International Journal of Chemical Studies

P-ISSN: 2349–8528
E-ISSN: 2321–4902
www.chemijournal.com
IJCS 2020; 8(6): 2383-2387

Received: 16-10-2020
Accepted: 29-11-2020

Dhanashri Gawas
Department of Agriculture Botany, Dr. BSKKV, Dapoli, Maharashtra, India

AV Mane
Department of Agriculture Botany, Dr. BSKKV, Dapoli, Maharashtra, India

MM Burondkar
Department of Agriculture Botany, Dr. BSKKV, Dapoli, Maharashtra, India

Tejas Kanase
Department of Plant Physiology, IGKV, Raipur, Chhattisgarh, India

MC Kasture
Department of SSAC, Dr. BSKKV, Dapoli, Maharashtra, India

VV Dalavi
Department of Agriculture Botany, Dr. BSKKV, Dapoli, Maharashtra, India

Corresponding Author:
Dhanashri Gawas
Department of Agriculture Botany, Dr. BSKKV, Dapoli, Maharashtra, India

Yield performance of groundnut (*Arachis hypogaea* L.) genotypes under varying plant densities and seasons

Dhanashri Gawas, AV Mane, MM Burondkar, Tejas Kanase, MC Kasture and VV Dalavi

DOI: https://doi.org/10.22271/chemi.2020.v8.i6ah.11130

Abstract
The experiment was conducted at the Education and Research Farm of the Department of Botany, College of Agriculture, Dapoli, Dist. Ratnagiri, Maharashtra state during the period from *Kharif* and *Rabbi* 2017-18 and 2018- 19 to study the yield performance of groundnut genotypes under varying plant densities and seasons. The experiment was laid out in a split plot design with three replications. Results showed that different treatments had significant influence on growth and yield contributing characters. Crop sown in *Rabbi* season (S2) exhibited better achievement than *kharif* season with respect to all yield and yield component. The genotype G3 (RTNG-27) performed best in yield contributing characters than other genotypes. The important findings emerged from this investigation revealed that groundnut sown at the spacing 30 × 20 cm recorded significantly highest number of pods per plant (25.13 plant-1), pod weight per plant (3.12 plant-1), shelling percentage (70.07 plant-1) and harvest index (40.84 plant-1) was comparable with spacing 30 ×15 cm and 30 × 10 cm. Closer spacing of 30 x 10 cm is the best spacing in terms of pod yield q/ha (38.09 q/ha) in groundnut genotypes.

Keywords: Groundnut, spacing, yield, genotypes

Introduction

Groundnut (*Arachis hypogaea* L.) is also known as peanut; it is an important oilseed crop of the tropical and subtropical countries. Oilseed crops have been the backbone of agriculture economy of India from the time immemorial. Among all the oilseed crops, groundnut accounts for more than 40% acreage and 60% production in the country and ranks first place among the oilseed crops in India. Groundnut has a useful role in offspring deficiencies as a rich source of edible oil and protein and play important position in Indian diet. Apart from its high oil (45-50%) and proteins (30-35%), it contains 15-18% carbohydrates. The Groundnut also good source of minerals and vitamins and its calorific value is 349 per hundred grams of seed. The oil cake contains 7-8 per cent nitrogen, 1.50 per cent P2O5 and 1.20 per cent K2O hence, it is used as fertilizer. It is one of the most important crops that have the ability to thrive on newly reclaimed sandy soils as a legume of high nutritive value as well as being a source of edible oil (Desire *et al.*, 2010) [5].

Choice of proper variety, spacing and optimum dose of fertilizer are some of the important practices for increasing the yield of groundnut. The yield of groundnut is very complicated, quantitative character mainly contributed by two critical factors *viz*; variety and number of plants per unit area. The relationship between row spacing, plant densities and yield; two approaches are used commonly. First, if the plant produces enough leaf area to maximize isolation interception during reproductive growth, maximum yield can be obtained. Secondly, equidistant row spacing between plants will provide maximum yield since it will minimize inter plant competition. Plant density (plant spacing) is an efficient management tool for maximizing grain yield by increasing capture of solar radiation within the canopy thereby increasing land use efficiency (Egli, 1988) [5]. Planting geometry is an important agronomical management practice and nonmonetary input, which has key role in increased crop production. Crop planted in appropriate geometry enhances use of natural resources as well as inputs given to the crop.

Groundnut crop competes with each other above and below the ground. Planting geometry varies according to species and region. Similarly, appropriate fertilizer dose is also an important aspect regarding crop production.

