.359**				0.678**			
LSD (0.05) Genotype x Sowing Date	1.137**				2.144**			

TABLE 8. EFFECT OF GENOTYPE AND SOWING DATE ON NUMBER OF SEEDS PER PLANT OF GROUNDNUT

GENOTYPE	SOWNG DATE							
	2018				2019			
	JUNE	JULY	AUGUST	MEAN	JUNE	JULY	AUGUST	MEAN
RRB	23.33	28.22	25.78	25.77	32.77	23.99	22.99	**26.59**
JL24	26.44	34.99	39.44	33.63	34.77	25.12	23.12	**30.66**
ICGV-IS-87281	30.33	40.77	41.55	37.55	32.44	29.44	27.99	**29.96**
SAM NUT 20	22.33	26.99	37.22	28.85	23.99	25.55	34.55	**28.03**
ICGV 89754	33.33	39.22	40.33	37.63	32.89	37.55	31.99	**34.14**
JL 12	39.33	33.78	40.22	34.44	28.33	31.33	29.66	**29.77**
ICGV 8124	25.66	33.55	36.99	32.07	34.99	30.33	24.99	**30.11**
RMP-91-S	28.22	44.66	41.77	38.22	36.22	31.66	33.33	**33.77**
RMP-91-B	26.88	34.99	41.55	34.45	35.66	31.33	25.44	**30.81**
SAM NUT 10	32.55	28.44	27.77	29.59	28.99	31.44	31.55	**30.66**
MEAN	27.84	34.56	37.26		32.12	29.77	29.46	
LSD (0.05) Genotype	0.662**				0.484**			
LSD (0.05) Sowing Date	0.362**				0.265**			
LSD (0.05) Genotype x Sowing Date	1.146**				0.838**			

*= significant, **= highly significant.

From Table 9, ANOVA showed that Genotype differed significantly (P< 0.05) with respect to Number of Pods per plant in both years. The genotypeICGV89754recorded the highest Number of pods per plant, 28.11in 2018 and 25.88 in 2019. Sowing date also differed significantly (P<0.05) with respect to Number of pods per plant in both years. In 2018, July and August Sowing dates produced plants with higher Number pods while in 2019, June and July Sowing date recorded higher Number of pods per plant. Genotype and Sowing date also affected Number of Pods per plant significantly (P<0.05) in both 2018 and 2017. In 2016, the genotypes

ICGV89754 sown in July and RMP-91-S sown in August produced highest number (30.99) and (30.77) of pods per plant respectively which differed significantly (P<0.05) from others. In 2019, ICGV89754 sown in the July also produced highest number (29.55) of pods per plant which differed statistically (P<0.05) from others.

From Table 10, ANOVA showed that Genotype differed significantly (P< 0.05) with respect to Weight of Seeds per plant in both years. The genotypeICGV89754recorded the highest Weight of Seeds per plant, 27.22gin 2018 and 20.92g in 2019. Sowing date also differed significantly (P<0.05) with respect to Weight of seeds per plant in both years. In 2018, June (22.78g) and July (23.14g) Sowing dates produced plants with higher Weight of Seeds per plant in 2019, June and July Sowing date also recorded plants with higher Weight of seeds per plant. Genotype and Sowing date also affected Weight of Seeds per plant significantly (P<0.05) in both 2018 and 2019. In 2018, the genotype ICGV89754 sown in June and July produced plants with heaviest seeds of 31.22g and 28.55g per plant respectively which differed significantly (P<0.05) from others. In 2019,ICGV89754 sown in the July also produced highest Weight (25.55) of seeds per plant which differed statistically (P<0.05) from others.

From Table 11 ANOVA showed that Genotype differed significantly (P< 0.05) with respect to 100-Seed weight in both years. The genotypesICGV-IS-87281 (69.17g) and ICGV89754 (67.22g)100-Seed were the heaviest in 2018 and 2019 respectively. Sowing date also differed significantly (P<0.05) in 100 Seed weight in both years. In 2018, July (64.83g) and August (64.67g) Sowing dates produced plants with heavier 100-Seed weight, while August Sowing date recorded plants with heaviest100Seed weight