Materials and Methods

The experiment was conducted at the Education and Research Farm of the Department of Botany, College of Agriculture, Dapoli, Dist. Ratnagiri, Maharashtra state during the *kharif* and *rabbi* 2017-18 and 2018-19 seasons. Eleven genotypes of groundnut were collected from Agriculture Research Station, Shirgaon. The selected varieties were having different duration, growth habbit, and also difference in 100 pod weight, 100 kernel weight, shelling percentage, oil content, protein content etc. The experiment was laid out in split plot design replicated three times. The main plot treatment consists of two season's *viz*., S1: *Kharif* and S2: *Rabbi.* However, sub plot treatments consist of eleven groundnut genotypes *viz*., G1: RTNG-14, G2: RTNG-53, G3: RTNG-27, G4: RHRG-1308, G5: RHRG-1435, G6: KDG-160, G7: KDG-187, G8: TKG-Bold, G9: JL-1232, G10: Konkan Bhuratna and G11: Konkan Gaurav. The sub- sub plot treatments consist of three plant spacing's *viz*., D1: 30 x 20 cm, D2: 30 x 15 cm and D3: 30 x 10 cm. Statistical analysis of the data obtained during the course of investigation was carried out by using standard statistical analysis method of analysis of variance and correlation coefficient, as described by Panse and Sukhatme (1985) [14].

Results and Discussion

Pooled data presented in Table 1 indicates that, number of pods plant^{-}1, shriveled pods plant^{-}1, pod weight plant^{-}1 and pod yield (q ha-1) were significantly influenced due to different treatments. Similarly, data furnished in Table 2 exhibited that Shelling percentage and harvest index influenced significantly by different treatments.

Table 1: Influence of seasons and spacings on yield and yield components of different groundnut genotypes (pooled).

Treatments	No. of pods plant^{-1}	Shriveled pods plant^{-1}	Pod weight plant (g plant^{-1})	Pod yield (q ha-1)
Seasons				
S1 –Kharif	19.23	2.58	15.71	29.01
S2 –Rabi	24.54	2.97	20.56	38.71
S.E±	0.138	0.137	0.153	0.190
C.D at 5%	0.838	NS	0.932	1.157
Genotypes				
G1 –RTNG 14	29.37	3.14	23.92	43.70
G2 –RTNG 53	26.91	3.27	22.53	41.40
G3 –RTNG 27	30.78	3.70	24.62	45.41
G4 –RHRG 1308	22.81	2.65	17.49	33.00
G5 –RHRG 1435	16.18	2.13	14.48	27.21
G6 –KDG 160	20.61	2.88	16.52	31.20
G7 –KDG 187	16.64	2.53	13.19	24.84
G8 –TKG Bold	19.37	2.68	18.42	34.70
G9 –JL 1232	18.10	2.51	15.78	29.65
G10 – Konkan Bhuratna	25.10	3.16	20.05	37.90
G11 – Konkan Gaurav	14.84	1.88	12.47	23.44
S.E±	0.595	0.180	0.743	0.645
C.D at 5%	1.700	0.513	2.123	1.843
Spacings				
D1 -30X20 cm	25.13	3.12	21.30	28.78
D2- 30X15 cm	21.98	2.80	18.24	34.70
D3 -30X10 cm	18.54	2.41	14.86	38.09
S.E±	0.260	0.053	0.320	0.278
C.D at 5%	0.731	0.149	0.898	0.780
Interaction effects				
S X G	SIG	NS	SIG	SIG
S X D	NS	NS	NS	SIG
G X D	NS	NS	NS	SIG
S X G X D	NS	NS	NS	NS
General Mean	21.883	2.776	18.133	33.86

Table 2: Influence of seasons and spacings on yield and yield components of different groundnut genotypes (pooled).

Treatments	Shelling percentage	Harvest index (%)
Seasons		
S1 –Kharif	69.87	39.77
S2 –Rabi	69.18	39.59
S.E±	0.037	0.087
C.D at 5%	0.223	NS
Genotypes		
G1 –RTNG 14	71.31	41.04
G2 –RTNG 53	72.95	41.34
G3 –RTNG 27	73.22	41.90
G4 –RHRG 1308	70.32	40.05
G5 –RHRG 1435	66.72	38.98
G6 –KDG 160	60.22	38.42

G7 –KDG 187	68.39	37.17
G8 –TKG Bold	70.30	40.40
G9 –JL 1232	70.02	39.12
G10 –Konkan Bhuratna	72.35	40.92
G11 –Konkan Gaurav	69.02	37.14
S.E±	0.221	0.426
C.D at 5%	0.633	1.219
Spacings		
D1 -30X20 cm	70.07	40.84
D2-30X15 cm	69.64	39.95
D3 -30X10 cm	68.88	38.25
S.E±	0.071	0.190
C.D at 5%	0.200	0.533
Interaction effects		
S X G	NS	SIG
S X D	NS	NS
G X D	NS	NS
S X G X D	NS	NS
General Mean	69.53	39.68

Number of pods per plant

The low irradiance in shaded plant showed more vegetative growth but decrease reproductive components and harvest index. Flowering and other reproductive components pegs, pods and seeds were reduced at low irradiance (Ketring, 1979) [9]. In the present study, significantly maximum number of pods plant^{-1} (24.54 plant^{-1}) was obtained in season S_2 *(rabi)* than *kharif* season. Raghavaiah *et al*. (1995) [15] also observed a wide seasonal variation in seed yield among genotypes due to variation in environmental variables. The highest number of pods plant^{-1} (30.78 plant^{-1}) was produced with G_3 (RTNG-27), which was significantly higher than rest of the genotypes. This might be due to compact growth with short statured plants of G_3 (RTNG-27) resulted in decreased internodal length and decumbent growth leads to increased translocation efficiency of photosynthates to sink. Similar findings were also reported by Jadhav *et al*. (2000) [8]. The lowest number of pods per plant was obtained in G11 (14.84 plant-1). The number of pods plant^{-1} was the most variable component bearing an inverse relation to plant spacing. The significantly highest number of pods plant^{-1} (25.13 plant^{-1}) was produced in spacing D_1 (30 X 20 cm). While, the lowest number of pods per plant was noted in spacing D3 (18.54 plant-1). This might be due to sufficient space available for individual plants which grow vigorously and produced more branches and more pods plant^{-1}. These results are in agreement with those of Senthil Kumar (2009) [16] and Meena *et al*. (2010) [11]. The interaction between seasons and genotypes (SXG) was found significant.

Interaction effects of Seasons and Genotypes:

The interaction (Table 3) revealed that, treatment S2G3 (34.85 plant-1) obtained highest number of pods per plant which was at par with S2G1 (33.40 plant-1) over other treatments. However, the lowest number of pods per plant was obtained in treatment combinations S1G11 (14.49 plant-1).

Table 3: Interaction effect of seasons and genotypes on number of pods plant^{-1} at harvest.

Seasons	Genotypes										
	G1	G2	G3	G4	G5	G6	G7	G8	G9	G10	G11
S1	25.34	23.13	26.71	20.44	15.09	17.93	14.68	16.05	15.81	21.81	14.49
S2	33.40	30.68	34.85	25.17	17.28	23.30	18.61	22.70	20.39	28.38	15.20
SEm±	0.841				C.D. at 5%	2.404					

Number of shriveled pods per plant

The effect of seasons on number of shriveled pods plant^{-1} was found non-significant. Significantly maximum number of shriveled pods plant^{-1} (3.70 plant^{-1}) was recorded in G_3 (RTNG-27) over other genotypes. The lowest number of shriveled pods plant^{-1} (1.88 plant^{-1}) was recorded in G_{11} (Konkan Gaurav) which was at par with G_5 (2.13 plant^{-1}). These results different genotypes might be due to particular genetic makeup of genotypes and their place of origin as well as environmental conditions (Abdul *et al*. 2017) [1].

Among three spacings tried, the highest number of shriveled pods plant^{-1} (3.12 plant^{-1}) was obtained in spacing D_1 (30 X 20 cm) whereas, the lowest number of shriveled pods plant^{-1} (2.41 plant^{-1}) was recorded in spacing D_3 (30 X 10 cm). This may be due to the decrease in number of branches per plant and severe competition offered for growth resources coupled with poor source sink relationship (Mohamed, 2005) [12].