TABLE 9. EFFECT OF GENOTYPE AND SOWING DATE ON WEIGHT OF PODS/ PLANTOF GROUNDNUT

GENOTYPE	SOWNG DATE							
	2018				2019			
	JUNE	JULY	AUGUST	MEAN	JUNE	JULY	AUGUST	MEAN
RRB	37.33	33.77	21.44	30.85	31.88	37.66	30.67	33.40
JL24	37.44	43.89	33.12	38.14	41.44	34.44	23.22	30.03
ICGV-IS-87281	32.22	40.66	32.55	35.14	28.33	28.66	22.99	26.66
SAM NUT 20	24.44	30.55	21.99	25.66	25.12	28.55	21.33	24.99
ICGV 89754	41.33	40.22	37.77	37.77	32.99	35.22	29.78	32.66
JL 12	40.12	37.99	31.77	36.63	31.77	34.22	30.89	32.29
ICGV 8124	31.12	31.33	22.89	28.44	32.88	35.12	19.55	29.18
RMP-91-S	38.66	40.88	27.11	35.55	30.11	32.66	20.66	27.81
RMP-91-B	34.99	34.99	36.99	32.33	37.77	31.33	27.55	32.22
SAM NUT 10	33.88	34.33	35.89	31.37	32.33	28.88	20.55	27.25
MEAN	35.15	36.86	27.85		32.46	32.68	24.72	
LSD (0.05) Genotype	0.748**				0.856**			
LSD (0.05) Sowing Date	0.409**				0.469**			
LSD (0.05) Genotype x Sowing Date	1.296**				1.482**			

*= significant, **= highly significant

TABLE 10. EFFECT OF GENOTYPE AND SOWING DATE ON WEIGHT OF SEEDS PER PLANT OF GROUNDNUT

GENOTYPE	SOWNG DATE							
	2018				2019			
	JUNE	JULY	AUGUST	MEAN	JUNE	JULY	AUGUST	MEAN
RRB	21.77	15.89	16.00	17.89	17.44	17.00	15.11	16.51
JL24	22.11	26.11	21.55	23.26	21.33	19.66	14.44	18.48
ICGV-IS-87281	25.66	27.77	20.44	24.63	22.33	18.33	15.55	18.74
SAM NUT 20	16.22	19.11	15.11	16.81	17.44	17.00	12.44	15.63
ICGV 89754	31.22	28.55	21.88	27.22	19.33	25.55	17.88	20.92
JL 12	20.77	22.77	18.55	20.70	17.00	21.00	16.66	18.22
ICGV 8124	18.88	18.33	13.77	17.00	21.00	19.44	12.78	17.74
RMP-91-S	21.78	28.08	11.11	20.55	18.00	16.33	13.00	15.77
RMP-91-B	22.55	26.00	16.11	21.55	22.66	20.11	14.78	19.18
SAM NUT 10	26.88	18.81	13.33	19.44	15.44	19.33	16.00	16.92
MEAN	22.78	23.14	16.78		19.20	19.37	14.86	
LSD (0.05) Genotype	1.198**				1.251**			
LSD (0.05) Sowing Date	0.656**				0.685**			
LSD (0.05) Genotype x Sowing Date	2.166**				2.166**			

*= significant, **= highly significant

TABLE 11. EFFECT OF GENOTYPE AND SOWING DATE ON 100 SEED WEIGHT PLANT[1]OF GROUNDNUT

GENOTYPE	SOWNG DATE							
	2018				2019			
	JUNE	JULY	AUGUST	MEAN	JUNE	JULY	AUGUST	MEAN
RRB	65.83	60.83	56.67	61.11	61.67	62.50	63.33	62.50
JL24	61.67	69.17	69.17	66.67	67.50	61.67	63.33	64.17
ICGV-IS-87281	68.33	67.67	68.17	68.06	65.83	61.67	66.67	64.72
SAM NUT 20	59.17	59.17	61.67	60.00	58.33	61.67	61.67	60.56
ICGV 89754	66.67	70.83	62.50	66.67	62.50	69.17	70.00	67.22
JL 12	65.00	61.67	63.33	63.33	63.33	65.83	68.33	65.83
ICGV 8124	59.17	63.33	70.00	64.17	61.67	61.67	65.83	63.06
RMP-91-S	64.17	61.67	63.33	63.06	56.67	57.50	56.67	56.94
RMP-91-B	67.17	70.00	63.33	66.94	66.67	66.67	63.33	65.56
SAM NUT 10	64.17	65.00	67.50	65.56	62.50	66.67	66.67	65.28
MEAN	64.17	64.83	64.67		62.67	63.50	64.58	
LSD (0.05) Genotype	1.425**				1.483**			
LSD (0.05) Sowing Date	0.581**				0.812**			
LSD (0.05) Genotype x Sowing Date	2.469**				2.569**			