Pod weight per plant

The data on pod weight per plant revealed that the pod weight per plant was influenced significantly by different treatments. Significantly highest pod weight per plant was recorded in season S2 (20.56 plant-1). Mainly because of maximum temperature and bright sunshine hours during the flowering phase. Due to longer duration and more sunshine hours, the dry season crop produced more pod yield and total dry matter than the wet season crop (Singh and Joshi, 1993) [18]. The plant spacings tried, significantly maximum pod weight (24.62 plant^{-1}) was recorded in G_3 (RTNG-27) which was at par with G_1 (23.92 plant^{-1}) and G_2 (22.53 plant^{-1}) over other genotypes. The lowest pod weight (12.47 plant^{-1}) was recorded in G_{11} (Konkan Gaurav) over other genotypes. Such increase in pods weight per plant may be attributed to the increase in number of branches per plant and total biomass production.

The plant spacing 30 x 20 cm (21.30 plant^{-1}) produced significantly higher pod weight per plant. This might be due to efficient utilization of space and other growth resources, which in turn created favorable environment for producing optimum stature of growth parameters like plant height, LAI and DMP coupled with better partitioning of phototsynthates to developing pods and finally produced the higher number of matured pods unit area^{-1} (Bhagavatha, 2016) [2]. While, plant spacings 30 x 10 cm (14.86 plant^{-1}) was recorded lowest pod weigh per plant. The interaction between seasons and genotypes (SXG) was found significant.

Interaction effects of Seasons and Genotypes
The interaction (Table 4) revealed that, treatment S2G3 (27.51 plant-1) showed highest pod weight per plant which was at par with S2G1 (26.99 plant-1) and S2G2 (25.38 plant-1) over other treatments. On the other hand, the lowest pod weight was recorded in treatment combinations S1G11 (10.76 plant-1).

Table 4: Interaction effect of seasons and genotypes on pod weight (g $plant^{-1}$) at harvest

Seasons	Genotypes										
	G1	G2	G3	G4	G5	G6	G7	G8	G9	G10	G11
S1	20.86	19.68	21.72	15.22	12.04	14.04	11.34	15.99	13.50	17.67	10.76
S2	26.99	25.38	27.51	19.77	16.91	19.00	15.04	20.85	18.07	22.42	14.17
SEm±	1.051				C.D. at 5%		3.003				

Pod yield q ha^{-1}
The influence of different treatments on pod yield q ha^{-1} was statistically significant (Table 1). Effect of seasons on pod yield q ha^{-1} was found significant, the maximum pod yield was recorded in season S2 (38.71 q ha^{-1}). It is suggested that low light intensity at the pod development stage would severely affect the groundnut yield due to the decrease in photosynthesis as well as reduced translocation of assimilates to the pods (Singh, 2004) [18].
The pod yield of groundnut mainly depends on partitioning ability of photosynthates from growth parameters *viz*., plant height, LAI and DMP to developing pods for producing more number of filled pods $plant^{-1}$ and hundred kernel weight which in turn led to increased pod yield (Labana *et al*. 1980) [10]. The highest pod yield (45.41 q ha^{-1}) of groundnut was obtained with G_3 (RTNG-27) which was at par with G_1 (43.70 q ha^{-1}) than rest of the genotypes studied.
The effect of spacing on the pod yield q ha^{-1} was found significant (Table 1) where the crop grown with 30 x 10 cm (38.09 q ha^{-1}) spacing produced the highest yield and lowest yield was obtained from the 30 x 20 cm (28.78 q ha^{-1}) spacing. Howlader *et al.* (2009) [7] who reported that the pod yield of groundnut was significantly greater with closer spacing might be due to the reason that the increased plant population. The interaction between Seasons and Genotypes (SXG), seasons and spacings (SXD) as well as genotypes and spacings (GXD) was found significant.

Interaction effects of Seasons and Genotypes
The interaction (Table 5) revealed that, treatment S2G3 (51.02 q ha^{-1}) showed highest pod yield which was at par with S2G1 (49.42 q ha^{-1}) over other treatments. Among the rest of treatment combinations, S2G1 (49.42 q ha^{-1}) recorded higher pod yield followed by S2G2 (47.16 q ha^{-1} which was statistically at par with each other. The lowest pod yield was recorded in S1G11 treatments combinations (19.84 q ha^{-1}).

Table 5: Interaction effect of seasons and genotypes on pod yield (q ha^{-1}) at harvest.

Seasons	Genotypes										
	G1	G2	G3	G4	G5	G6	G7	G8	G9	G10	G11
S1	37.97	35.65	39.80	28.42	22.37	26.20	20.98	29.73	25.09	33.01	19.84
S2	49.42	47.16	51.02	37.58	32.05	36.20	28.71	39.66	34.22	42.78	27.03
SEm±	0.912				C.D. at 5%		2.606				

Interaction effects of Seasons and Spacings
Result in (table 6) indicated that, treatment S2D3 (44.75 q ha^{-1}) recorded significantly highest pod yield over other treatment combinations. On the other hand, the lowest pod yield was found in S1D1 (25.64 q ha^{-1}).

Table 6: Interaction effect of seasons and spacings on pod yield (q ha^{-1}) at harvest

Seasons	Spacings		
	At harvest		
	D1	D2	D3
S1	25.64	29.94	31.44
S2	31.92	39.47	44.75
SEm±	0.393	C.D. at 5%	1.104

Interaction effects of Genotypes and Spacings
The interaction (Table 7) revealed that, treatment G3D3 (52.32 q ha^{-1}) recorded significantly highest pod yield which was at par with G1D3 (50.26 q ha^{-1}) over other treatments. Whereas, the lowest pod yield was recorded in G11D1 (20.72 q ha^{-1}).

Table 7: Interaction effect of genotypes and spacings pod yield (q ha^{-1}) at harvest

Genotypes	Spacings		
	At harvest		
	D1	D2	D3
G1	36.43	44.40	50.26
G2	34.63	42.01	47.57
G3	37.92	45.99	52.32
G4	28.02	34.07	36.92
G5	23.99	28.18	29.45
G6	26.38	32.19	35.02
G7	21.78	25.57	27.19
G8	29.44	35.67	38.99
G9	25.73	30.69	32.54
G10	31.54	38.86	43.29
G11	20.72	24.11	25.47
S.E±	0.921		
C.D at 5%	2.588		

Shelling percentage
The shelling percentage depends upon the thickness of the pod wall, development of the kernel and flowering pattern during crop period. The data furnished in Table 2 exhibited that significantly highest shelling percentage (69.87%) was recorded in season S_1 *(kharif)*. The maximum shelling percentage (73.22%) was recorded in G_3 (RTNG-27) which was at par with G_2 (72.95%) over other genotypes might be due to its genotypic character with thin shell development and might be due to channelization of more photosynthates from pod wall to kernel. The lowest shelling percentage (60.22%) obtained with G_6 (KDG-160) might be due to deeply constricted pods and poor filling percentage. Similar results were obtained by Bhargavi H., (2014) [3] and Bhagavatha (2016) [2].
Among the plant spacings studied, significantly highest shelling percentage (70.07%) was recorded in spacing D_1 (30 X 20 cm). Shelling percentage was decreased with increasing plant population was also reported by Nagaraj *et al.* (2001) [13] [13]. The interaction effect between seasons, genotypes and plant spacings did not reach to the level of significance.

Harvest index (%)
In the present investigation, the effect of seasons on harvest index was found non-significant and this indicates that harvest index is more of genetically controlled factor and is less influenced by season. Among eleven genotypes tried, significantly maximum harvest index (41.90%) was recorded in G_3 (RTNG-27) which was at par with G_2 (41.34%) and G_1 (41.04%) over other genotypes. However, the lowest harvest index (37.14%) was recorded in G_{11} (Konkan Gaurav) over

other genotypes might be due to poor partitioning ability of photosynthates to developing pods leading to reduced pod yield, which in turn reduced the harvest index. The varietal difference for harvest index was also reported by Bharud and Pawar (2005) [4].

The harvest index was significantly reduced with increasing plant population from and the highest harvest index (40.84%) was noticed in spacing D_1 (30 X 20 cm). The highest harvest index with lesser plant population was mainly due to lesser total biological yield unit area^{-1} compared to higher plant population. These results are in acceptance with those of Jadhav *et al.* (2000) [8]. The interaction between seasons and genotypes (SXG) was found significant.

Interaction effects of Seasons and Genotypes

The presented data in table (8) indicated that, treatments S1G3 (42.72%) showed significantly highest harvest index which was at par with S1G1 (42.11%), S1G2 (41.95%) and S1G10 (41.34%) over other treatments. The lowest harvest index was recorded in treatments combinations S1G7 (36.16%).