*= significant, **= highly significant

TABLE 12. EFFECT OF GENOTYPE AND SOWING DATE POD YIELD HECTARE[1] OF GROUNDNUT

GENOTYPE	SOWNG DATE							
	2018				2019			
	JUNE	JULY	AUGUST	MEAN	JUNE	JULY	AUGUST	MEAN
RRB	4148.1	3753.0	2154.1	3457.6	3643.1	3885.4	3370.0	3633.3
JL24	4193.8	4876.5	3767.8	4279.4	4607.5	3827.3	2669.7	3700.0
ICGV-IS-87281	3420.2	4778.5	3706.1	3934.9	3.148	3185.5	2644.4	2993.8
SAM NUT 20	2716.0	3382.7	2533.3	2877.3	2951.9	3173.8	2459.1	2861.4
ICGV 89754	4592.5	4469.1	3953.0	4338.2	3667.7	3964.1	3348.2	3759.7
JL 12	4456.7	4037.0	3619.7	4037.8	3531.4	3802.2	3521.9	3618.2
ICGV 8124	3456.7	3481.4	2595.0	3177.7	3654.7	3902.8	2225.0	3260.9
RMP-91-S	4296.3	4543.1	3101.2	3980.2	3346.1	3630.2	2385.4	3120.4
RMP-91-B	3888.8	3962.9	3088.8	3646.9	4197.0	3515.0	3151.2	3621.9
SAM NUT 10	3765.4	3814.8	2965.4	3515.2	3593.8	3243.9	2373.9	3069.2
MEAN	3909.5	4083.9	3180.2		3623.0	3638.5	2799.7	
LSD (0.05) Genotype	71.66**				91.02**			
[illegible]	[illegible]				[illegible]			

(64.58g) in 2019. Genotype and Sowing date also affected 100-Seed weight significantly (P<0.05) in both years. In 2018, the genotypes JL24, sown in July and August, ICGV89754 sown in July and RMP-91-B sown in July produced plants whose100 seeds were heaviest and differed significantly (P<0.05) from others. In 2019, ICGV89754 sown in the July and August with JL12sown in August produced heaviest 100-Seed weight which differed statistically (P<0.05) from others.

From Table 12, Genotype differed significantly (P< 0.05) in Pod yield hectare[1] in 2018 and 2019. The genotypesICGV89754(4338.2kg)and JL24 (4279.4kg)recorded the highest Pod yield hectare[1] in 2018 In 2019. the same genotypes ICGV89754(3759.70kg) and JL24 (3700.00kg) also recorded the highest Pod yield hectare[1]. Sowing dates significantly differed (P<0.05) in Pod yield hectare[1]of the plants in both years. Thehighest Pod yield hectare[1] (4083.90kg) was recorded for July Sowing date in 2018 while in

2019, June and July Sowing dates produced higher Pod yield of 3623.50kgand 3623.00kg hectare^{1} respectively. Genotype and Sowing date also affected Pod yield hectare^{1} significantly (P<0.05) in both years. In 2018, the genotypes JL24 (4876.50kg) and ICGV89754 (4778.50kg) sown in July had the highest Pod yield hectare1. In 2019, the genotypes RRB (4085.40kg) and ICGV89754(3964.10kg) sown in July produced highest Pod yield hectare^{1}. From Table 13, Genotype differed significantly (P< 0.05) in Seed yield hectare^{1}in 2018 and 2019. Highest Seed yield hectare^{1}was recorded for ICGV89754in 2018 (3043.10 kg) and in 2019 (2331.2 kg). Sowing date also differed significantly (P< 0.05) in Seed yield hectare^{1}of groundnut. In both years, June and July Sowing dates' Seed yield hectare^{1} were significantly (P<0.05) higher than that recorded for August Sowing date. Genotype and Sowing date also affected Seed yield hectare^{1} significantly (P<0.05) in both years. ICGV89754 (3172.80kg) and RMP-91-S (3197.50kg) sown in Julyin 2018 and ICGV89754 also sown Julyin 2019 produced higher Seed yield hectare^{1} differed statistically (P<0.05) from Seed yield of others. The genotypes JL12, JL24, ICGV8124 and ICGV89754 performed significantly higher than others in their vegetative characters (length of branches, number of leaves and number of branches plant-^{1}.The same genotypes also recorded superior reproductive