Table 8: Interaction effect of seasons and genotypes on harvest index (%) at harvest

Seasons	Genotypes										
	G1	G2	G3	G4	G5	G6	G7	G8	G9	G10	G11
S1	42.11	41.95	42.72	40.18	38.93	37.32	36.16	41.15	38.95	41.34	36.64
S2	39.97	40.73	41.07	39.92	39.03	39.52	38.19	39.65	39.28	40.51	37.64
SEm±	0.603				C.D. at 5%		1.724				

Conclusion

Crop sown in *Rabi* season (S2) exhibited better achievement than *kharif* season with respect to all yield and yield component. Irrespective of genotypes and spacings the *rabi* groundnut gives higher yield than that of *kharif* season mainly because of higher photosynthetic rate, stomatal conductance, water use efficiency, net assimilation rate and leaf area index. Among the eleven genotypes tested, in two seasons genotype RTNG-27 was found to be significantly superior to all the other genotypes showing better performance in context with all yield and yield contributing characters under both seasons. Out of all the plant density studied, plant spacing 30 X 10 cm performed best with respect to seed yield (q/ha). Plant spacing 30 X 20 cm produced dwarf plants, more no. of pods per plant, pod weight per plant, harvest index and higher shelling percentage over other plant spacings.

References

1. Abdul M, Muhammad NA, Muhammad TS, Muhammad I, Humair A. Yield and quality of groundnut genotypes as affected by different sources of sulphur under rainfed conditions. Soil Environ 2017;36(2):166-173.
2. Bhagavatha Priya T, Subramanyam D, Sumathi V, Naidu MVS. Growth characters and yield of early kharif groundnut as influenced by varieties and plant populations. IOSR Journal of Agriculture and Veterinary Science 2016;9(5):81-83.
3. Bhargavi H. Response of rabi groundnut (Arachis hypogaea l.) to different plant densities in scarce rainfall zone of A.P. Master of Science in agriculture (agronomy) thesis submitted to the acharya N. G. ranga agricultural university 2014.
4. Bharud RW, Pawar MR. Physiological basis of yield variation in groundnut varieties under summer conditions. Journal Maharashtra Agricultural Universities 2005;30(1):100-102.
5. Desire TV, Liliane MT, Le prince NM, Jonas PI, Akoa A. Mineral nutrient status, some quality and morphological characteristic changes in peanut (Arachis hypogaea L.) cultivars under salt stress. African J Environ. Sci. Technol 2010;4:471-479.
6. Egli DB. Plant Density and Soybean Yield. Crop Science 1988;28:977-980.
7. Howlader SH, Bashar HMK, Islam MS, Mamun MH, Jahan SMH. Effect of plant spacings on the yield and yield attributes of groundnut. International Journal on Sustainable Crop Production 2009;4(1):41-44.
8. Jadhav GS, Shinde BA, Suryawanshi MW. Comparative performance of groundnut (Arachis hypogaea L.) genotypes under varying row and plant spacing in post-monsoon environment. Journal of Oilseeds Research 2000;17(1):70-76.
9. Ketring DL. Light effects on development of an indeterminate plant. Plant Physiol 1979;64:665-667.
10. Labana KS, Singh Mohinder, Sangha AS, Jaswal SV. Variability and inter-relations among characters in F2 progeny of groundnut. Journal of Research, Punjab Agricultural University 1980;17(2):107-114.
11. Meena BP, Kumawat SM, Yadav RS. Effect of planting geometry and nitrogen management on groundnut (Arachis hypogaea L.) in loamy sand soil of Rajasthan. Indian Journal of Agricultural Sciences 2010;81(1):86-88.
12. Mohamed. Effect of some cultural treatments on peanut. M.Sc. thesis submitted to the, Department of Agronomy Faculty of Agriculture Cairo University 2005.
13. Nagaraj MV, Malligawad LH, Biradar DP. Productivity and economics of confectionery groundnut as influenced by plant density and fertilizer management. Karnataka Journal of Agricultural Sciences 2001;14(4):932-937.
14. Panse VG, Sukhatme PV. Statistical Methods for Agricultural Workers. Indian Council of Agricultural Research, New Delhi 1985, 167-174.
15. Raghavaiah CV, Padmavathi P, Prasad MV. Response of groundnut genotypes to plant density and phosphorus nutrition in alfisols. J Oilseeds Res 1995;12:295-298.
16. Senthil Kumar N. Effect of plant density and weed management practices on production potential of groundnut (Arachis hypogaea L.). Indian Journal of Agricultural Research 2009;43(1):57-60.
17. Singh. Response of groundnut (Arachis hypogea L.) to bio fertilizer, organic and inorganic sources of nutrient in North East India. Legume Research 2004;34(3):196-201.
18. Singh AL, Joshi YC. Comparative studies on chlorophyll content, growth, N uptake and yield of groundnut varieties of different habit groups. Oleagineux 1993;48:27-34.