TABLE 13. EFFECT OF GENOTYPE AND SOWING DATE ON SEED YIELD HECTARE[1] OF GROUNDNUT

GENOTYPE	SOWNG DATE							
	2018				2019			
	JUNE	JULY	AUGUST	MEAN	JUNE	JULY	AUGUST	MEAN
RRB	2419.7	1765.4	1800.0	1995.0	1938.2	1888.8	1701.2	1842.7
JL24	2456.7	2934.5	2383.9	2591.3	2370.3	2185.1	1660.4	2072.0
ICGV-IS-87281	2851.8	3086.4	2327.1	2755.1	2481.4	2037.0	1753.9	2090.8
SAM NUT 20	1802.4	2123.4	1179.0	1701.6	1938.2	1888.8	1438.2	1755.1
ICGV 89754	3469.1	3172.8	2487.6	3043.1	2148.1	2839.5	2006.1	2331.2
JL 12	2308.6	2530.8	2117.3	2318.9	1888.8	2333.3	1907.4	2043.2
ICGV 8124	2098.7	2103.7	1586.4	1929.6	2333.3	2160.4	1475.3	1989.7
RMP-91-S	2444.4	3197.5	1290.1	2310.7	2000.0	1814.8	1500.0	1771.6
RMP-91-B	2506.1	2855.5	1845.6	2402.4	2518.5	2234.5	1660.5	2137.8
SAM NUT 10	2987.6	2012.3	1537.0	2179.0	1737.0	2148.1	1833.3	1906.1
MEAN	2534.5	2578.2	1855.4		2135.4	2153.0	1693.6	
LSD (0.05) Genotype	68.85**				53.71**			
LSD (0.05) Sowing Date	37.72**				29.42**			
LSD (0.05) Genotype x Sowing Date	119.25**				93.03**			

*= significant, **= highly significant

characters (number of seeds pod^{-1}, number of pods^{-1}, Weight of seeds plant^{-1}, weight of pods plant^{-1} and 100seed weight) performance. High vegetative characters performance of these genotypes ensured high performance of their reproductive characters. which led to high pod and seed yield ha^{-1}. According to Anonymous, (2010) and Chinatu *et al*., (2017) vegetative characters determine the amount of photosynthates available to plants for growth, pod and seed yield in okra and Cucumber respectively. Tenebee*et al*,. (1995) had reported that growth parameters (plant height, number of leaves, and number of branches) are strong yield parameters. Adeniji and Aremu (2007) reported that the proportion of the assimilates (photosynthates) allocated to the reproductive parts during flowering and fruit set goa long way to determine the number of pods, weight of pods, number and weight of seeds for okra varieties. The finding from this work is that higher vegetative characters performance influenced higher performance of reproductive characters, which led to significantly (P<0.05) higher pod and seed yield in JL12, JL24, ICGV8124 and ICGV89754.

June and July Sowing datesperformed significantly higher than August Sowing date because theyprovided more moisture for more effective vegetative and reproductive phases performance. This accounted for the longer length of branches, higher number of branches plant^{-1}and more number of leaves of the genotypes sown in June and July which through photosynthesis provided more photosynthates that ensured higher reproductive characters performance which translated into higher pod and seed yield hectare^{-1}. Genotypes sown in June and July had more exposure to rains before setting in of dry spells. In Southeast, sowing groundnutin June or July is preferable to sowing in August to ensure both highest pod and seed yield^{-1}. The genotypes RMP-91-S, ICGV89754 and ICGV-IS-87281 are best sown in July for highest seed yield ha^{-1}while JL24, RRB, RMP-91-S, ICGV89754 and ICGV-IS-8728 are best sown in June or July for highest pod yield ha^{-1}.

Conclusion

The finding from this work is that higher vegetative characters performance influenced higher performance of reproductive characters, which led to significantly (P<0.05) higher pod and seed yield in JL12, JL24, ICGV8124 and ICGV89754. June and July Sowing dates performed significantly higher than August Sowing date, hence, for high pod and seed yield in groundnut production in Southeast, June or July Sowing date is preferable. The genotypes RMP-91-S, ICGV89754 and ICGV-IS-87281 are best sown in July for highest seed yield ha^{-1} while JL24, RRB, RMP-91-S, ICGV89754 and ICGV-

IS-8728 are best sown in June or July for highest

pod yield ha^{-1} .

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